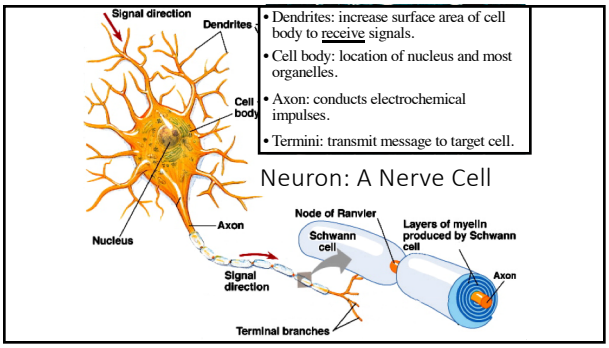
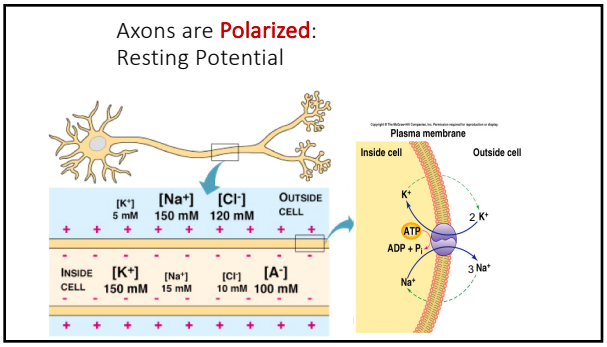
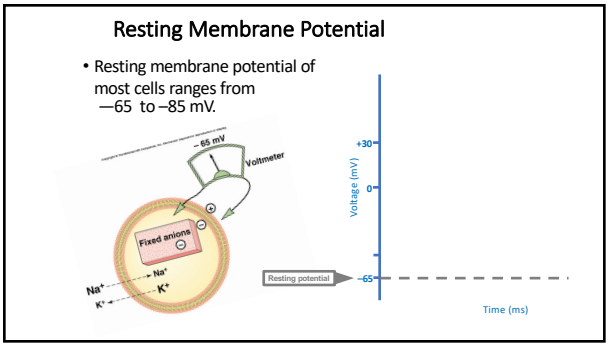
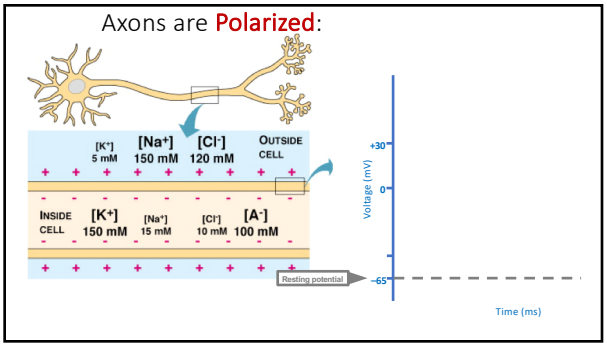
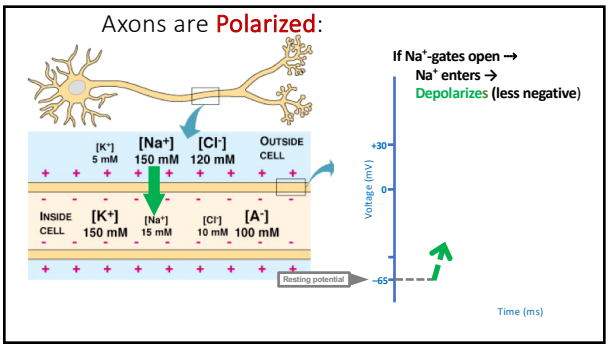
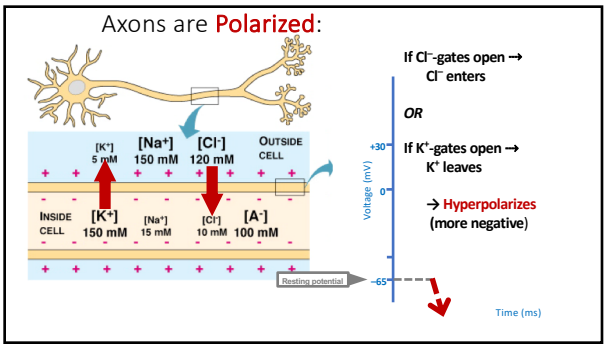

Signal direction
Dendrites
Cell body
Nucleus
Axon
Signal direction
Terminal branches
Node of Ranvier
Schwann cell
Layers of myelin produced by Schwann cell
Axon
• Dendrites: increase surface area of cell body to receive signals.
• Cell body: location of nucleus and most organelles.
• Axon: conducts electrochemical impulses.
• Termini: transmit message to target cell.
Neuron: A Nerve Cell

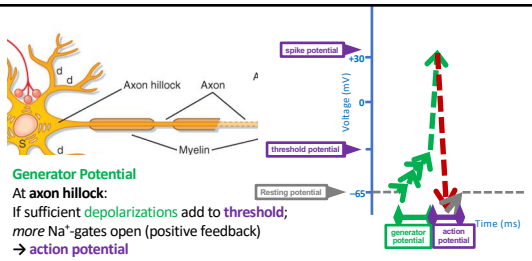

Axons are Polarized:
Resting Potential
[K+] 5 mM
[Na+] 150 mM
[Cl-] 120 mM
OUTSIDE CELL
INSIDE CELL
[K+] 150 mM
[Na+] 15 mM
[Cl-] 10 mM
[A-] 100 mM
Plasma membrane
Inside cell
Outside cell
K+
ATP
ADP + Pi
2 K+
3 Na+
Na+


Resting Membrane Potential
• Resting membrane potential of most cells ranges from —65 to –85 mV.
–65 mV
Voltmeter
Fixed anions
Na+
K+
Voltage (mV)
+30
0
–65
Resting potential
Time (ms)

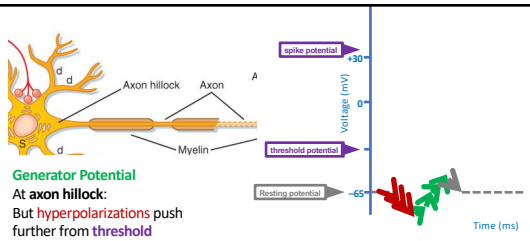

Axons are Polarized:
[K+] 5 mM
[Na+] 150 mM
[Cl-] 120 mM
OUTSIDE CELL
INSIDE CELL
[K+] 150 mM
[Na+] 15 mM
[Cl-] 10 mM
[A-] 100 mM
Voltage (mV)
+30
0
–65
Resting potential
Time (ms)


Axons are Polarized:
If Na+-gates open →
Na+ enters →
Depolarizes (less negative)
[K+] 5 mM
[Na+] 150 mM
[Cl-] 120 mM
OUTSIDE CELL
INSIDE CELL
[K+] 150 mM
[Na+] 15 mM
[Cl-] 10 mM
[A-] 100 mM
Voltage (mV)
+30
0
–65
Resting potential
Time (ms)

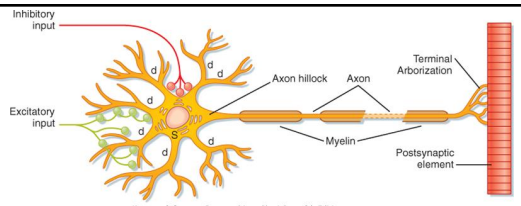

Axons are Polarized:
If Cl−-gates open →
Cl− enters
OR
If K+-gates open →
K+ leaves
→ Hyperpolarizes
(more negative)
[K+] 5 mM
[Na+] 150 mM
[Cl-] 120 mM
OUTSIDE CELL
INSIDE CELL
[K+] 150 mM
[Na+] 15 mM
[Cl-] 10 mM
[A-] 100 mM
Voltage (mV)
+30
0
–65
Resting potential
Time (ms)



Generator Potential
At **axon hillock**:
If sufficient depolarizations add to **threshold**;
more Na^+-gates open (positive feedback)
→ **action potential**



Generator Potential
At **axon hillock**:
But hyperpolarizations push
further from **threshold**
→ *inhibit* action potential from starting



Koeppen & Stanton: Berne and Levy Physiology, 6th Edition.
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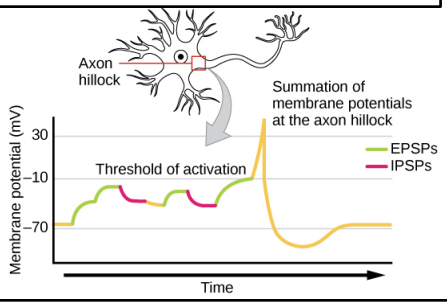
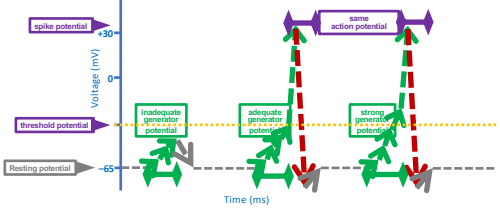
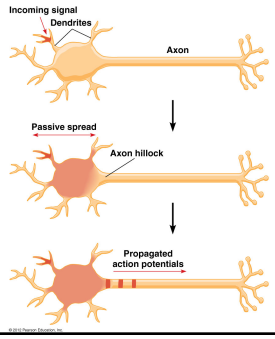
Generator Potential = *summation* of **EPSP**s and **IPSP**s

- Excitatory neurons ⇢ neurotransmitter opens Na^+-gates
  → Excitatory post-synaptic potentials (**EPSP**)
- Inhibitory neurons ⇢ neurotransmitter opens K^+-gates or Cl^--gates
  → Inhibitory post-synaptic potentials (**IPSP**)

Generator Potential = *summation* of **EPSP**s and **IPSP**s



- **Generator Potential** is **graded**
- **Action potential** is **"all-or-none"**



- **Once an action potential is generated at the axon hillock, the signal is conducted down the axon.**
  - **Since each action potential is "all-or-none", so is each nerve impulse.**