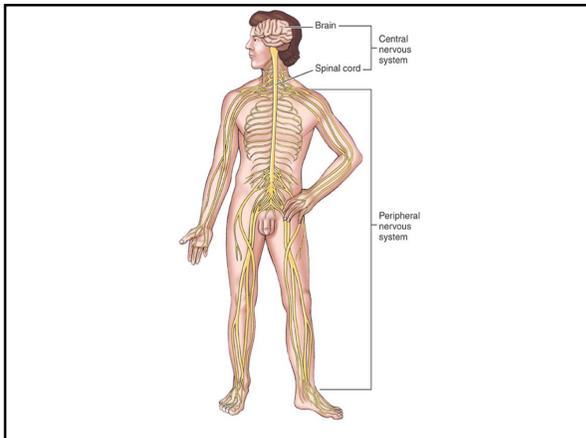


Nervous System: Tissue & Brain

Rita Carey-Nita, R.N., B.S.N.

- The Nervous System is divided into two divisions:
 - The Central Nervous System which includes the brain & spinal cord
 - The Peripheral Nervous System located outside the CNS
 - consists of the cranial & peripheral nerves



Function of the Nervous System

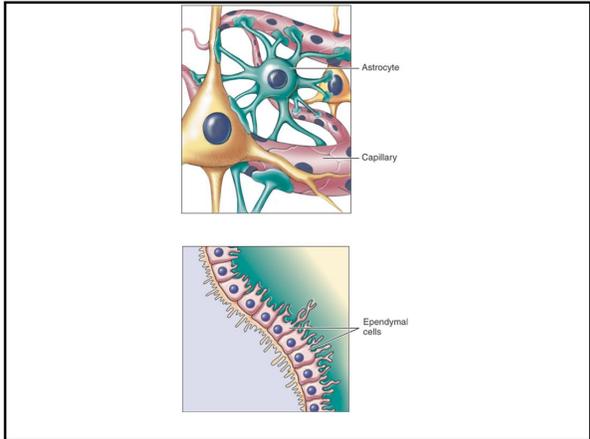
- Sensory function: nerves that gather information from inside & outside the body & carry it to the CNS
- Integrative function: sensory information is brought to the CNS & interpreted
- Motor function: nerves carry message from CNS to muscles & glands in the body

Cells of the Nervous System

- Neuroglia: AKA glial cell
 - Most abundant of nerve cells
 - Supports, protects, insulates & nourishes neurons
 - Does not conduct an impulse

Types of Neuroglia

- Astrocytes: form protective barrier around neuron blocking toxins in blood from entering the CNS
- Ependymal: line inside cavity of brain & assist with formation of CSF
- Microglia: participates in phagocytosis of pathogens
- Oligodendrocytes: form CNS myelin sheath

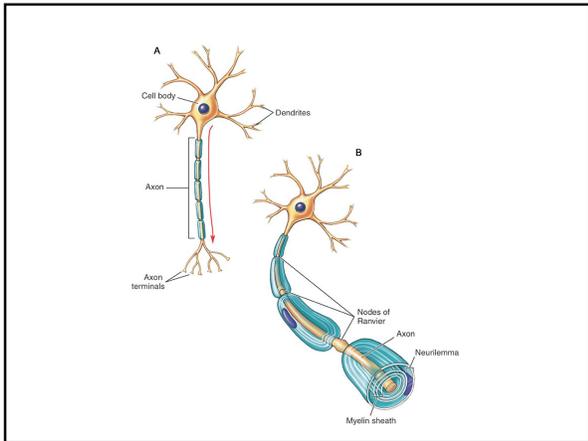


Cells of the Nervous System

- Neuron
 - Most important for transmission of information
 - Vary in shape & size
 - Three parts:
 - Dendrite: tree like projections receives information from other neurons & sends impulse to body
 - Body: contains nucleus
 - Axon: long extension that transmits information away from the cell body which branch off to axon terminals

Structure of an Axon

- Myelin sheath: layer of white fatty material which encases the axon to protect & insulate
- CNS & PNS differ in development of myelin sheath
 - PNS: Schwann cells form the myelin sheath (Cytoplasm & nuclei lie outside the myelin sheath called neurilemma which plays key role in nerve regeneration)
 - CNS: oligodendrocytes form myelin sheath
- Nodes of Ranvier: areas along axon not covered with myelin



Three types of Neurons

- Sensory neuron:
 - carries information from the periphery to CNS
 - AKA afferent neuron
 - Found in CNS & PNS
- Motor neuron:
 - carries information from the CNS to the periphery
 - AKA efferent neuron
 - Found in CNS & PNS
- Interneuron:
 - form connections between sensory & motor neurons
 - Only located in the CNS
 - Play role in thinking, learning & memory

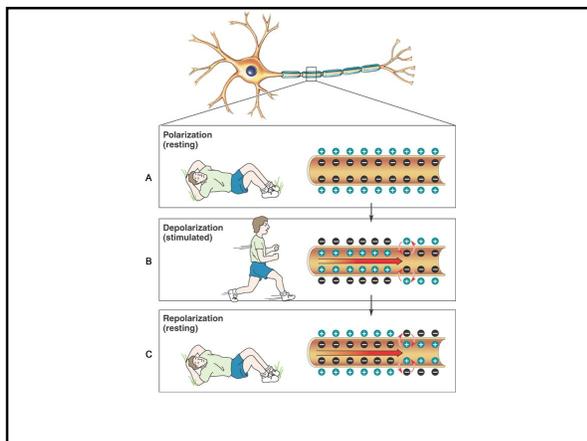
Tissue of the CNS

- White matter:
 - White because myelinated
 - Gathered together in tracts according to function
- Gray matter:
 - Composed of cell bodies, interneurons & unmyelinated fibers
- Cell bodies appear in clusters
 - In CNS clusters are called nuclei (nucleus)
 - In PNS clusters are called ganglia (ganglion)

- Neurons carrying information
 - Nerve impulse is an electrical impulse or signal that conveys information along a neuron
 - Occurs as a result of the movement of ions across the cell membrane
 - Series of events causes electrical charge

Nerve Impulse

- Polarization:
 - resting state of the neuron: cell quiet & resting
 - inside of neuron is negative charge & outside is positive
 - No nerve impulse is transmitted
- Depolarization:
 - Neuron is stimulated
 - Change inside cell to positive charge
- Repolarization:
 - Quick change inside cell back to negative charge
 - Need to repolarize in order to be stimulated again
- Refractory period is the unresponsive period before repolarization

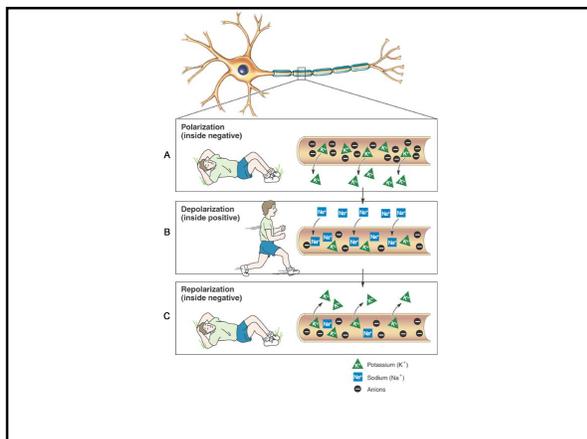


Cause of Nerve Impulse

- Nerve impulse is due to movement of ions across the cell membrane of the neuron
 - Polarization (resting state): excessive anions remain in the cell while potassium (cation) leaks out during rest period creating a negative environment
 - Depolarization (stimulated state): when stimulated, neuronal membrane changes occur allowing sodium (cation) to cross the membrane carrying a positive charge into the cell

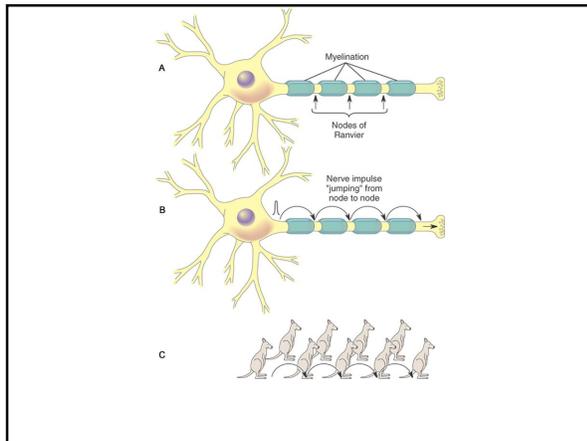
Cause of Nerve Impulse

- Repolarization (return to resting): soon after depolarization, the neuronal membrane undergoes another change stopping the diffusion of sodium (cation) into the cell & allows diffusion of potassium (cation) out of the cell leaving the remaining anions thus creating a negative charge



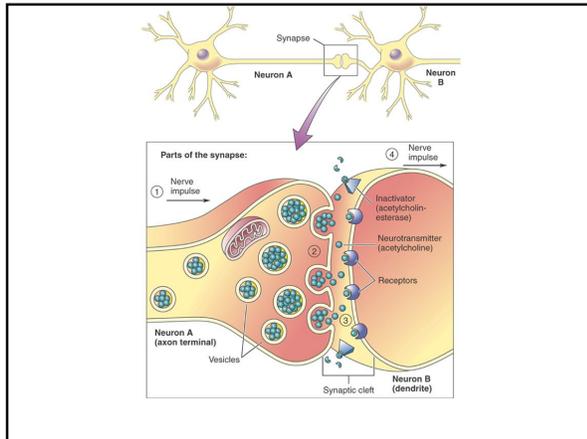
Nerve Impulse

- The impulse moves along the axon by stimulating segments of the membrane like a wave
- Nerve impulse cannot stimulate areas that are myelinated
- Nodes of Ranvier are not myelinated therefore the impulse jumps from node to node called saltatory conduction
- Saltatory conduction is fast mode of transmission



Nerve Impulse

- Synapse is a junction or space between two neurons which information is transmitted across
- Process:
 - The impulse travels along first neuron to its end at the axon terminal
 - Neurotransmitters diffuse across the synapse & binds with the receptor site on the dendrite of the next neuron (new neuron now stimulated)
 - Once the neurotransmitter has stimulated the neuron it is terminated by inactivator substance (acetylcholinesterase) on the dendrite



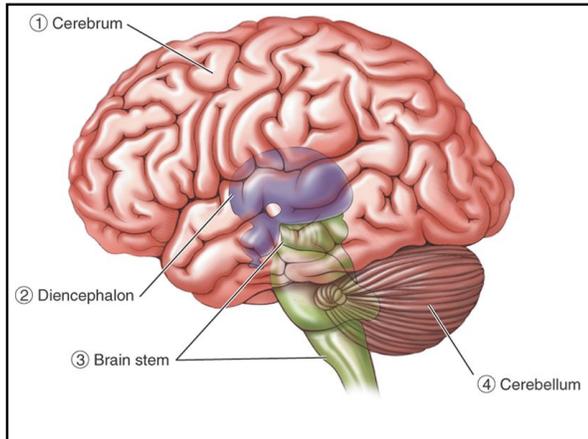
Nerve Impulse

Neurotransmitters

- Two most common:
 - Acetylcholine
 - Norepinephrine
- Others include:
 - Serotonin
 - Gamma-aminobutyric acid (GABA)
 - Endorphins

Brain Structure & Function

- 4 Major areas:
 - Cerebrum
 - Diencephalon
 - Brain stem
 - Cerebellum



Cerebrum

- Largest part of brain
- Contains right & left hemispheres
- Joined together by corpus callosum
- Each hemisphere has 4 major lobes
 - Frontal
 - Parietal
 - Temporal
 - Occipital

Cerebrum

- Contains both gray & white matter
- Gray matter forms outer layer called cerebral cortex & is composed of cell bodies & interneurons. This allows us to perform higher mental tasks such as reasoning, learning, language & memory
- White matter is located below the cortex & is composed of myelinated axons that form connections between spinal cord & brain
- There are patches of gray matter scattered throughout

Cerebrum

- Structures of the surface of cerebrum:
 - Convolutions or gyri: elevations along the surface of the cerebrum
 - The more convolutions the greater the intelligences
 - Sulci: grooves that separate gyri
 - Fissures: deep sulcus
 - Sulcus & Fissures separate the lobes of the brain

Cerebrum

- Ventricles
 - Four cavities in the brain
 - Two lateral
 - Third
 - Fourth
 - Each contains a capillary network called choroid plexus which forms CSF from blood plasma

Cerebral Lobes

- Frontal lobe:
 - Located at front of cranium
 - Controls voluntary motor activity
 - Personality
 - Emotions
 - Behavior
 - High level tasks such as learning & thinking
 - Motor speech called Broca's area

Cerebral Lobes

- Parietal Lobe:
 - Located behind central sulcus
 - Primarily receives sensory information from the body esp. Skin & muscle
 - Allows you to experience pain, touch, temperature & proprioception
 - AKA primary somatosensory area
 - Because of crossover fibers has role in reading, speech & taste

Cerebral Lobes

- Temporal:
 - Located inferior to lateral fissure in an area above the ear
 - Auditory area controls hearing
 - Olfactory area controls smell
 - Taste is interpreted
 - Wernicke's area is located in the posterior temporal lobe & controls comprehension of speech

Cerebral Lobes

- Occipital Lobe:
 - Located at the back of head
 - Contains the visual cortex which interprets sight
 - Allows us to read, interpret what we see, judge distance or see in three dimension

Cerebral Lobe Function

- Each lobe may have specific function but many functions depend on more than one lobe.
- Example: speech area is located in an area of three lobes: temporal, parietal, occipital

Cerebrum

- Association Area:
 - Large area of cerebral cortex
 - Area of analyzing, interpreting & integrating information
 - Has large stores of knowledge to help interpret information received in an area of the brain.

Cerebrum

- Patches of Gray:
 - Located throughout the cerebral white matter
 - Called Basal Nuclei
 - Helps regulate body movement & facial expression
 - Dopamine is neurotransmitter responsible for activity

Diencephalon

- Located beneath the cerebrum & above the brain stem
- Contains the thalamus & hypothalamus
- Thalamus sorts out sensory information from lower brain & spinal cord and sends it to the appropriate area in the cerebrum
- Hypothalamus is located below the thalamus & helps regulate temperature, water balance & metabolism
- Also affects autonomic nerves that control BP, HR & respirations

Diencephalon

- Pituitary gland
 - located under the hypothalamus
 - affects hormones in the body
 - hypothalamus controls pituitary function therefore controls endocrine function

Brain Stem

- Connects the spinal cord with higher brain structures
- Three parts:
 - Midbrain—Pons—Medulla Oblongata
- Midbrain
 - relays sensory & motor information
 - reflex center for vision

Brain Stem

- Pons:
 - Acts as bridge for information to travel to and from brain structures
 - Regulates respiratory rate & rhythm
- Medulla Oblongata:
 - Connects spinal cord with pons
 - Relay for sensory & motor information
 - Called vital center because of control of HR, BP & respiration
 - Area is sensitive to narcotics

Cerebellum

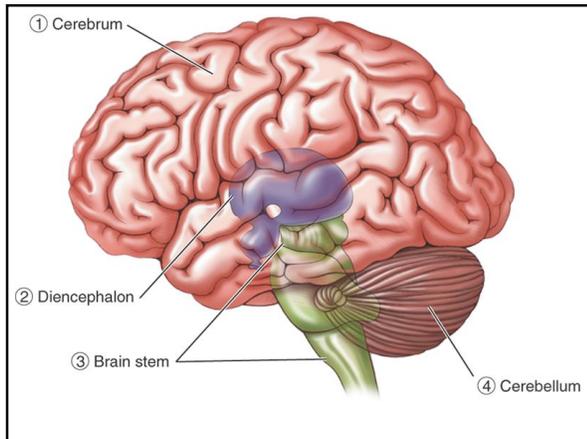
- Protrudes under the occipital lobe at the base of the skull
- Concerned with coordinated voluntary movements
- Receives information from many areas of body, integrates & produces smooth coordinated muscle response
- Trauma to this area results in jerky muscle movement, staggering unsteady gait

Limbic System

- One of two overlapping structures
- AKA: Emotional Brain
- Parts of cerebrum & diencephalon that form wishbone shape
- Contributes to memory
- Functions in emotional behavior & states

Reticular Formation

- Second structure to overlap in the brain
- Extends the entire brain stem and connect to cerebral cortex
- Special mass of gray matter
- Concerned with sleep/wake cycle & consciousness
- Sensitive to the effects of certain drugs & alcohol



Consciousness, Sleep & Coma

- Consciousness:
 - state of wakefulness that depends on information from the body to the reticular activating system
 - Different levels of consciousness: attentiveness, alertness, relaxation & inattentiveness
- Sleep:
 - occurs when RAS is inhibited or slowed
 - Cause is unknown
- Coma:
 - Several stages from light to deep

Stages of Sleep

- Two types:
 - Non-rapid eye movements sleep (NREM)
 - 4 stages of NREM from light to deep in cycles from light to deep then deep to light
 - Rapid eye movement sleep (REM)
 - Averages 90 – 120 minutes per night
 - Just as name there is rapid movement of eyes
 - Fluctuating BP, resp rate & rhythm
 - Dreaming occurs in REM
 - Associated with mental & physical distress

Protection of the CNS

- Bone:
 - First layer of protection
 - Brain in cranium & spinal cord in vertebral column
- Meninges:
 - Second layer
 - Contains three layers of connective tissue

Protection of the CNS

- Meninges:
 - Dura Mater:
 - outermost layer
 - thick & tough
 - Arachnoid layer
 - middle layer
 - Resembles a spider web
 - Contain arachnoid villi which are specialized projections
 - Pia Mater:
 - Innermost layer
 - Soft layer containing many blood vessels

Protection of the CNS

- Subarachnoid space:
 - Located between arachnoid layer & pia mater
 - CSF circulates in this space forming a cushion around the brain & spinal cord
- Inflammation or infection of the meninges is causes meningitis

Protection of the CNS

- Cerebrospinal fluid:
 - Third layer of protection
 - Formed from blood within brain within the ventricles by the choroid plexus
 - Clear fluid containing water, glucose, protein & several ions (Na & Cl)
 - Adult circulate ½ cup of CSF

Protection of the CNS

- Cerebrospinal fluid flows in two ways:
 - Through hole in the spinal cord called central canal draining into the subarachnoid space at the base of the spinal cord
 - Rest flows from the 4th ventricle through tiny holes (foramina) into the subarachnoid space that encircles the brain. It leaves the space & drains into the blood stream & returns to the heart
 - If drains less increased intracranial pressure develops

Protection of the CNS

- Blood-Brain Barrier:
 - Arrangement of cells associated with blood vessels that supply the brain & spinal cord
 - Selects substances that are allowed to enter the CNS
 - Prevents certain harmful substances from entering
 - Not all toxic substances are blocked. i.e alcohol
 - Some antibiotics do not cross the barrier
