Nervous System Notes: Physiology

- Membranes of neurons are polarized due to an _____ _____ called the _____
    - The inside of the cell is _____ relative to the _____ and is measured using a voltmeter

- The resting membrane potential is when a neuron is not transmitting a signal
    - Resting membrane potential = _____

Resting Membrane Potential

- In all neurons, the resting membrane potential depends on the _____ that exist across the plasma membrane
    - Ion pumps and ion channels maintain the resting potential of a neuron
- The concentration of Na^+ is _____ in the extracellular fluid than in the cytosol while the _____ is true for K^+
- A neuron that is not transmitting signals contains many _____ and _____ Na^+ channels in its plasma membrane
- The diffusion of K^+ and Na^+ through these channels leads to a _____ _____ across the membrane, producing the resting potential

Action Potential

- Gated ion channels open or close in response to the binding of a specific _____ or a _____ change
    - The response is a change in the membrane potential
- When ion channels are stimulated, two different responses can occur: hyperpolarization or depolarization
    - Both are called _____ because the magnitude of the change in membrane potential varies with the _____ of the stimulus

- Cell Responses
    - Some stimuli trigger a hyperpolarization
        - An increase in the magnitude of the membrane potential (_____ _____ difference from outside to inside)
    - Other stimuli trigger a depolarization
        - A reduction in the magnitude of the membrane potential (move towards a _____ difference from outside to inside)
    - A stimulus strong enough to produce a depolarization that reaches the threshold will trigger an _____
        - _____ = membrane voltage amount needed to cause an action potential which is -55 mV

4 Steps of Detecting, Generating, and Transmitting an Action Potential:

- **Resting membrane potential**
- **Depolarization after threshold**
- **Action Potential**
- **Repolarization**

Action Potential Steps

- An action potential is a brief _____ depolarization of a neuron's plasma membrane that carries information along axons
- Both voltage-gated Na^+ channels and voltage-gated K^+ channels are involved in the production of an action potential
    - Voltage-gated channels rely of electrical signals rather than ligands

- Depolarization
    - Membrane _____ open which allows Na^+ to diffuse _____ the cell
    - This causes the charge on the neuron membrane to change to _____ inside and negative outside

- Action Potential
    - Propagation of the signal is _____ down the axon

- Repolarization
    - As the action potential subsides _____, and K^+ flows _____ the cell which _____ on the membrane
    - _____ restores the ion concentration differences with the use of _____
        - This comes back to the resting membrane potential

- A _____ follows the action potential during which a second action potential cannot be initiated

Conduction of Action Potentials

- An action potential can travel long distances by regenerating itself along the axon
- The opening of Na+ channels triggers the _____ channels
- The speed of an action potential increases with the diameter of an axon

- Action potentials in myelinated axons jump between the nodes of Ranvier in a process called _____
    - This allows the signal to travel _____ down the axon

Synapse

- In an electrical synapse, electrical current flows directly from one cell to another via a _____
    - The vast majority of synapses are chemical synapses

- In a chemical synapse, a _____ neuron releases chemical neurotransmitters, which are stored in the synaptic terminal
    - The neurotransmitters will travel through the space between the cells called the _____ to bind to the _____ neuron

- When an action potential reaches the terminal a _____ opens to allow Ca^{2+} to flow into the _____
- Ca^{2+} acts a second messenger and causes the _____ holding the neurotransmitters to _____ with the plasma membrane
- The final result is the _____ of neurotransmitters into the synaptic cleft

Direct Synaptic Transmission

- The process of direct synaptic transmission involves the binding of _____ to ligand-gated ion channels
- Neurotransmitter binding causes the ion channels to _____, generating a postsynaptic _____
- Postsynaptic potentials fall into two categories: Excitatory (stimulatory) or Inhibitory
- After its release, the neurotransmitter diffuses out of the synaptic cleft
    - May be _____ by the pre-synaptic cell or degraded by _____

Neurotransmitters

- _____ that act on cells to create a response
- The same neurotransmitter can produce _____ in different types of cells
- Examples:
    - Acetylcholine – most common type and stimulates _____ contractions
        - Loss or dysfunction of this neurotransmitter will lead to various disorders
    - Epinephrine and Norepinephrine – _____ response
    - Dopamine and Serotonin – _____ responses
    - GABA – _____ neuron activity especially during fear or anxiety when neurons are overstimulated
        - The medicine benzodiazepines help GABA reduce neural activity even further
    - Gases such as nitric oxide and carbon monoxide are local regulators in the PNS