### Physiologic Anatomy of Neuron

- **Basic parts of neuron (nerve cell)**
  - Cell body
  - Dendrites
  - Axon
  - Axon hillock
  - Axon terminals
- Action potentials are initiated at the axon hillock, and conducted throughout a nerve fiber

<table>
<thead>
<tr>
<th>Cell body</th>
<th>Houses the nucleus and organelles</th>
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<tbody>
<tr>
<td>Dendrites</td>
<td>Project from cell body and increase surface area available for receiving signals from other nerve cells</td>
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<td>Signal toward the cell body</td>
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<tr>
<td>Dendrite and cell body serve as the neurons input zone</td>
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Physiologic Anatomy of Neuron

- **Axon**
  - Nerve fiber
  - Single, elongated tubular extension that conducts action potentials away from the cell body
  - Conducting zone of the neuron
  - Collaterals

- Axon hillock
  - First portion of the axon plus the region of the cell body from which the axon leaves
  - Neuron’s trigger zone

- Axon terminals
  - Release chemical messengers that simultaneously influence other cells with which they come into close association
  - Output zone of the neuron
Excitable Tissue Terminology

- **Membrane electrical states (different than text)**
  - **Polarization**
    - Any state when the membrane potential is other than 0mV
  - **Hyperpolarization**
    - Membrane becomes more polarized than its resting membrane potential (eg -70mv to -80mv)
  - **Hypopolarization**
    - Membrane becomes less polarized than its resting membrane potential (eg -70mv to -60mv)
  - **Depolarization**
    - Membrane rapidly approaches $E_{Na}^0$ (+60mV) in less than 1 msec after having first hypopolarized to its THRESHOLD POTENTIAL (voltage at which voltage regulated Na+ channel (gates) open)
  - **Repolarization**
    - Membrane rapidly approaches $E_K$ (-90mv) in less than 2 msec (must occur after DEPOLARIZATION TO TAKE THIS LONG)
**TEXT EXPLANATION**

- **Membrane potential (mV)**
  - Hyperpolarization (increase in potential; membrane more negative)
  - Depolarization (decrease in potential; membrane less negative)
  - Repolarization (return to resting potential after depolarization)

**CORRECT EXPLANATION**

- **Membrane potential (mV)**
  - Hypopolarization (decrease in potential; membrane less negative)
  - Hyperpolarization (increase in potential; membrane more negative)
  - Resting potential (return to resting potential after depolarization)
  - Resting potential (return to resting potential after hypopolarization)
**Introduction to Neural Communication**

- Two kinds of potential (voltage) change
  - Graded potentials
    - Serve as short-distance integrating signals
    - Generated at dendrites due to opening of chemically regulated ion channels by incoming signaling molecules (neurotransmitters) that are ligands for the dendritic receptor proteins
    - Graded (vary) in strength and duration
    - Affect, by local current flow, the voltage at the axon hillock
    - Effects of multiple graded potentials are summed at the hillock
  - Action potentials
    - Serve as long-distance (electrical) communicating signals
    - Originate at axon hillock and conducted along axon because they initiate a positive feedback cycle opens successively more ion gated channels
    - ALL or NONE: if hillock reaches threshold, an action potential will result. All action potentials are the same magnitude (size and duration)
Unbalanced charges distributed across the plasma membrane that are responsible for membrane potential.

Extracellular fluid

(a) Entire membrane at resting potential

Portion of an excitable cell

Intracellular fluid

Closed channels

(b) Inward movement of Na+ hypopolarizes membrane, producing a graded potential

Chemical or mechanical messaging event opens ion channels, most commonly permitting slow net Na+ entry.

Inactive area at resting potential

Active area hypopolarized (a graded potential)

Inactive area at resting potential

Fig. 4-2a, p. 73

Fig. 4-2b, p. 73
Graded Potentials

- Occurs in small, specialized region of excitable cell membranes (receptor area or dendrite of neuron)
  - Magnitude of graded potential varies directly with the magnitude of the triggering event
  - Due to opening or closing of chemically regulated gates by chemical messengers from other neurons
Graded Potentials

- The stronger a triggering event is, the larger the resultant graded potential
- Graded potential spread by passive current flow
- Graded potentials show decrement over short distance

Fig. 4-3a, p. 74

* Numbers refer to the local potential in mV at various points along the membrane.

(a) Current loss across the membrane
Change in membrane potential in mV relative to resting potential (i.e., magnitude of electrical signal)

Decremental spread of graded potentials

Distance

Few mm

Few mm

Initial active

Area

Decremental spread of graded potential

Resting potential

Fig. 4-3b, p. 74