



Action Potential

Psychology 372

Physiological Psychology

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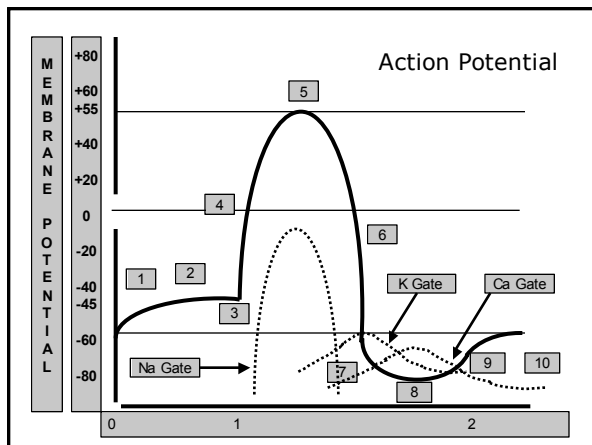
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General Overview

- Occurs because voltage gated channels open
- Results in rapid and large Na influx
- Get rapid depolarization and hyperpolarization

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Process of an Action Potential

1. Stimulation Begins
2. K begins to leave by passive channels. Na enters by passive channels.
 - Get a change in concentration gradients
 - Amount that leaves depends on the strength of the stimulus, temporal summation, etc.
 - Begins depolarization.
3. If depolarization reaches 15mV, voltage gated Na channels open.
 - Get Na influx
4. Na K ATPases start
 - Removes Na and brings in K
 - Three Na per Two K
 - K also leaves through passive channels.
 - K voltage gated channel begins to open about 1/2 millisecond after Na voltage gated channels open

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Process of an Action Potential (cont.)

5. Na voltage gated inactive channel finally closes,
 - Action Potential begins to fall
6. K inactive gate finally closes
 - K is still leaving by passive channels
 - Na is leaving by Na K pump
 - Action potential continues to fall
 - Get a negative undershoot from resting state.
7. Ca voltage gated channel begins to open
8. Still do not have enough K so get Ca influx
9. Finally enough K so Ca inactive channel begins to close
10. Ca channel finally closed
11. Process Repeats

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Review

- When a stimulus enters a receptor on a dendrite, it causes change in polarity.
- Causes a change in the chemical concentration gradients.
- Allows sodium to enter in small amounts and depolarizes the neuron.
- The depolarization travels to the axon hillock. If the charge depolarizes hillock 15mv, get an action potential.
- If the charge is not strong enough, the signal stops.

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Review

- Causes sodium gates in the axon to open.
- Get Na Influx
- Result, the axon goes from negative on the inside to positive on the inside.
- This change goes down the axon like a wave.
- After the sodium enters, the sodium potassium pumps turn on and begin removing sodium.
- Also goes down like a wave

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Review

- So we have two waves going down the axon,
 - The sodium entering the axon
 - The sodium being pumped out
- Ultimately the result is a negative undershoot

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When the Axon Potential Reaches the Presynaptic Element

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When the Axon Potential Reaches the Presynaptic Element

- It causes calcium (Ca) to enter the presynaptic element.
- Calcium causes the synaptic vesicles to move down protein filaments and bind with the presynaptic membrane.
- No Ca, no efflux of NT
 - Botulinum Toxin blocks Ca influx
 - Mg also interferes with Ca influx

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When the Axon Potential Reaches the Presynaptic Element

- The neurotransmitter is then released into the synaptic cleft.
- The neurotransmitter crosses the cleft and binds on receptors in the post synaptic element
- Causes a small depolarization and the process repeats itself.
 - Called a Excitatory Post Synaptic Potential (EPSP)

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Saltatory Conduction

- As action potentials travel down the axon
 1. It depolarizes the next Na voltage gated channel
 2. Process of each channel slows down conduction speed
 - Depends on size of the axon
- Myelin
- Allows the action potential to jumps from one Node of Ranvier to another node:
 - AP depolarizes next Na voltage gated channel at Node of Ranvier
 - Less work
 - Increases speed of the action potential even in small axons

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Summary

- Is an “all or none” event:
- Has a fixed height +55mV
- Has a specific velocity (meters/sec)
 - Depending on two variables
 - Myelin, and amount of it
 - Axon size
- Has an absolute refractory period in which stimulation will not produce an AP.