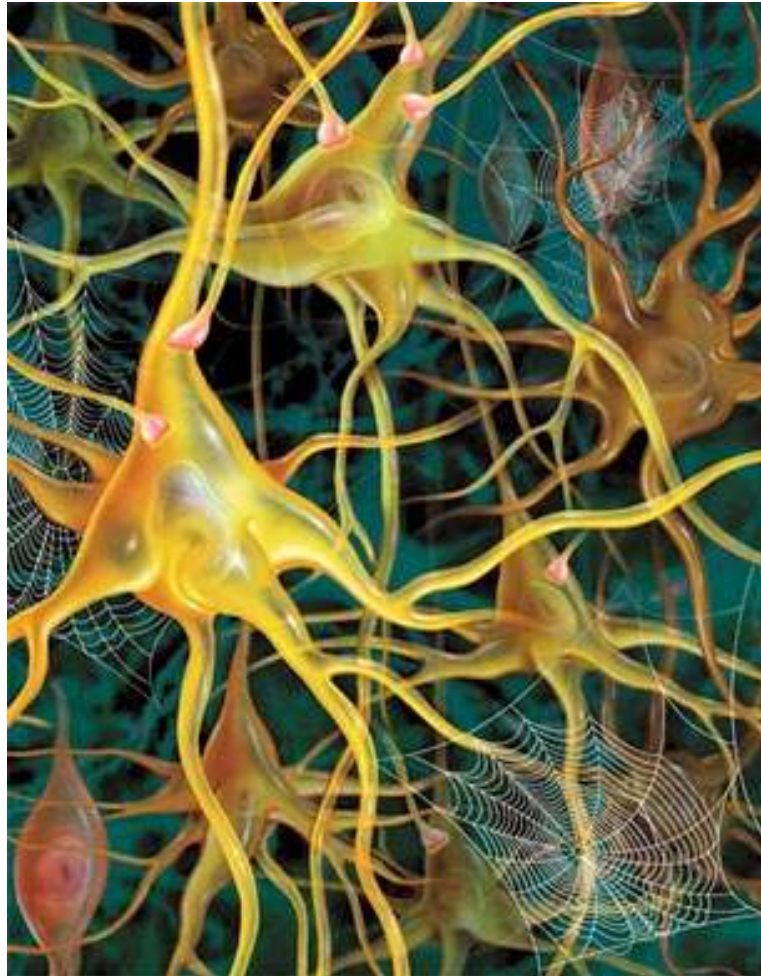


# Neurons

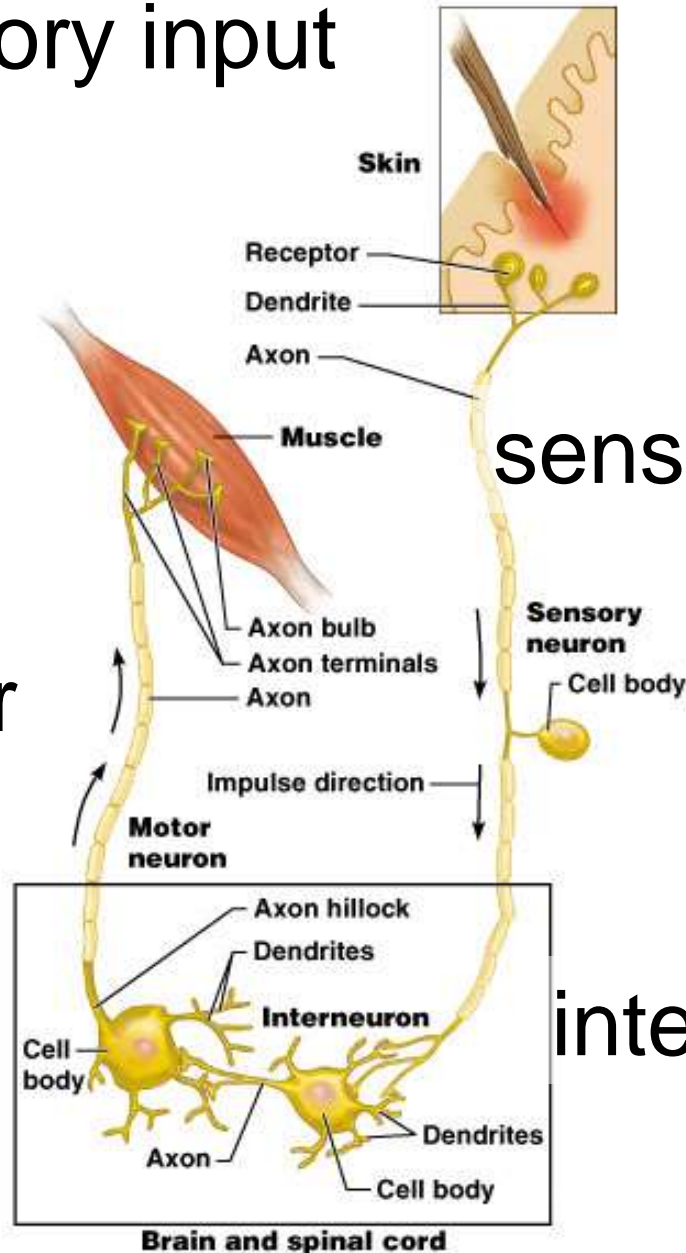


# Function of the Nervous System

sensory input

motor input

effector



sensory receptor

integration

# Anatomical Divisions of the Nervous System

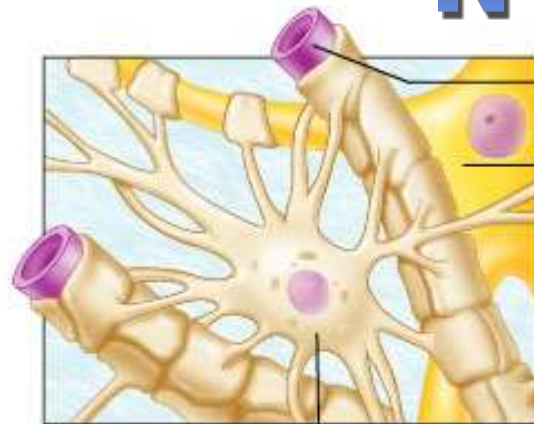
## Central Nervous System (CNS)

- brain
- spinal cord

## Peripheral Nervous System (PNS)

- cranial nerves
- spinal nerves

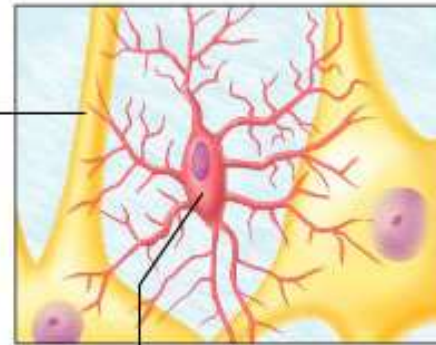
# Neuroglia



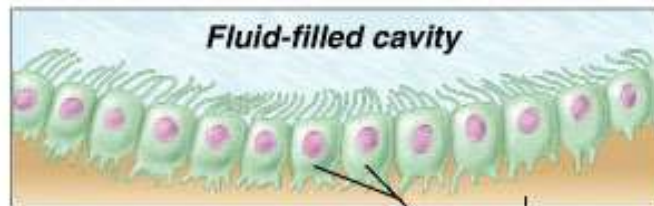
**(a) Astrocyte**

Capillary

Neuron



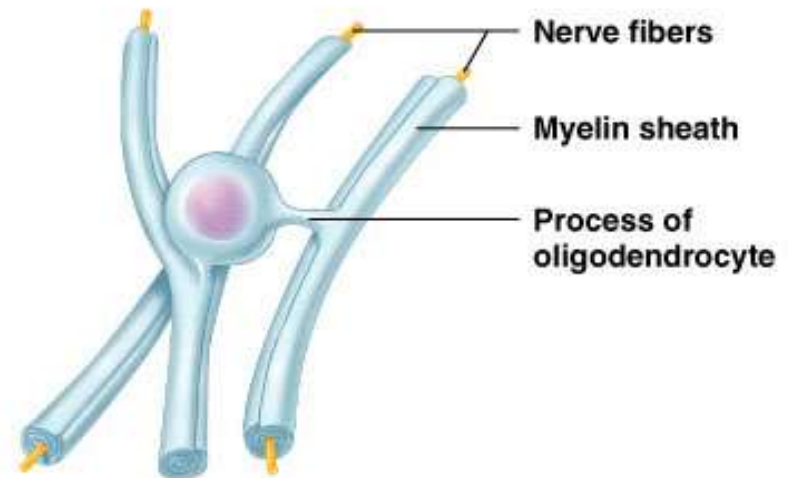
**(b) Microglial cell**



**(c) Ependymal cells**

*Fluid-filled cavity*

Brain or spinal cord tissue

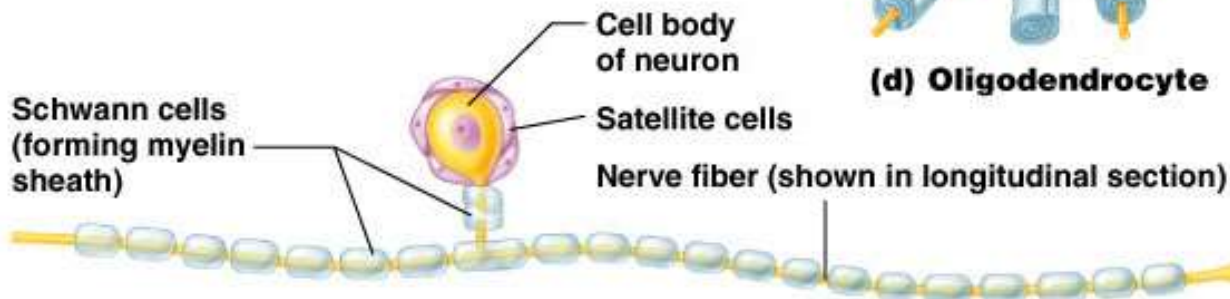


**(d) Oligodendrocyte**

Nerve fibers

Myelin sheath

Process of oligodendrocyte



**(e) Sensory neuron with Schwann cells and satellite cells**

Cell body of neuron

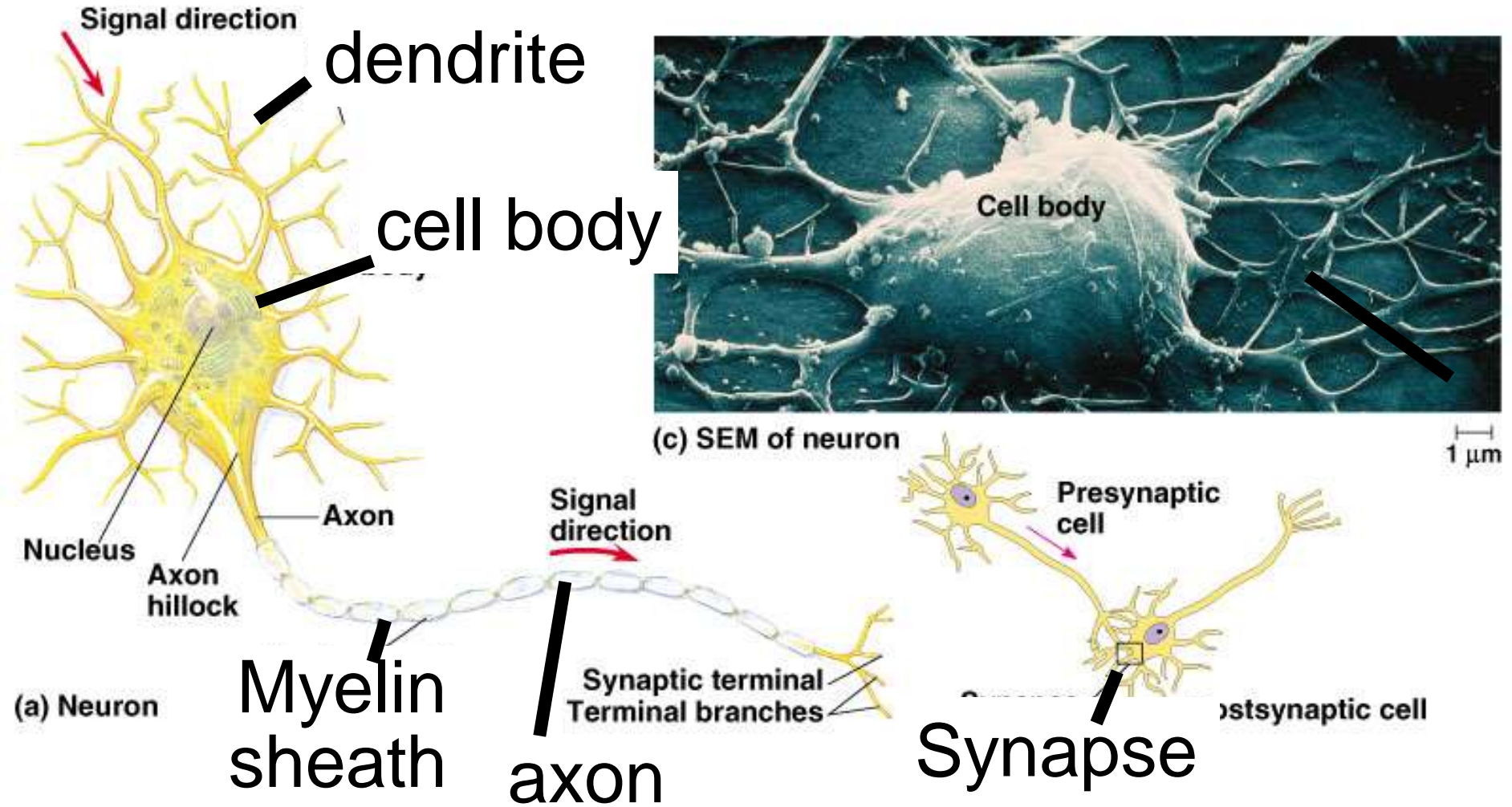
Satellite cells

Nerve fiber (shown in longitudinal section)

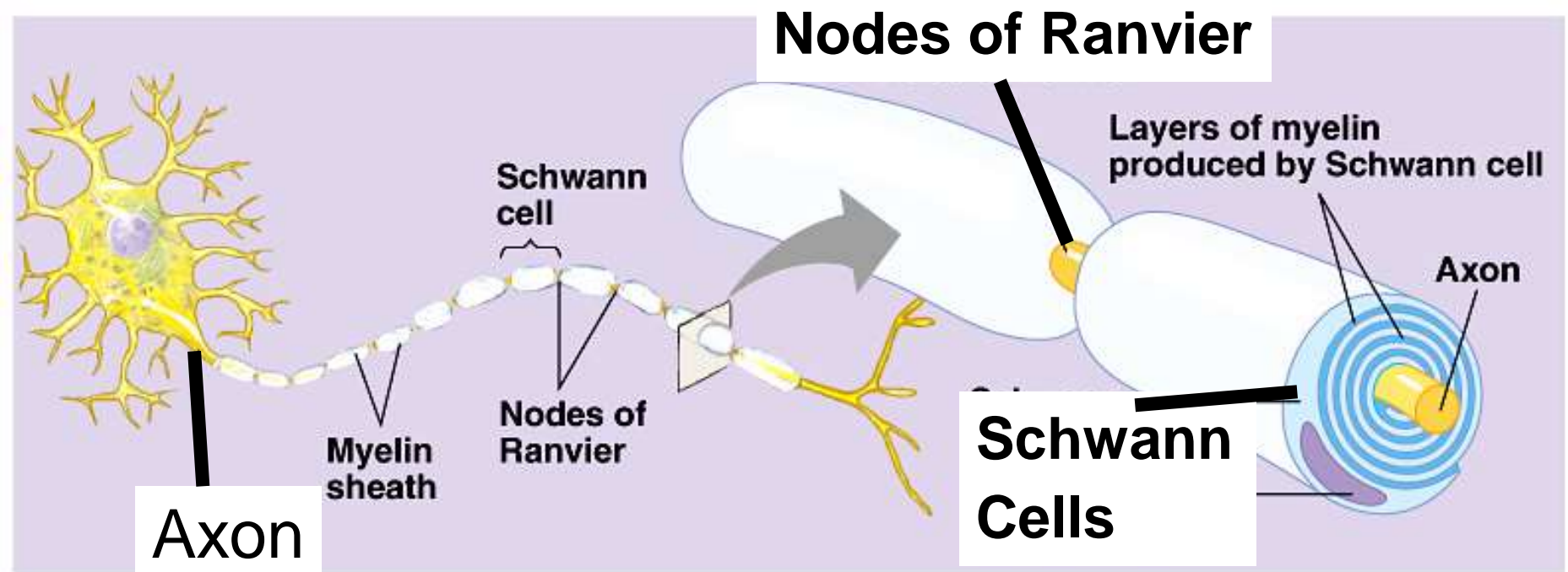
Schwann cells  
(forming myelin sheath)



# Typical Neuron



# Myelin Sheath & Shwann Cell



# Types of Neurons



**unipolar**

Dorsal root  
ganglion cells



**bipolar**

eye, ear, & olfactory

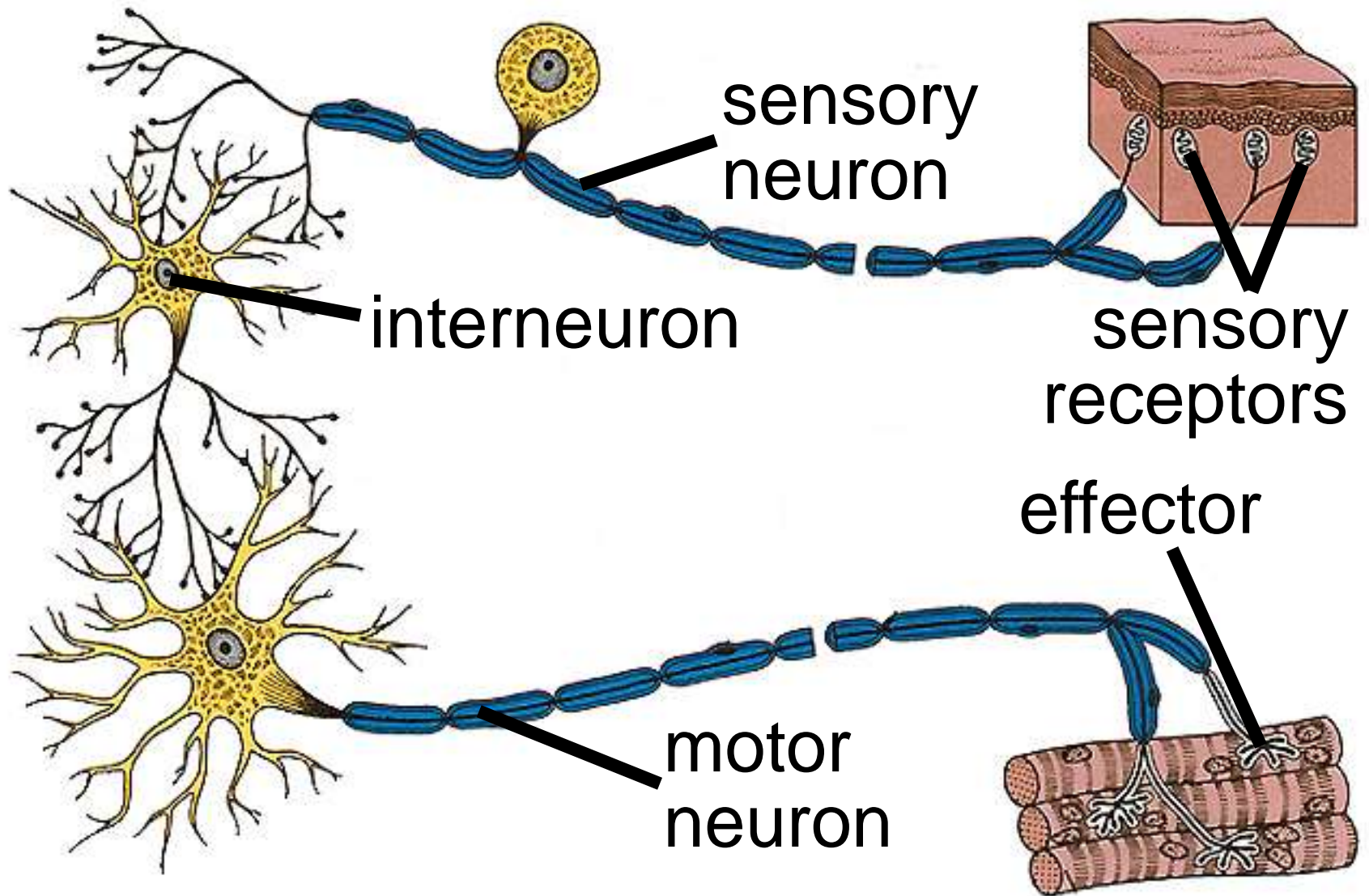


**multipolar**

most abundant type in CNS

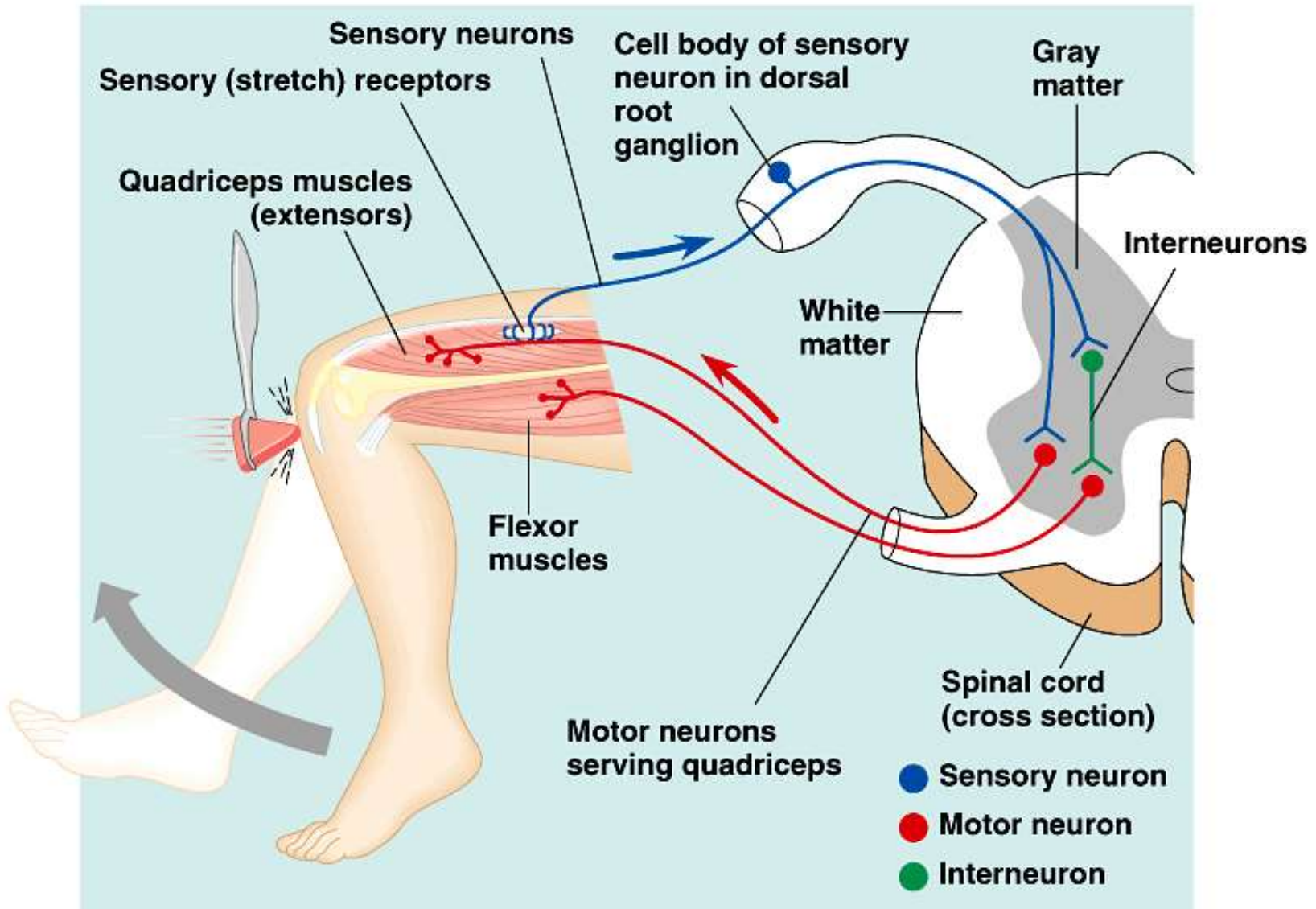


# Neuron Interaction & Integration

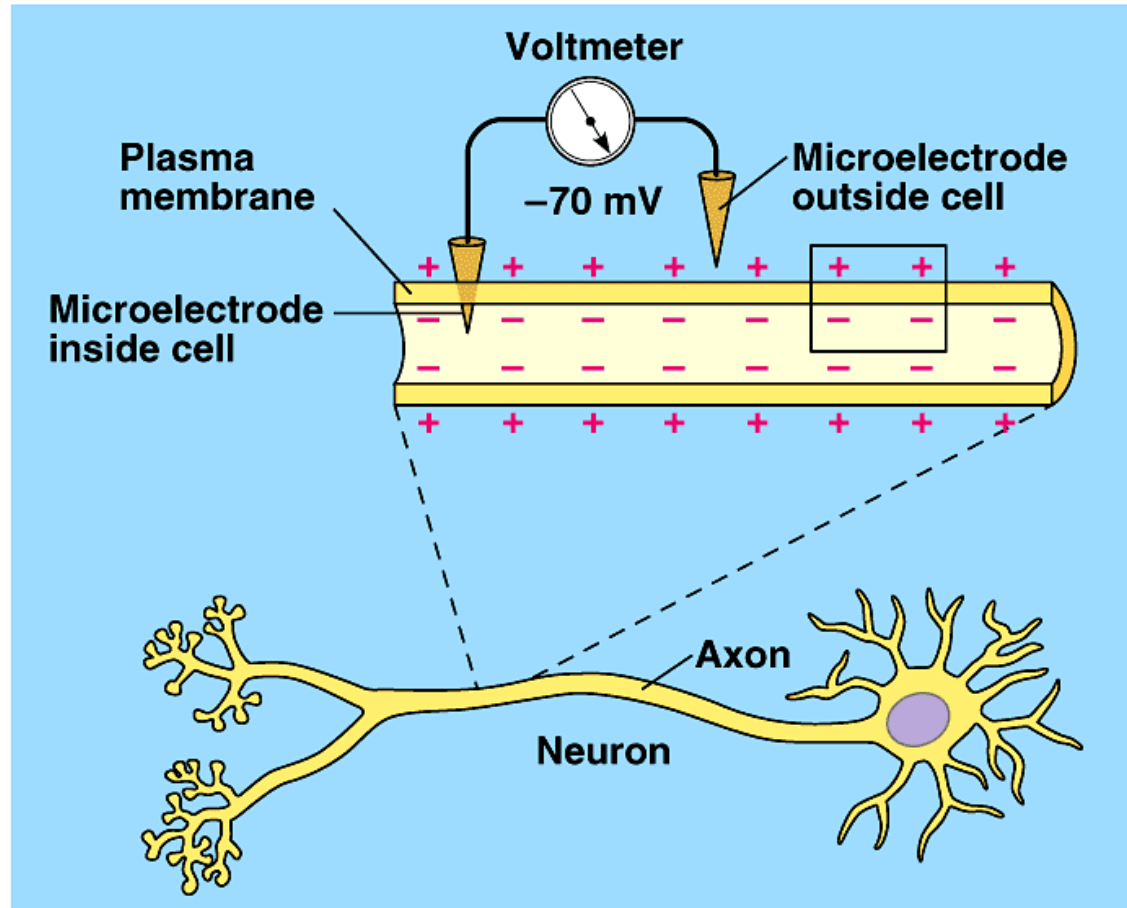




- A Simple Nerve Circuit – the Reflex Arc.
  - A **reflex** is an autonomic response.

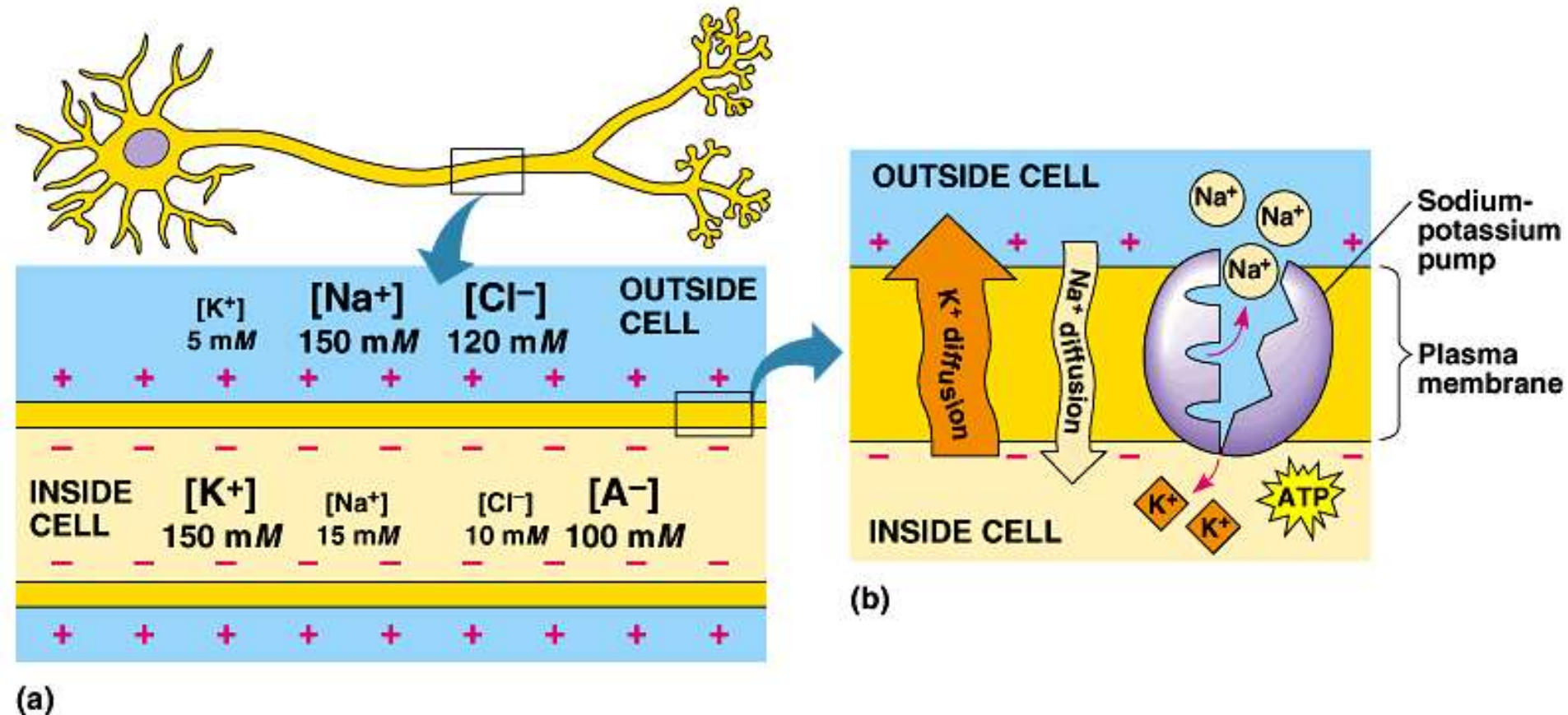


- Measuring Membrane Potentials.

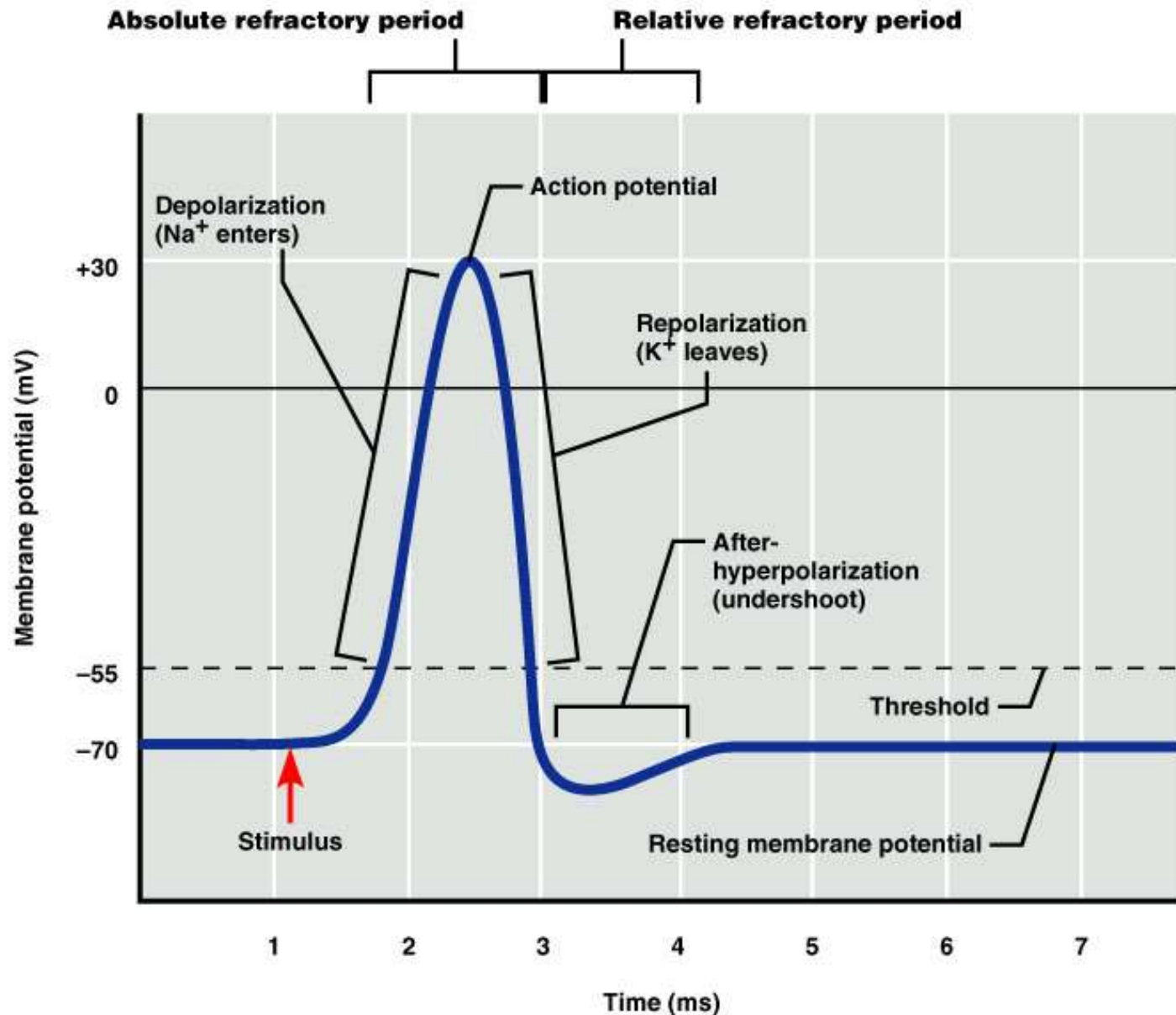


- An unstimulated cell usually have a **resting potential** of  $-70\text{mV}$ .

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



# Refractory Period

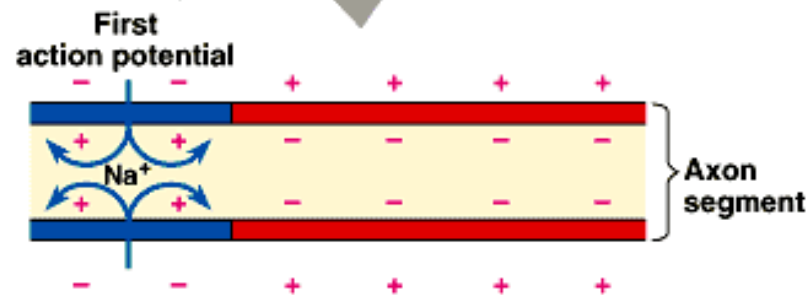
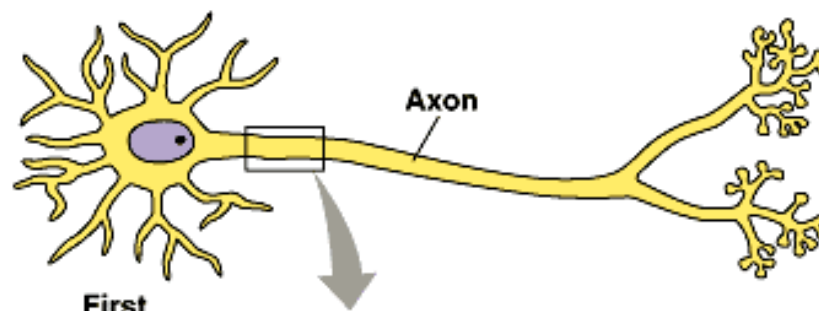




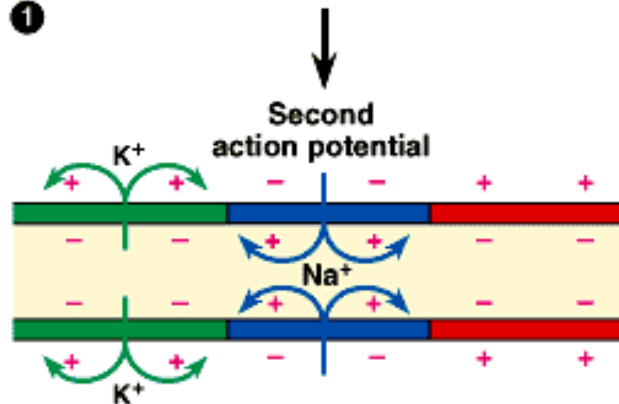
# Nerve impulses propagate themselves along an axon

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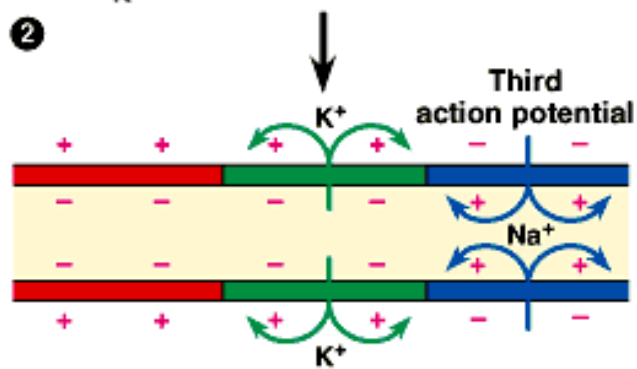
- The action potential is repeatedly regenerated along the length of the axon.
  - An action potential achieved at one region of the membrane is sufficient to depolarize a neighboring region above threshold.
    - Thus triggering a new action potential.
    - The refractory period assures that impulse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



1



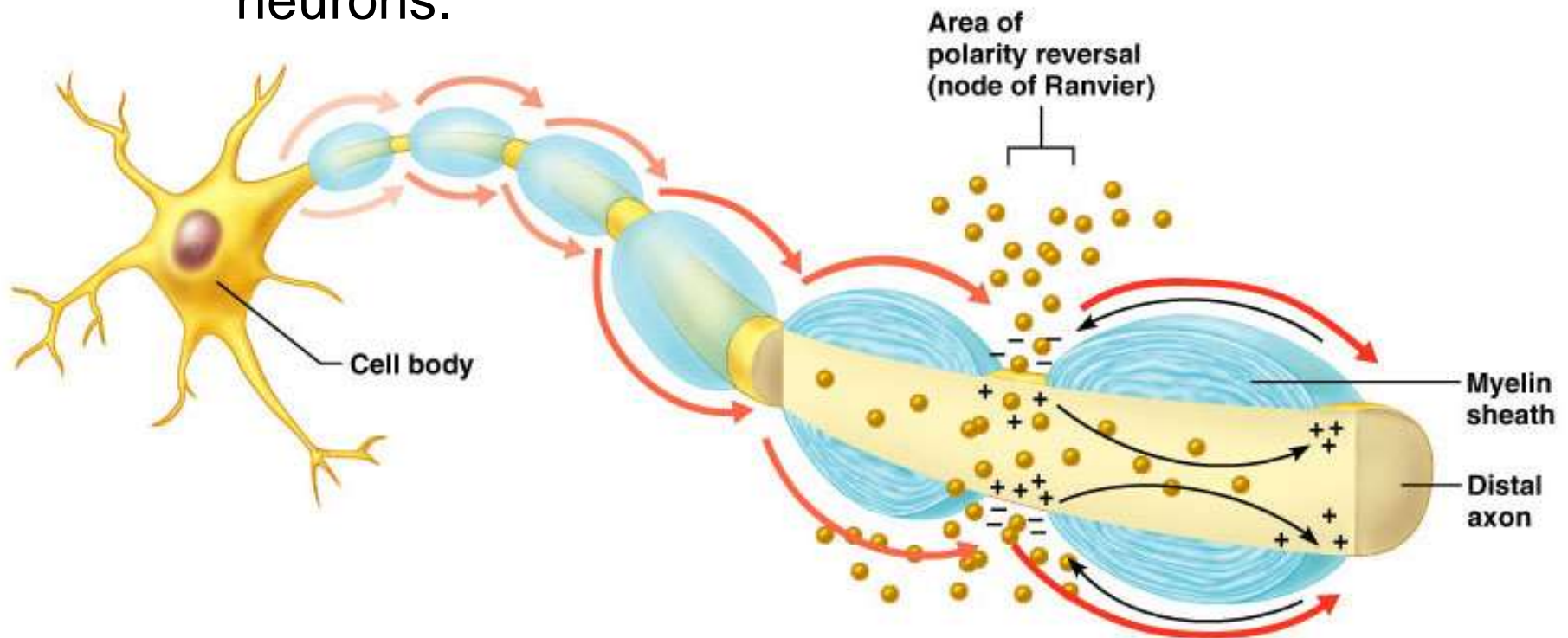
2



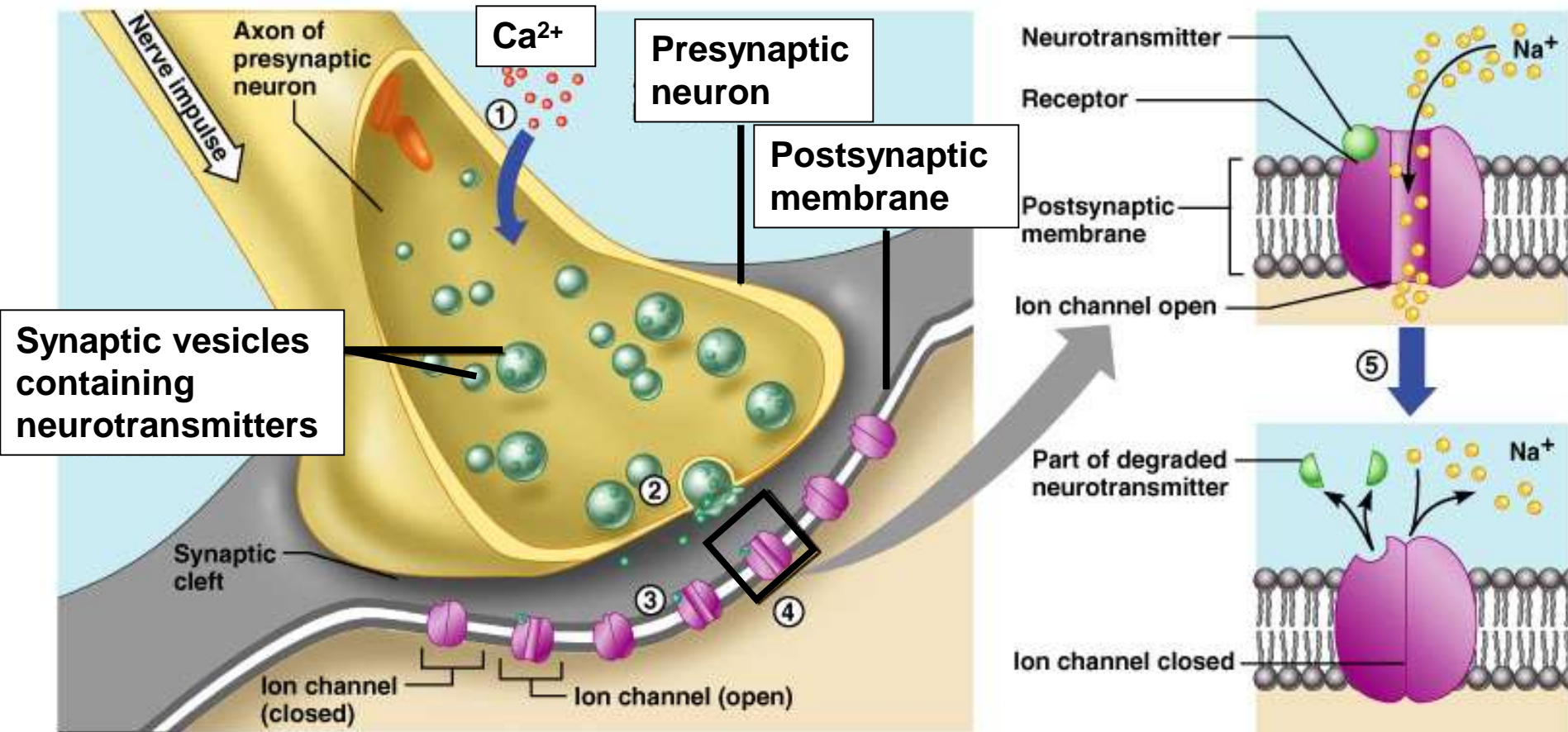
3

# Saltatory Conduction

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



# Synapses





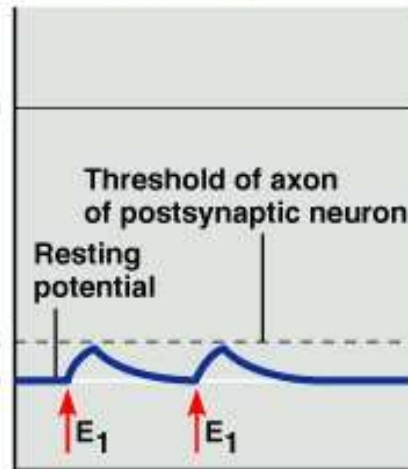
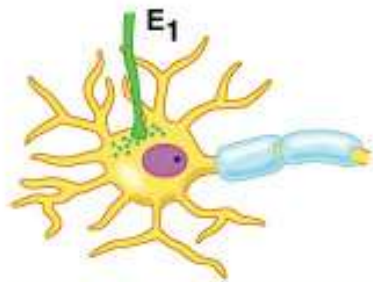
# Neural integration occurs at the cellular level

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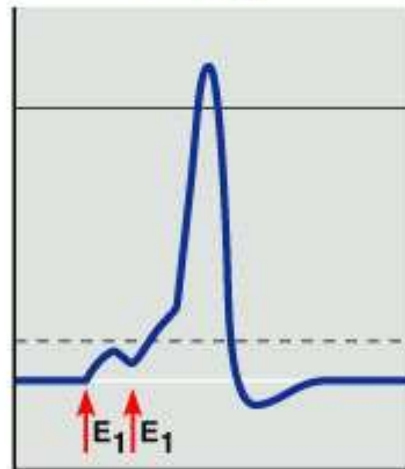
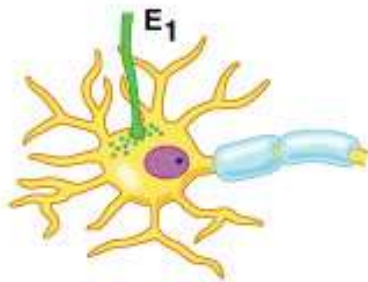
- **Excitatory postsynaptic potentials (EPSP)** depolarize the postsynaptic neuron.
  - The binding of neurotransmitter to postsynaptic receptors open gated channels that allow  $\text{Na}^+$  to diffuse into and  $\text{K}^+$  to diffuse out of the cell.

- **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.

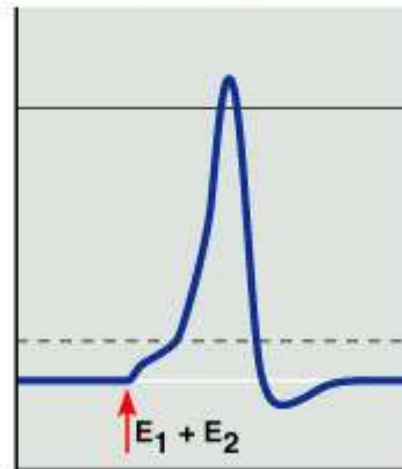
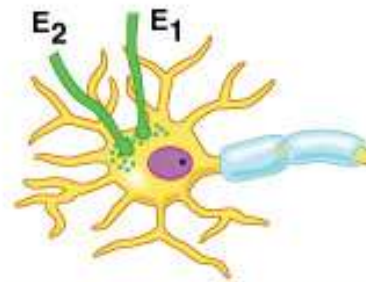
# EPSP & IPSP



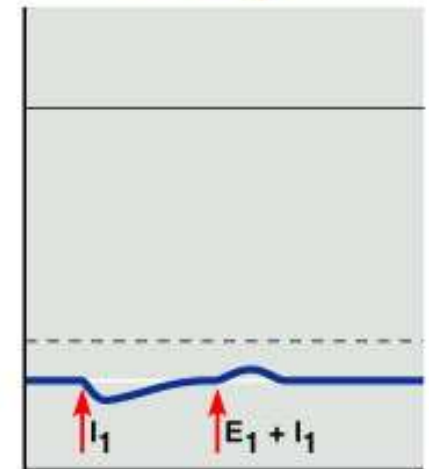
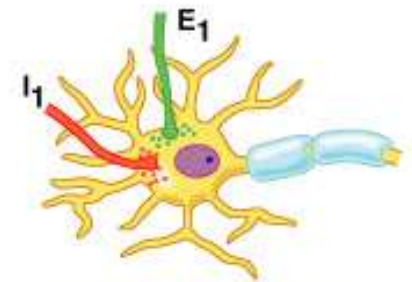
**(a) Subthreshold, no summation**



**(b) Temporal summation**

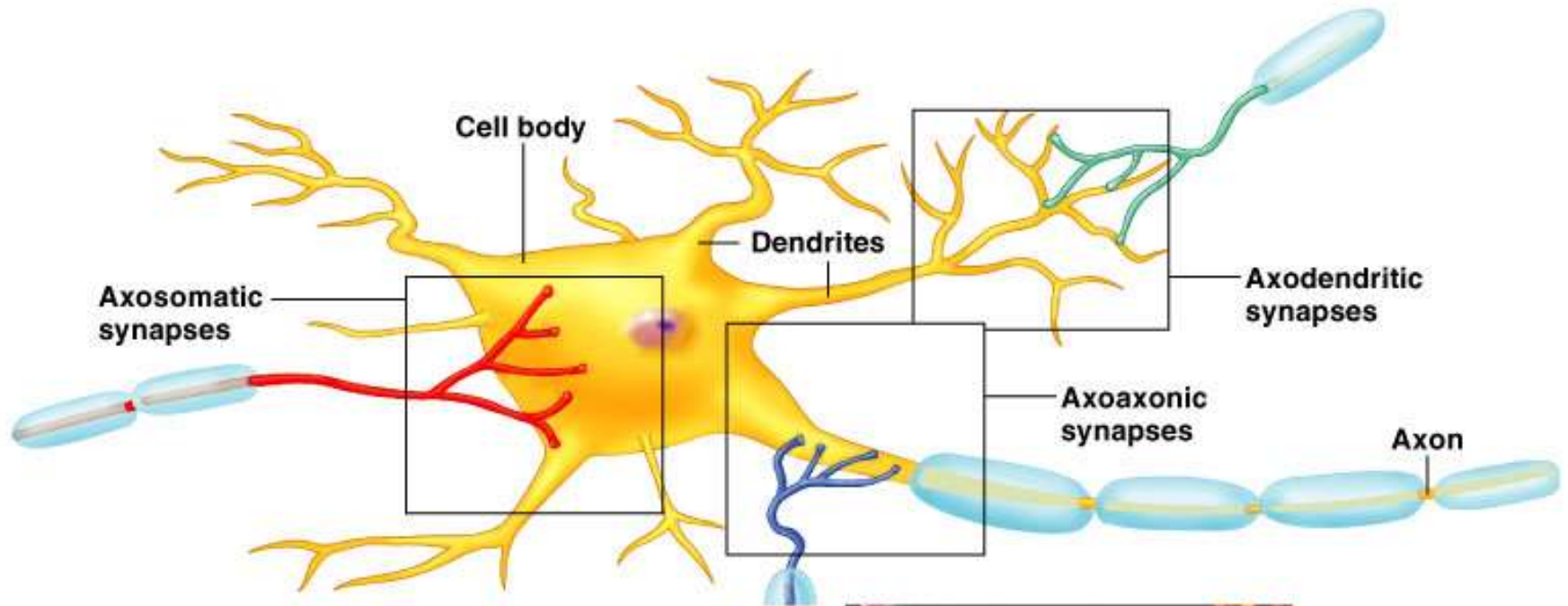


**(c) Spatial summation**

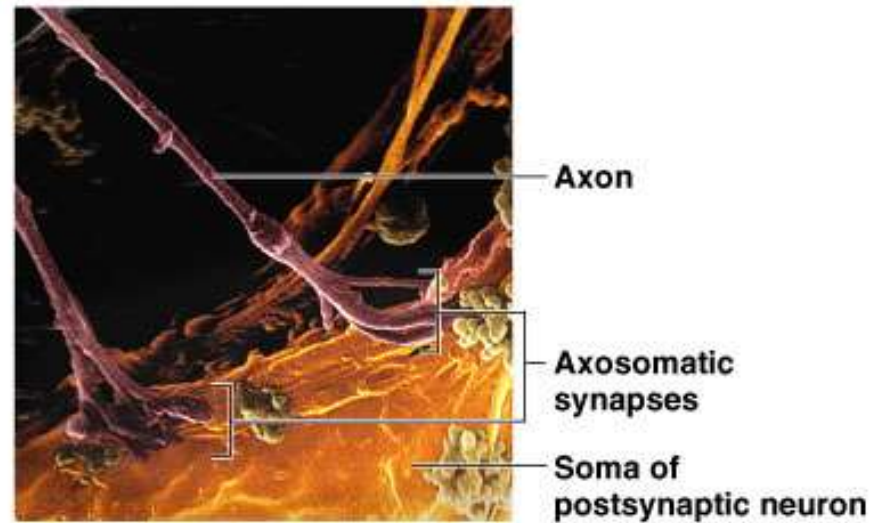


**(d) Spatial summation of EPSP and IPSP**

# Synapses



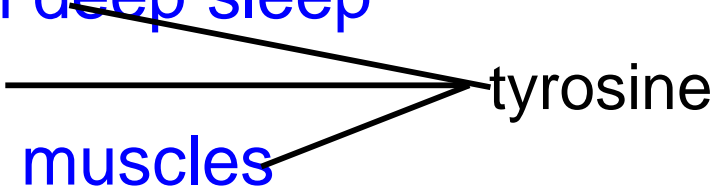
(a)



(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
- 
- A diagram consisting of three lines originating from the word 'tyrosine' on the right and pointing to the words 'Epinephrine', 'Dopamine', and 'Norepinephrine' in the list above.