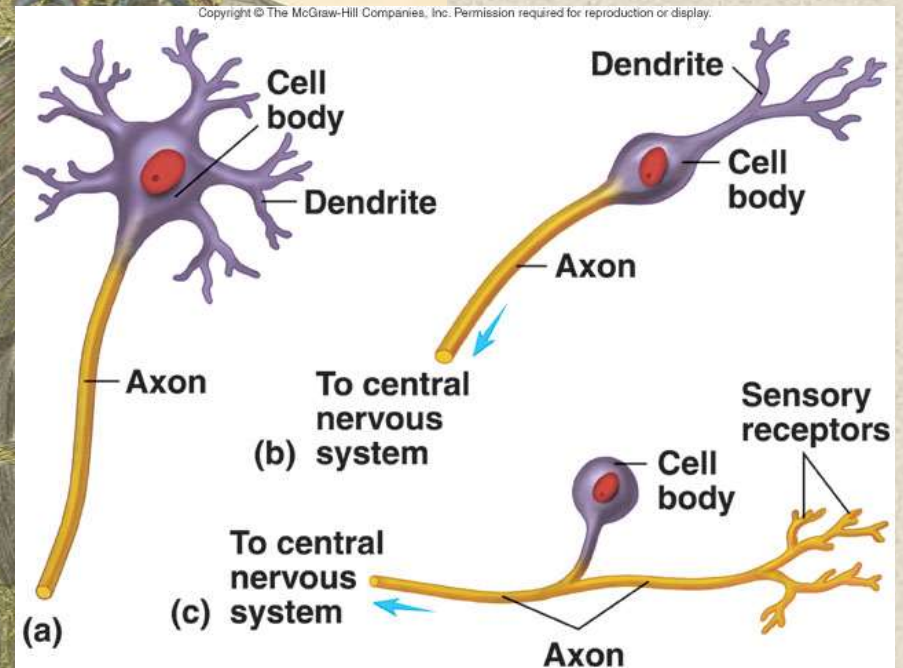


Functional Organization of Nervous Tissue

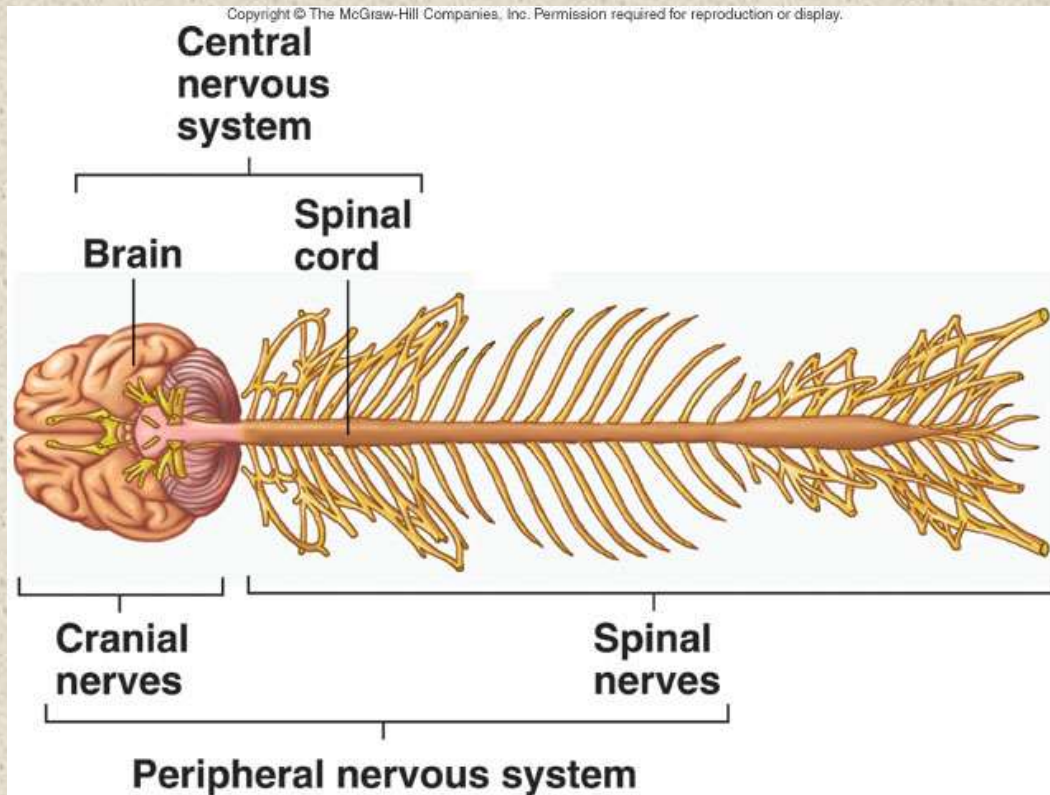


Dr. Moch. Bahrudin, Sp.S

The Nervous System

- **Components**
 - Brain, spinal cord, nerves, sensory receptors
- **Responsible for**
 - Sensory perceptions, mental activities, stimulating muscle movements, secretions of many glands
- **Subdivisions**
 - Central nervous system (**CNS**)
 - Peripheral nervous system (**PNS**)

Central Nervous System



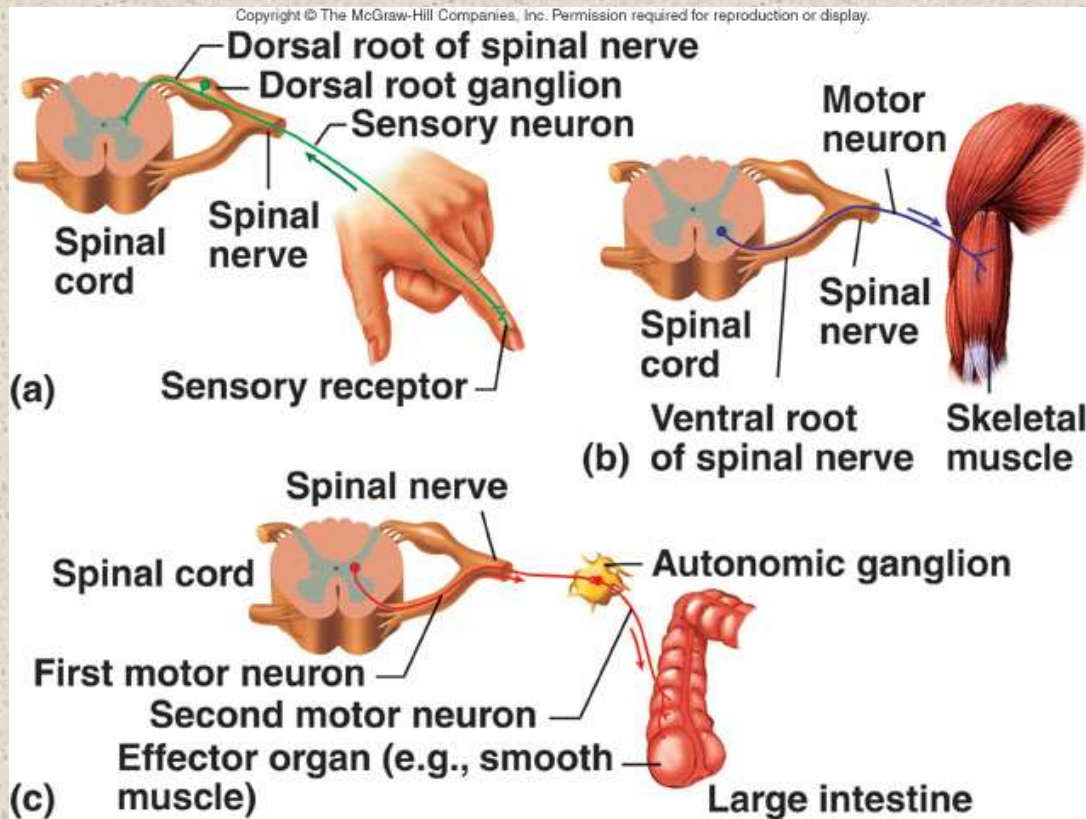
- Consists of
 - Brain
 - Located in cranial vault of skull
 - Spinal cord
 - Located in vertebral canal
- Brain and spinal cord
 - Continuous with each other at foramen magnum

Peripheral Nervous System

- Two subcategories
 - Sensory or afferent
 - Motor or efferent

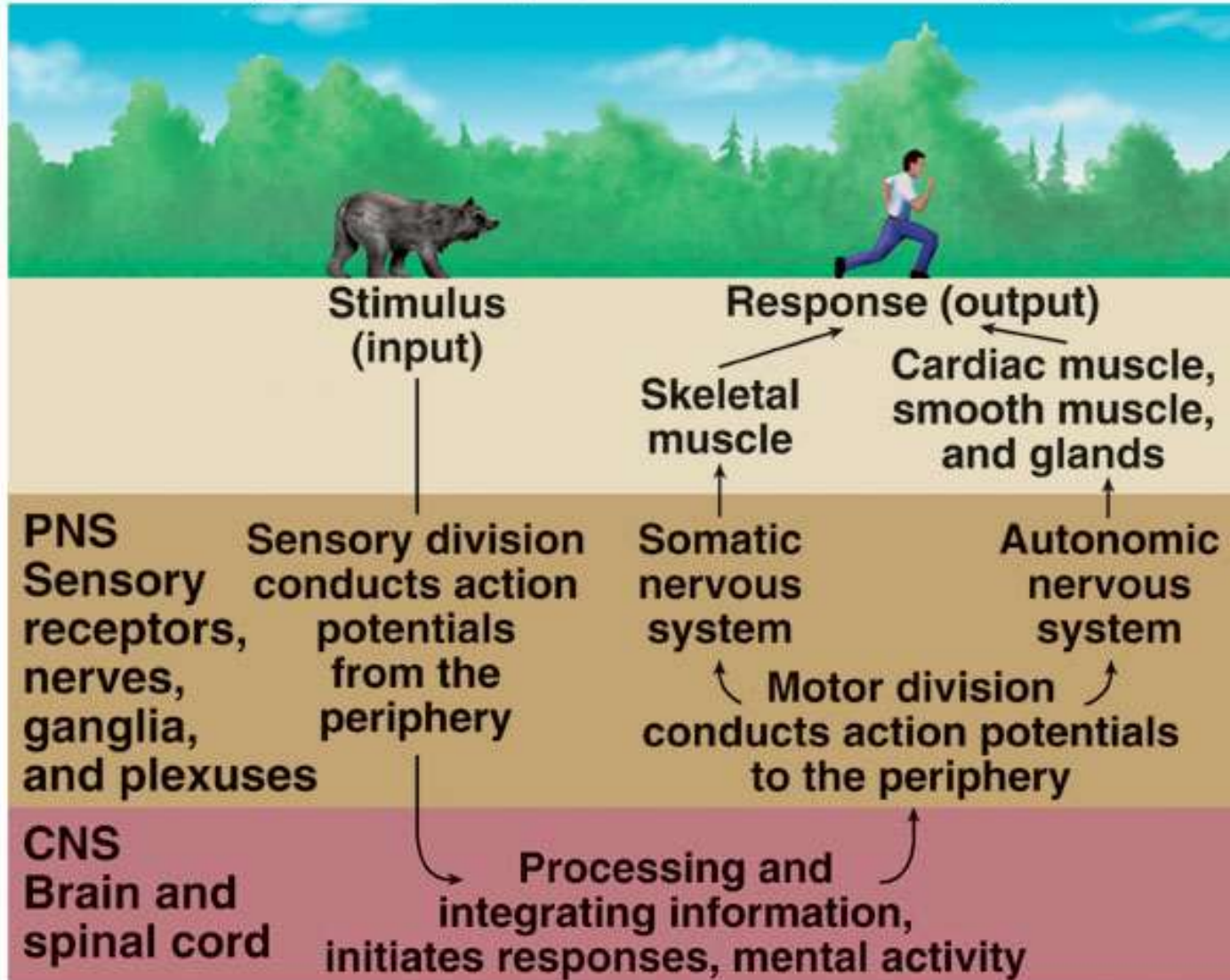
- Divisions

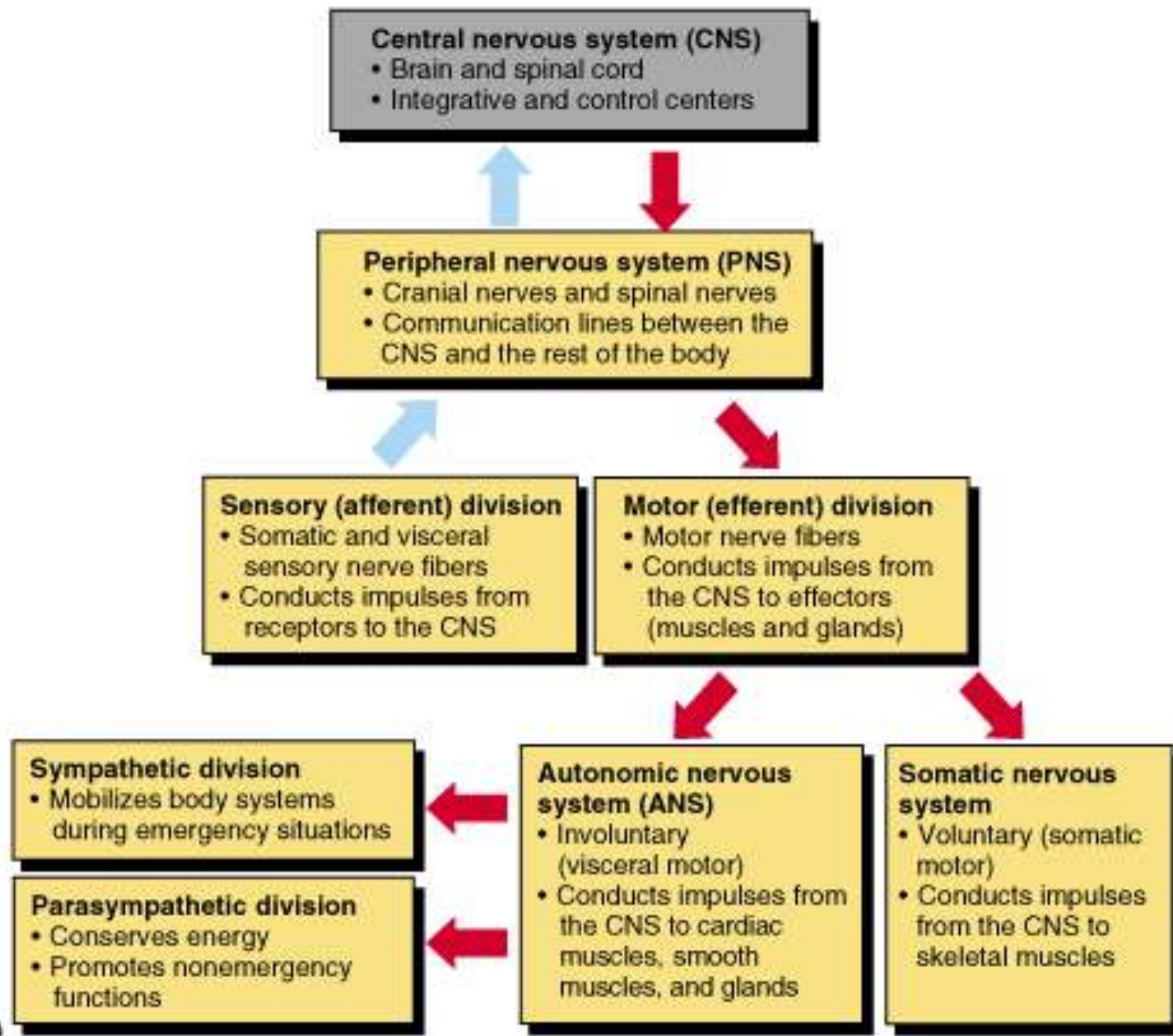
- Somatic nervous system
- Autonomic nervous system (ANS)
 - » Sympathetic
 - » Parasympathetic
 - » Enteric



Nervous System Organization

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



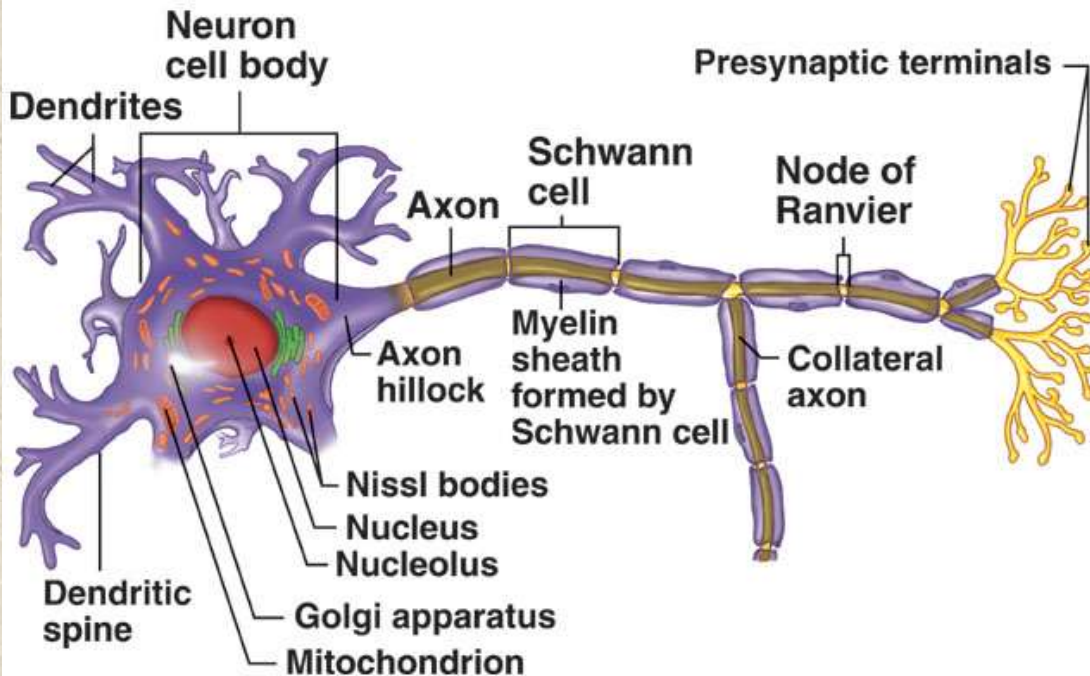


(a)

Cells of Nervous System

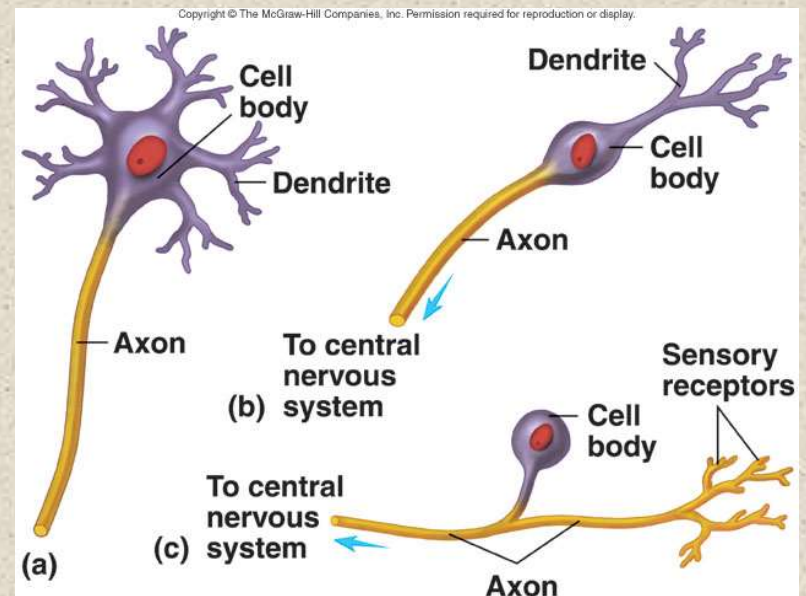
- Neurons or nerve cells
 - Receive stimuli and transmit action potentials
 - Organization
 - Cell body or soma
 - Dendrites: Input
 - Axons: Output
- Neuroglia or glial cells
 - Support and protect neurons

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

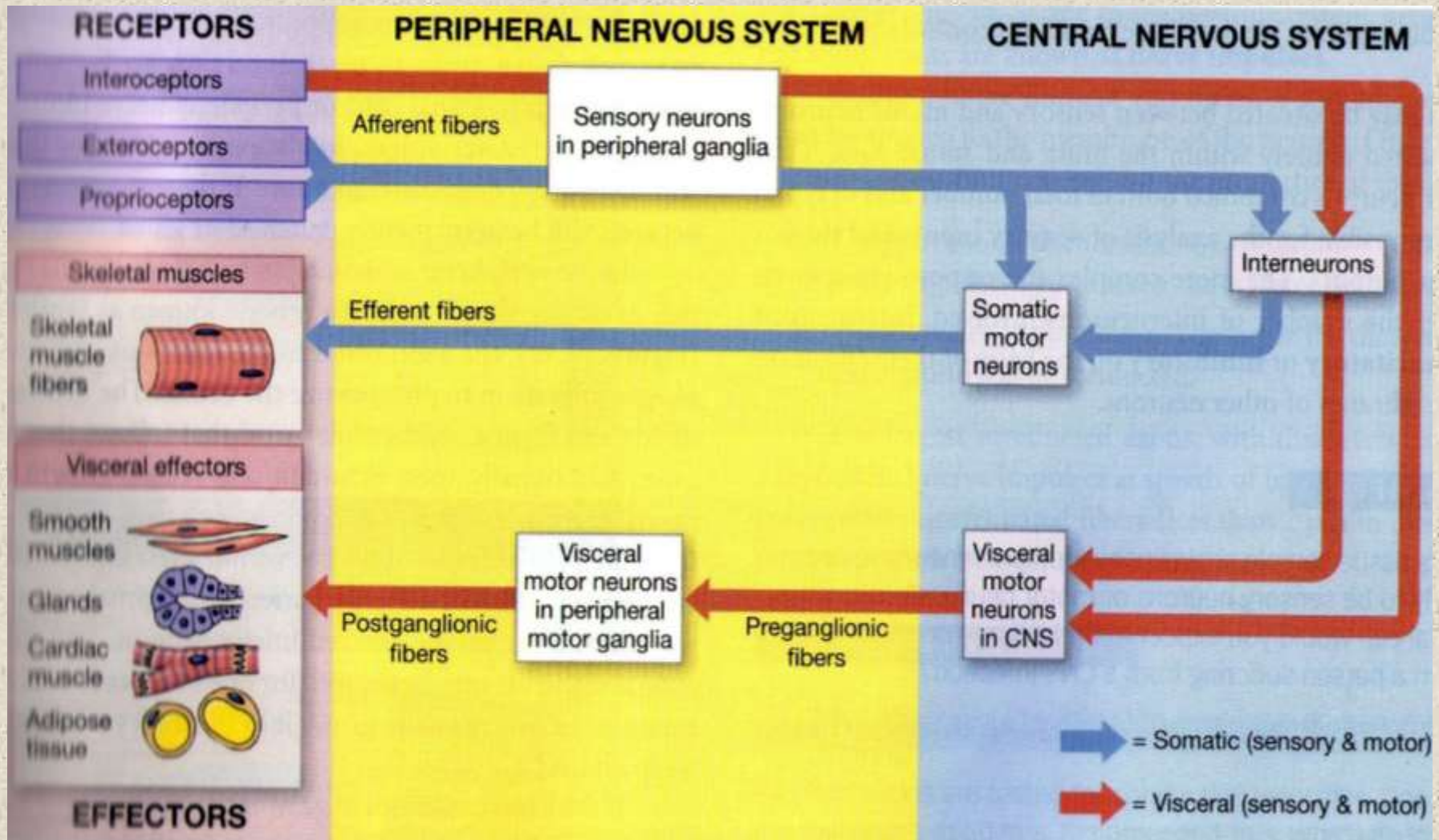


Types of Neurons

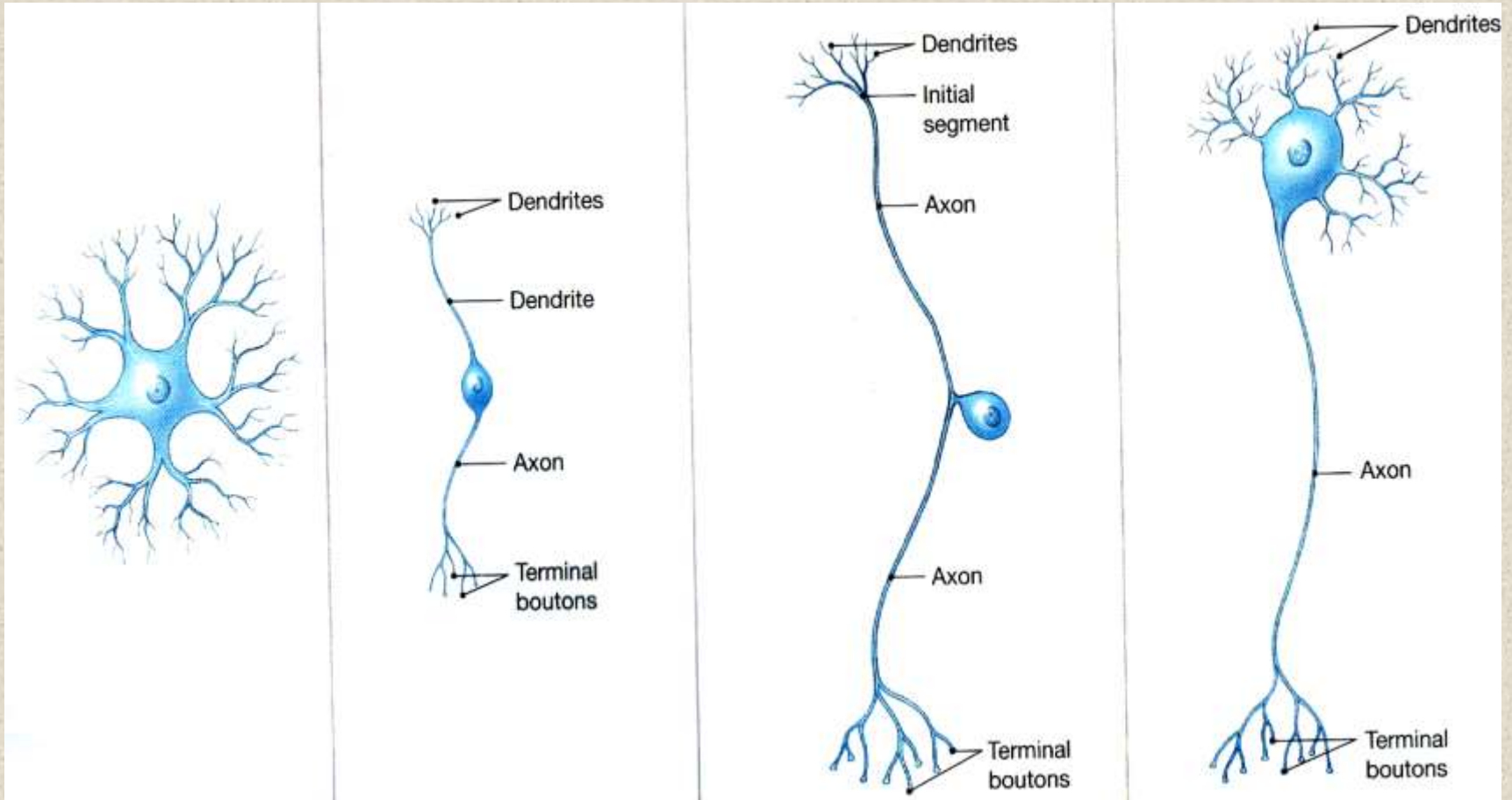
- Functional classification
 - Sensory or afferent: Action potentials toward CNS
 - Motor or efferent: Action potentials away from CNS
 - Interneurons or association neurons: Within CNS from one neuron to another
- Structural classification
 - Multipolar, bipolar, unipolar



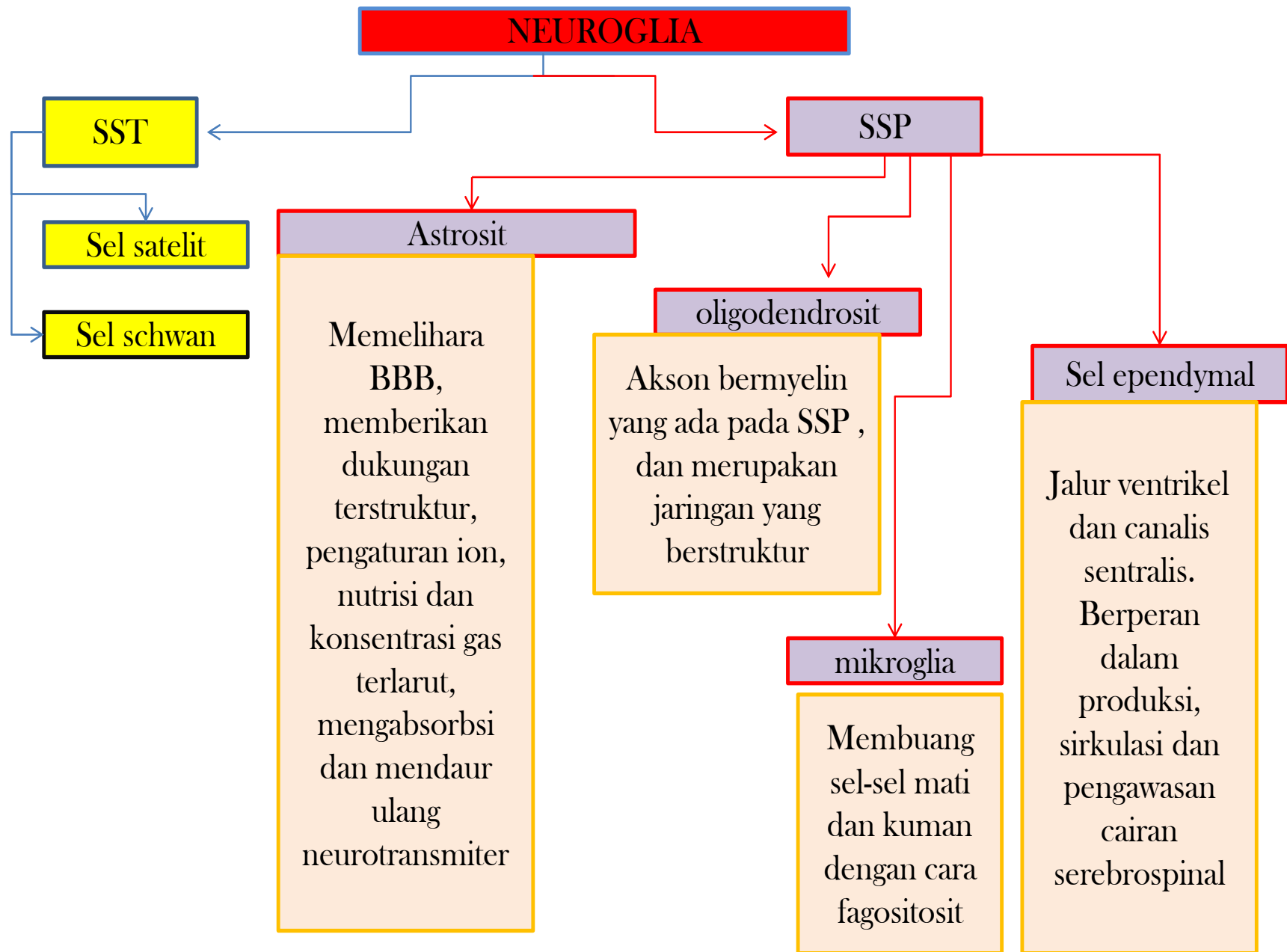
Functional classification



1. Anaxonic Neurons b. Bipolar Neuron c. Pseudounipolar Neuron d. Multipolar Neuron

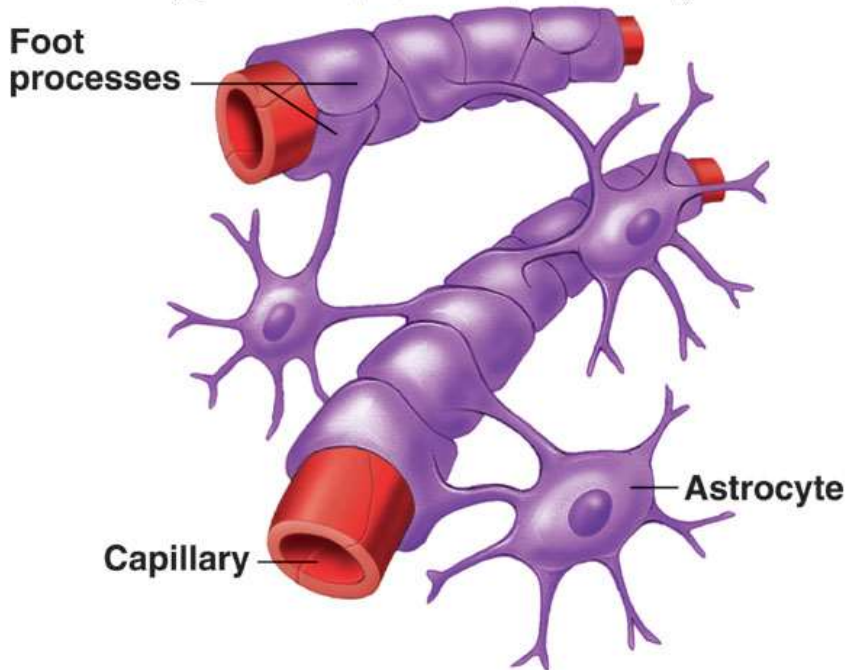


Structural classification

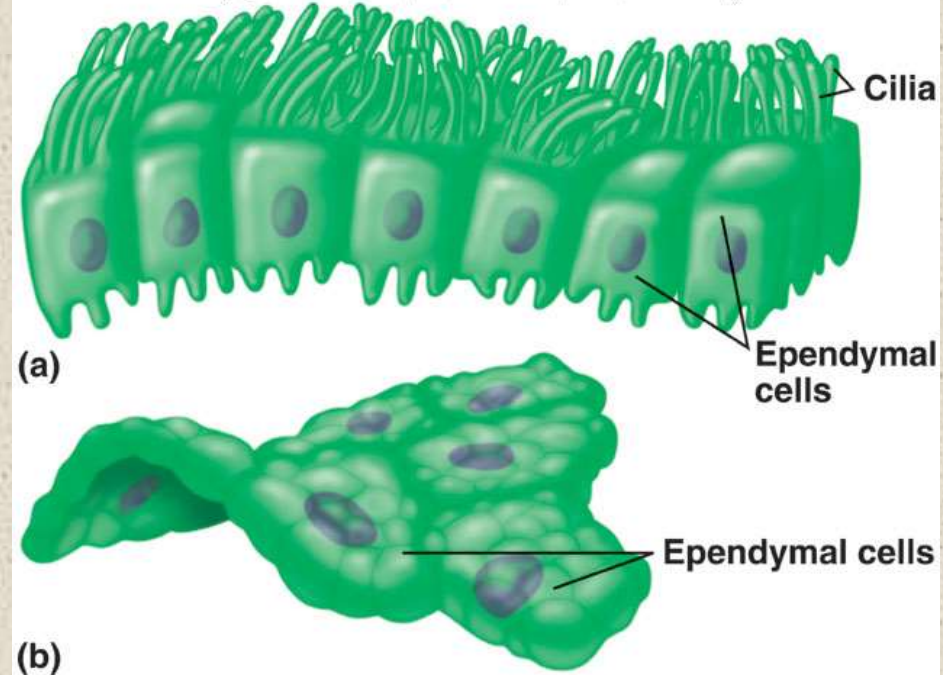


Neuroglia of CNS

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

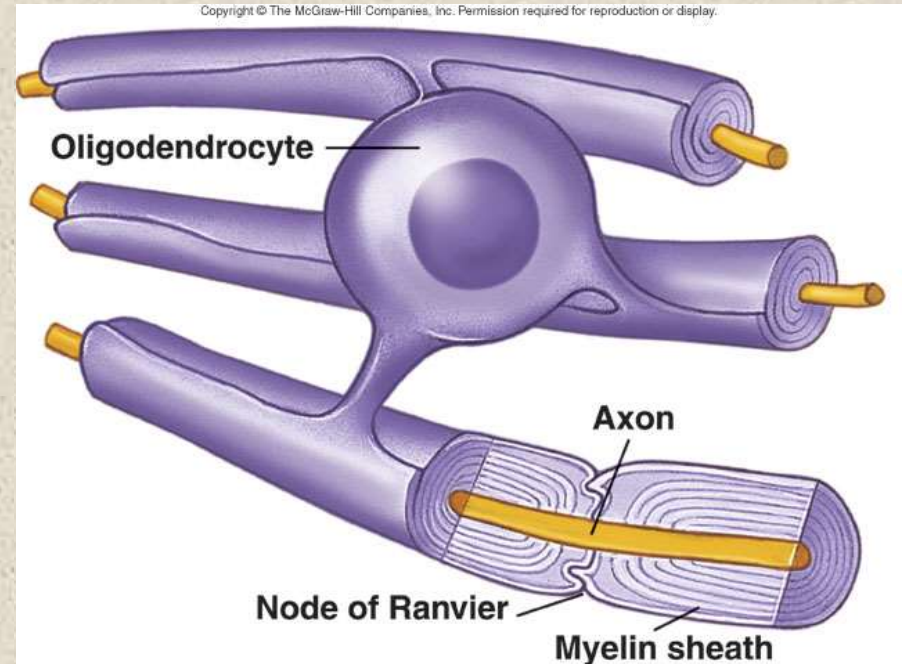
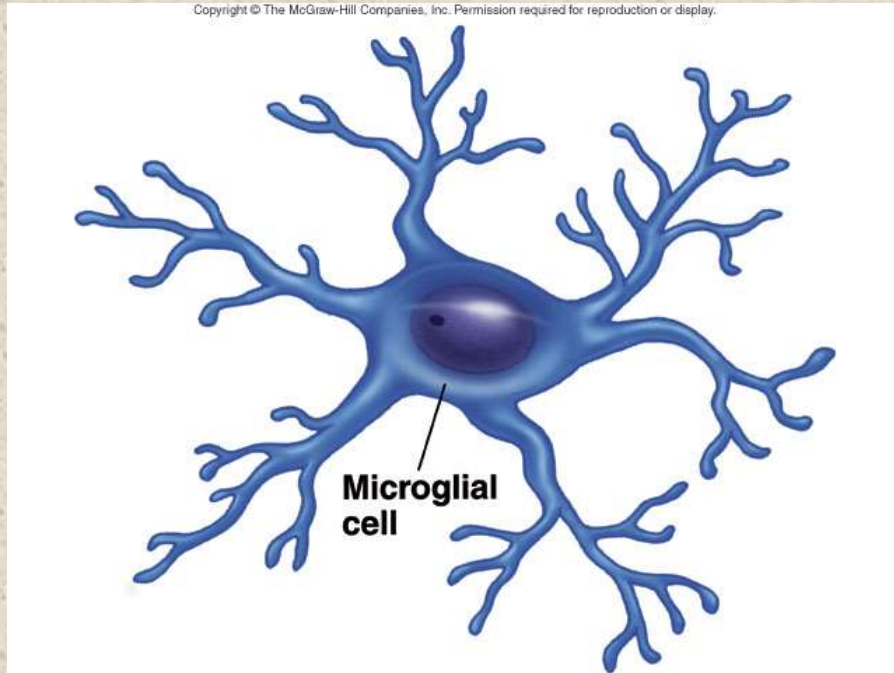


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



- **Astrocytes**
 - Regulate extracellular brain fluid composition
 - Promote tight junctions to form blood-brain barrier
- **Ependymal Cells**
 - Line brain ventricles and spinal cord central canal
 - Help form choroid plexuses that secrete CSF

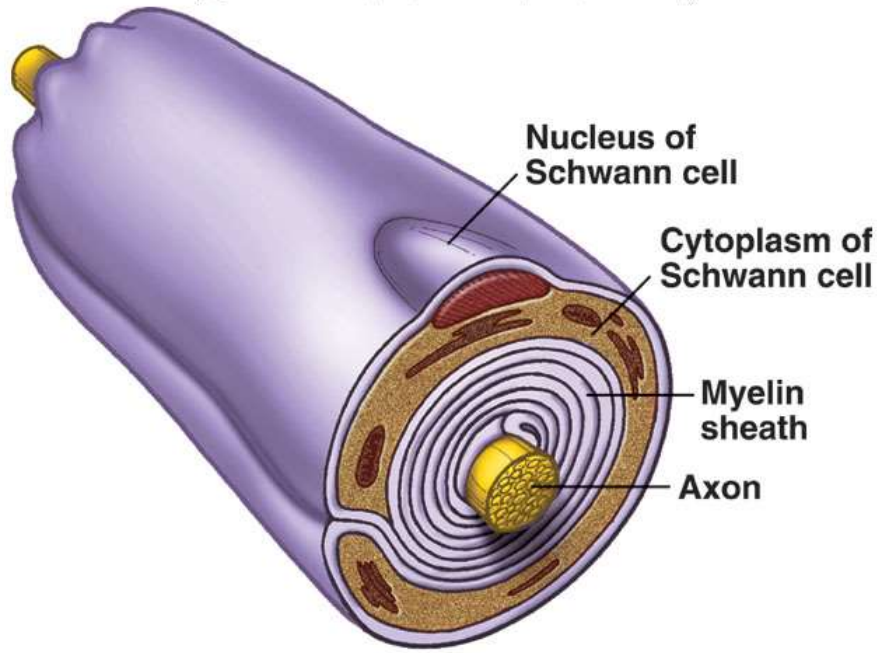
Neuroglia of CNS



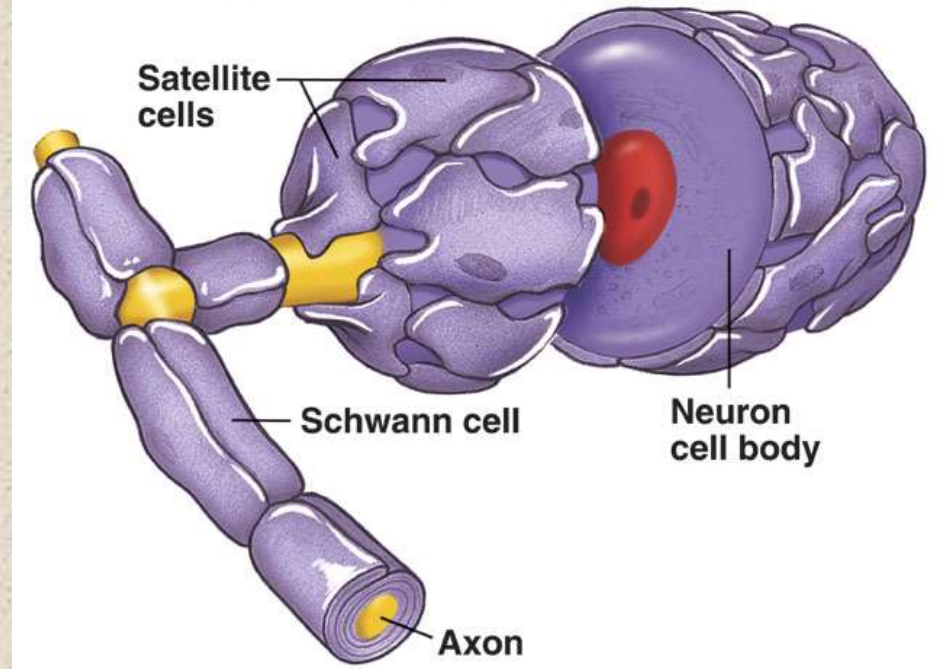
- **Microglia**
 - Specialized macrophages
- **Oligodendrocytes**
 - Form myelin sheaths if surround axon

Neuroglia of PNS

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

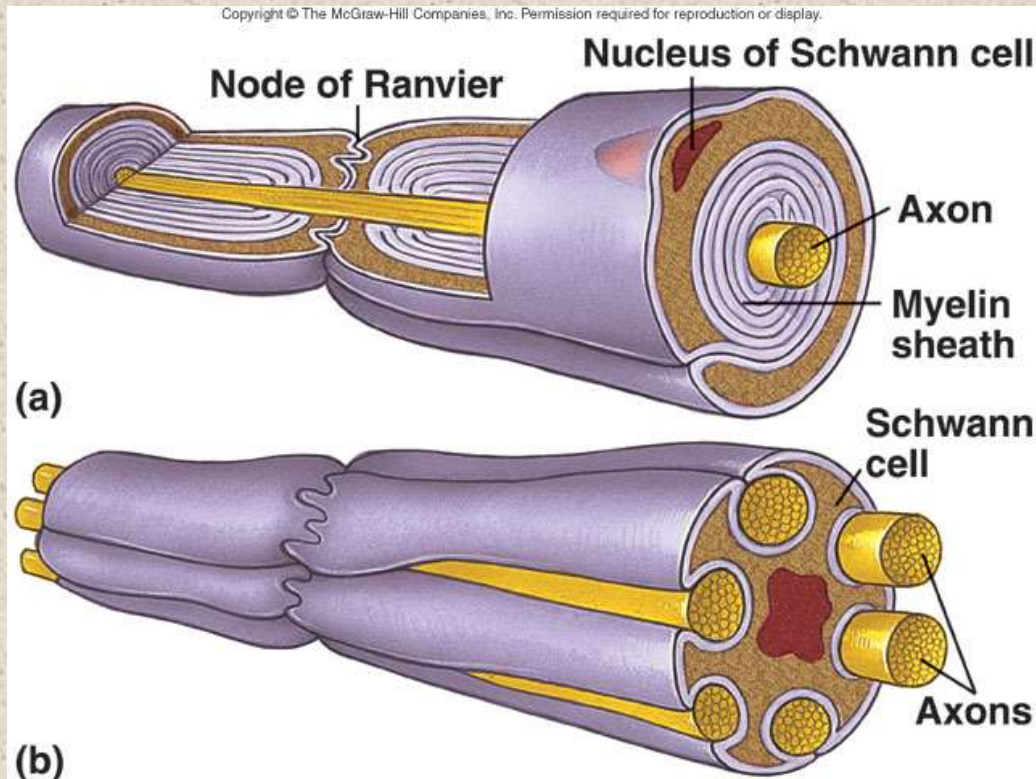


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

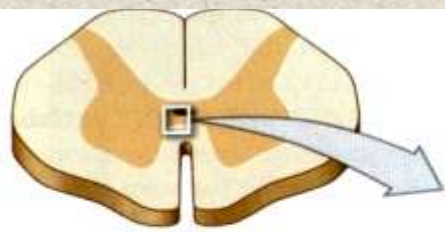


- Schwann cells or **neurolemmocytes**
 - Wrap around portion of only one axon to form myelin sheath
- Satellite cells
 - Surround neuron cell bodies in ganglia, provide support and nutrients

Myelinated and Unmyelinated Axons

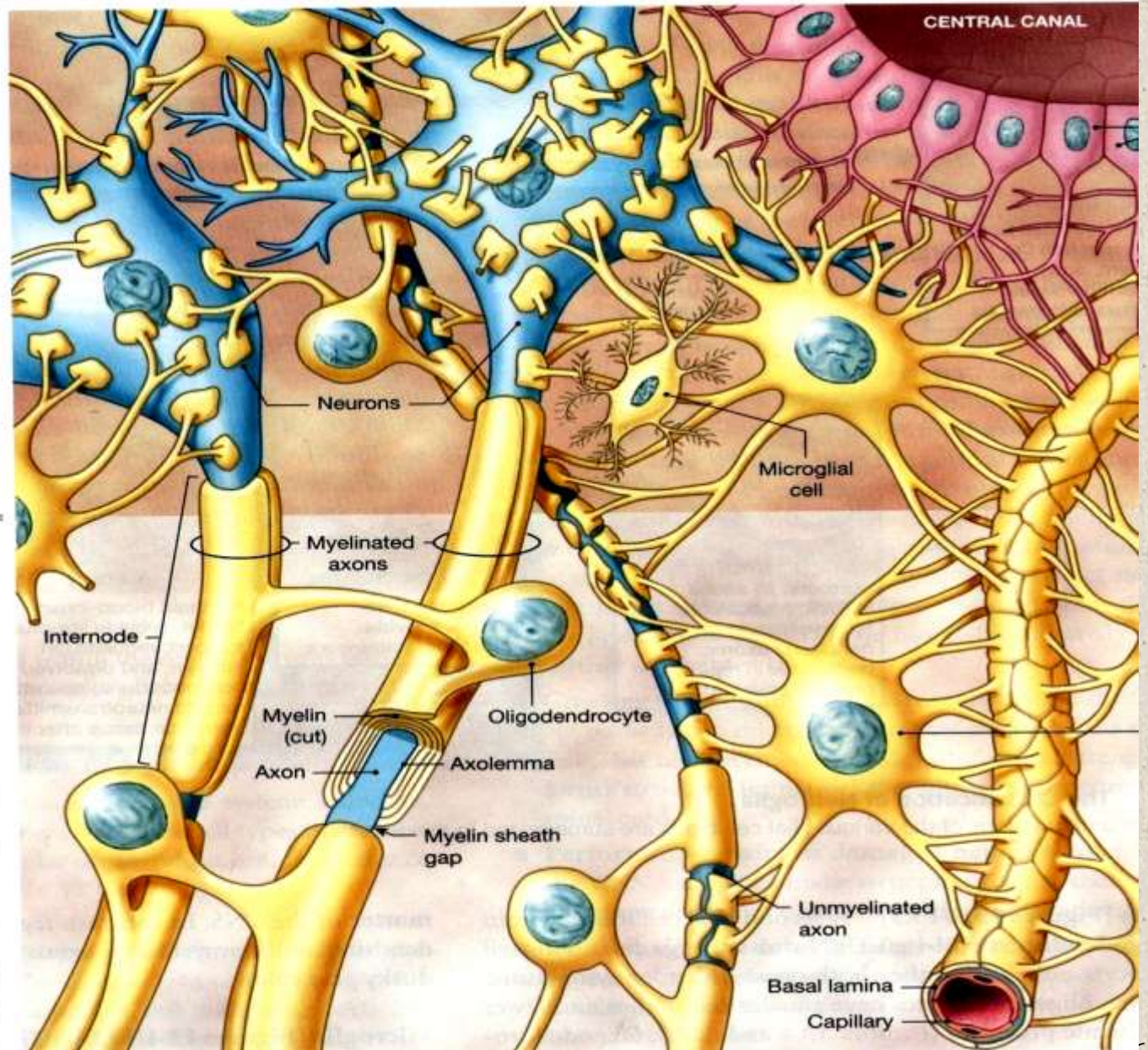


- Myelinated axons
 - Myelin protects and insulates axons from one another
 - Not continuous
 - Nodes of Ranvier
- Unmyelinated axons



Gray matter

White matter



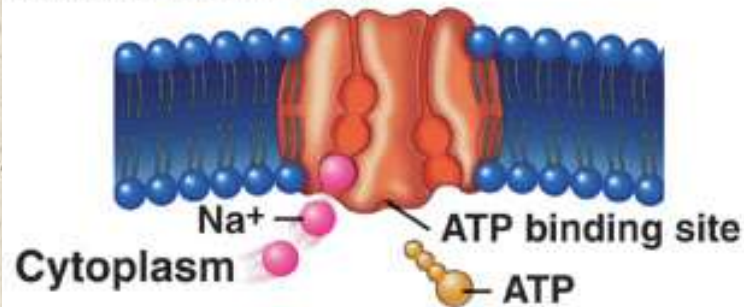
Electrical Signals

- Cells produce electrical signals called **action potentials**
- Transfer of information from **one part of body to another**
- Electrical properties result from **ionic concentration** differences across plasma membrane and permeability of membrane

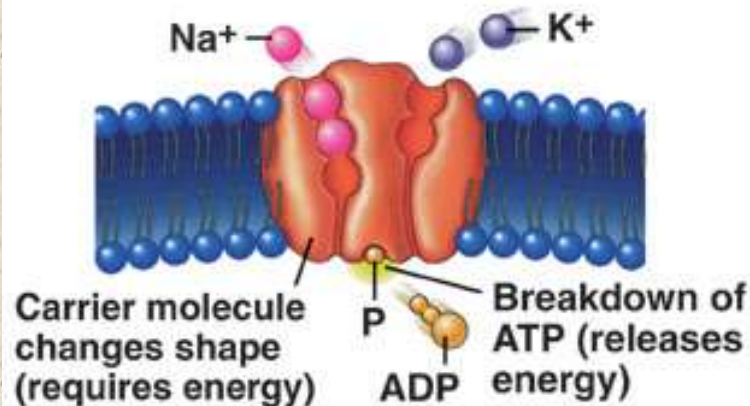
Sodium-Potassium Exchange Pump

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

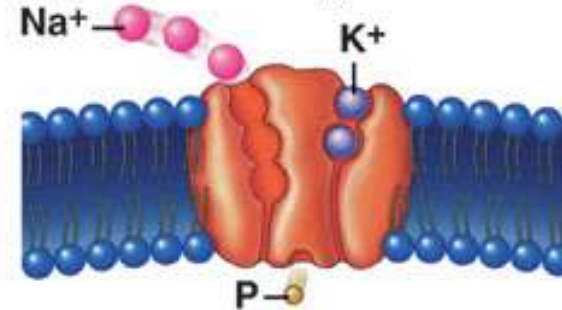
Extracellular fluid



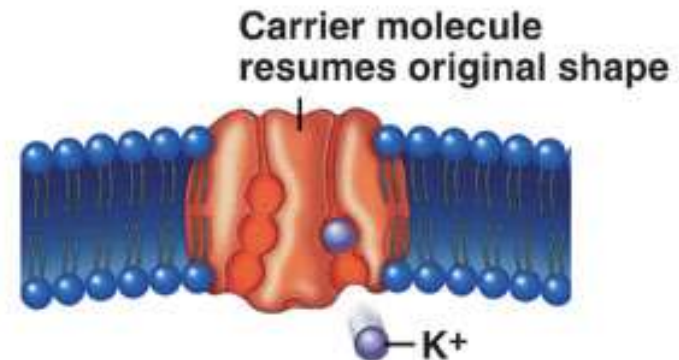
1. Three Na⁺ and ATP bind to the carrier molecule.



2. The ATP breaks down to ADP and phosphate and releases energy. The carrier molecule changes shape, and Na⁺ are transported across the membrane.



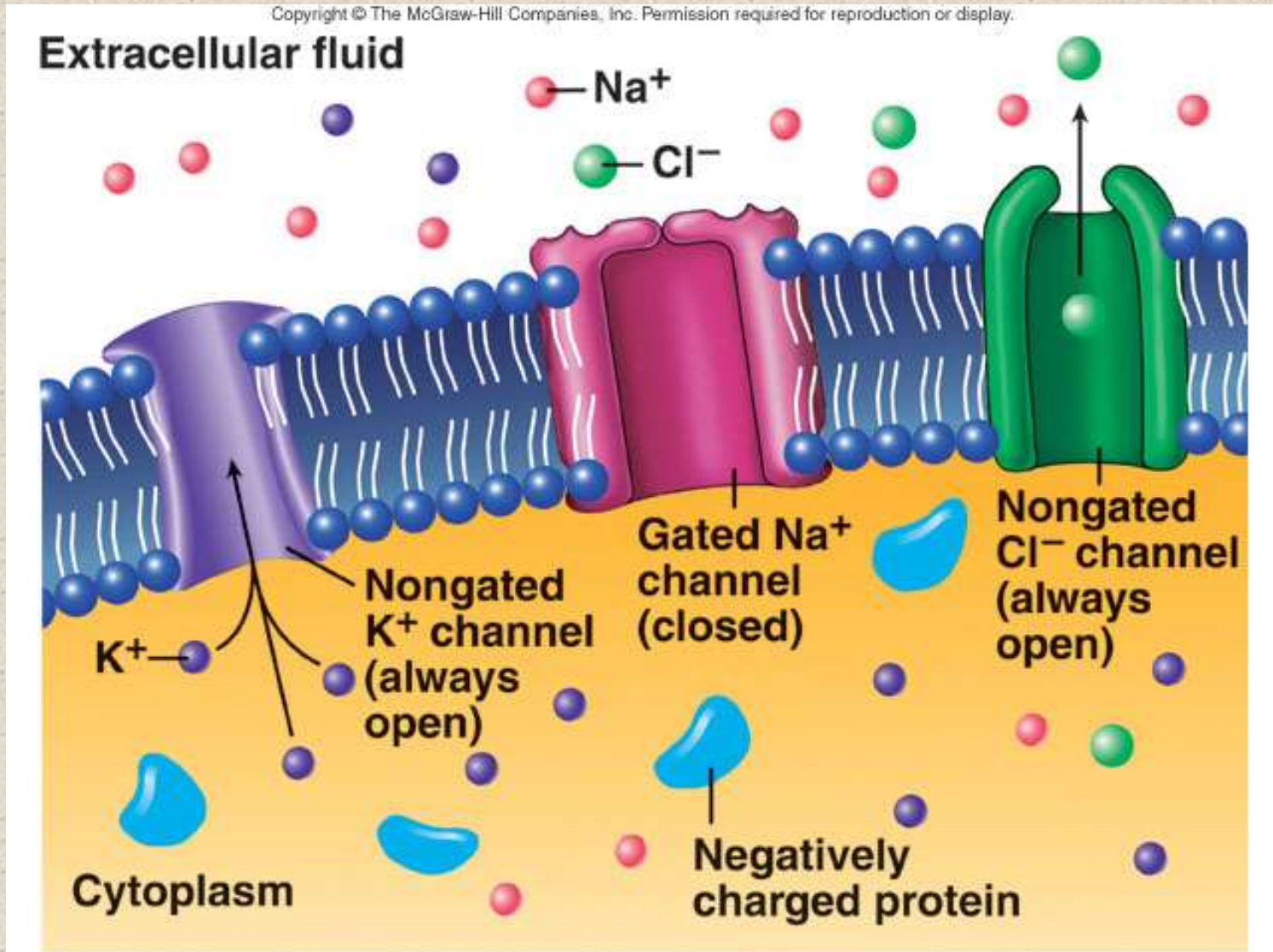
3. Na⁺ diffuse away from the carrier molecule, two K⁺ bind to the carrier molecule, and the phosphate is released.



4. The carrier molecule resumes original shape, transporting K⁺ across the membrane, and K⁺ diffuse away from the carrier molecule. The carrier molecule can again bind to Na⁺ and ATP.

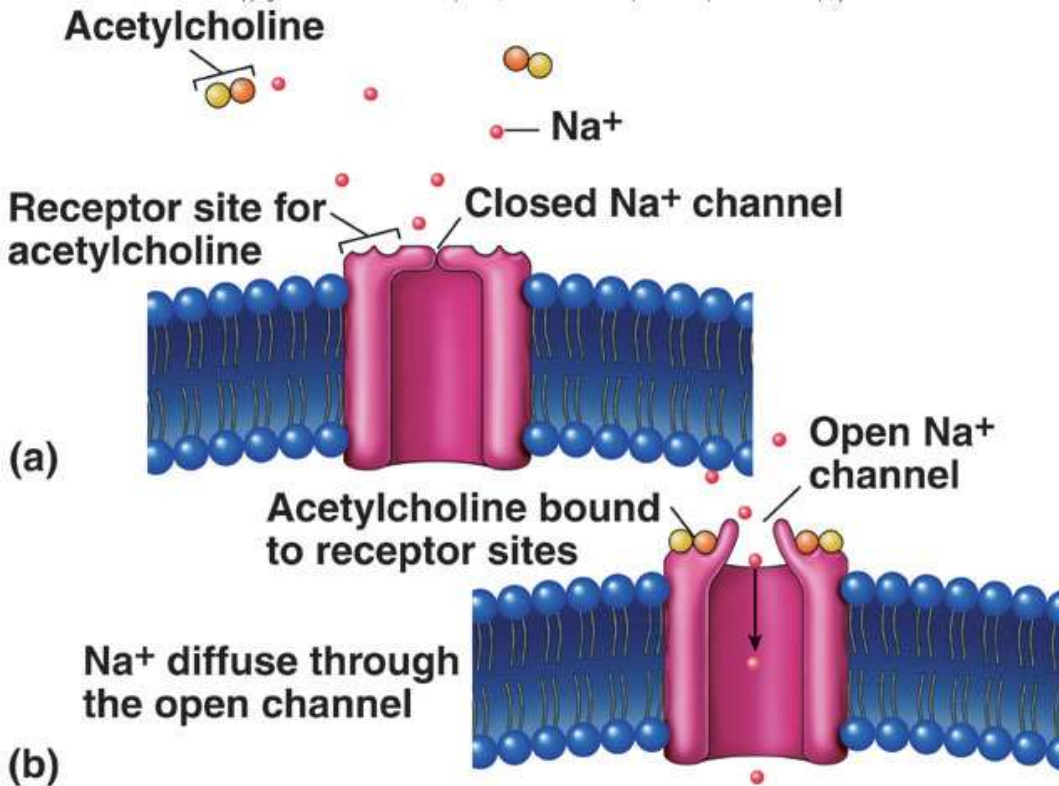
Membrane Permeability

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Ion Channels

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



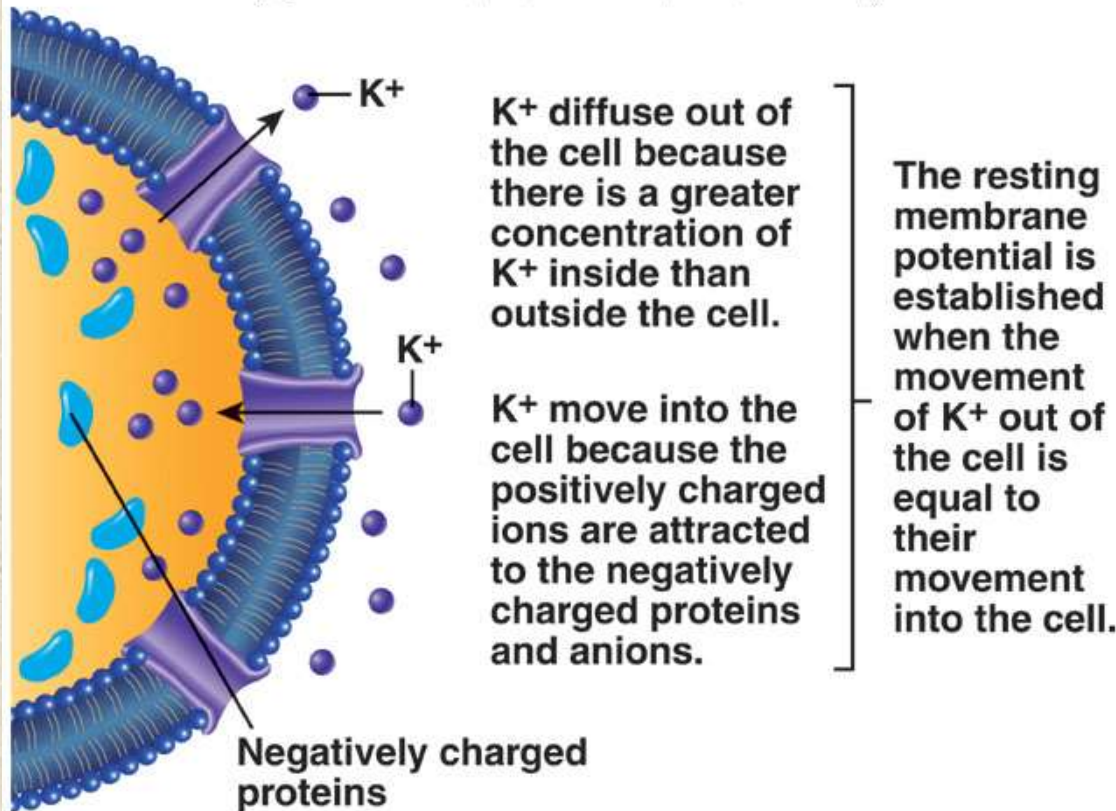
- **Nongated or leak channels**
 - Always open and responsible for permeability
 - Specific for one type of ion although not absolute
- **Gated ion channels**
 - **Ligand-gated**
 - Open or close in response to ligand binding to receptor as ACh
 - **Voltage-gated**
 - Open or close in response to small voltage changes

Resting Membrane Potential

- **Characteristics**

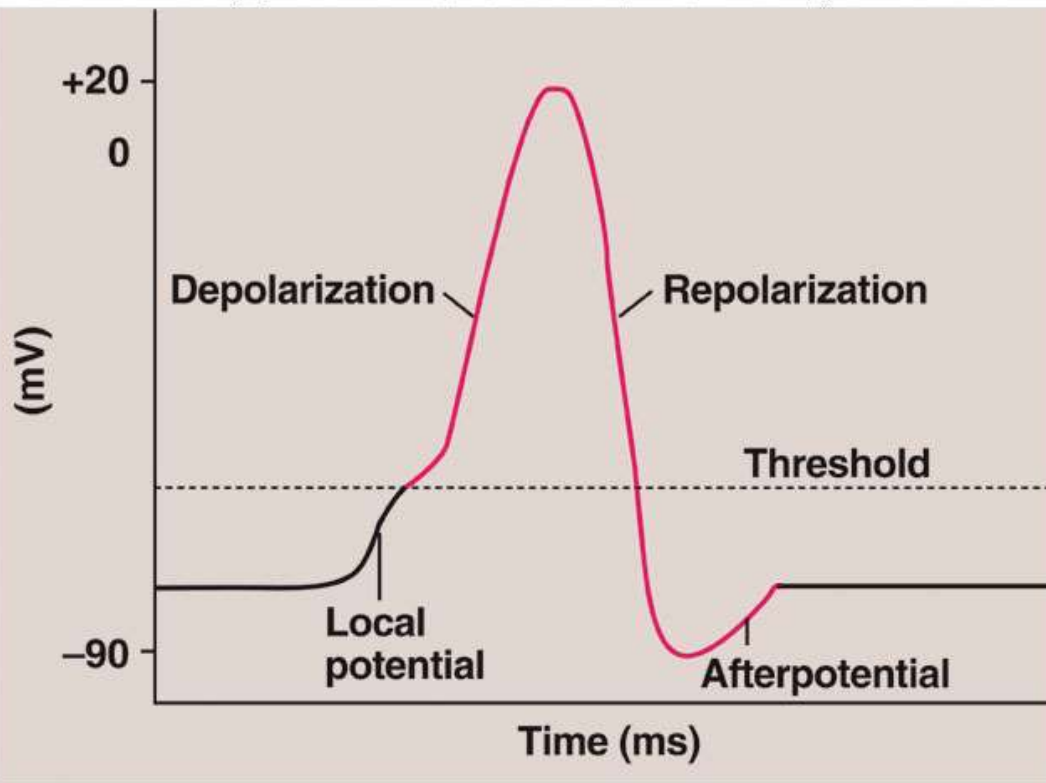
- Number of charged molecules and ions inside and outside cell nearly equal
- Concentration of K^+ higher inside than outside cell, Na^+ higher outside than inside
- At equilibrium there is very little movement of K^+ or other ions across plasma membrane

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Action Potentials

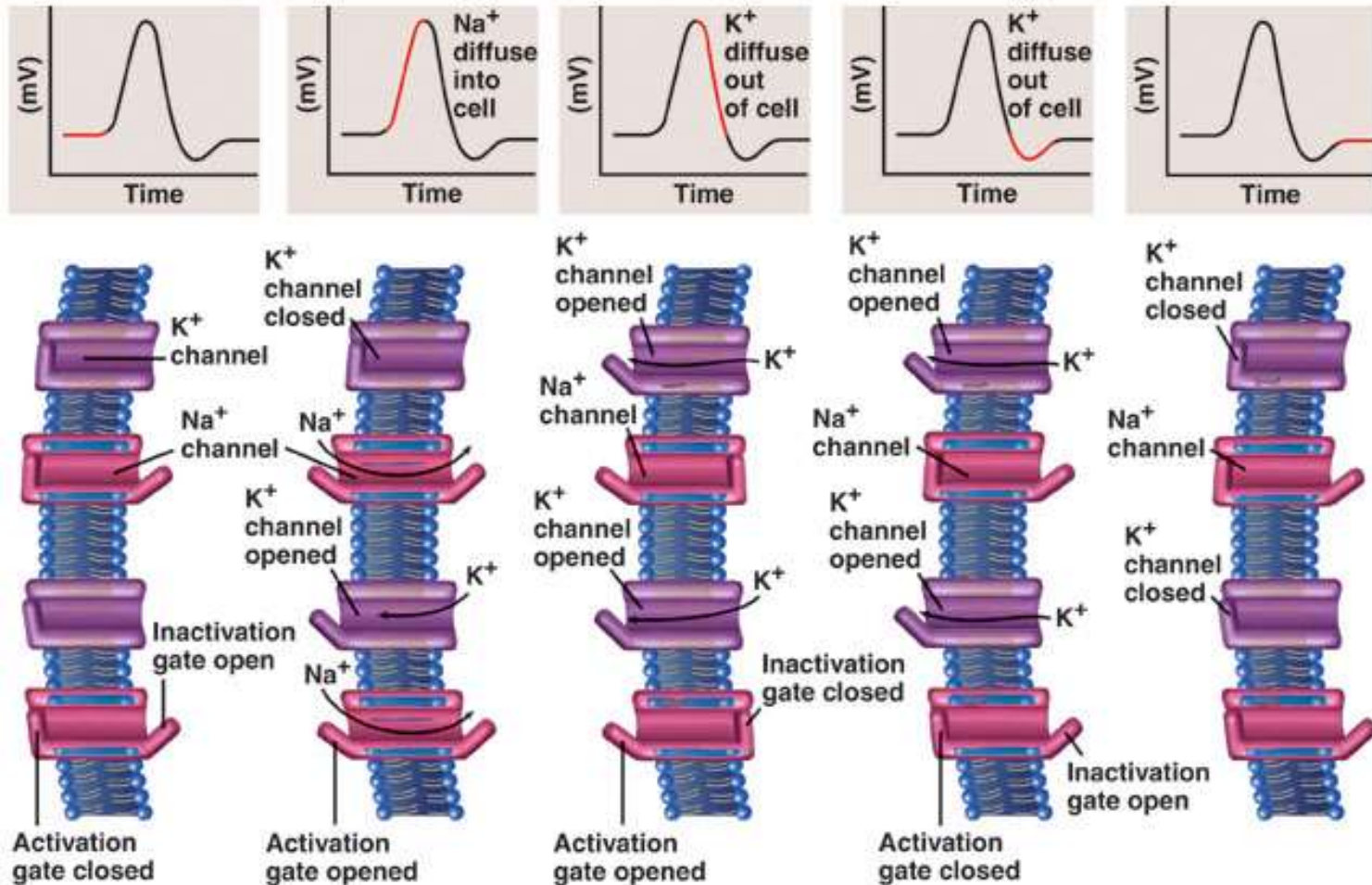
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



- Series of permeability changes when a local potential causes **depolarization** of membrane
- **Phases**
 - **Depolarization**
 - More positive
 - **Repolarization**
 - More negative
- All-or-none principle
 - Camera flash system

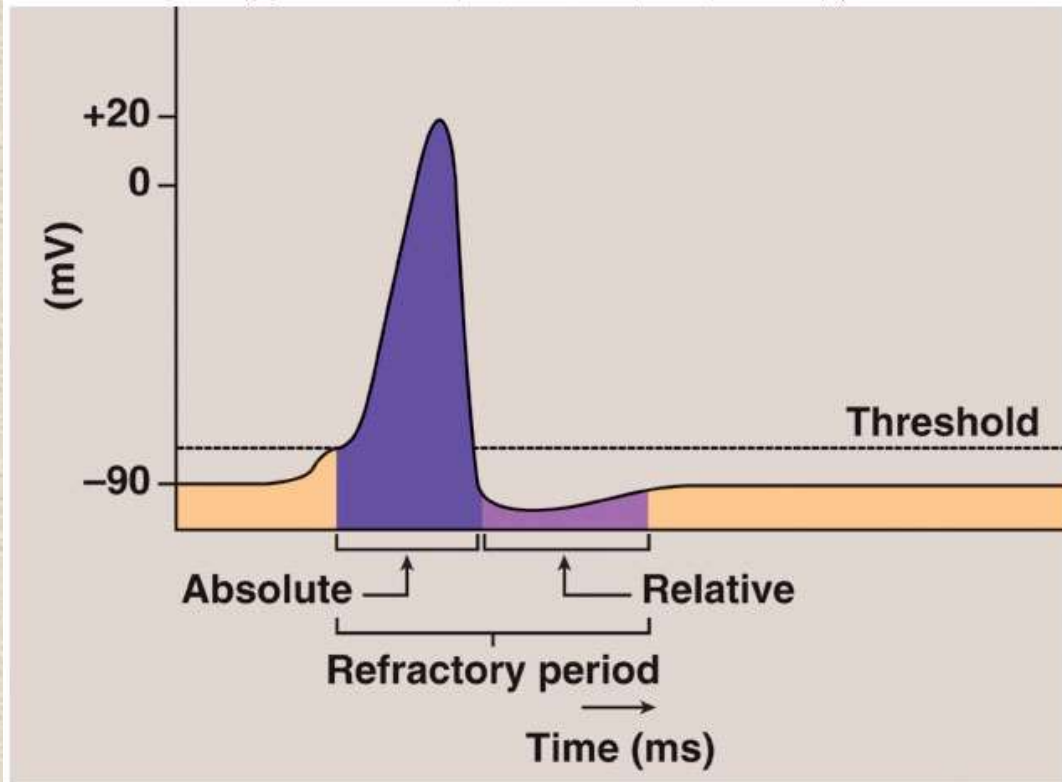
Action Potential

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



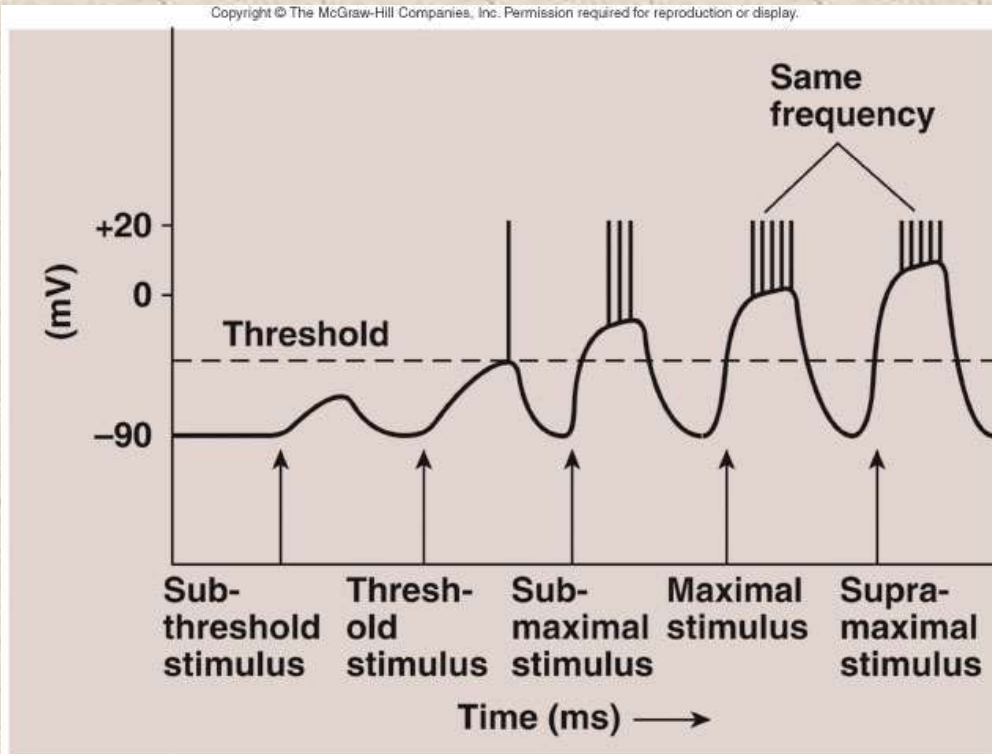
Refractory Period

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



- **Sensitivity** of area to further stimulation **decreases** for a time
- **Parts**
 - Absolute
 - Complete insensitivity exists to another stimulus
 - From beginning of action potential until near end of repolarization
 - Relative
 - A stronger-than-threshold stimulus can initiate another action potential

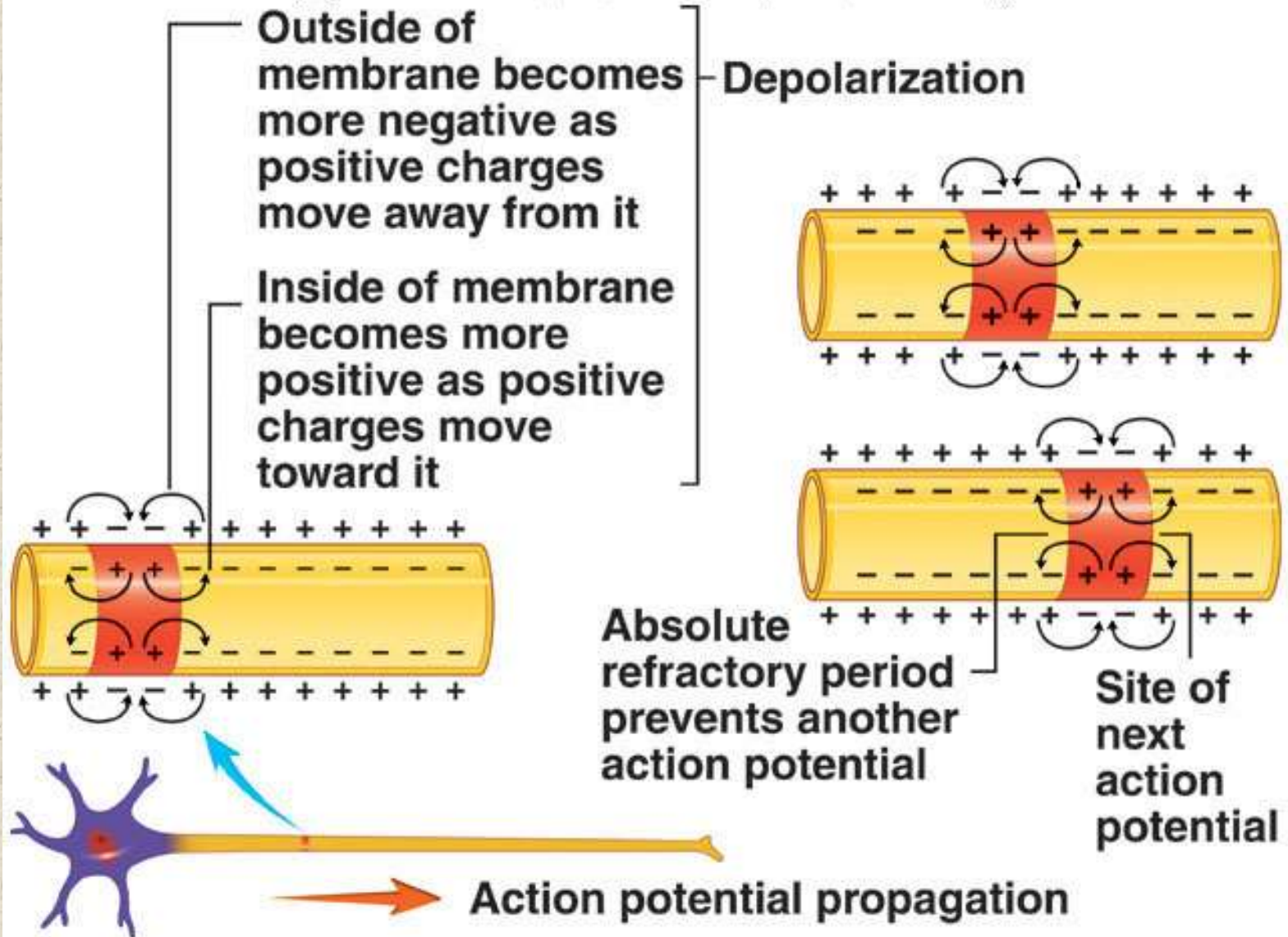
Action Potential Frequency



- Number of potentials produced per unit of time to a stimulus
- **Threshold stimulus**
 - Cause an action potential
- **Maximal stimulus**
- **Submaximal stimulus**
- **Supramaximal stimulus**

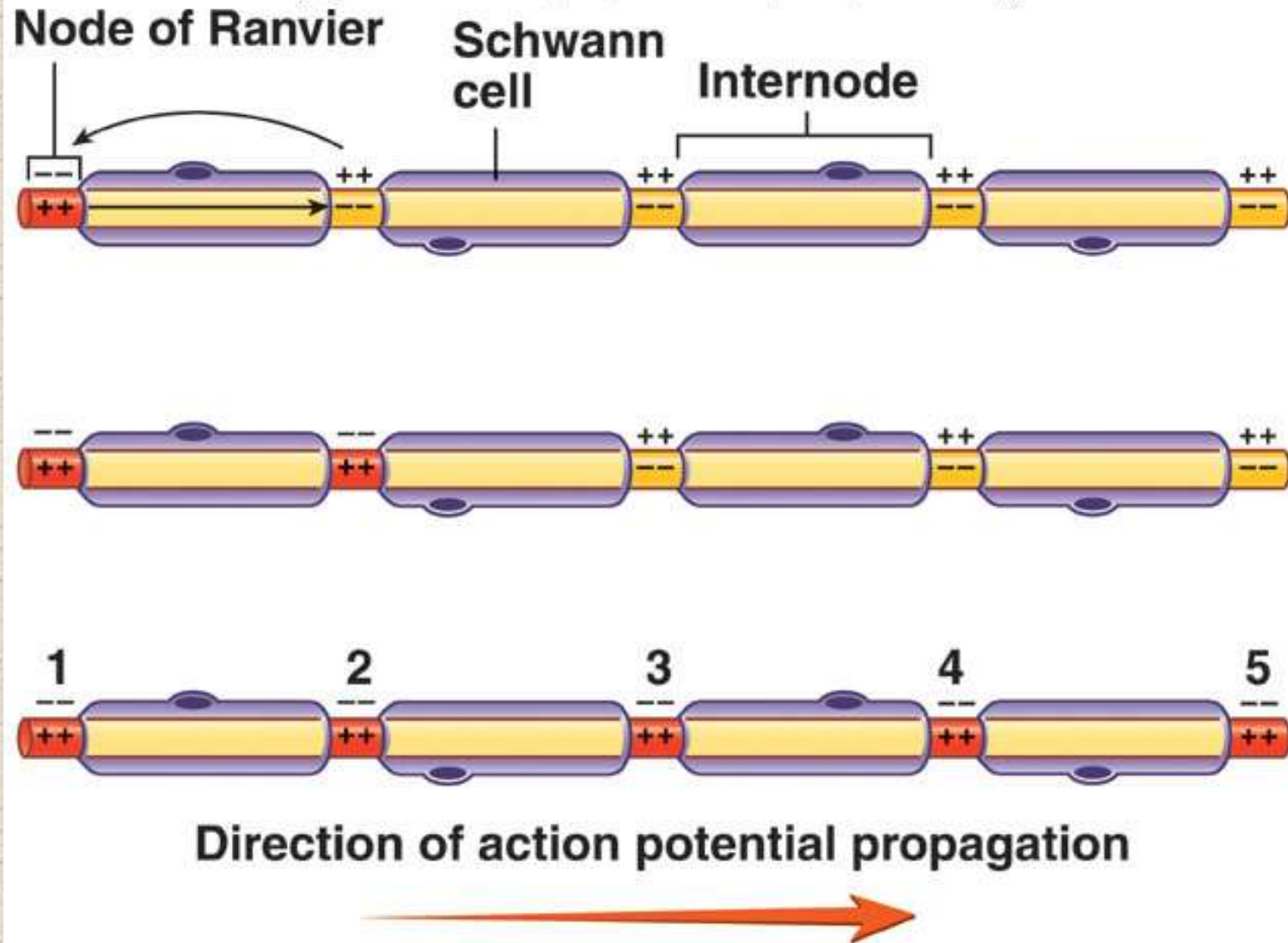
Action Potential Propagation

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



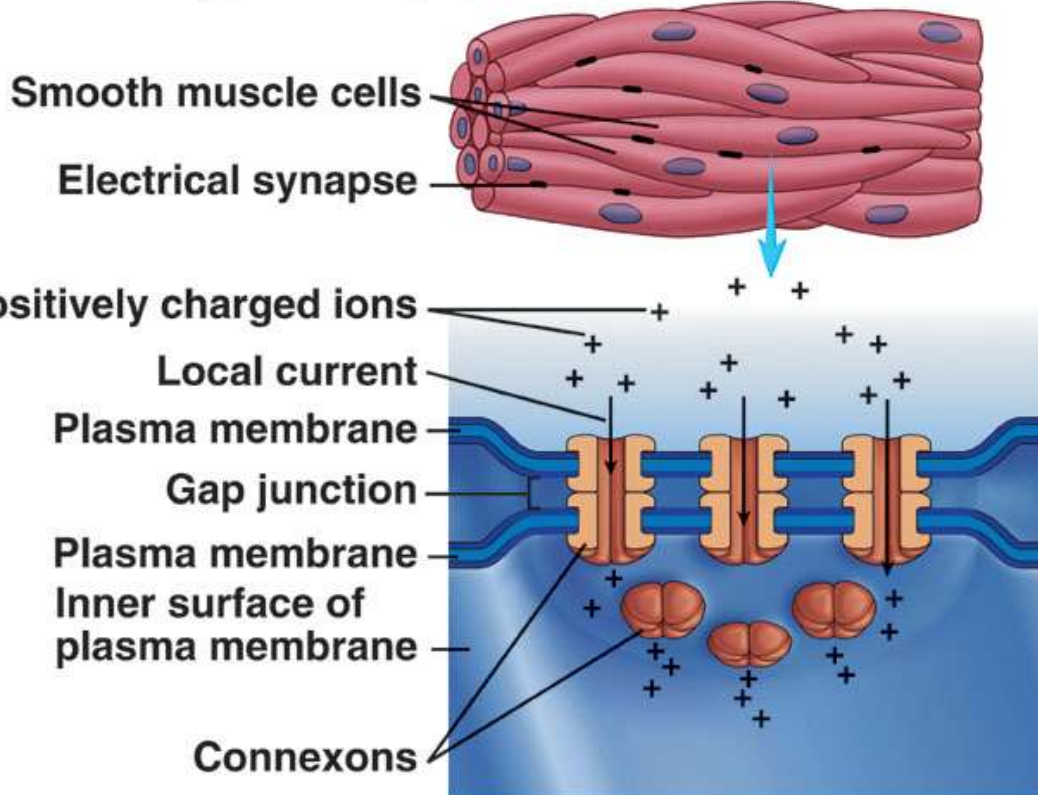
Saltatory Conduction

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



The Synapse

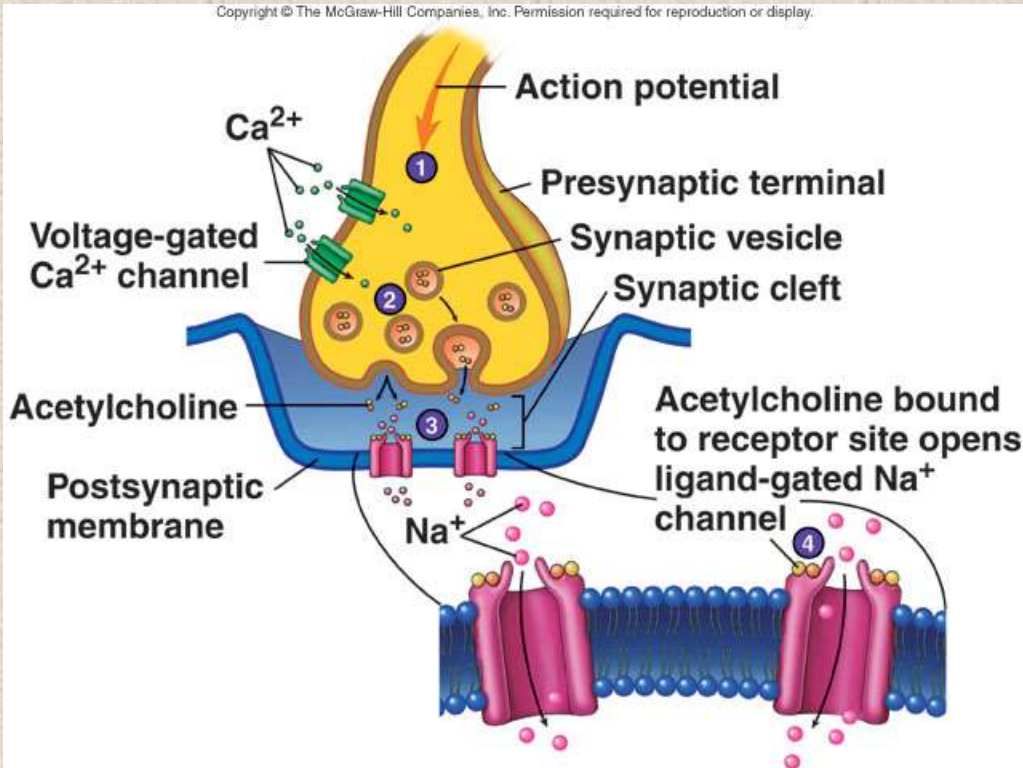
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



- **Junction** between two cells
- Site where action potentials in one cell cause action potentials in another cell
- **Types**
 - Presynaptic
 - Postsynaptic

Chemical Synapses

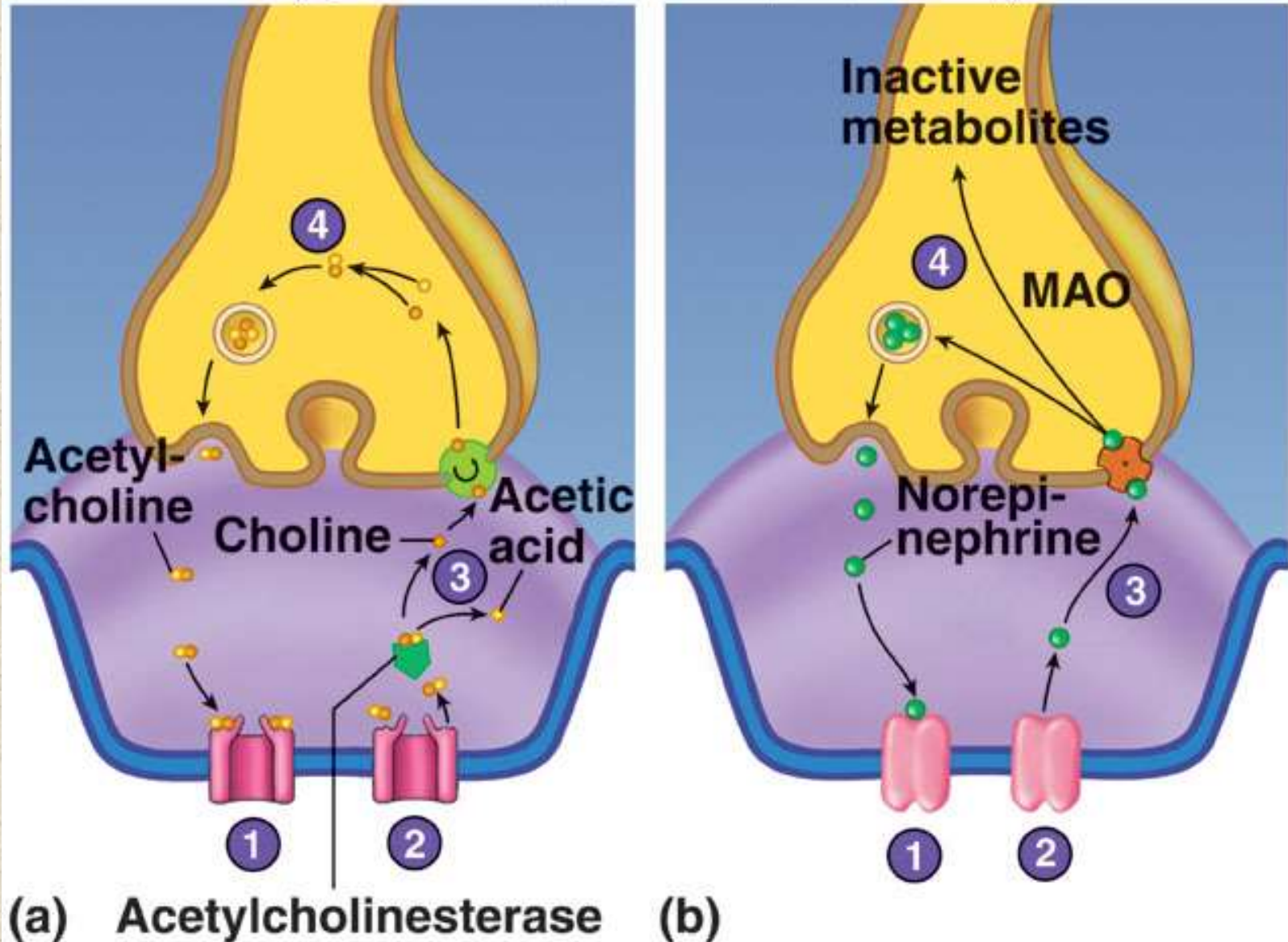
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



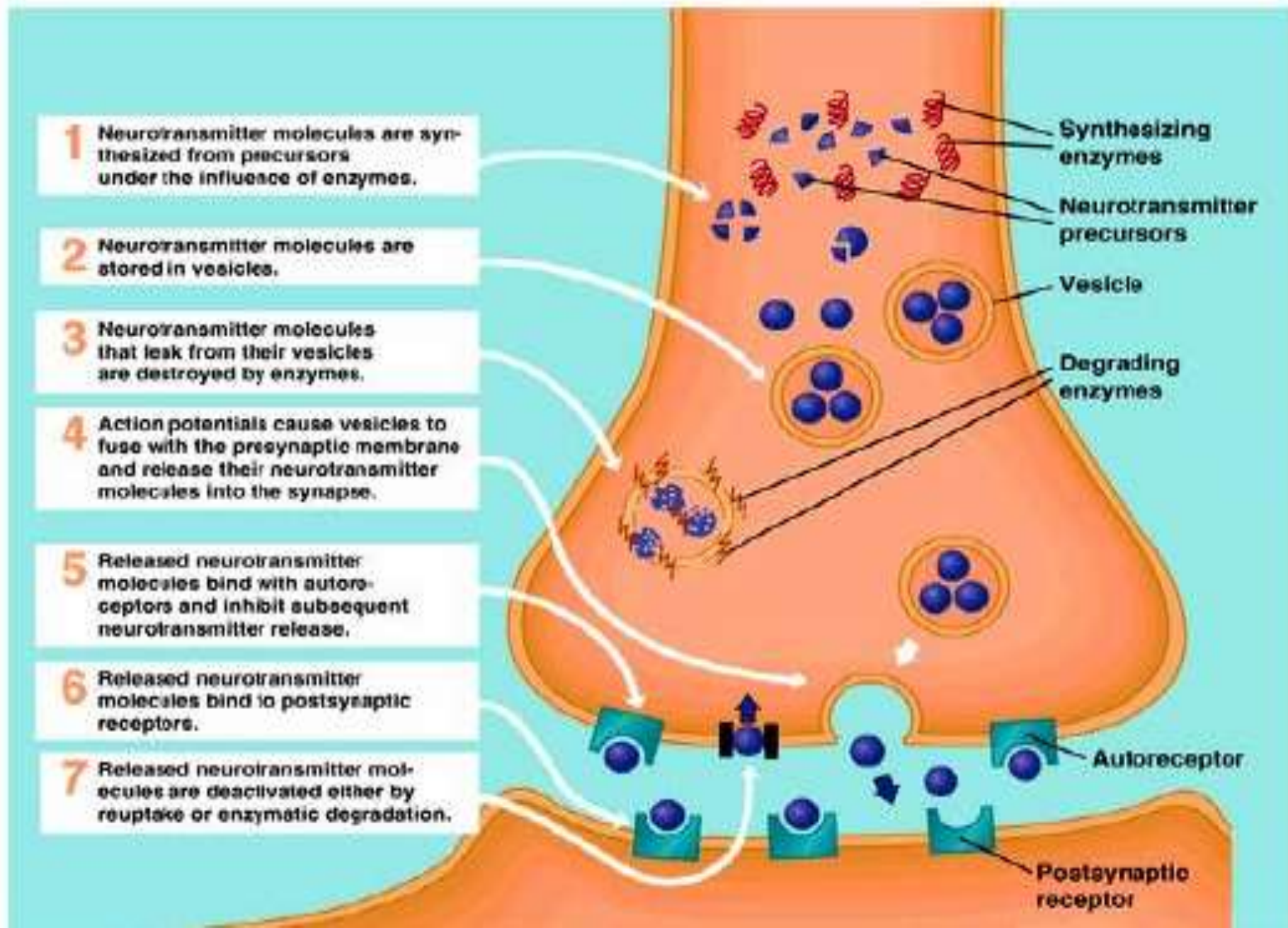
- **Components**
 - Presynaptic terminal
 - Synaptic cleft
 - Postsynaptic membrane
- Neurotransmitters released by action potentials in **presynaptic terminal**
 - Synaptic vesicles
 - Diffusion
 - Postsynaptic membrane
- Neurotransmitter removal

Neurotransmitter Removal

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



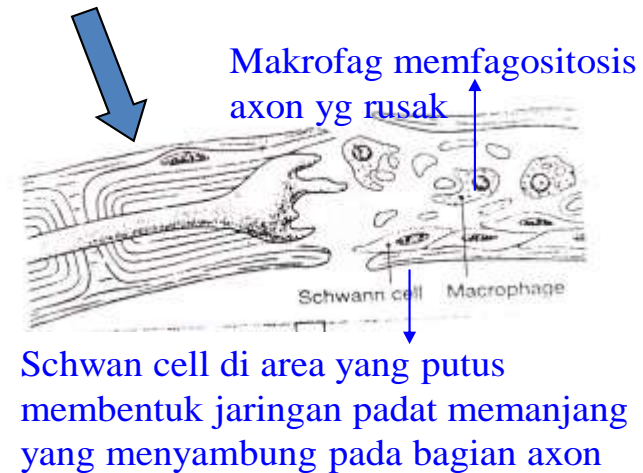
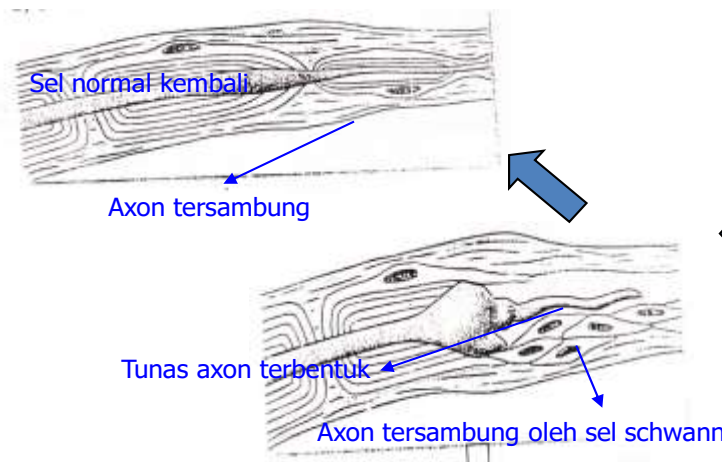
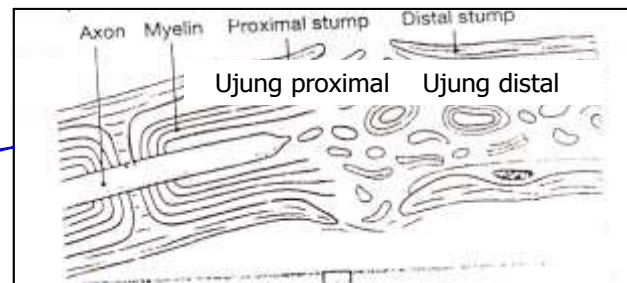
Seven Processes in Neurotransmitter Action



Mekanisme Regenerasi Neuron pada SST

wallerian degeneration

Kerusakan di sel neuron →
memutus axon

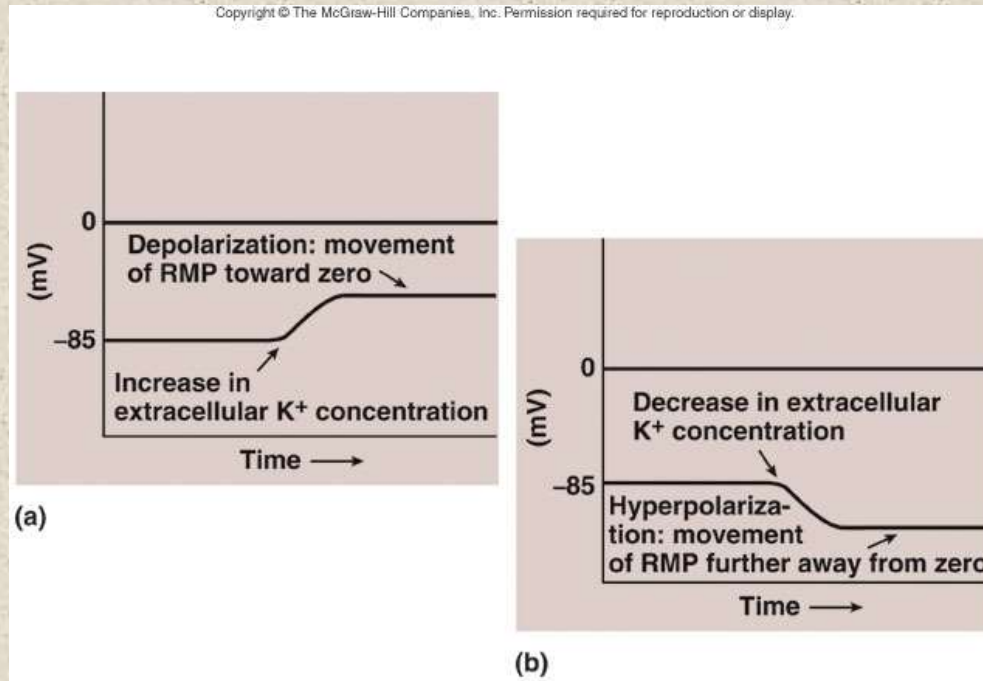




Terima Kasih

SEMOGA BERMANFAAT

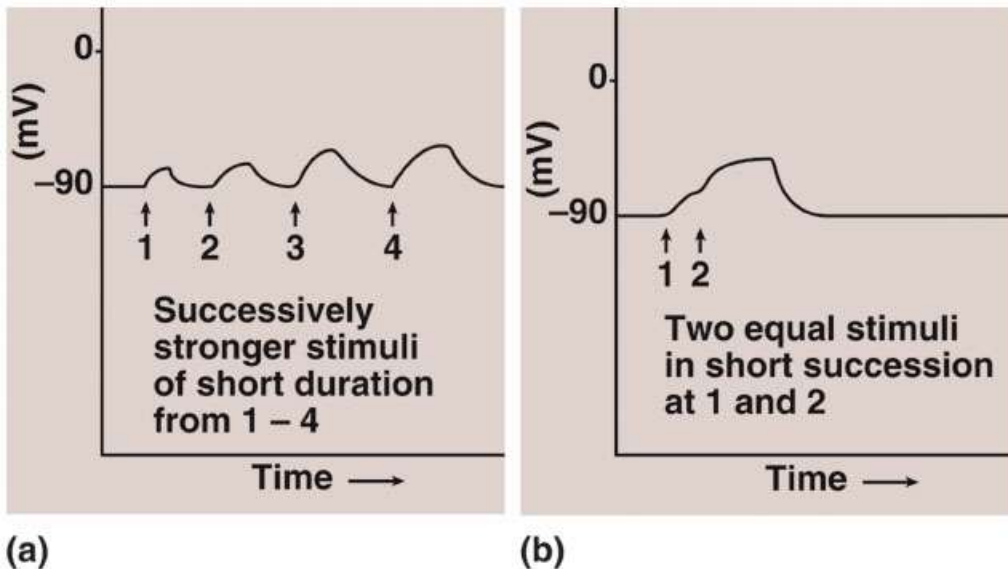
Changes in Resting Membrane Potential



- K^+ concentration gradient alterations
- K^+ membrane permeability changes
 - Depolarization or **hyperpolarization**: Potential difference across membrane becomes smaller or less polar
 - **Hyperpolarization**: Potential difference becomes greater or more polar
- Na^+ membrane permeability changes
- Changes in Extracellular Ca^{2+} concentrations

Local Potentials

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



- Result from
 - Ligands binding to receptors
 - Changes in charge across membrane
 - Mechanical stimulation
 - Temperature or changes
 - Spontaneous change in permeability
- Graded
 - Magnitude varies from small to large depending on stimulus strength or frequency
- Can summate or add onto each other

PRE TEST (Sistem somatomotorik)

1. Sebutkan jaras yang terpenting pada sistem saraf somato motorik
2. Jelaskan perjalanan jaras tersebut dengan ringkas
3. Apakah yang dimaksud dengan UMN dan jaras ini berjalan dari mana, sampai mana ?
4. Apakah yang dimaksud dengan LMN dan jaras ini berjalan dari mana, sampai mana ?
5. Jelaskan bagaimana otot dapat bergerak

PRE TEST (Sistem somatosensorik)

1. Jelaskan ada berapa macam sensorik ?
2. Sebutkan jaras – jara pada sistem saraf somato sensorik
3. Jelaskan perjalanan jaras tersebut dengan ringkas
4. Jelaskan bagaimana system sensorik itu bekerja.

Summation

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

