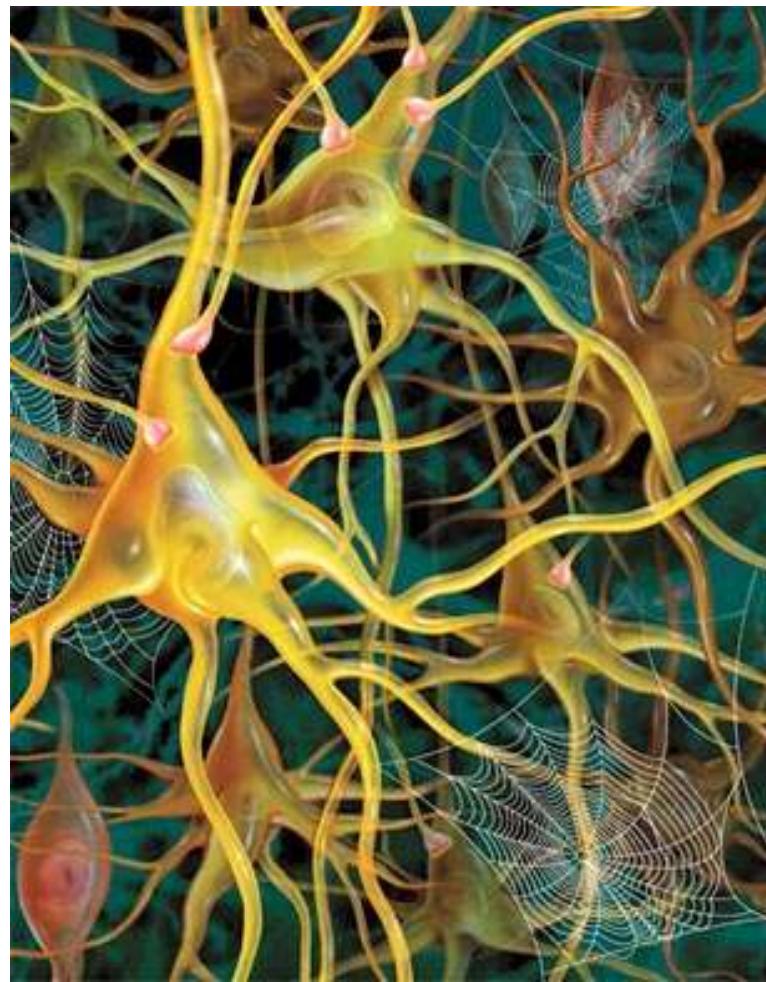


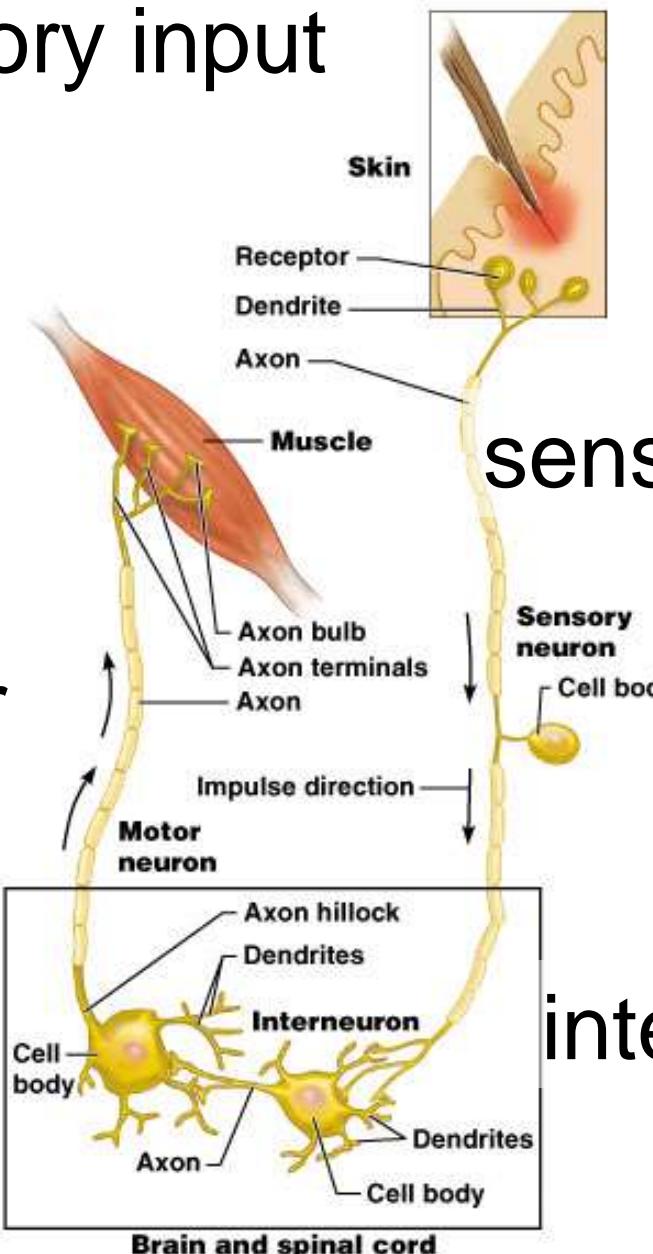
# Neurons



# Function of the Nervous System

sensory input

motor input



sensory receptor

effector

integration

# Anatomical Divisions of the Nervous System

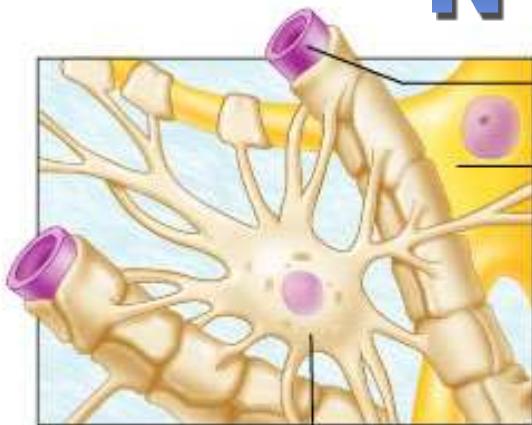
## Central Nervous System (CNS)

- brain
- spinal cord

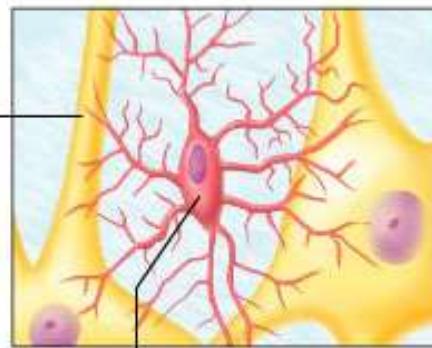
## Peripheral Nervous System (PNS)

- cranial nerves
- spinal nerves

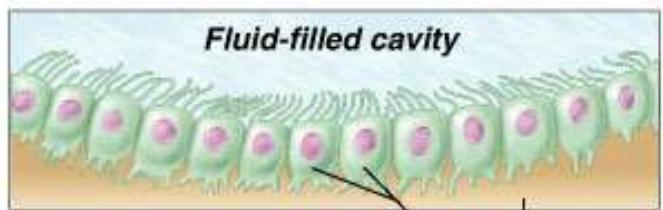
# Neuroglia



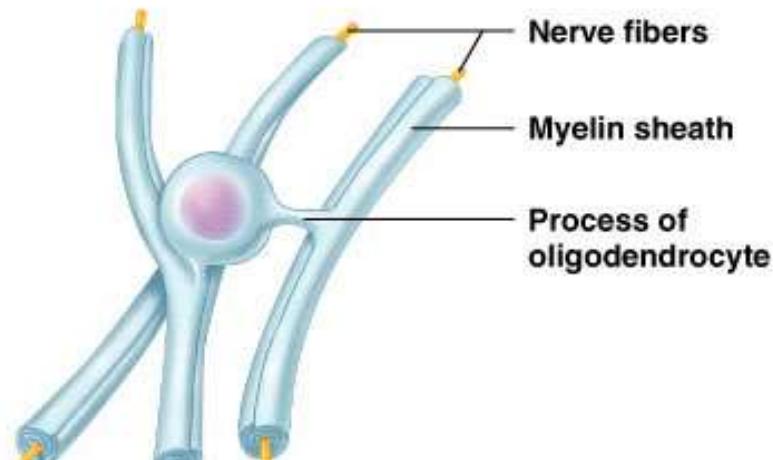
(a) Astrocyte



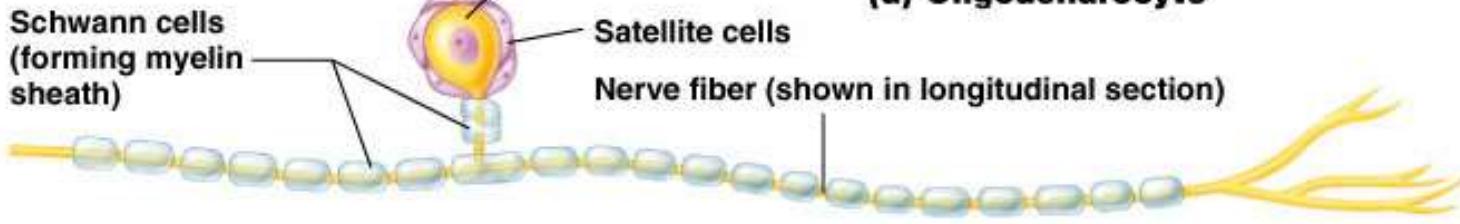
(b) Microglial cell



(c) Ependymal cells

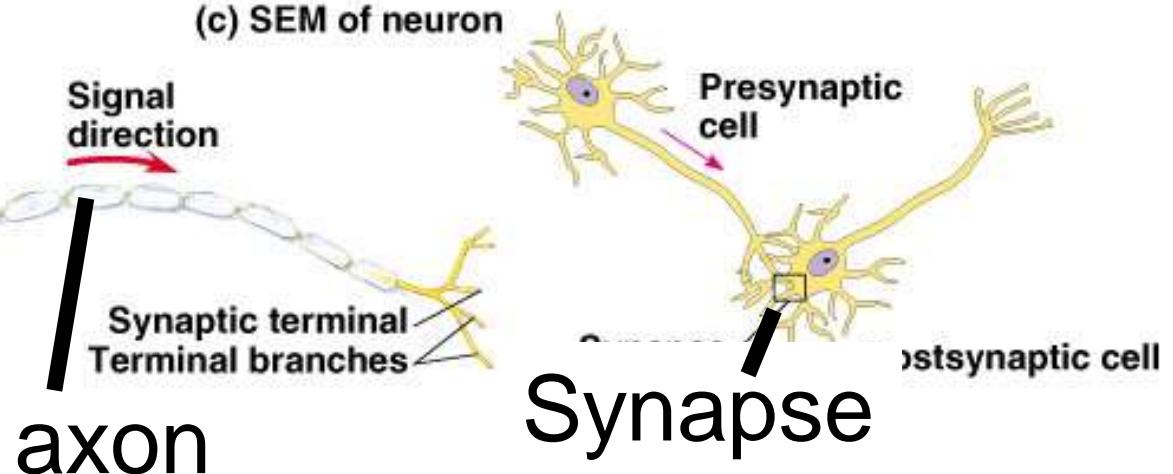
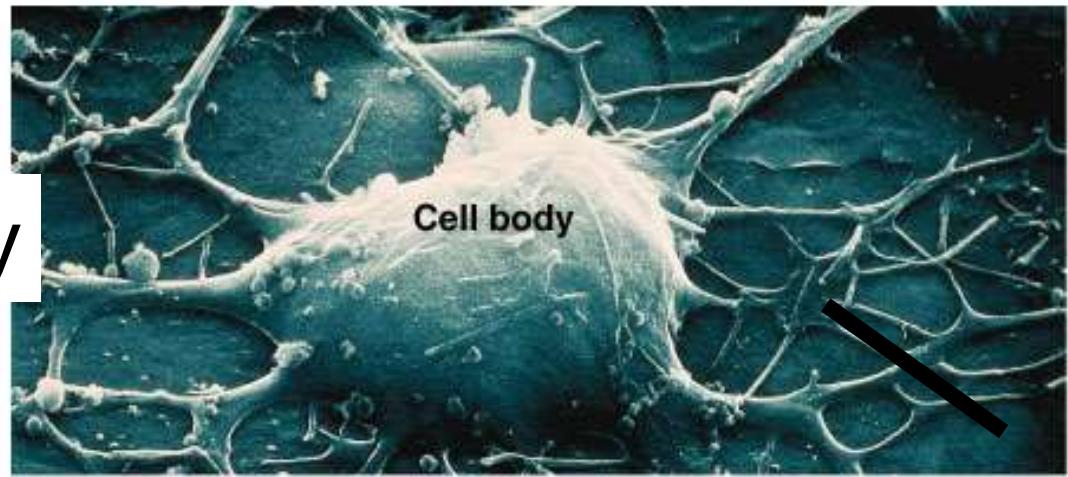
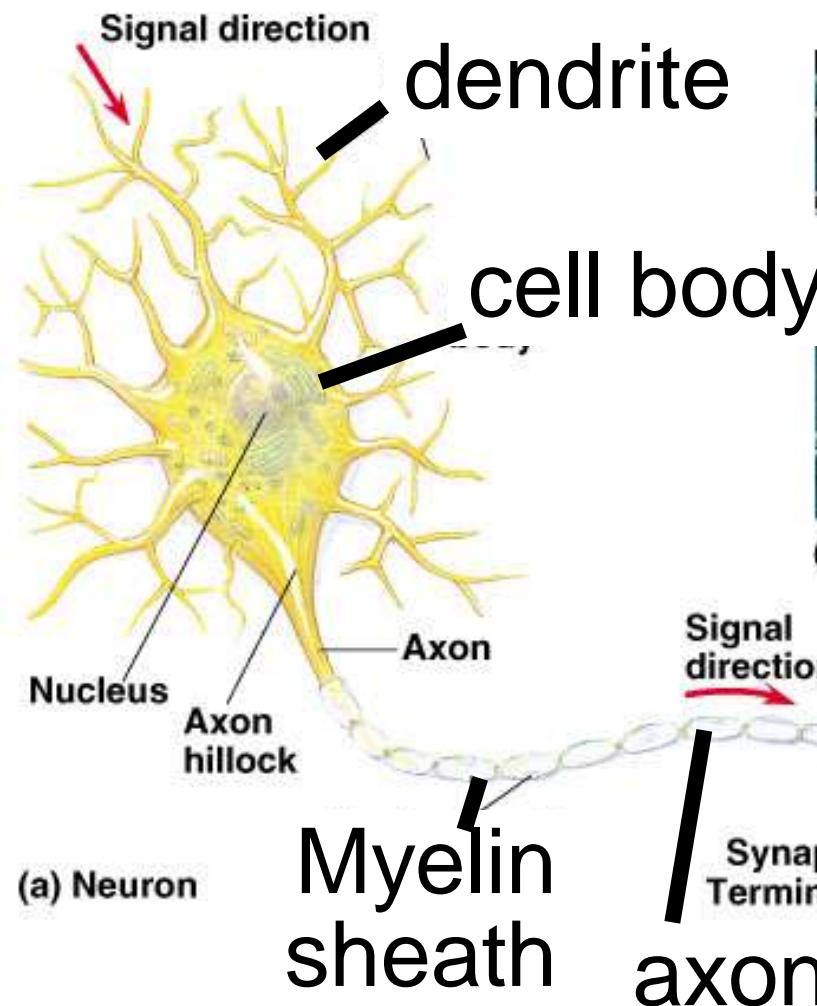


(d) Oligodendrocyte

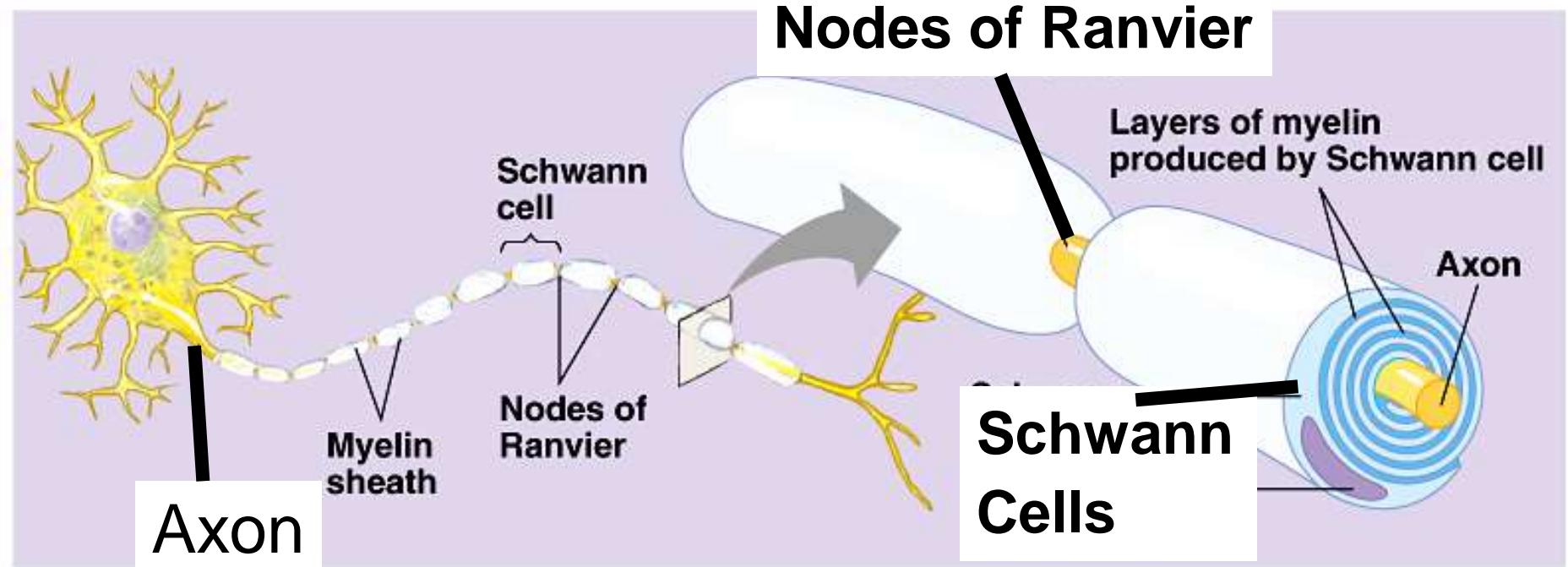


(e) Sensory neuron with Schwann cells and satellite cells

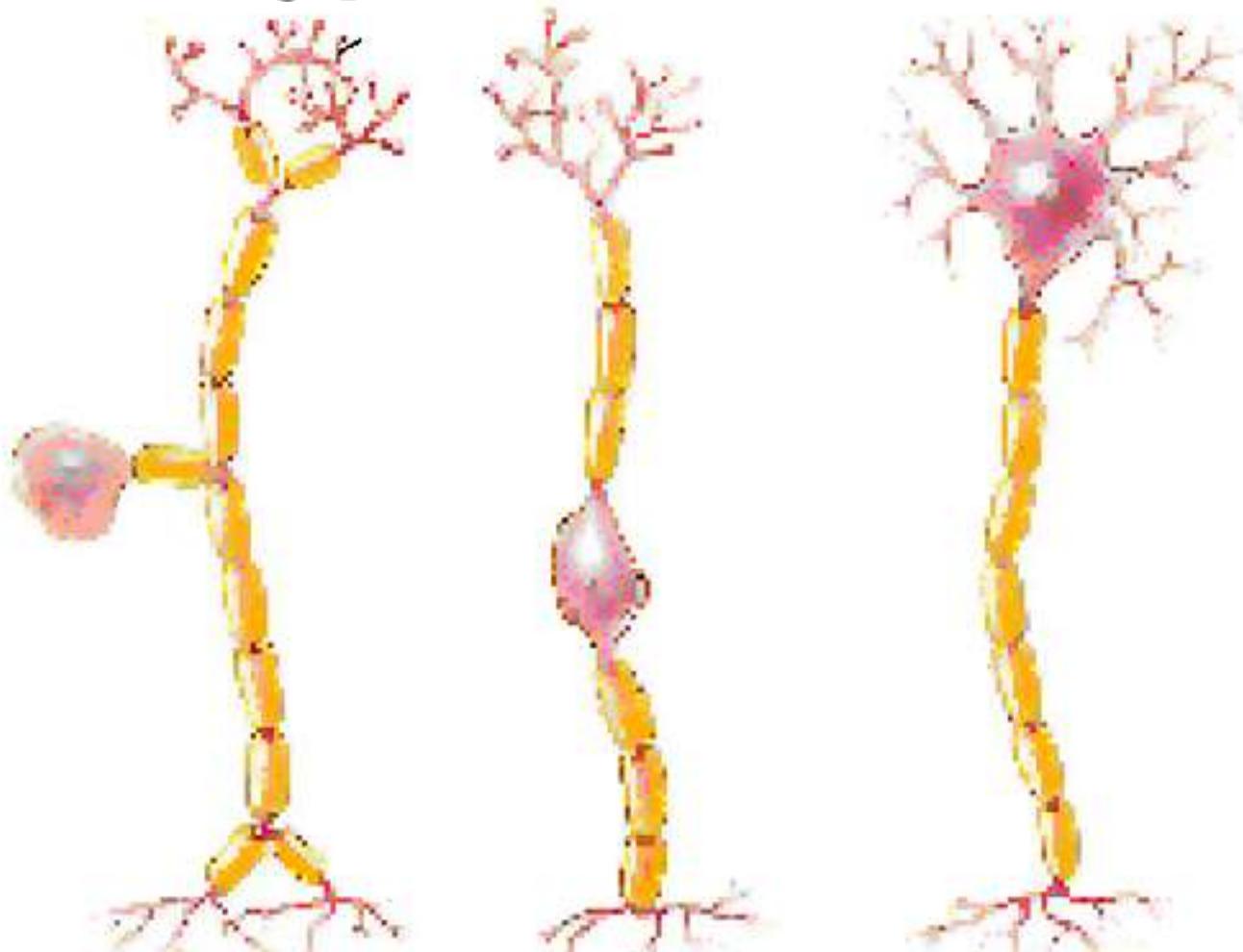
# Typical Neuron



# Myelin Sheath & Schwann Cell



# Types of Neurons



**unipolar**

Dorsal root  
ganglion cells

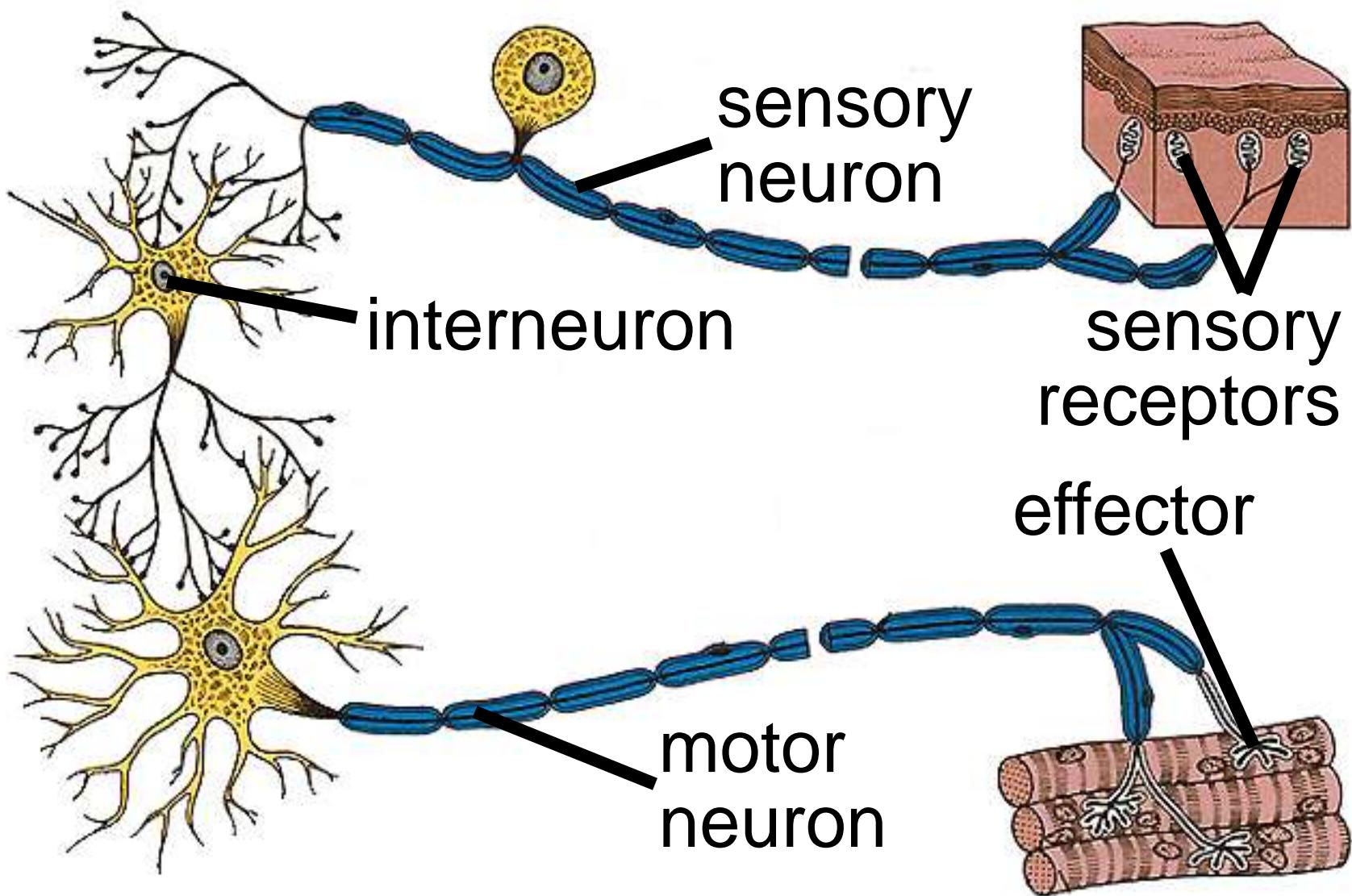
**bipolar**

eye, ear, & olfactory

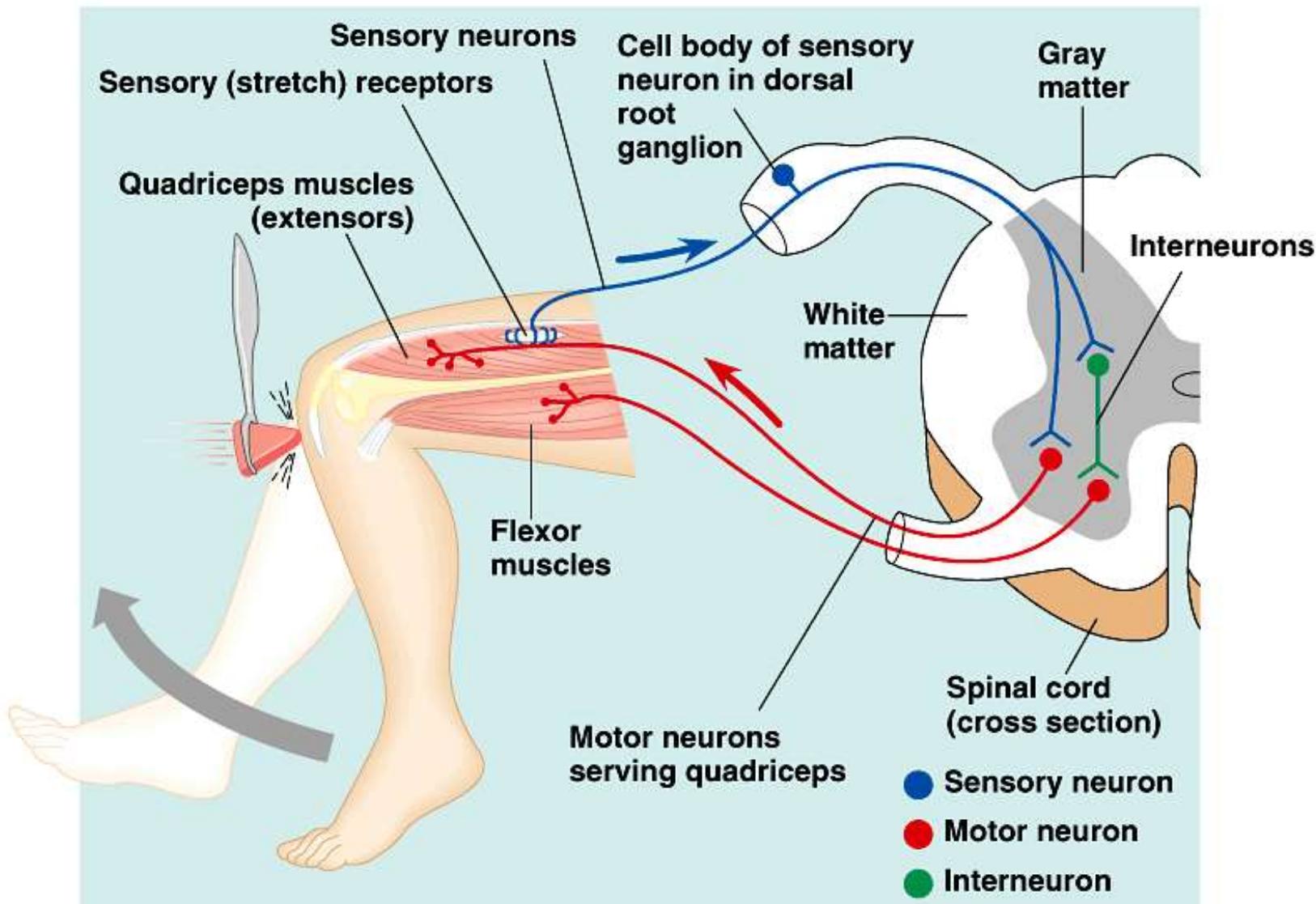
**multipolar**

most abundant type in CNS

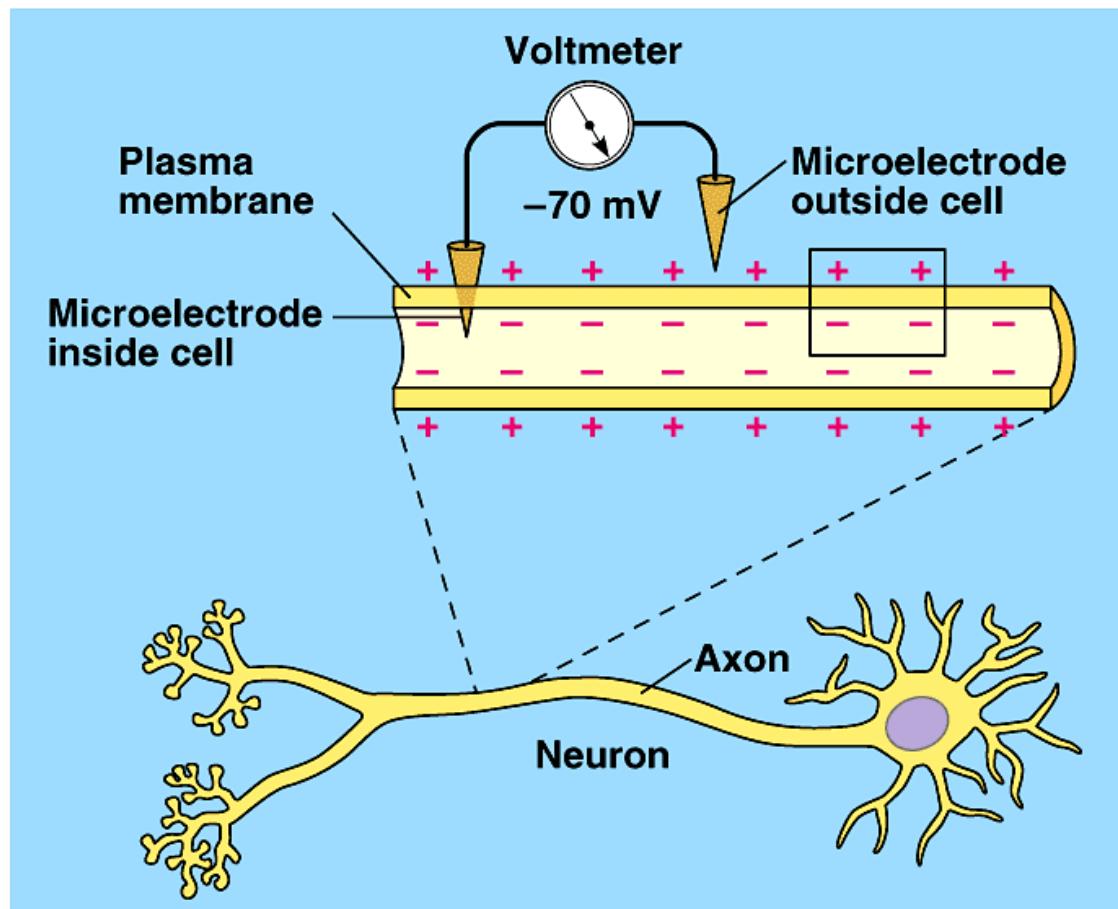
# Neuron Interaction & Integration



- A Simple Nerve Circuit – the Reflex Arc.
  - A reflex is an autonomic response.

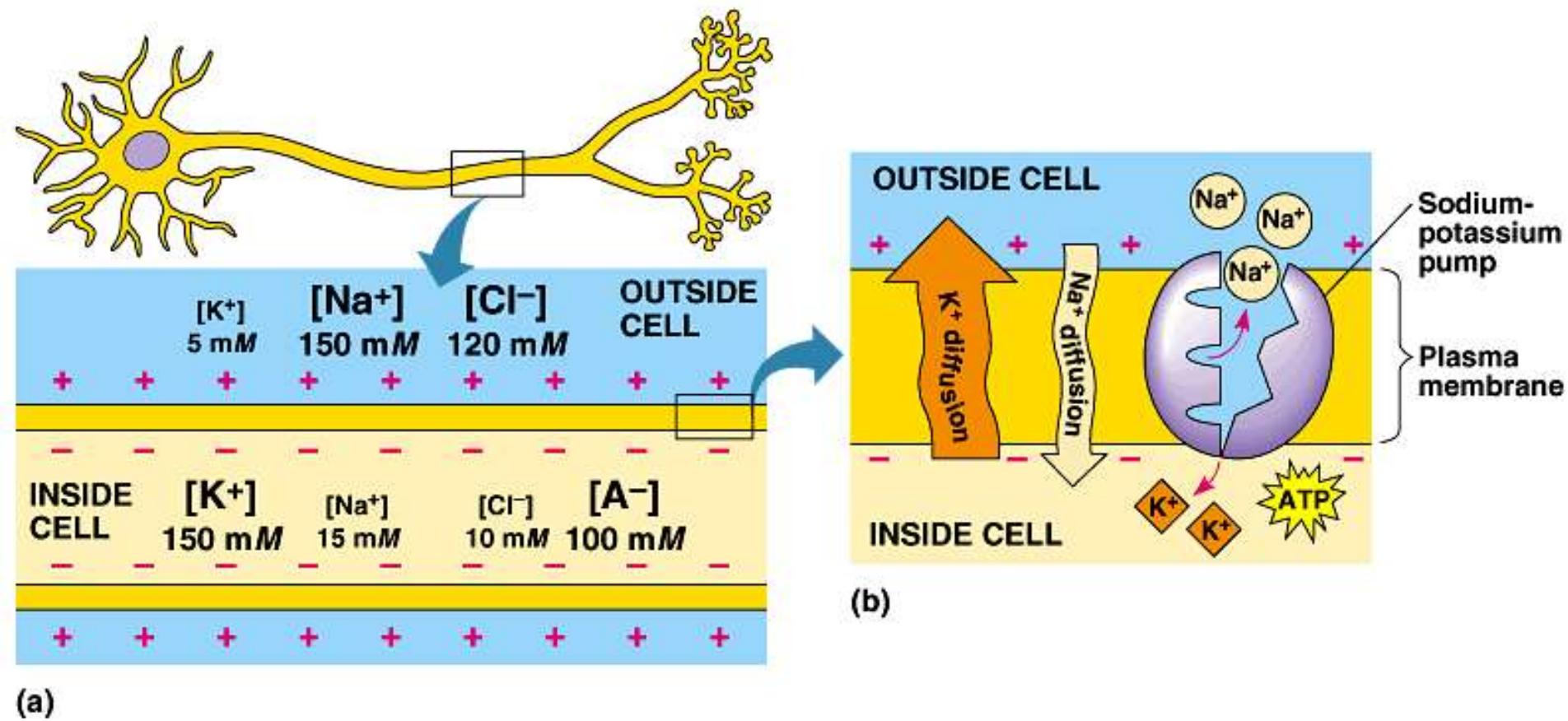


- Measuring Membrane Potentials.

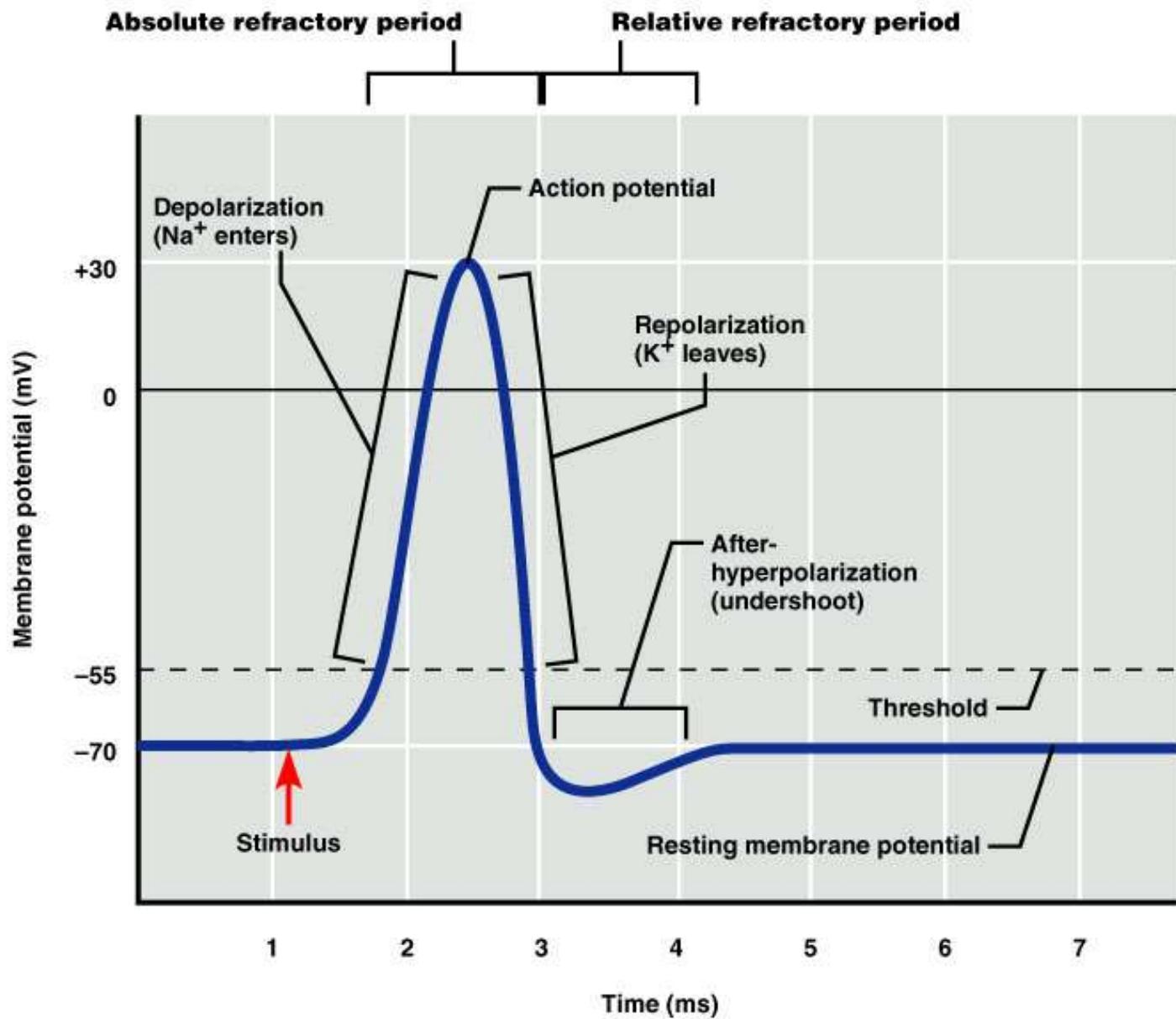


- An unstimulated cell usually have a **resting potential** of  $-70\text{mV}$ .

- **Ungated ion channels** allow ions to diffuse across the plasma membrane.
  - These channels are always open.



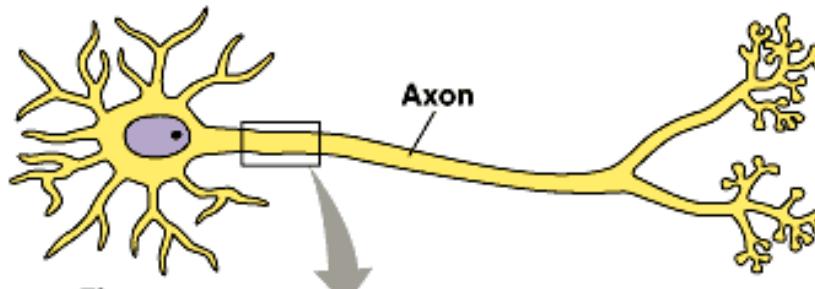
# Refractory Period



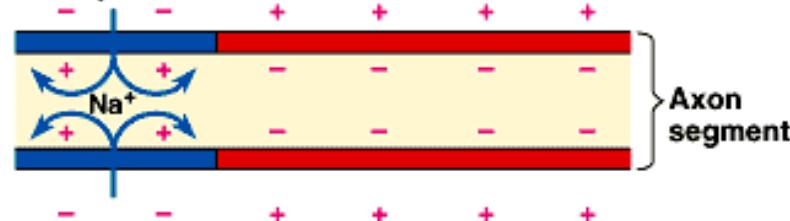
# **Nerve impulses propagate themselves along an axon**

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- The action potential is repeatedly regenerated along the length of the axon.
  - An action potential achieved at one region of the membrane is sufficient to depolarize a neighboring region above threshold.
    - Thus triggering a new action potential.
    - The refractory period assures that impulse conduction is unidirectional.

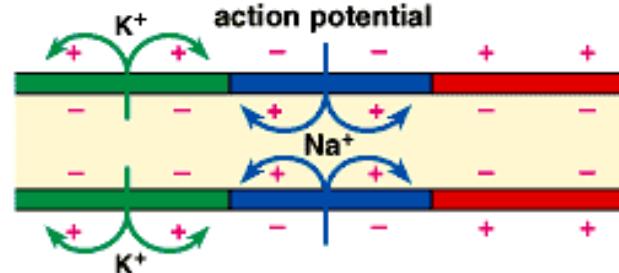


First  
action potential



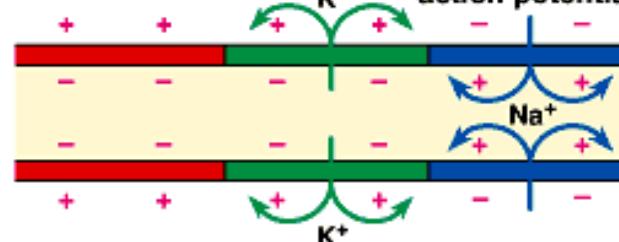
①

Second  
action potential



②

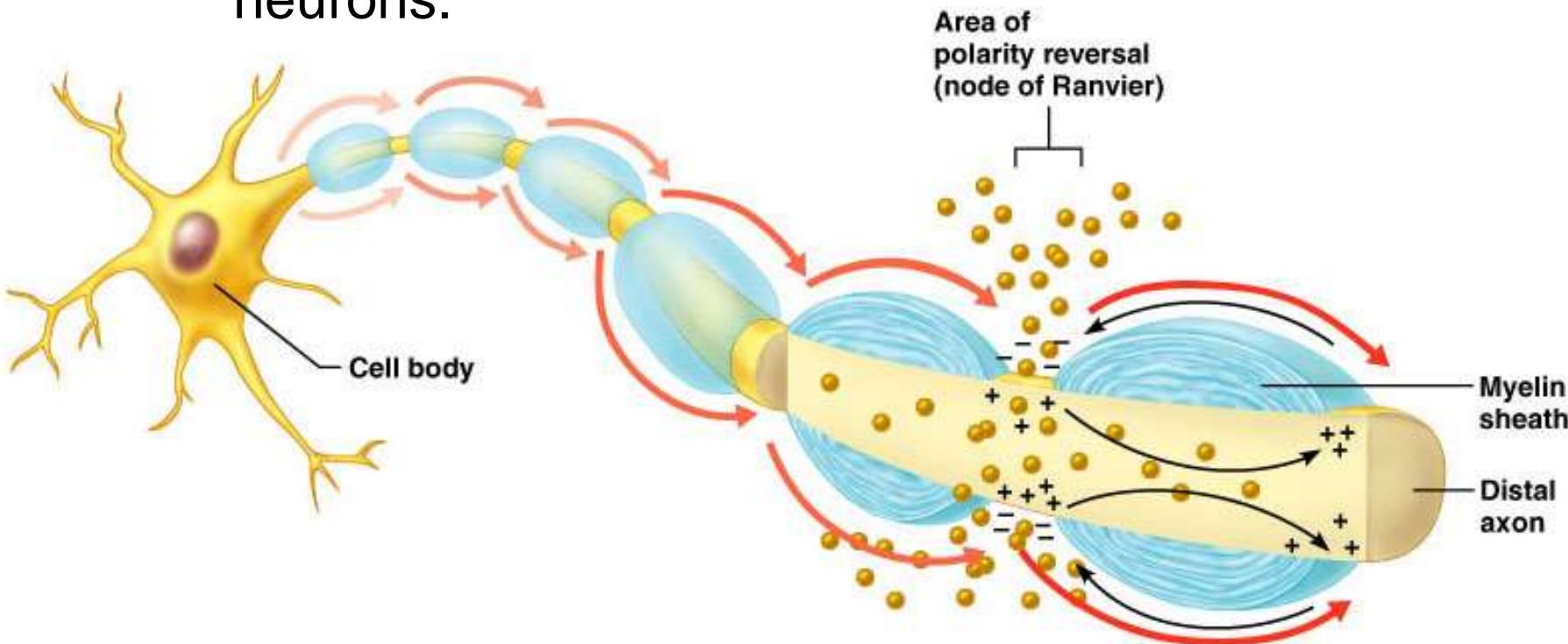
Third  
action potential



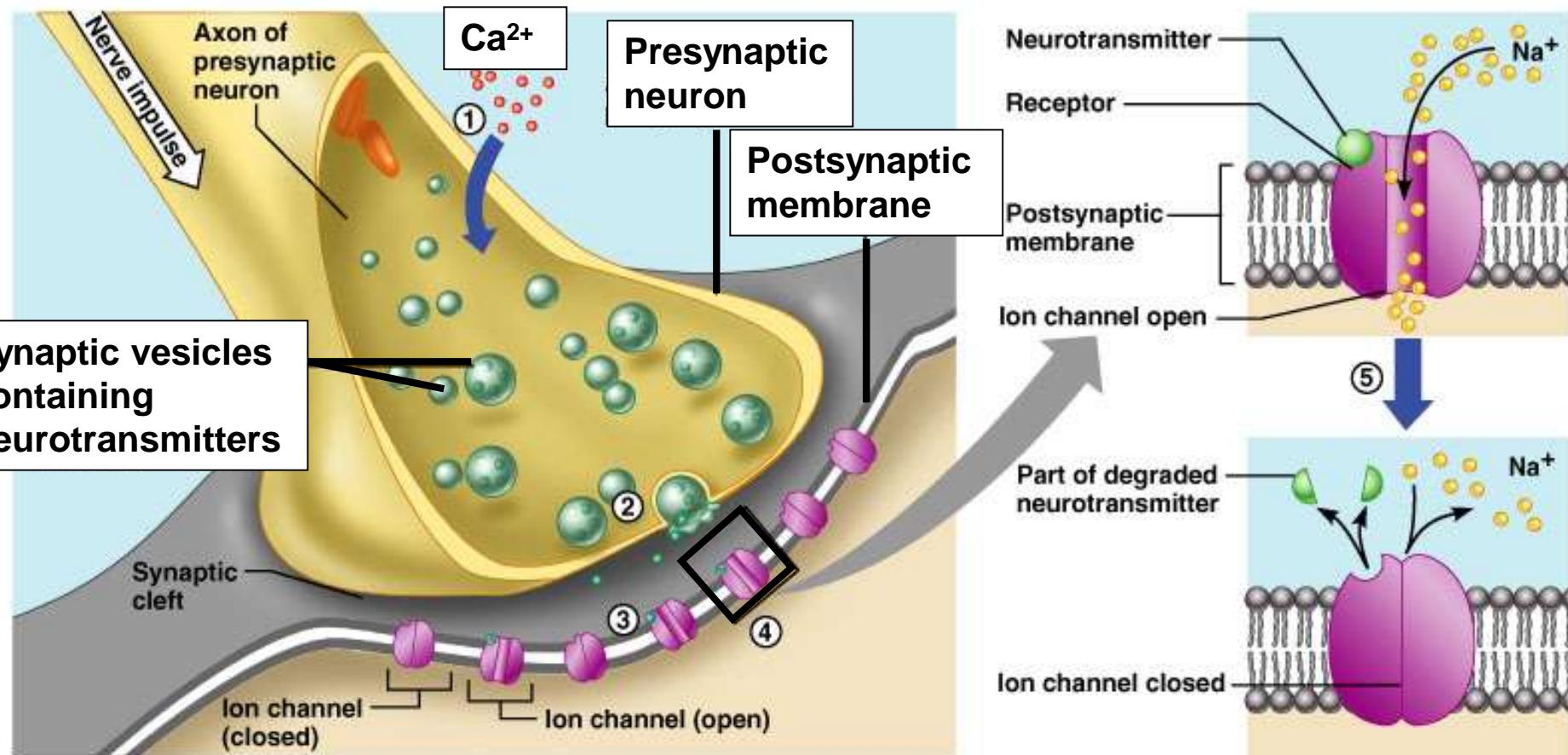
③

# Saltatory Conduction

- Saltatory conduction.
  - In myelinated neurons only unmyelinated regions of the axon depolarize.
    - Thus, the impulse moves faster than in unmyelinated neurons.



# Synapses



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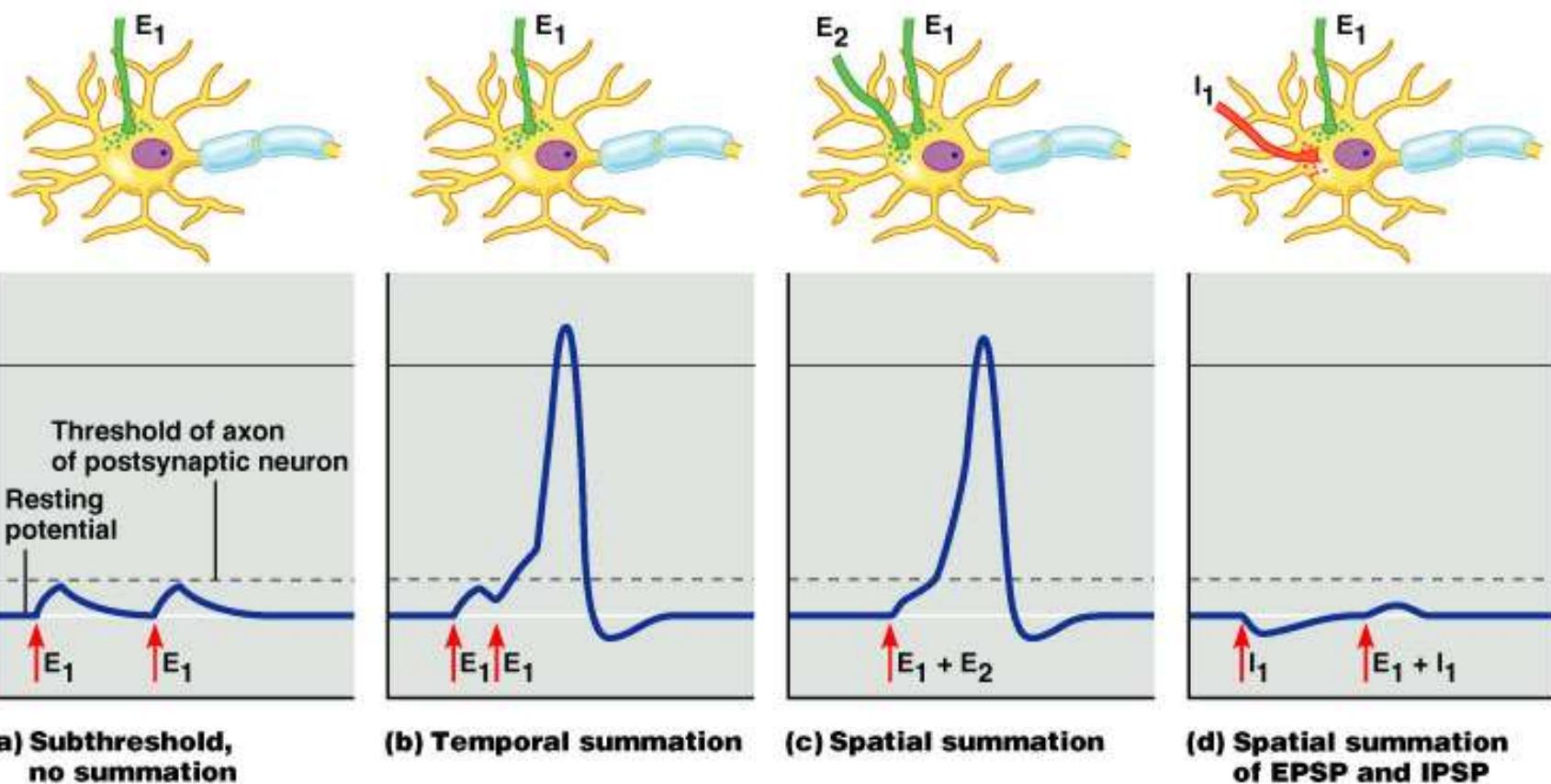
# Neural integration occurs at the cellular level

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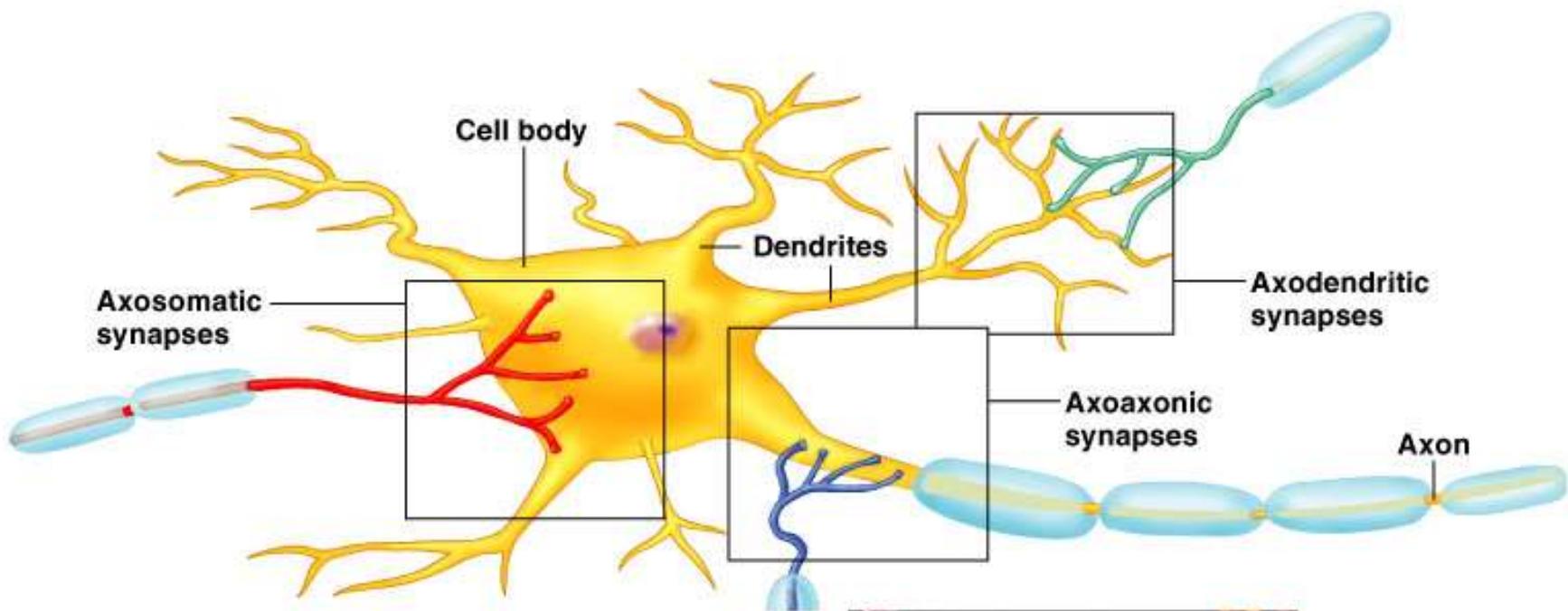
- **Excitatory postsynaptic potentials (EPSP)** depolarize the postsynaptic neuron.
  - The binding of neurotransmitter to postsynaptic receptors open gated channels that allow  $\text{Na}^+$  to diffuse into and  $\text{K}^+$  to diffuse out of the cell.

- **Inhibitory postsynaptic potential (IPSP)** hyperpolarize the postsynaptic neuron.
  - The binding of neurotransmitter to postsynaptic receptors open gated channels that allow  $K^+$  to diffuse out of the cell and/or  $Cl^-$  to diffuse into the cell.

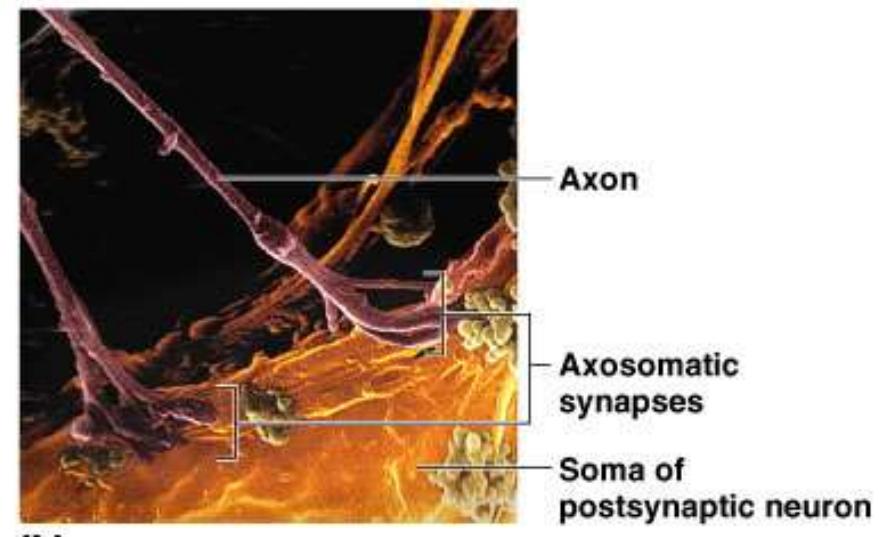
# EPSP & IPSP



# Synapses



(a)



(b)

# Neurotransmitters

- **Acetylcholine**- slows heart rate; PNS
- **Glutamate**- most prevalent neurotransmitter in the brain
- **Aspartate**- in CNS
- **GABA**- inhibitory neurotransmitter
- **Glycine**- inhibitory neurotransmitter
- **Norepinephrine**- awakening from deep sleep
- **Epinephrine**- increase heart rate
- **Dopamine**- movement of skeletal muscles
- **Serotonin**- sensory perception, temp regulation, mood, sleep
- **Nitric oxide**- may play a role in memory and learning
- **Enkephalin**- inhibit pain impulses by suppressing release of substance P
- **Substance P**- enhances perception of pain

tyrosine