The Human Body in Health and Illness

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Chapter 10:

Nervous System: Nervous Tissue and Brain

Lesson 10.1 Objectives

- Define the two divisions of the nervous system.
- List three general functions of the nervous system.
- Compare the structure and functions of the neuroglia and neuron.

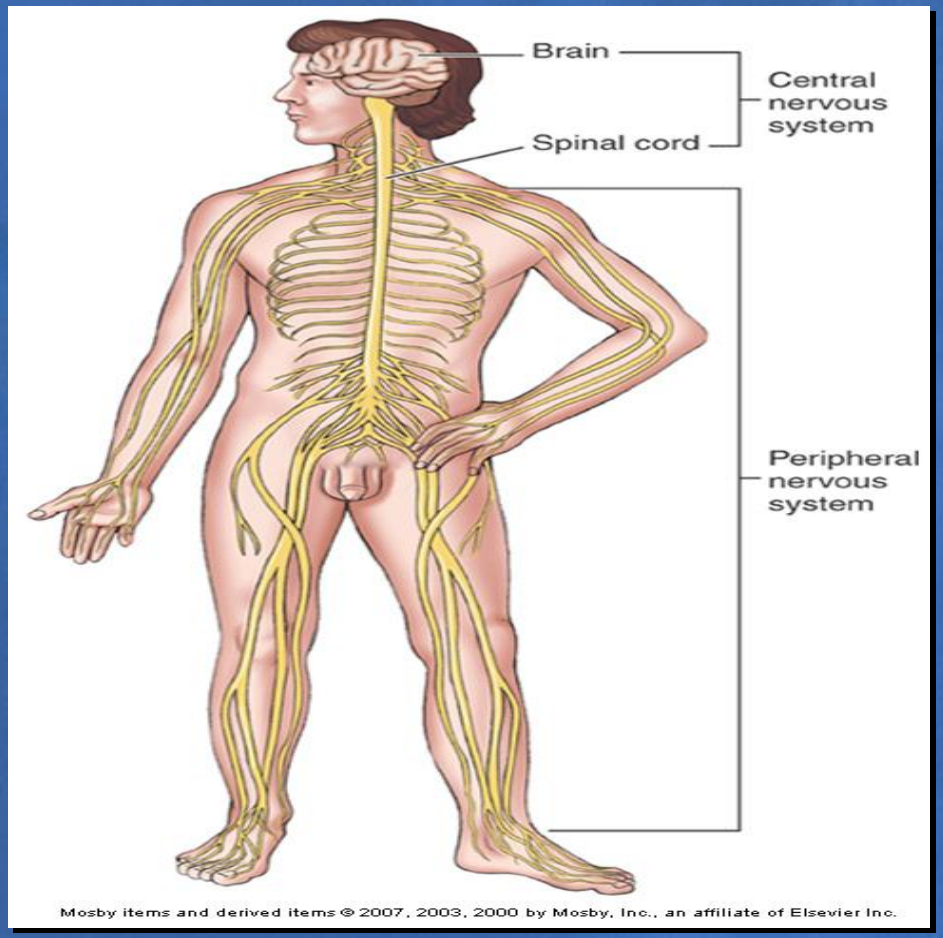
Lesson 10.1 Objectives (cont'd.)

- Explain the function of the myelin sheath.
- Explain how a neuron transmits information.
- Describe the structure and function of a synapse.

The Nervous System

- Divisions of the nervous system:
  - Central nervous system (CNS)
    - Brain and Spinal cord
  - Peripheral nervous system (PNS)
    - Outside CNS – Nerves that connect CNS with the rest of the body

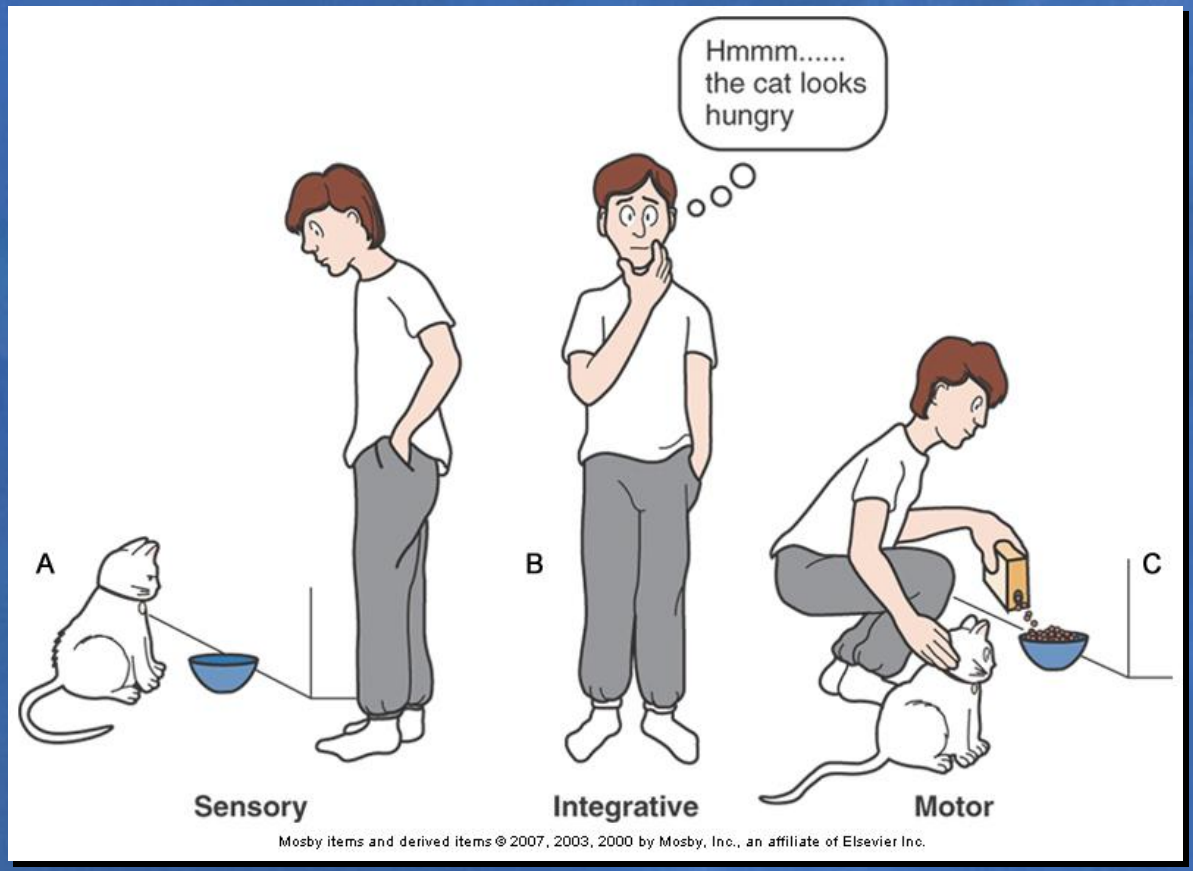
The Nervous System (cont'd.)



Functions of the Nervous System

- Three general functions
  - Sensory Function
    - Gather information from inside/outside the body and carry information to CNS
  - Integrative Function
    - Information brought to CNS is interpreted
    - Puts together all info and makes a plan
  - Motor Function
    - Convey info from CNS to muscles and glands of the body, motor nerves carry out the plan

The Nervous System (cont'd.)

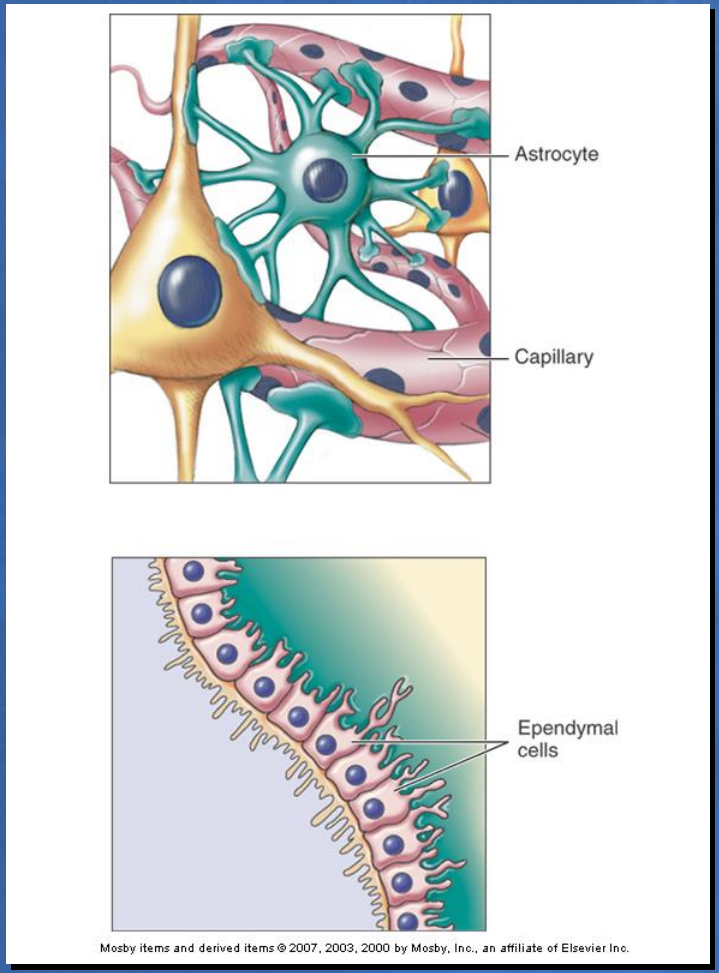


Three functions of the nervous system.

Cells that make up Nervous system

- Neuroglia & Neurons
- Neuroglia - Aka Glial cells
  - Most abundant of the nerve cells
  - Most found in CNS
- Neuroglia functions
  - Support, protect, insulate, nourish and care for delicate neurons, phagocyotosis, assist in secretion of cerebral spinal fluid
  - DO NOT CONDUCT NERVE IMPULSES

Neuroglia



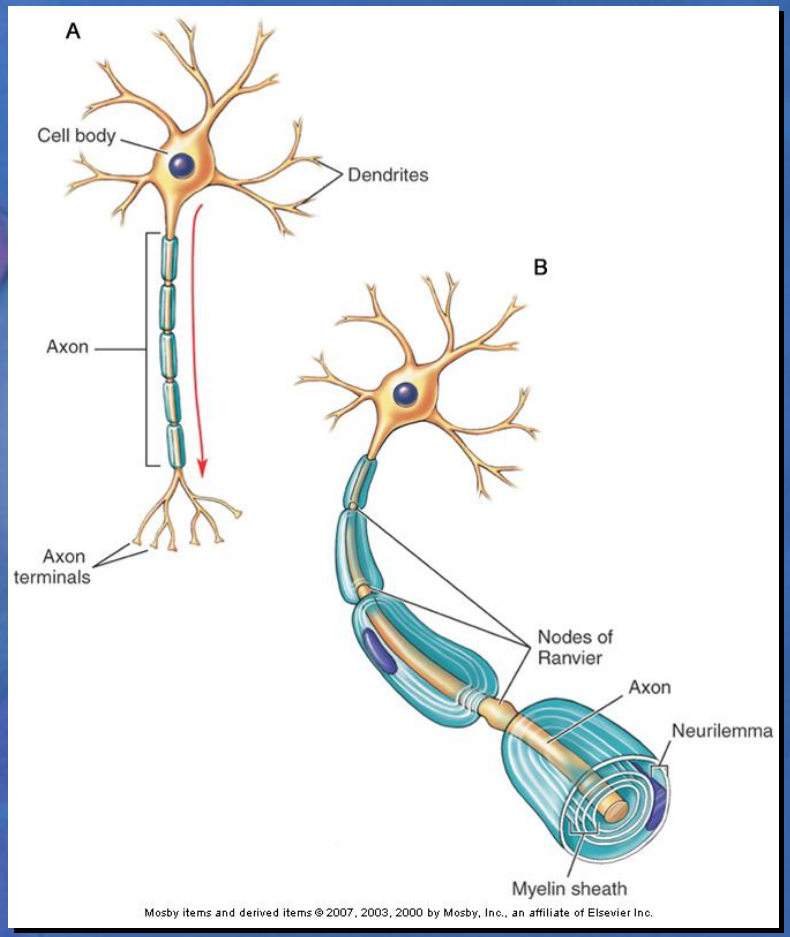
Types of Neuroglia

Cell Name	Function
Astrocytes	Star-shaped cells present in blood-brain barrier; also anchor or bind blood vessels to nerves for support; act as phagocytes
Ependymal cells	Line the ventricles as part of the choroid plexus; involved in the formation of cerebrospinal fluid

Types of Neuroglia (cont'd.)

Cell Name	Function
Microglia	Protective role; phagocytosis of pathogens and damaged tissue
Schwann cells	Produce myelin sheath for neurons in the peripheral nervous system
Oligodendrocytes	Produce myelin sheath for neurons in the central nervous system

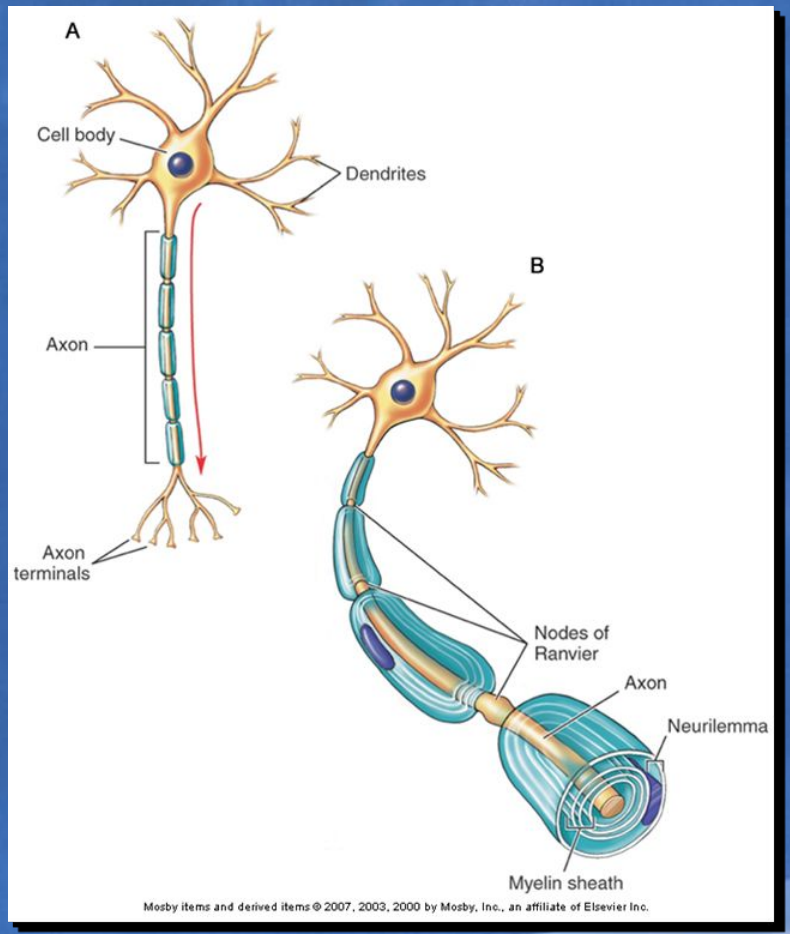
Neuron



- Most important in transmission of electrical signals
- Many shapes and sizes
- Nonmitotic - do not replicate or replace

Parts of a Neuron

- Dendrites – receive signals from other neurons and transmit signals toward cell body
- Cell body - contains nucleus, essential for life of cell
- Axon – long extension transmits signal away from cell body



Neuron (cont'd.)

- Myelin sheath: white fatty material that encases most long nerve fibers of the peripheral nervous system and the CNS
- Nodes of Ranvier: areas found along the axon not covered by myelin

Neuron (cont'd.)

- Types of neurons:
  - Sensory neuron
  - Motor neuron
  - Interneuron (found only in CNS important for integrating sensory information to the appropriate motor response)

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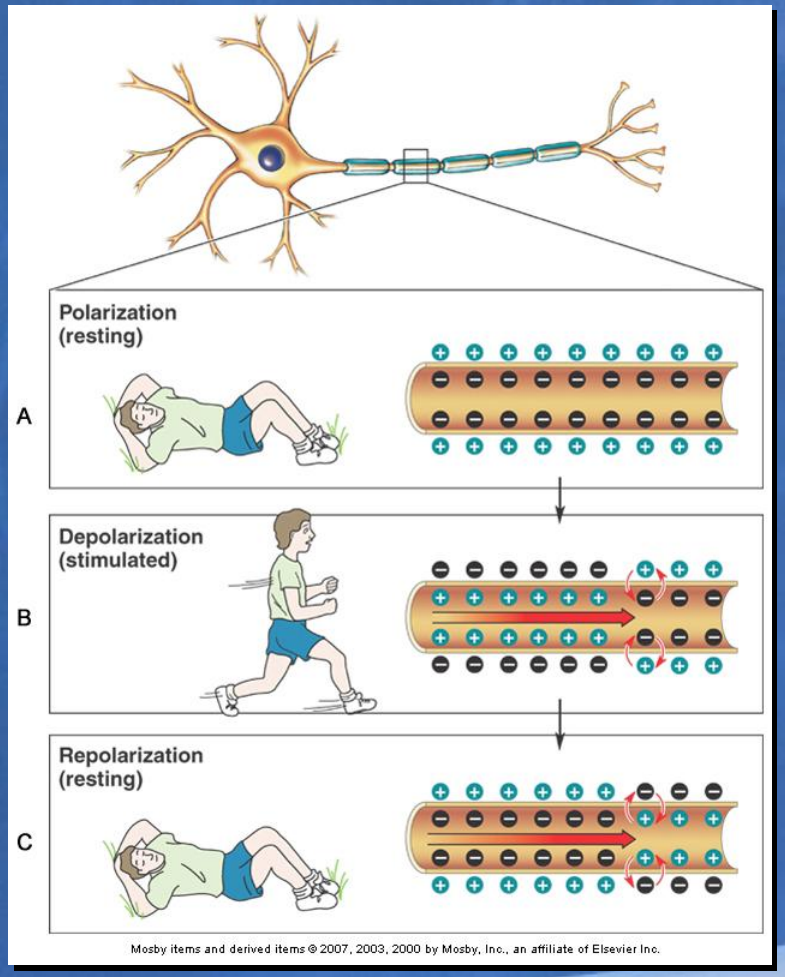
The Neuron Carrying Information

- Nerve impulse: aka action potential = electrical signal that conveys the information along a neuron; process of polarization , depolarization, and repolarization
- Polarization – Inside of resting cell is more - than the outside which is more +. Said to be the cells Resting membrane potential. No action potential occurs while cell is polarized
- Depolarization – Inside of the cell becomes more positive (action potential)
- Repolarization - Return to resting membrane potential – inside of the cell becoming more negative

The Neuron Carrying Information (cont'd.)

Nerve impulse (action potential)



The Neuron Carrying Information (cont'd.)

Cause of the nerve impulse?

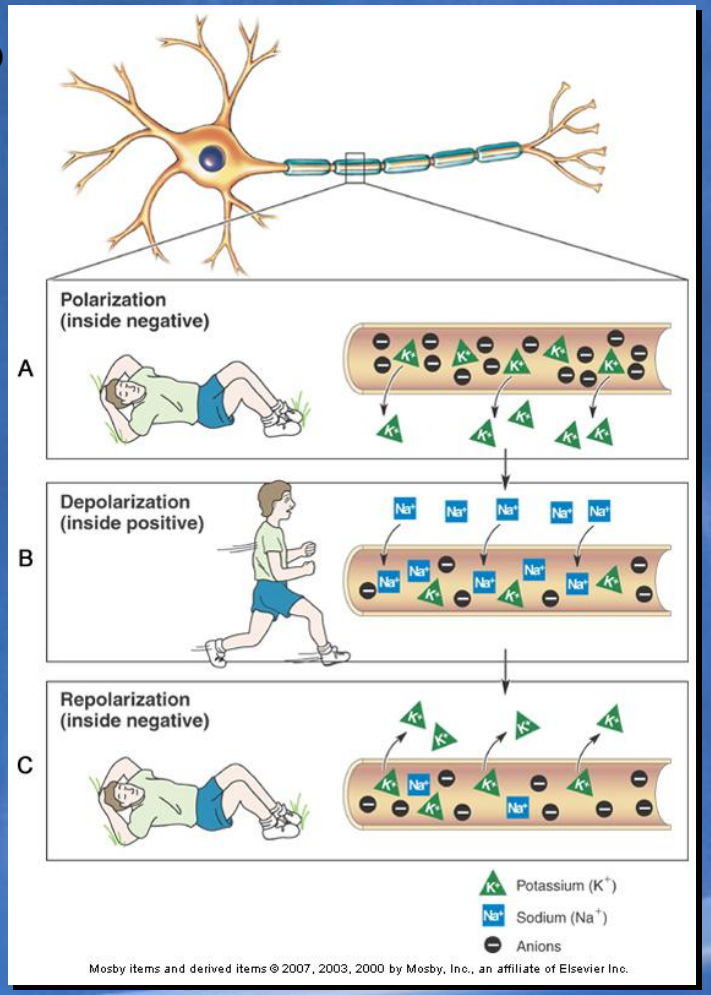
movement of ions through the cell membrane

Anions = negative ions

Cations = positive ions

Intracellular cation – K+

Extracellular cation – NA +



Ion movement continued

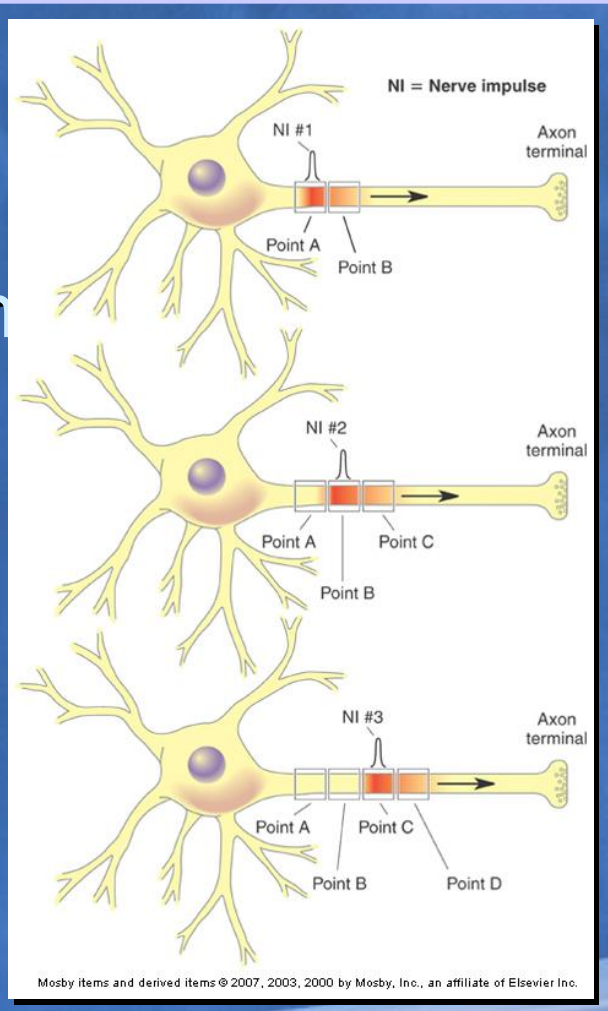
- Cell membrane can become permeable to NA+ and k+
- In resting K+ leaks out of channels in the membrane resulting from a higher number of anions inside the cell
- Depolarization – When stimulated – the cell membrane becomes more permeable to NA + and it rushes into the cell making it more positive
- Repolarization – membrane permeability changes again – stops NA + from entering the cell and allows K + to rapidly leak out returning the inside of the cell to its resting membrane potential

The Neuron Carrying Information (cont'd.)

Nerve impulse movement?

-All or nothing principle

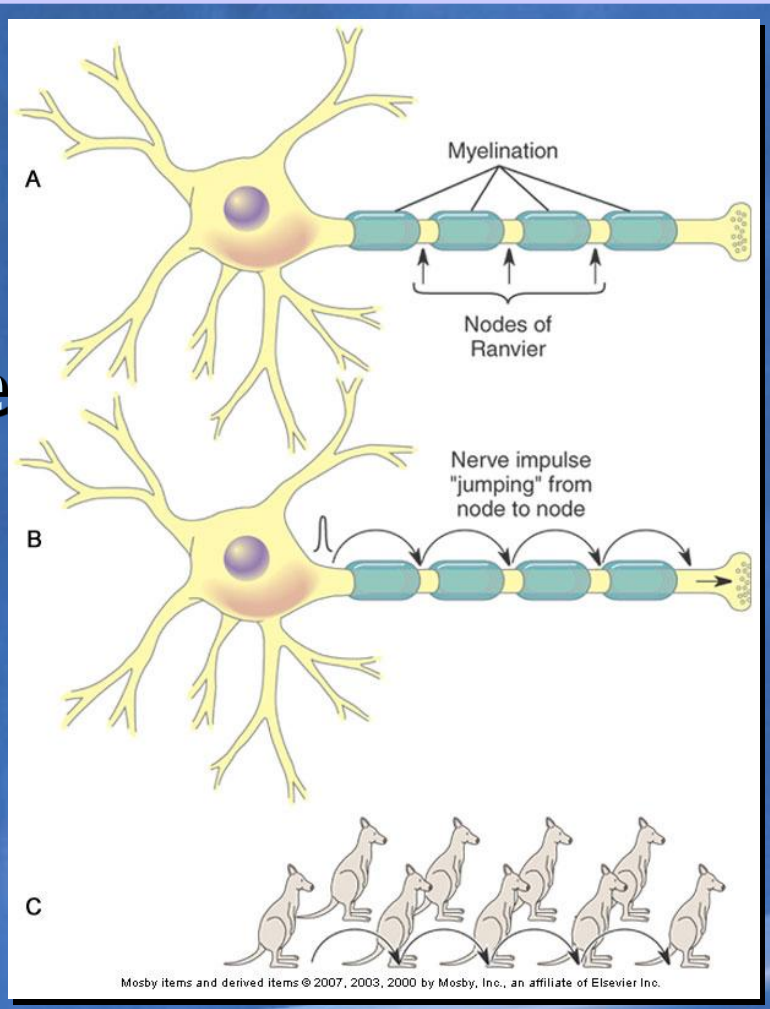
- Depolarization must reach threshold or the action potential will not occur
- Each nerve impulse can cause the adjacent membrane to depolarize



The Neuron Carrying Information (cont'd.)

Jumping from node to node

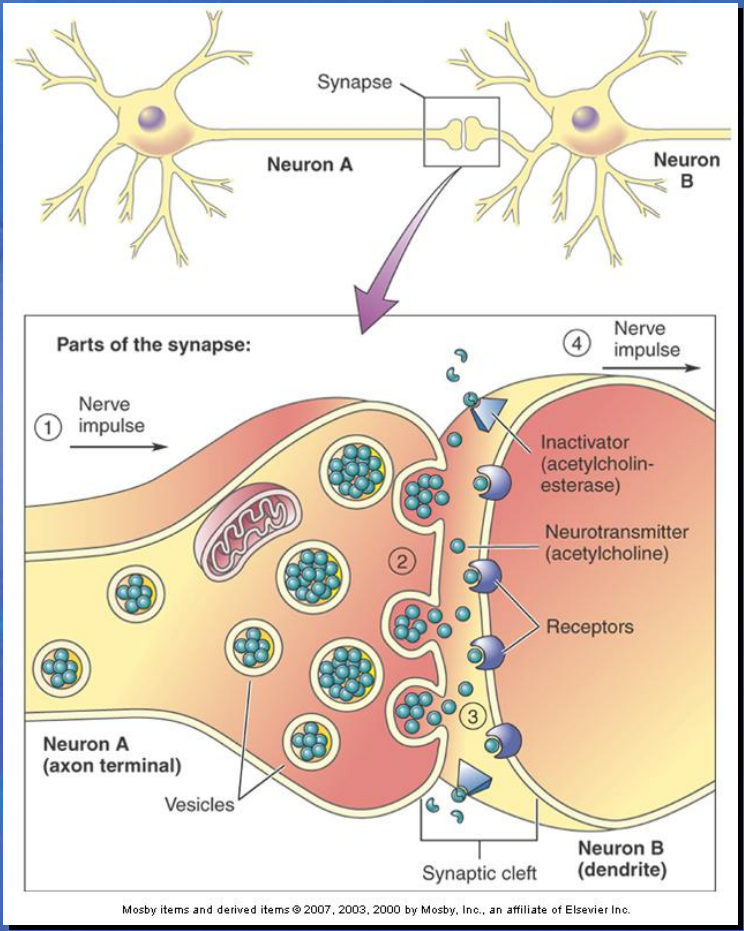
- Nodes of Ranvier are unmyelinated, causes the nerve impulse to jump the myelin sheath
- Called Saltatory conduction



Synapse Across Neurons

- Synapse: helps information move from one neuron to the next
  - Synaptic cleft
    - Space b/w Axon terminal of A and dendrite of B
  - Receptors
    - Dendrite of B has receptor sites where neurotransmitters bind
  - Neurotransmitters
    - Found in axon terminal, examples Ach, NE, Epinephrine, GABA etc
  - Inactivators
    - Terminate the activity of neurotransmitters

Synapse Across Neurons (cont'd.)



1. Along A to axon terminal
2. N/T vesicles fuse with membrane and release into synaptic cleft
3. Diffuses across and binds to receptor. Cause change in MP in B developing a nerve impulse
4. Impulse travels to the body and Axon of B

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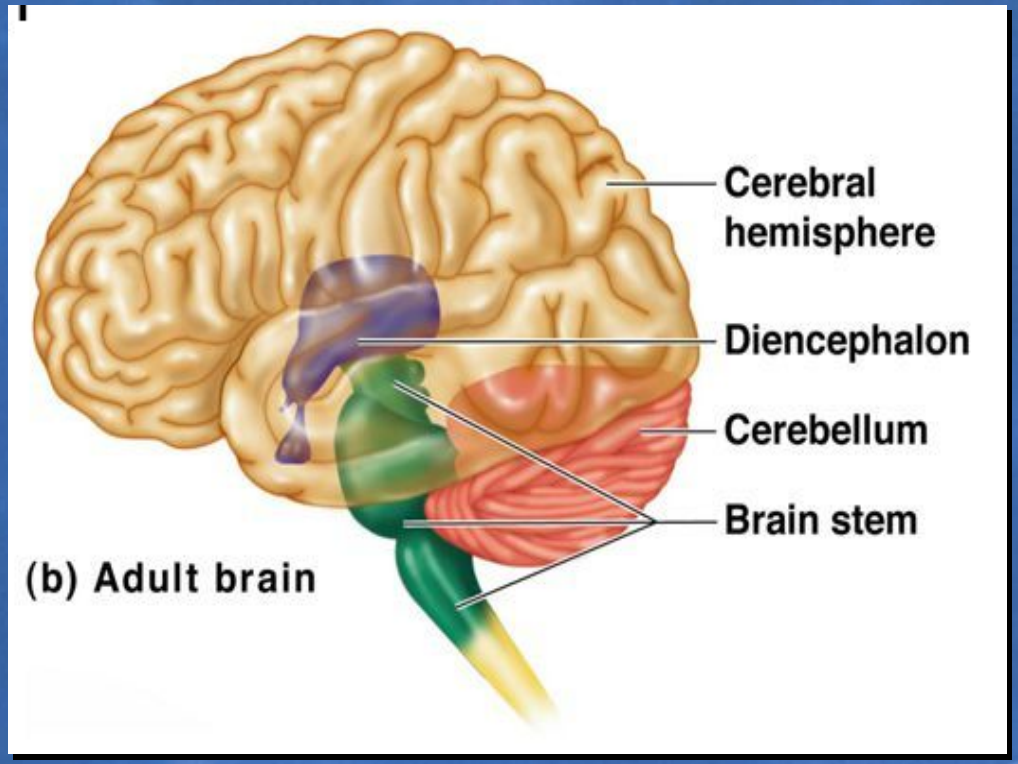
Lesson 10.2 Objectives

- Describe the functions of the four lobes of the cerebrum.
- Describe the functions of the four major areas of the brain.
- Describe how the skull, meninges, cerebrospinal fluid, and blood-brain barrier protect the central nervous system.

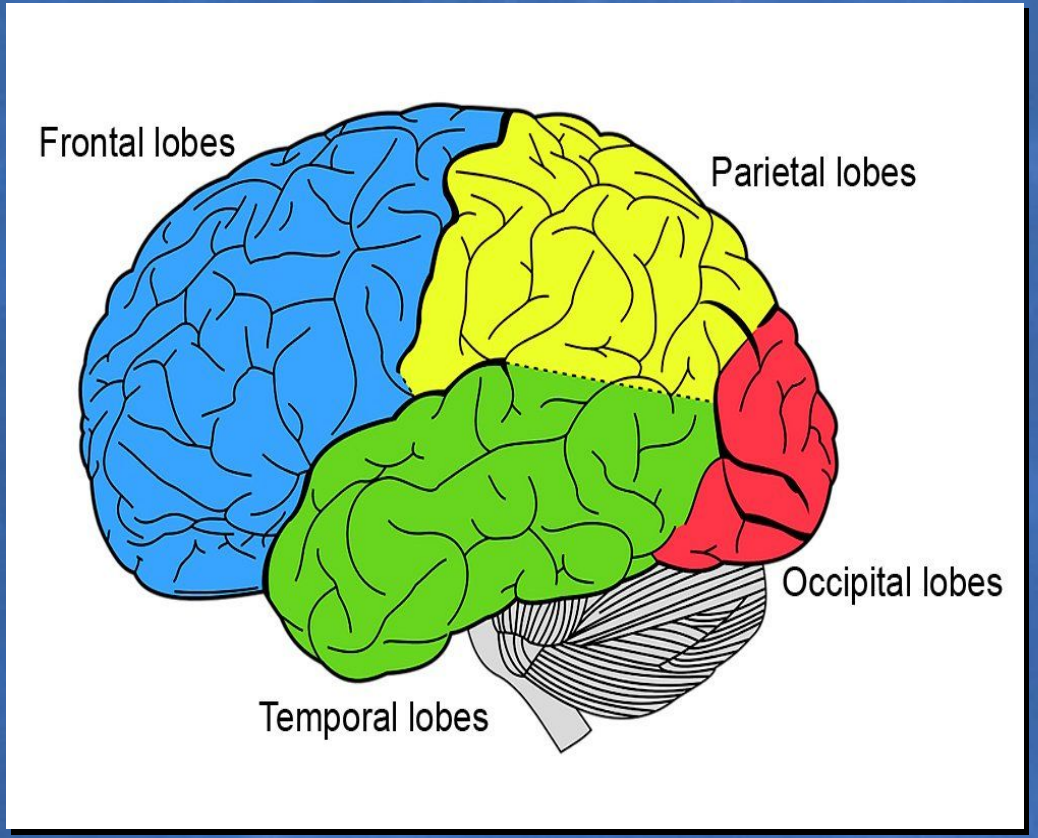
Brain: Structure and Function

- Four major areas of the brain:
  - Cerebrum
  - Diencephalon
  - Brain stem
  - Cerebellum

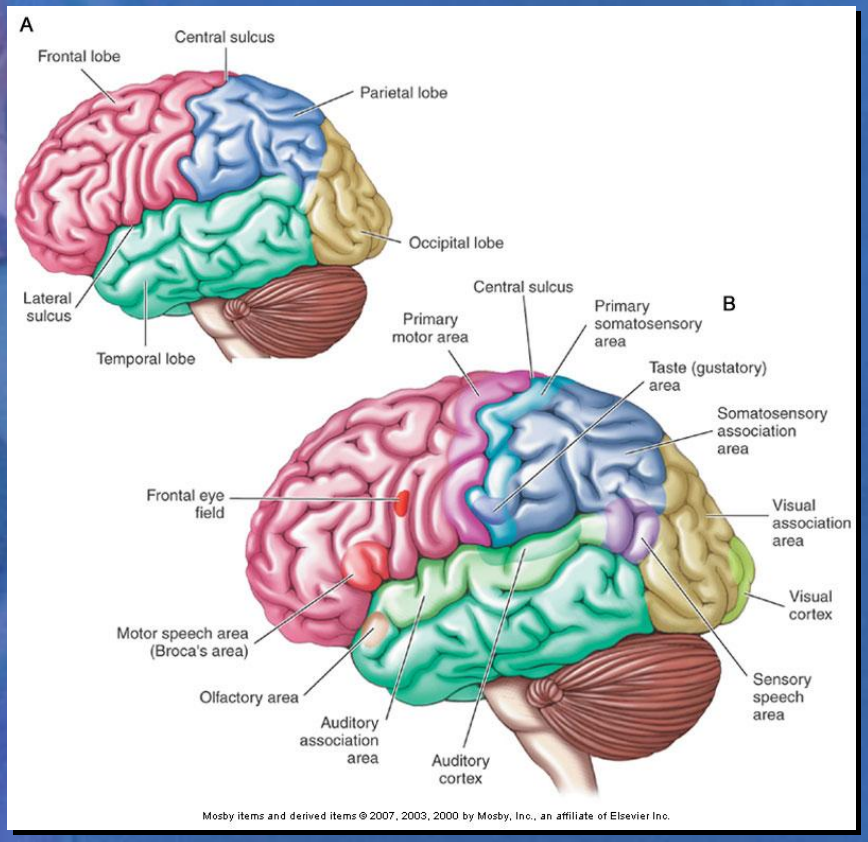


Brain: Structure and Function (cont'd.)

- Cerebrum:
  - Frontal lobe
  - Parietal lobe
  - Occipital lobe
  - Temporal lobe



Brain: Structure and Function (cont'd.)



Cerebrum

- Largest part of the brain
- Divided into 2 hemispheres
- Joined by corpus callosum (white matter that allows the sides to communicate)

Cerebrum continued

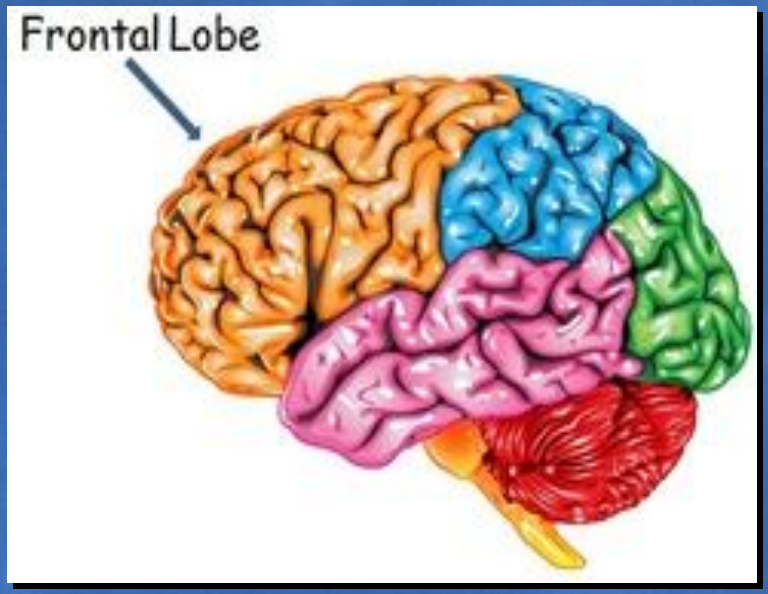
- Each hemisphere has 4 parts
  - Frontal, parietal, temporal and occipital
- Contains grey and white matter
  - Cerebral cortex thin outermost portion grey matter, allows for higher mental tasks
  - Bulk of cerebrum white matter, form connections between other parts of brain and spinal cord
  - Patches of grey 'nuclei" scattered throughout white

Brain: Structure and Function (cont'd.)

Cerebrum:

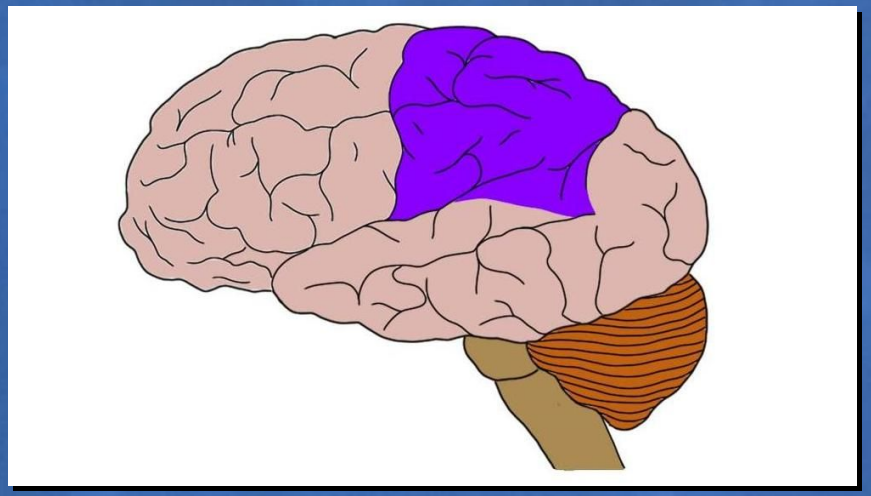
Frontal Lobe

- Located under frontal bone
- Functions – Voluntary motor function, personality, behavior, emotional expression, intellectual functions, memory storage



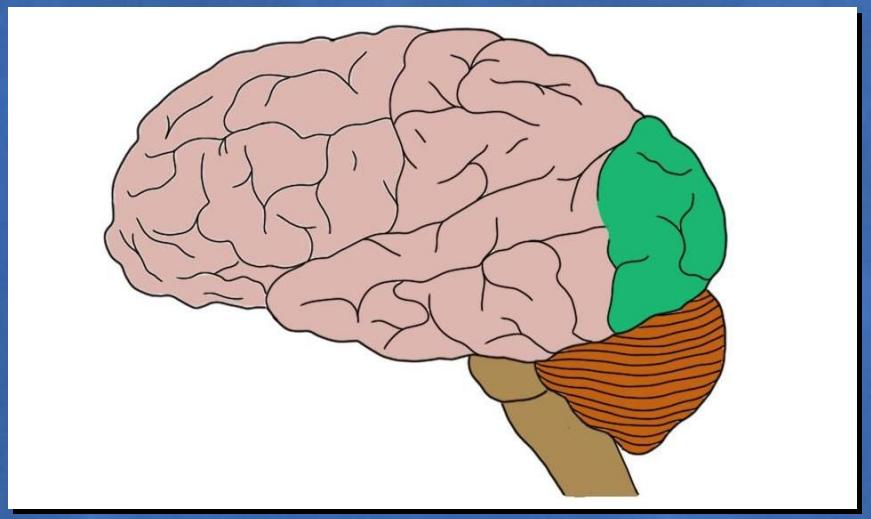
Parietal Lobe

- Somatosensory area (especially from skin and muscle; taste; speech; reading)



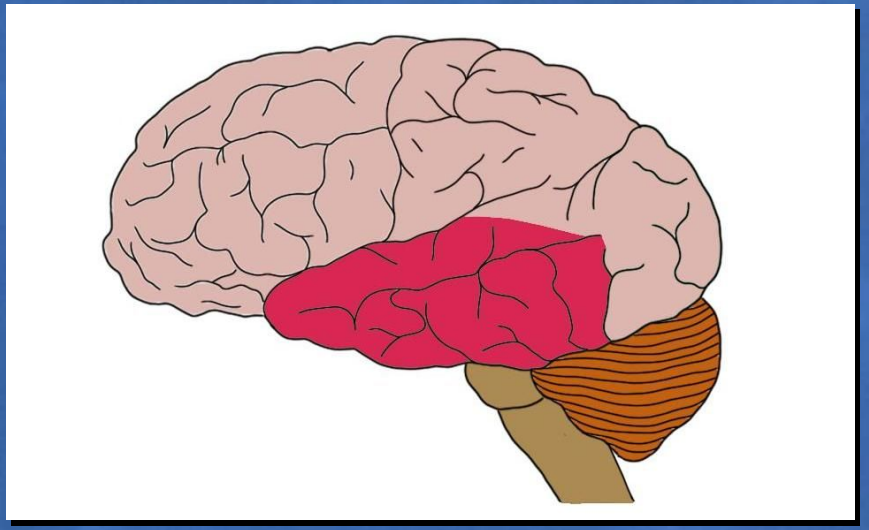
Occipital Lobe

- Vision and vision related reflexes and functions
  - Reading, judging distances, seeing in 3 dimension

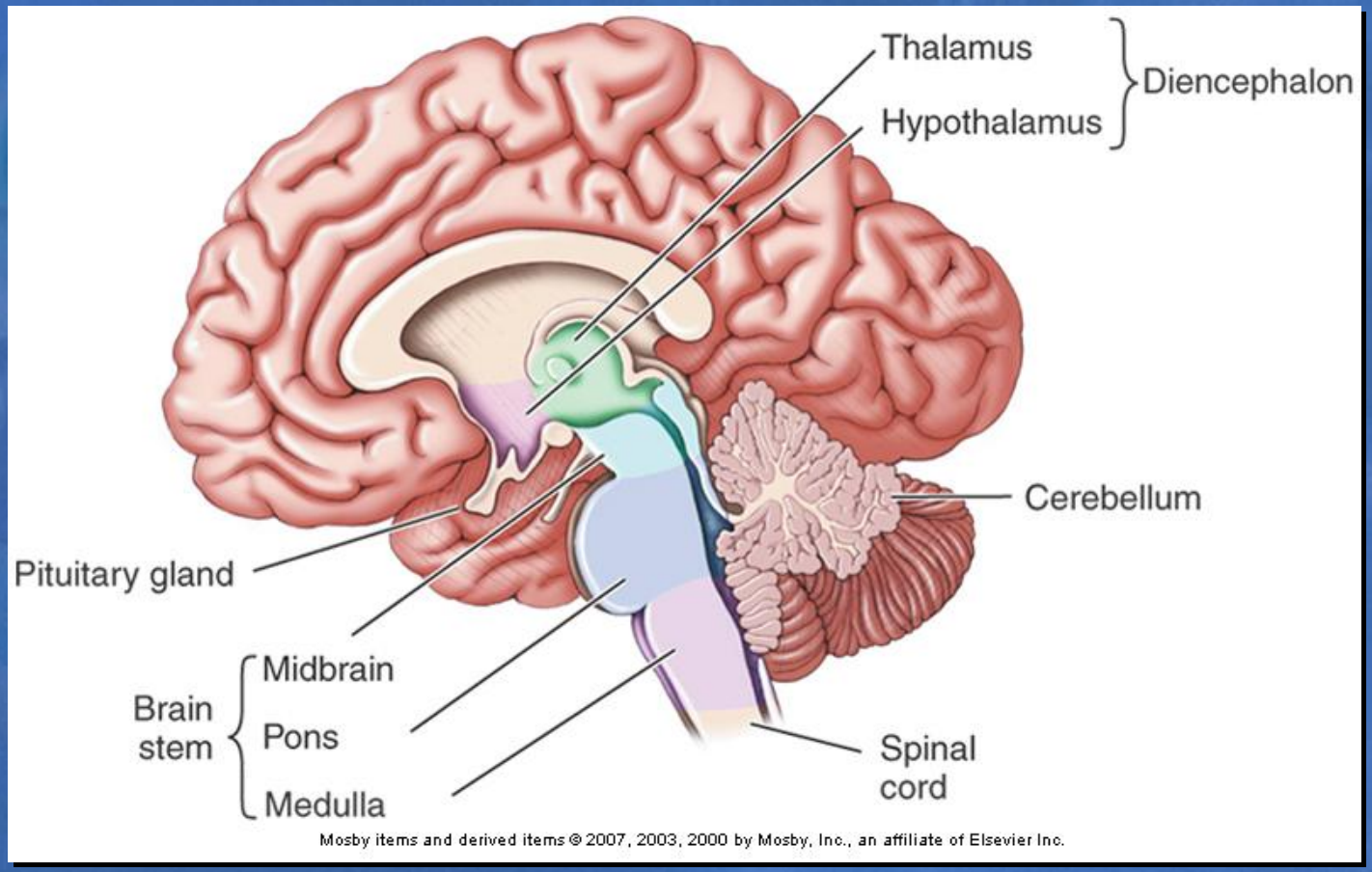


Temporal Lobe

- Auditory area
- Olfactory area
- Taste
- Memory storage
- Part of speech area



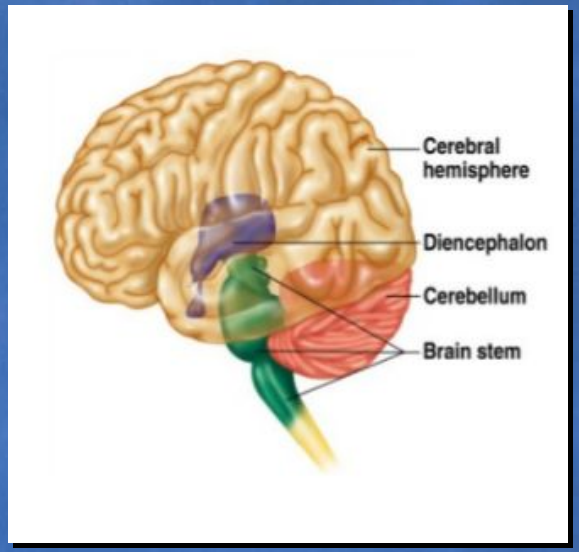
Brain: Structure and Function (cont'd.)



Diencephalon, brain stem, and cerebellum.

Brain: Structure and Function (cont'd.)

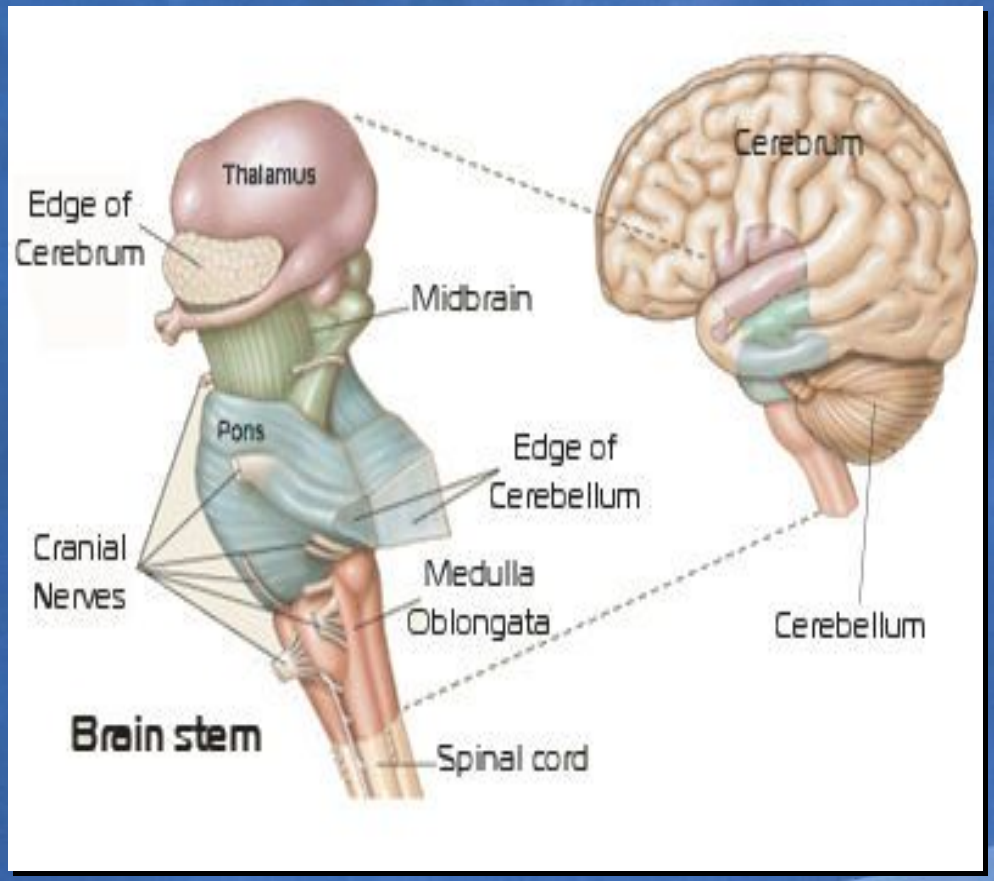
- Diencephalon: 2nd main brain structure b/w cerebrum & brain stem
  - Thalamus – relay structure & processing centre for most sensory info to cerebrum
  - Hypothalamus – integrating system for ANS, regulates temp. H2o balance, sex, thirst appetite, pleasure and fear
  - Regulates Pituitary gland and controls endocrine function



Brain: Structure and Function (cont'd.)

Brain stem: Connects the brain with the spinal cord with the higher brain structures.

- Made up of:
  - Midbrain
  - Pons
  - Medulla oblongata (vital center)

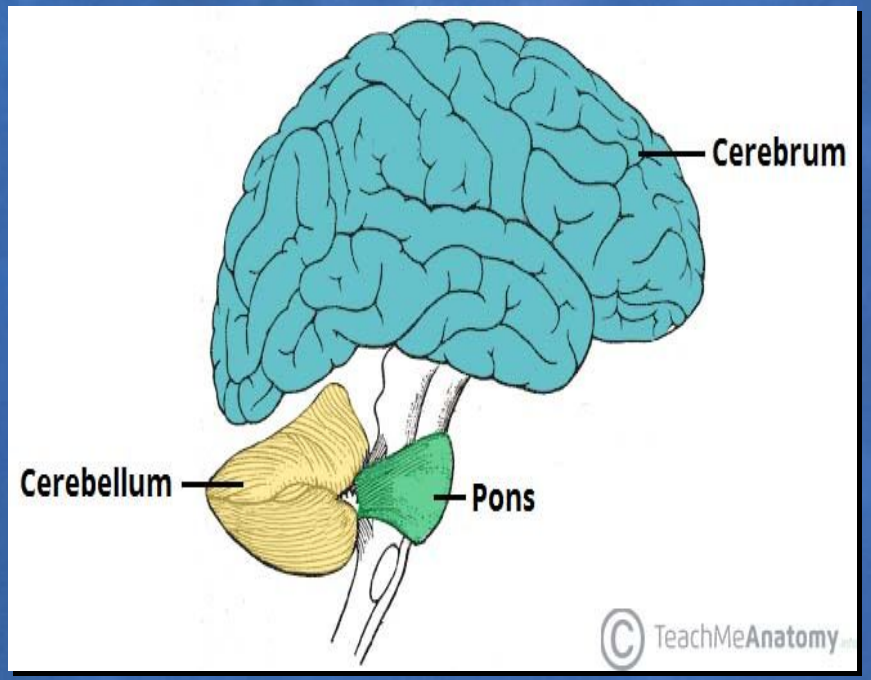


Midbrain, Pons & Medulla oblongata Functions

- Midbrain – Relays info (Sensory & Motor); assoc. with visual and auditory reflexes
- Pons – Relays info (Sensory & Motor); plays role in respiration
- Medulla Oblongata – regulation of heart rate, blood flow, blood pressure, respiratory centres; reflex centre for coughing, sneezing, swallowing and vomitting

Brain: Structure and Function (cont'd.)

- Cerebellum:
  - Protrudes from under the occipital lobe at the base of the skull
- Functions:
  - Smooths/coordinates voluntary muscle activity, helps maintain balance and muscle tone



Brain: Structure and Function (cont'd.)

- Structures across (overlap)divisions of the brain:
  - Limbic system: functions in emotional states and behavior
  - Reticular formation: special mass of gray matter extending through the entire brain stem with numerous connections to the cerebral cortex – primary sensory function – alert cerebral cortex of incoming sensory information
  - Memory areas: responsible for both short-term memory and long-term memory

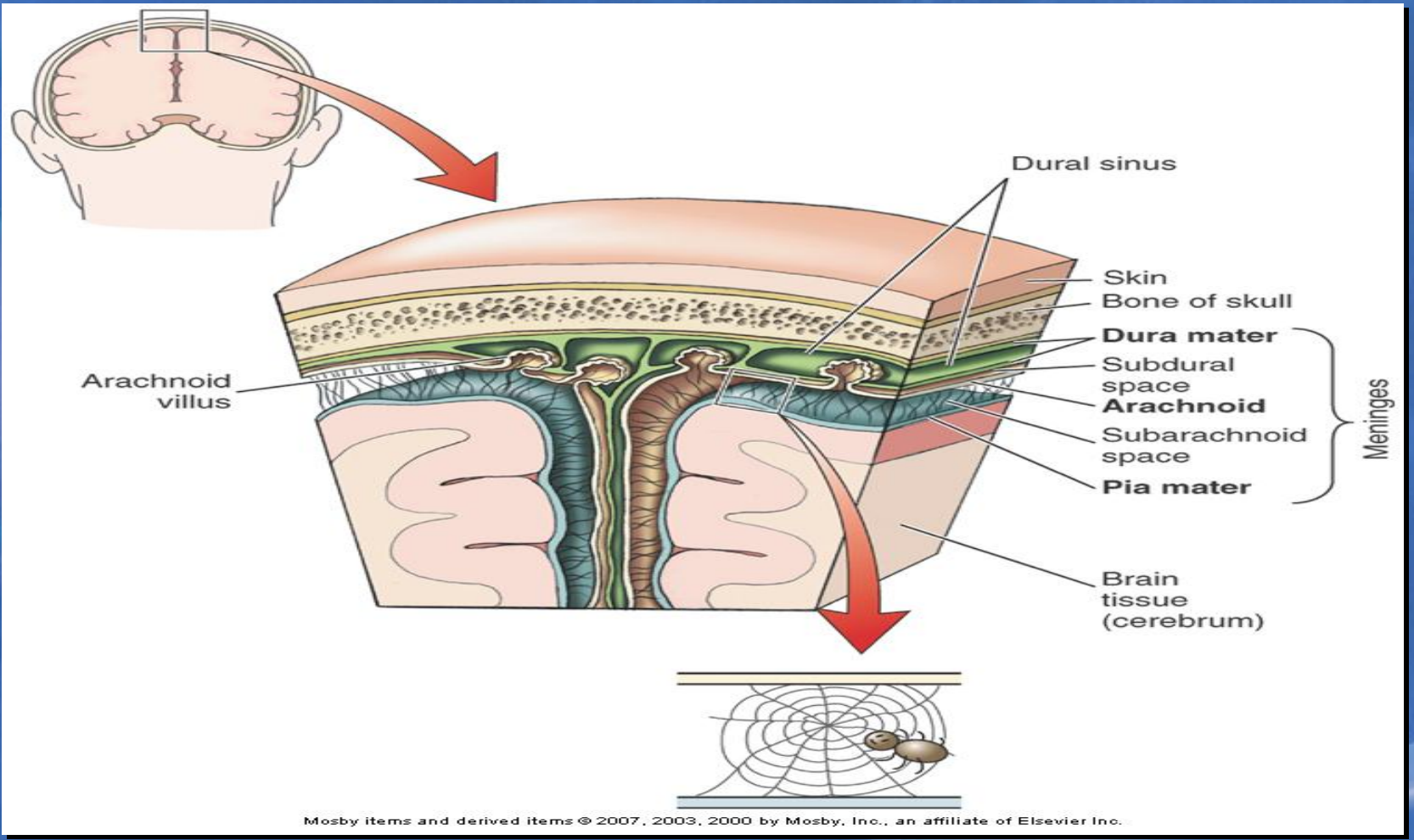
Protecting the Central Nervous System

- Four layers of protection:
  - Bone
  - Meninges
  - Cerebrospinal fluid
  - Blood-brain barrier

Protecting the Central Nervous System (cont'd.)

- Bone:
  - Cranium
  - Vertebral column
- Meninges: 3 layers of connective tissue that surround the brain and spinal cord
  - Pia mater – innermost layer, contains many blood vessels and lies delicately over brain and spinal cord
  - Arachnoid layer – middle layer (looks like a spider web)
  - Dura mater – thick tough outer layer

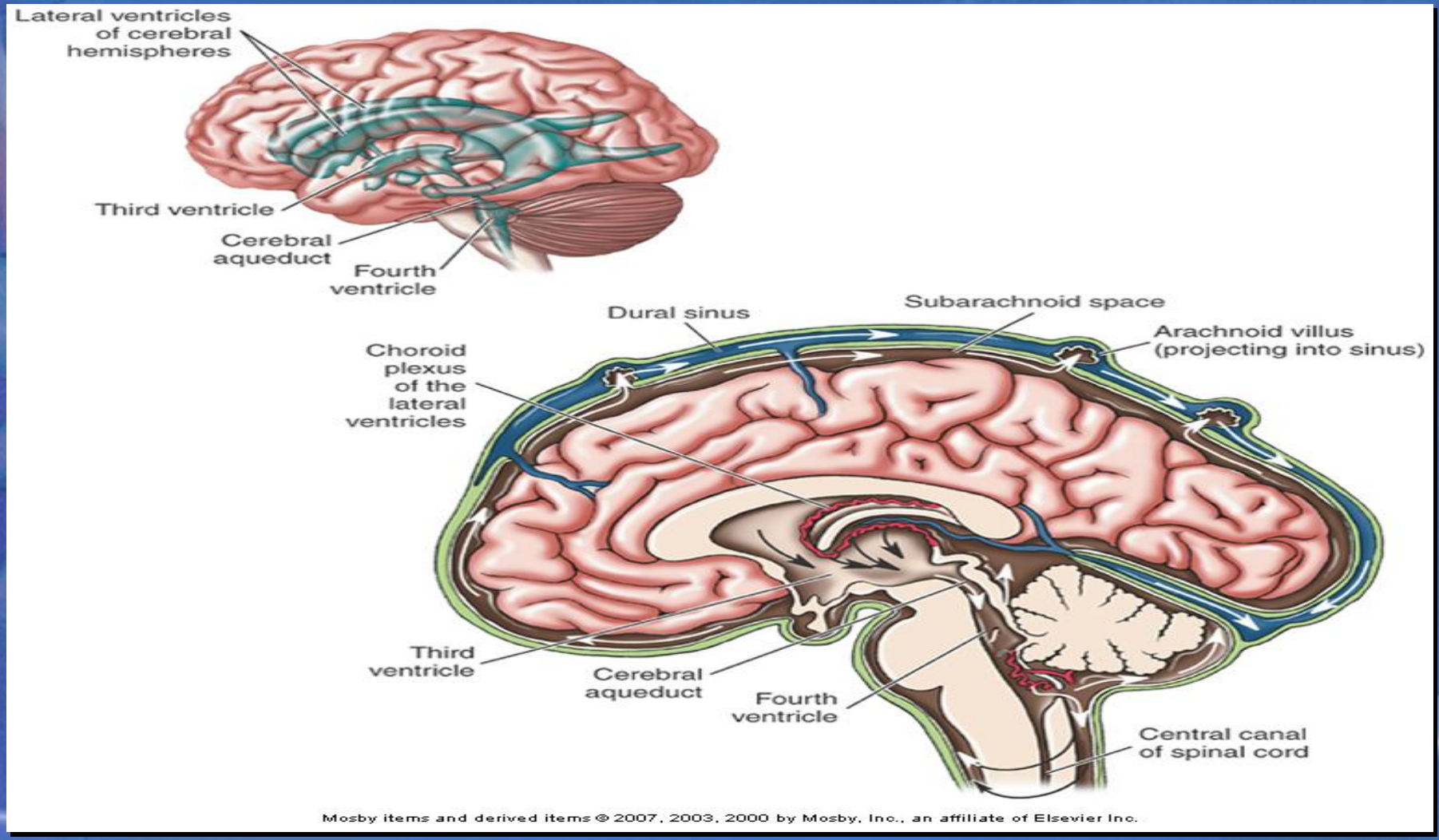
Protecting the Central Nervous System (cont'd.)



Protecting the Central Nervous System (cont'd.)

- Cerebrospinal fluid:
  - Flows in the subarachnoid space in the brain and spinal cord/
  - Formed within ventricles of the brain by choroid plexus
  - Delivers nutrients & removes wastes
  - Flows from ventricles down two paths: through central canal of spinal cord or into subarachnoid space that encircles brain

Protecting the Central Nervous System (cont'd.)



Protecting the Central Nervous System (cont'd.)

- Blood-brain barrier: an arrangement of cells – glial cells and selectively permeable capillary cells
  - Glial astrocytes
  - Blood vessels that supply the brain and spinal cord
- Helps to prevent dangerous substances from entering the brain and spinal cord
- Not all toxic substances are blocked, alcohol can pass bbb