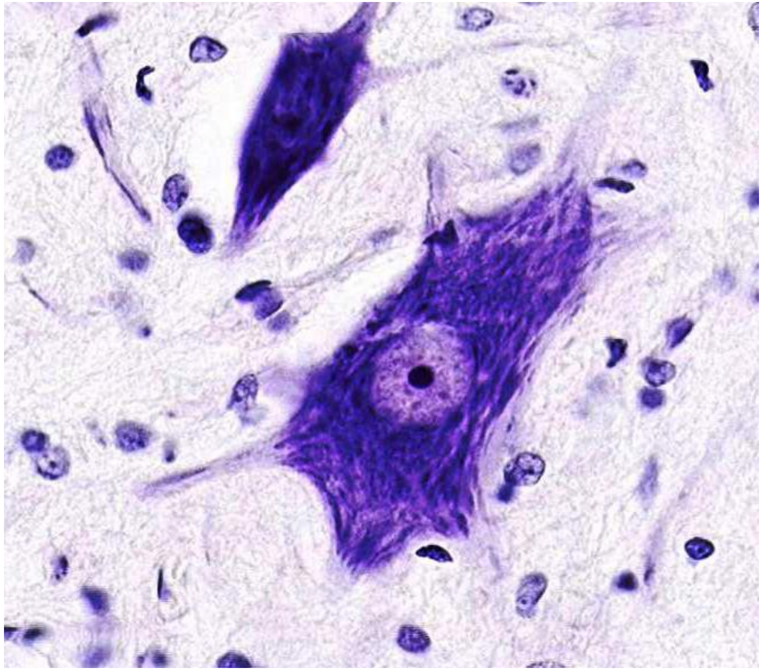
The Nervous System
Action potentials



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Nervous System

Cell types

- neurons
- glial cells

Methods of communication in
nervous system – action potentials

How the nervous system is organized

- central vs. peripheral

Voltage Gated Na^+ & K^+ Channels

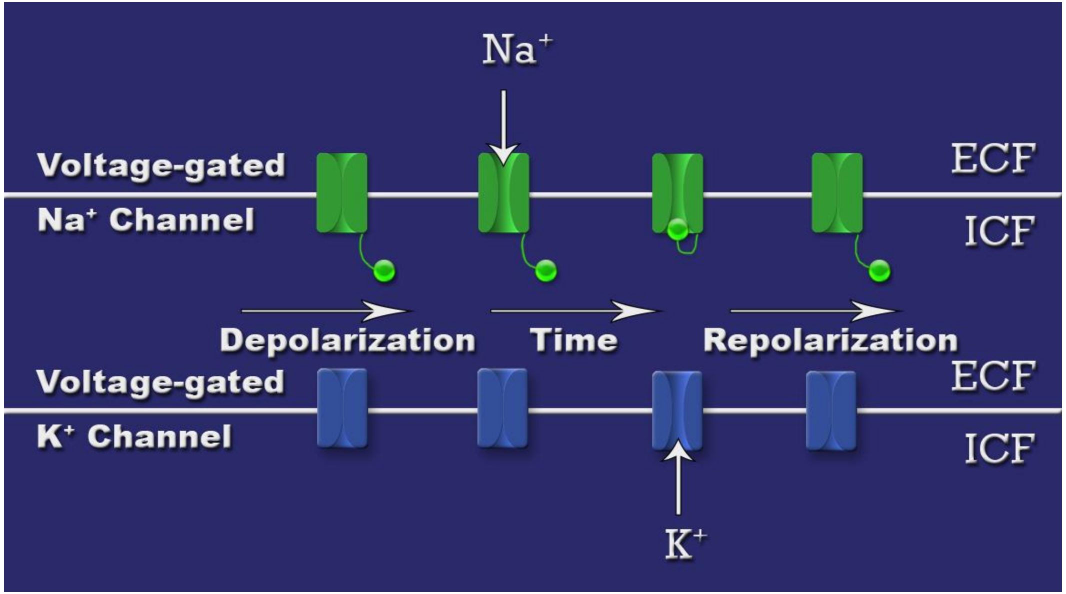
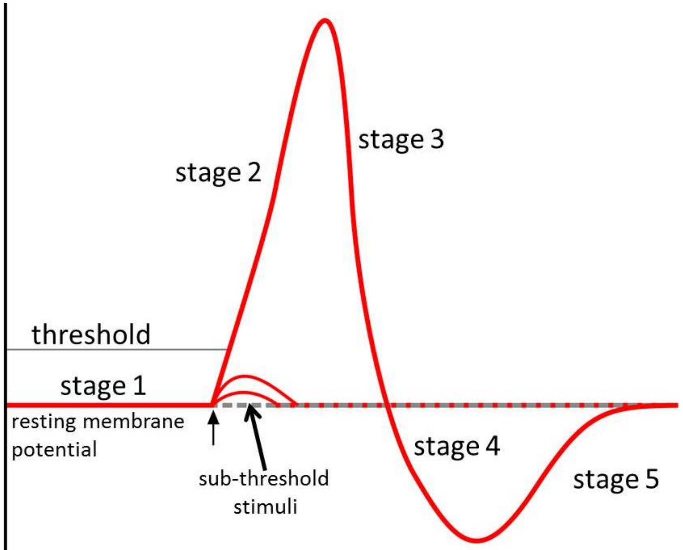
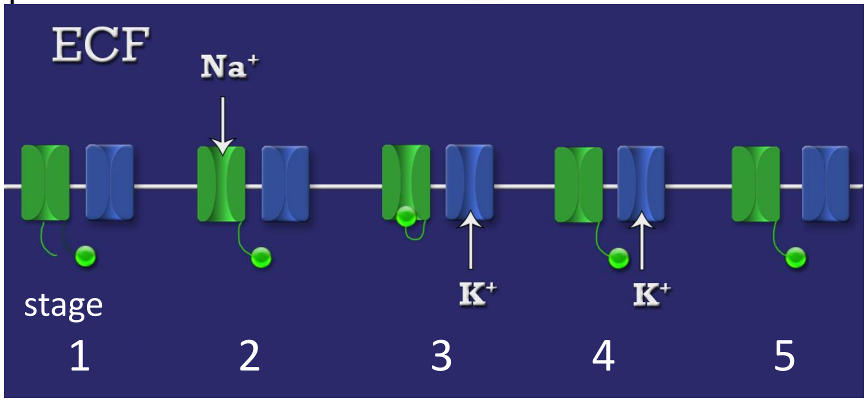


image by Rick Melges, Duke University

Depolarization of the membrane is the stimulus which leads to both channels opening.
To reset the Na+ channel from inactive to closed need to repolarize the membrane.
Refractory period is when Na+ channels are inactivated.

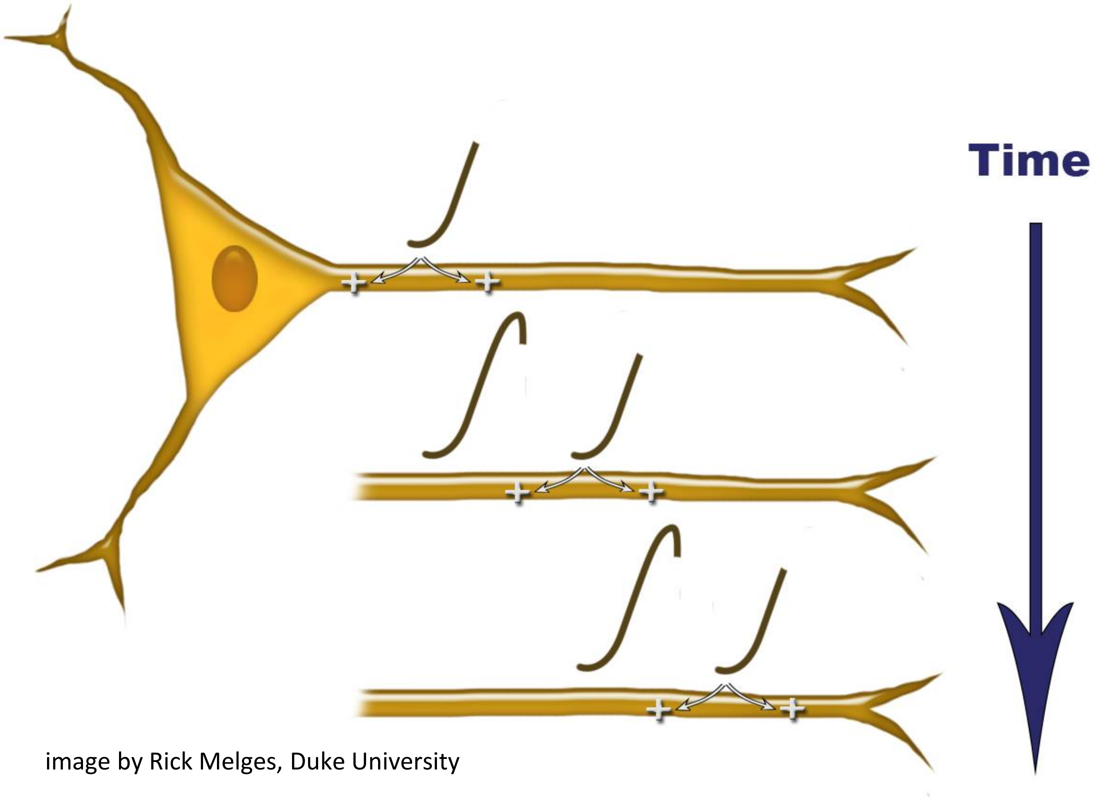
Action Potentials





are rapid, “all or none” and do not decay over distances

Unidirectional Propagation of AP



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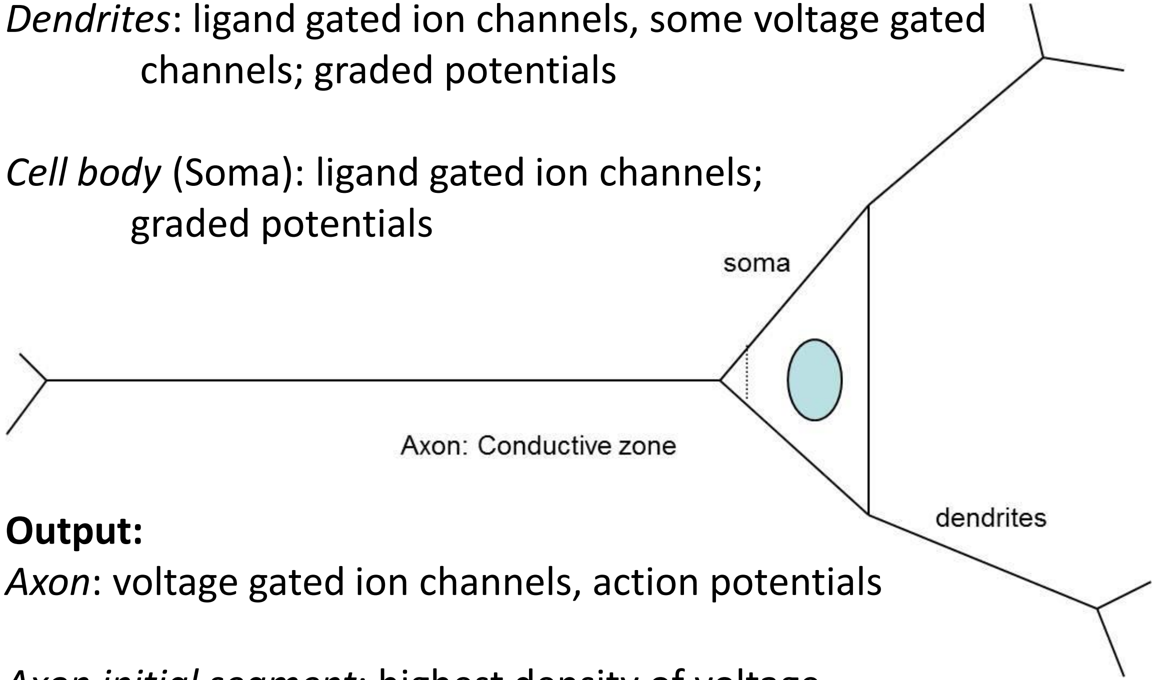
Action potentials move one-way along the axon because of the absolute refractory period of the voltage gated Na+ channel.

Integration of Signals

Input:

Dendrites: ligand gated ion channels, some voltage gated channels; graded potentials

Cell body (Soma): ligand gated ion channels; graded potentials



Output:

Axon: voltage gated ion channels, action potentials

Axon initial segment: highest density of voltage gated ion channels & lowest threshold for initiating an action potential, **“integrative zone”**

Axon Initial Segment

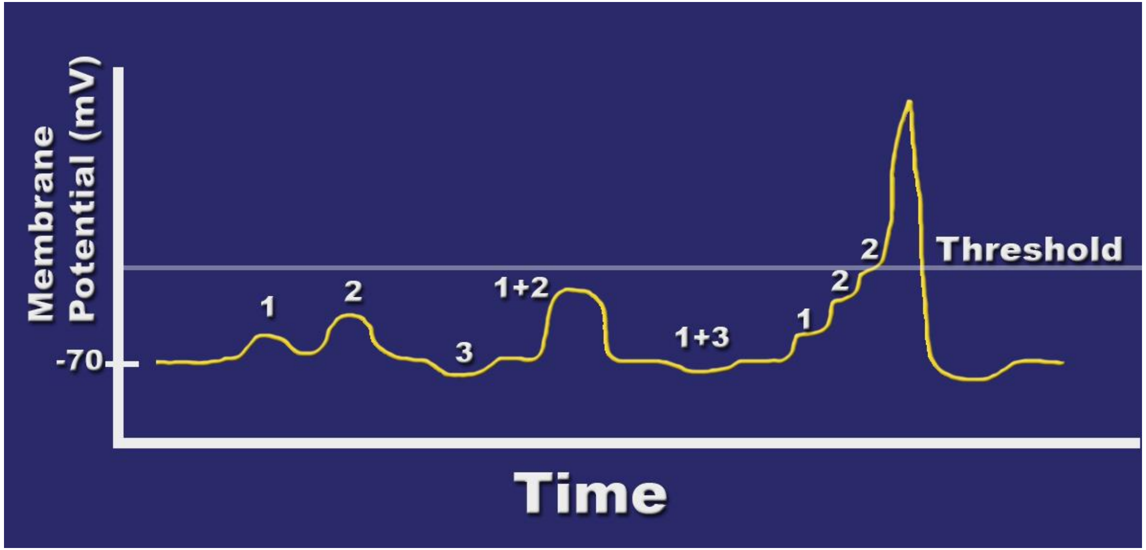
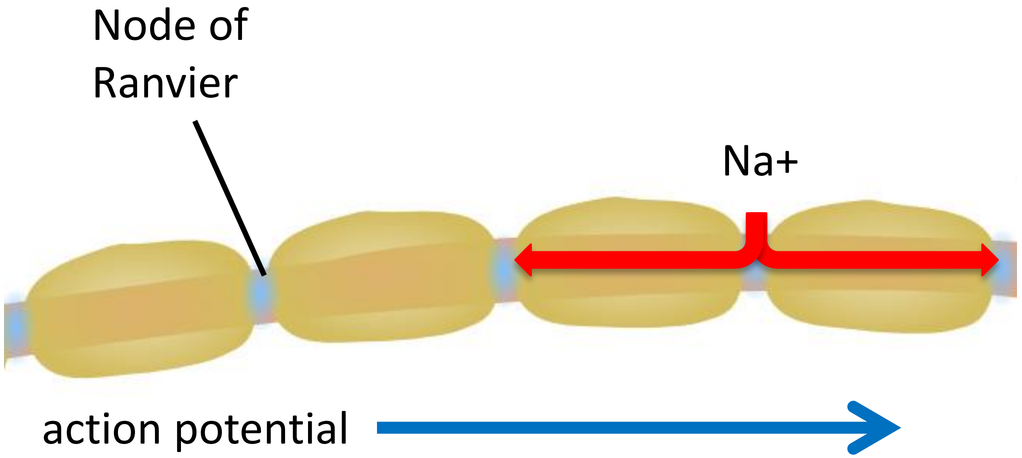


image by Rick Melges, Duke University

Integration of signals at initial segment

Saltatory Conduction



Large diameter, myelinated axons transmit action potentials very rapidly.
Voltage gated channels are concentrated at the nodes.
Inactivation of voltage gated Na+ channels insures uni-directional propagation along the axon.

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Key Concepts

An action potential is a wave of depolarization followed immediately by a wave of repolarization. During an action potential, *depolarization* is due to the movement of Na+ into the nerve cell. *Repolarization* is due to the movement of K+ out of the cell.

Action potentials are electrical signals that propagate without decrement along axons, are "all or none", have refractory periods, and uni-directional propagation in neurons.