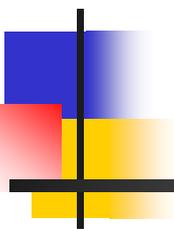
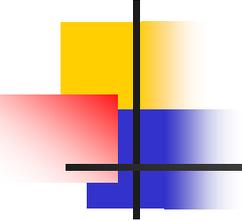


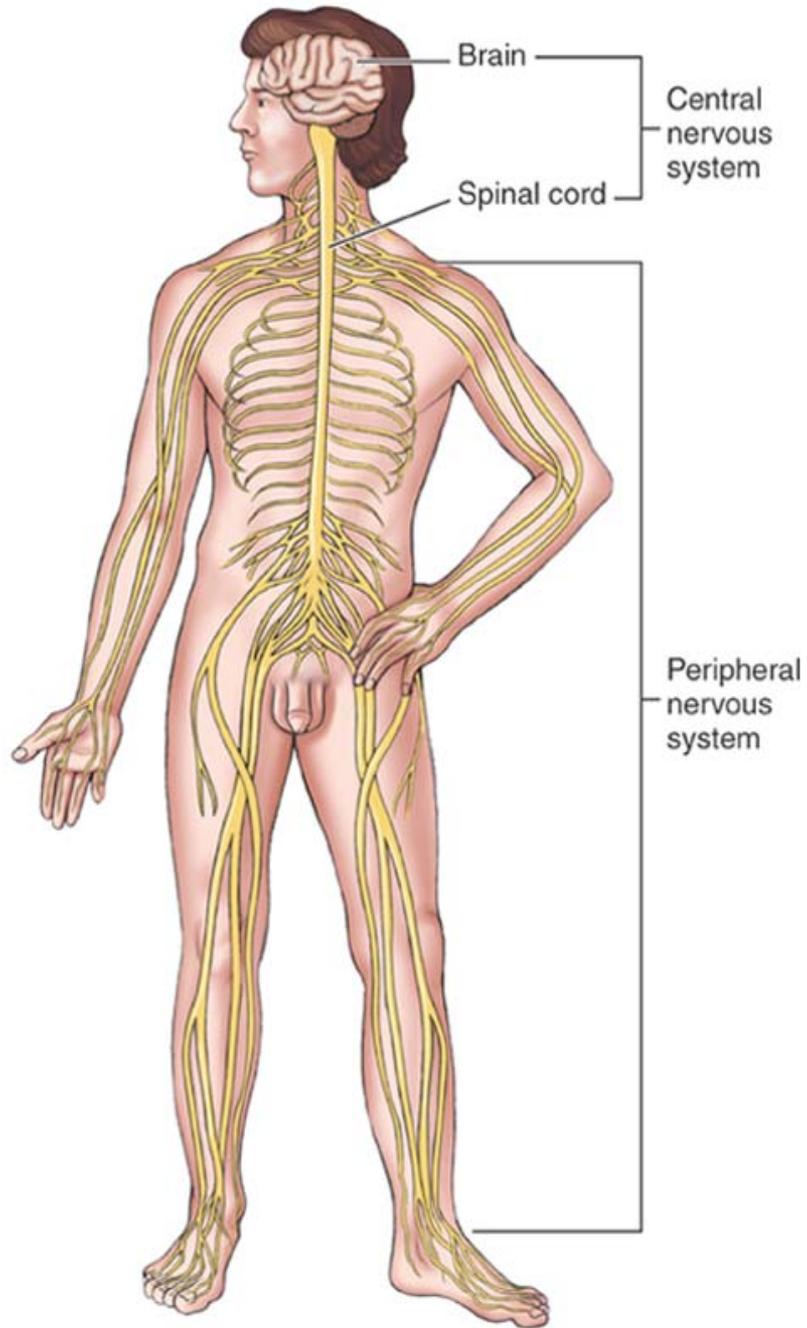
# Nervous System: Tissue & Brain

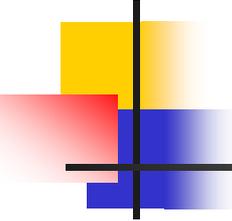


---

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 nerves

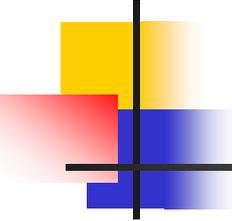




# Function of the Nervous System

---

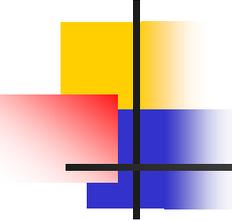
- Sensory: nerves that gather information from inside & outside the body & carry it to the CNS
- Integrative: sensory information is brought to the CNS & interpreted
- Motor: nerves carry message from CNS to muscles & glands in the body



# Cells of the Nervous System

---

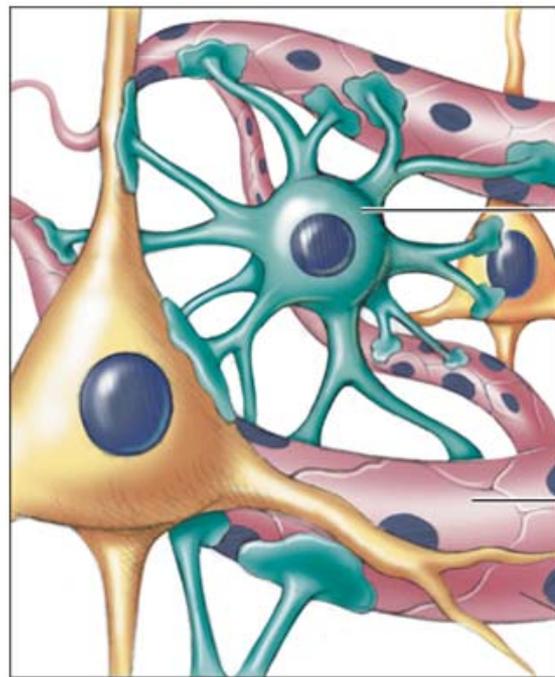
- Neuroglia: AKA glial cell
  - Most abundant of nerve cells
  - Supports, protects, insulates & nourishes neurons
  - Do not conduct impulses



# Types of Neuroglia

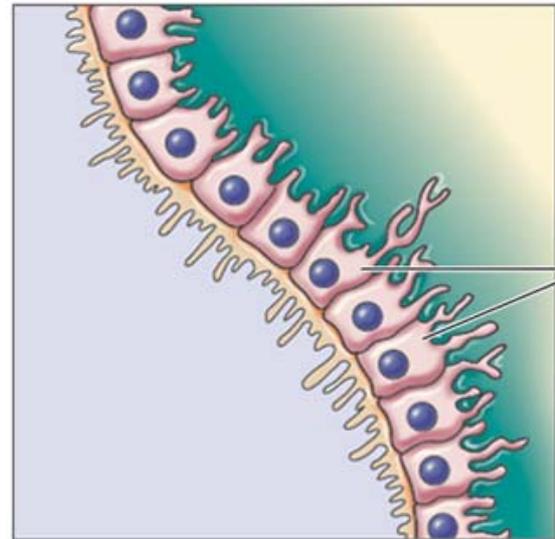
---

- 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

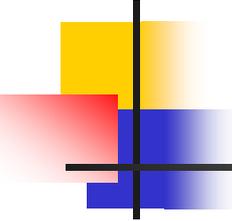


Astrocyte

Capillary



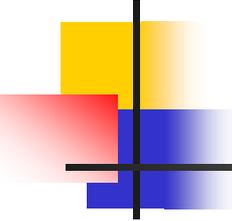
Ependymal cells



# Cells of the Nervous System

---

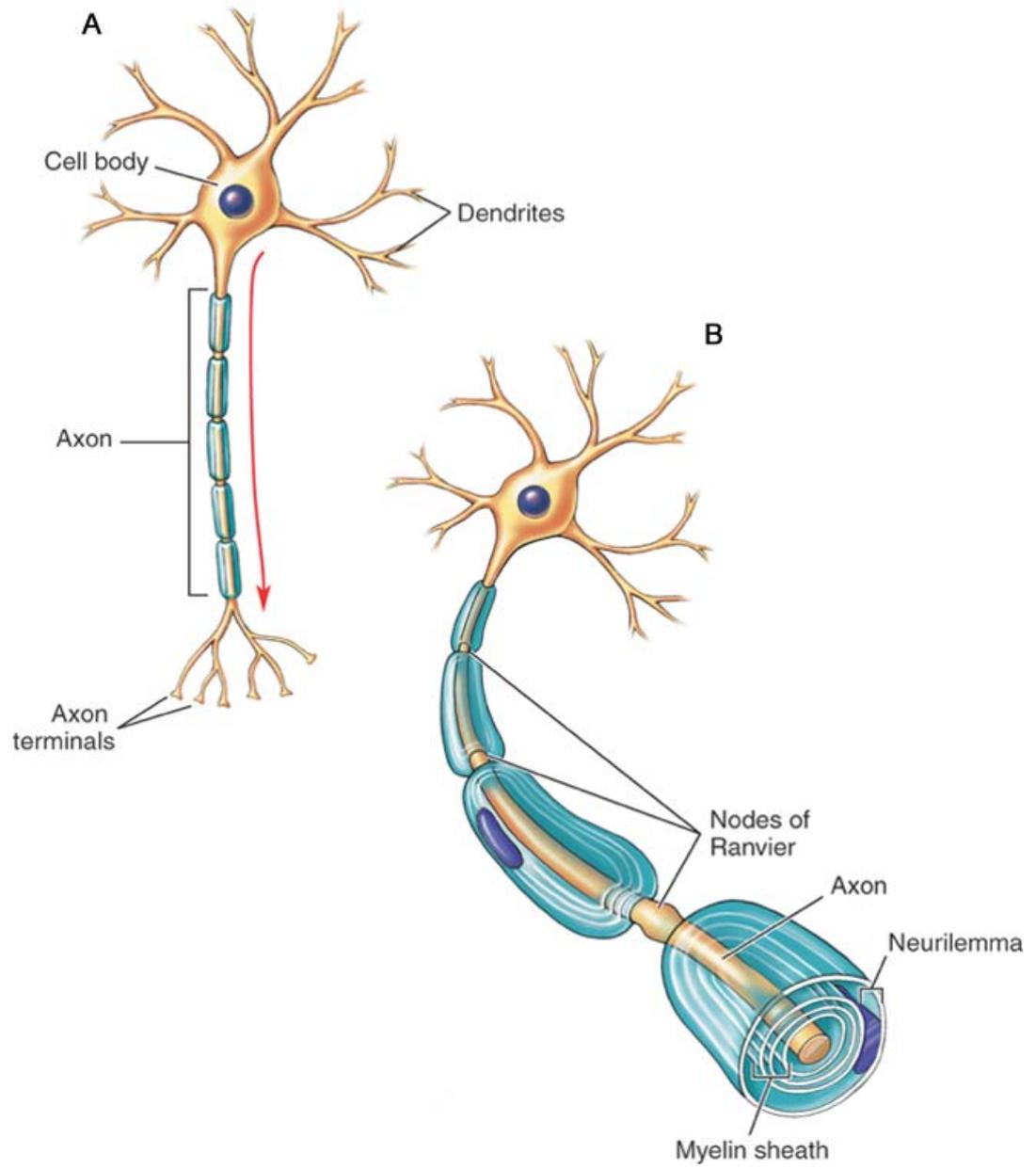
- Neuron
  - Most important for transmission of information
  - Vary in shape & size
  - Three parts:
    - Dendrite: tree like projections receives information from other neurons & sends impulse to body
    - Body: contains nucleus
    - Axon: long extension that transmits information away from the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

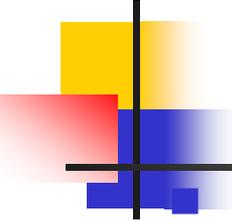


# Structure of an Axon

---

- 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 & contain neurilemma (Cytoplasm & nuclei lie outside the myelin sheath)
  - CNS: oligodendrocytes form myelin sheath
- Nodes of Ranvier: areas along axon not covered with myelin





# Three types of Neurons

---

## ■ Sensory neuron:

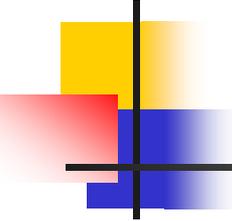
- carries information from the periphery to CNS
- AKA afferent neuron
- Found in CNS & PNS

## ■ Motor neuron:

- carries information from the CNS to the periphery
- AKA efferent neuron
- Found in CNS & PNS

## ■ Interneuron:

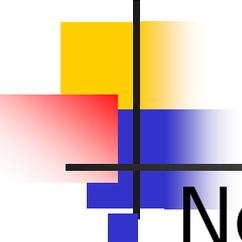
- form connections between sensory & motor neurons
- Only located in the CNS
- Play role in thinking, learning & memory



# Tissue of the CNS

---

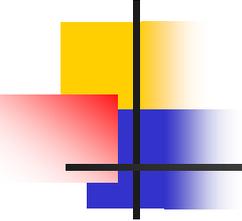
- White matter:
  - White because myelinated
  - Gathered together in tracts according to function
- Gray matter:
  - Composed of cell bodies, interneurons & unmyelinated fibers
- Cell bodies appear in clusters
  - In CNS clusters are called nuclei (nucleus)
  - In PNS clusters are called ganglia (ganglion)

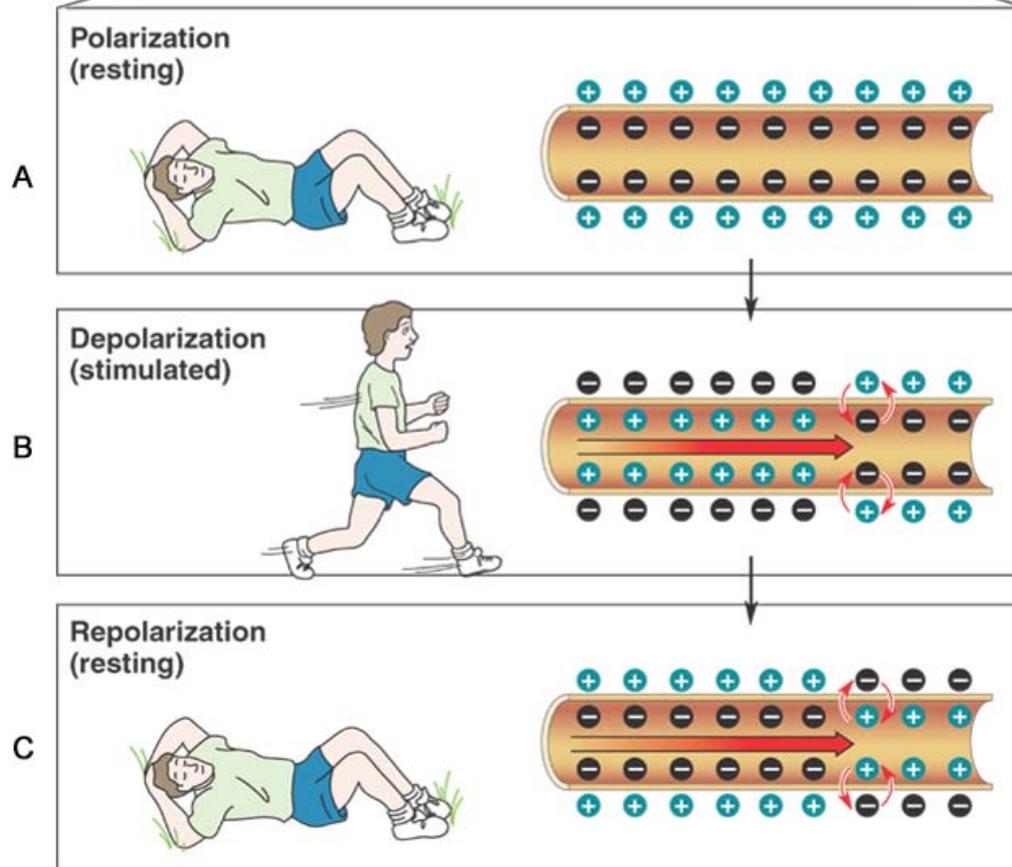
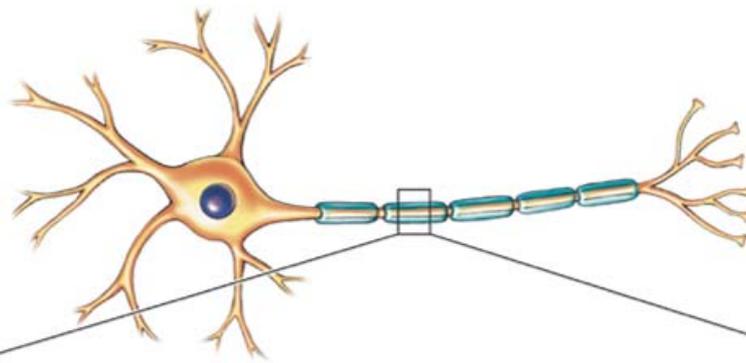


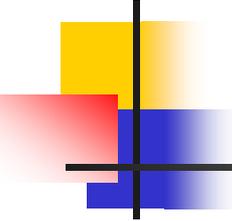
---

## ■ 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

- 
- 
- Polarization:
    - resting state of the neuron; cell quiet & resting
    - inside of neuron is negative & 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

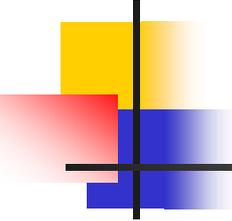




# Cause of Nerve Impulse

---

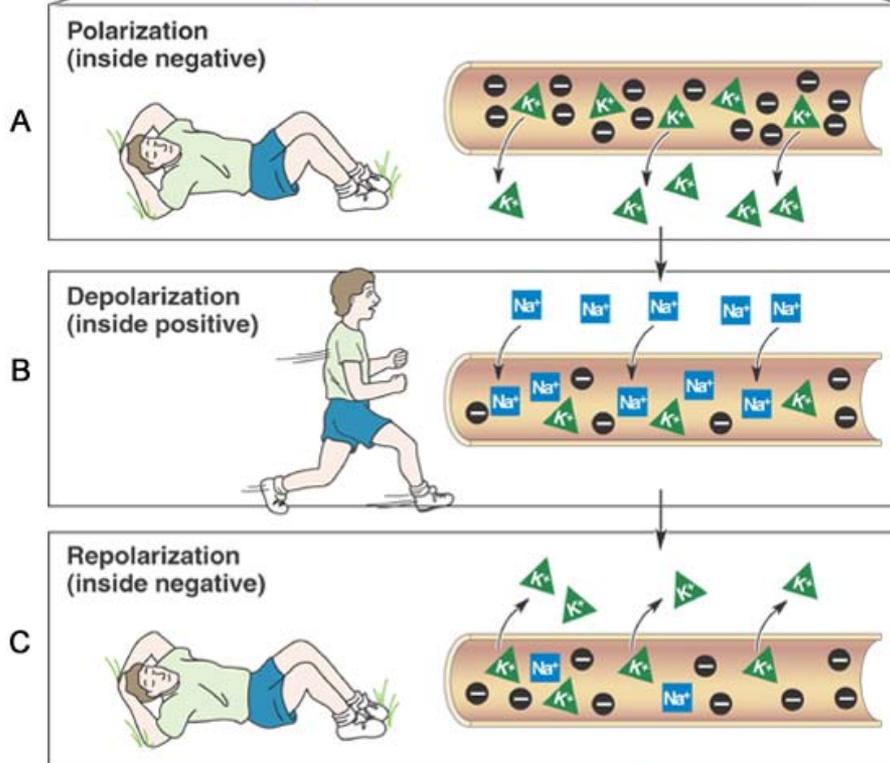
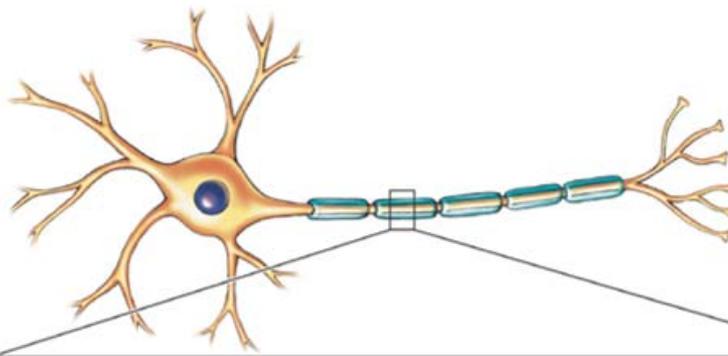
- Nerve impulse is due to movement of ions across the cell membrane of the neuron
  - Polarization (resting state): excessive anions remain in the cell while potassium (cation) leaks out during rest period creating a negative environment
  - Depolarization (stimulated state): when stimulated, neuronal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



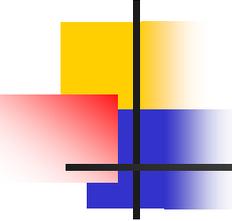
# Cause of Nerve Impulse

---

- 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



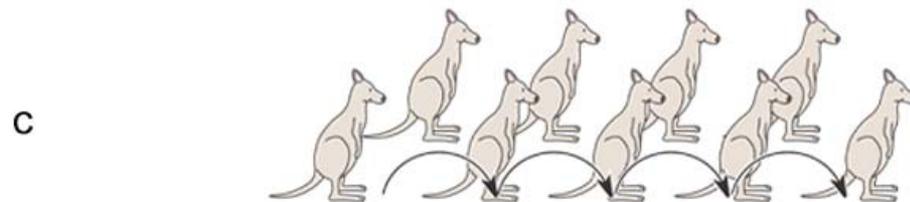
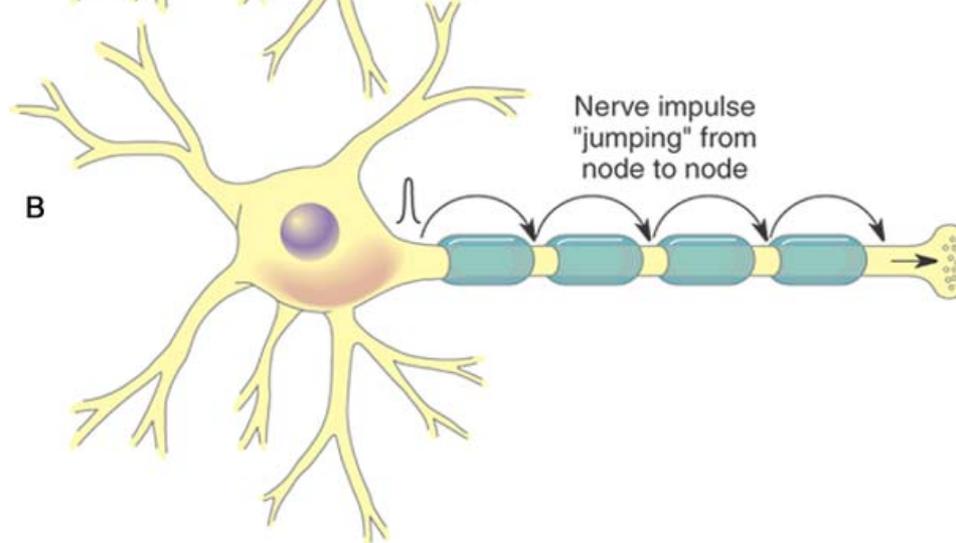
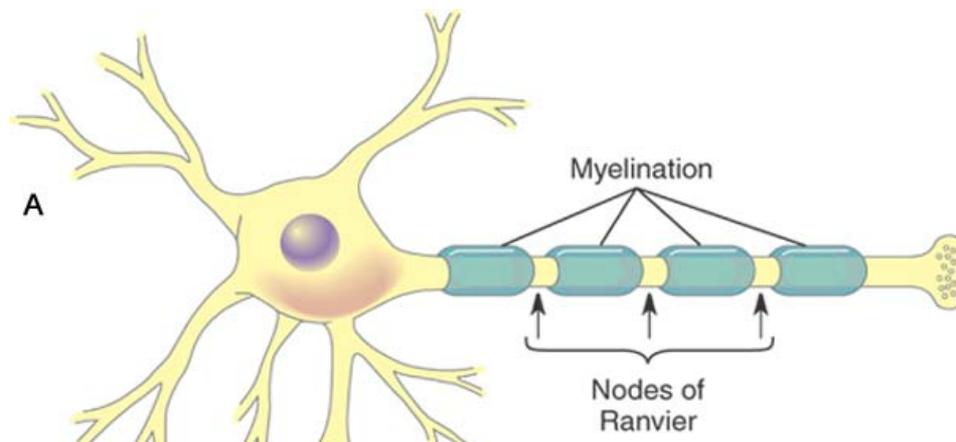
 Potassium ( $K^+$ )  
 Sodium ( $Na^+$ )  
 Anions

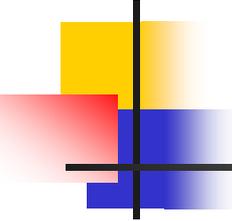


# Nerve Impulse

---

- 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

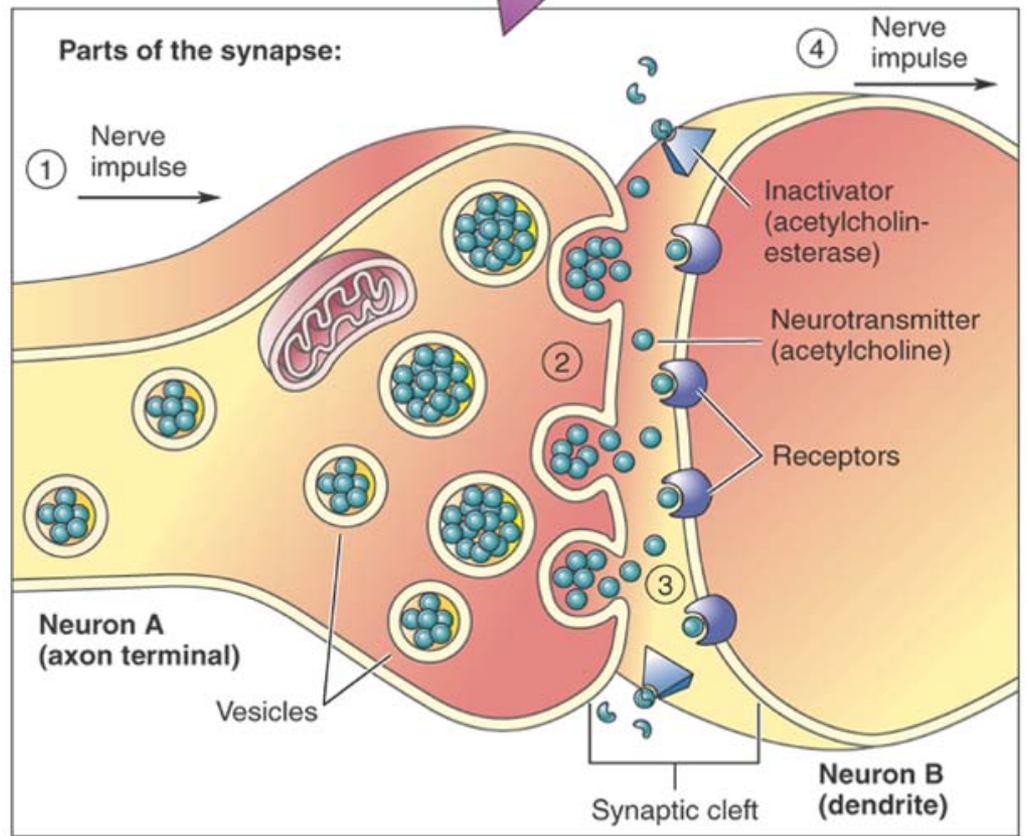
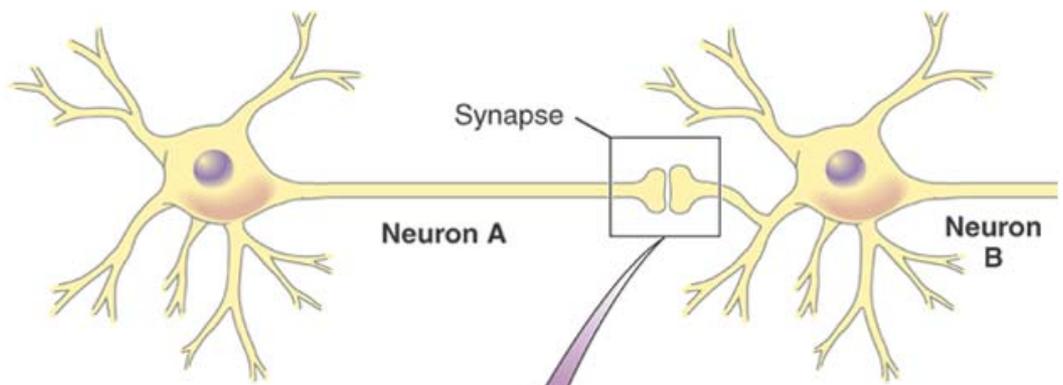


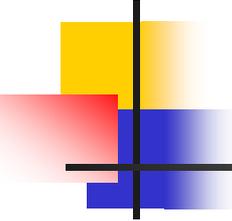


# Nerve Impulse

---

- 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

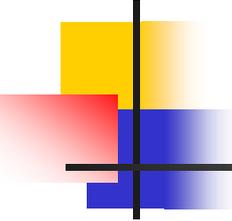




# Nerve Impulse

---

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

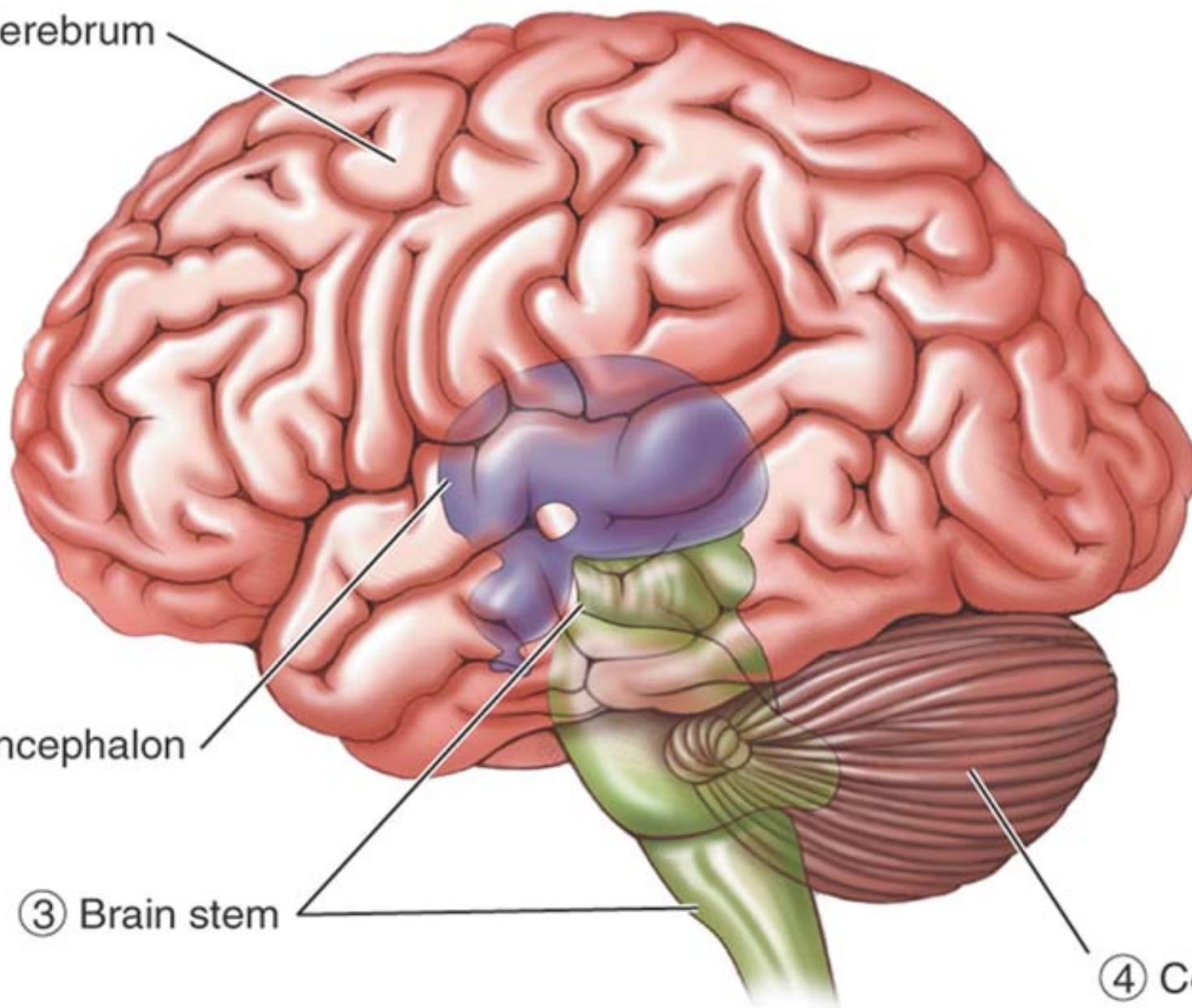


# Brain Structure & Function

---

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

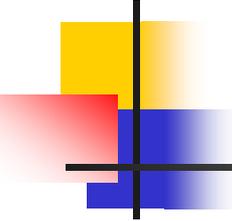
① Cerebrum



② Diencephalon

③ Brain stem

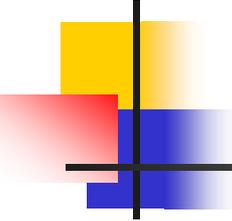
④ Cerebellum



# Cerebrum

---

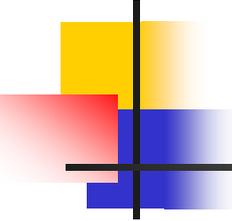
- Largest part of brain
- Contains right & left hemispheres
- Joined together by corpus callosum
- Each hemisphere has 4 major lobes
  - Frontal
  - Parietal
  - Temporal
  - Occipital



# Cerebrum

---

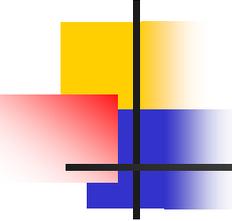
- Contains both gray & white matter
- Gray matter forms outer layer called cerebral cortex & is composed of cell bodies & interneurons. This allows us to perform higher mental tasks such as reasoning, learning, language & memory
- White matter is located below the cortex & is composed of myelinated axons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



# Cerebrum

---

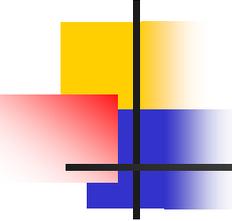
- Structures of the surface of cerebrum:
  - Convolutions or gyri: elevations along the surface of the cerebrum
  - The more convolutions the greater the intelligences
  - Sulci: grooves that separate gyri
  - Fissures: deep sulcus
  - Sulcus & Fissures separate the lobes of the brain



# Cerebral Lobes

---

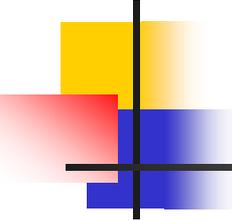
- Frontal lobe:
  - Located at front of cranium
  - Controls voluntary motor activity
  - Personality
  - Emotions
  - Behavior
  - High level tasks such as learning & thinking
  - Motor speech called Broca's area



# Cerebral Lobes

---

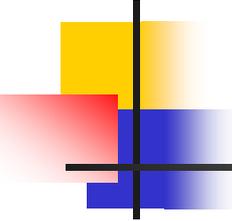
- Parietal Lobe:
  - Located behind central sulcus
  - Primarily receives sensory information from the body esp. Skin & muscle
  - Allows you to experience pain, touch, temperature & proprioception
  - AKA primary somatosensory area
  - Because of crossover fibers has role in reading, speech & taste



# Cerebral Lobes

---

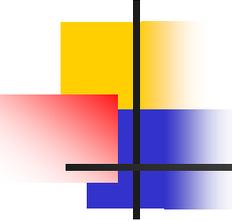
- Temporal:
  - Located inferior to lateral fissure in an area above the ear
  - Auditory area controls hearing
  - Olfactory area controls smell
  - Taste is interpreted
  - Wernicke's area is located in the posterior temporal lobe & controls comprehension of speech



# Cerebral Lobes

---

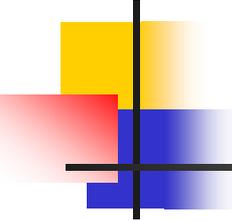
- Occipital Lobe:
  - Located at the back of head
  - Contains the visual cortex which interprets sight
  - Allows us to read, interpret what we see, judge distance or see in three dimension



# Cerebral Lobe Function

---

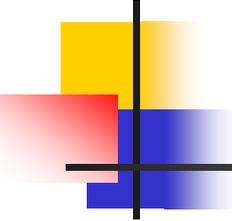
- Each lobe may have specific function but many functions depend on more than one lobe.
- Example: speech area is located in an area of three lobes: temporal, parietal, occipital



# Cerebrum

---

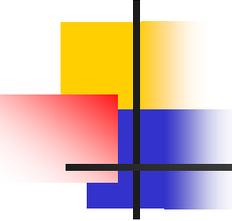
- Association Area:
  - Large area of cerebral cortex
  - Area of analyzing, interpreting & integrating information
  - Has large stores of knowledge to help interpret information received in an area of the brain.



# Cerebrum

---

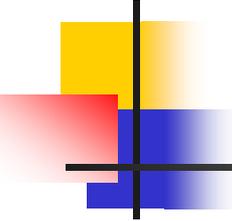
- Patches of Gray:
  - Located throughout the cerebral white matter
  - Called Basal Nuclei
  - Helps regulate body movement & facial expression
  - Dopamine is neurotransmitter responsible for activity



# Diencephalon

---

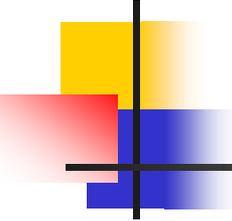
- Located beneath the cerebrum & above the brain stem
- Contains the thalamus & hypothalamus
- Thalamus sorts out sensory information from lower brain & spinal cord and sends it to the appropriate area in the cerebrum
- Hypothalamus is located below the thalamus & helps regulate temperature, water balance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



# Diencephalon

---

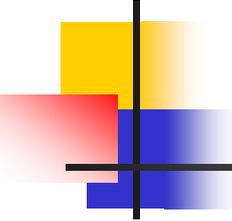
- Pituitary gland
  - located under the hypothalamus
  - affects hormones in the body
  - hypothalamus controls pituitary function therefore controls endocrine function



# Brain Stem

---

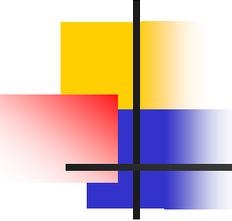
- Connects the spinal cord with higher brain structures
- Three parts:
  - Midbrain—Pons—Medulla Oblongata
- Midbrain
  - relays sensory & motor information
  - reflex center for vision



# Brain Stem

---

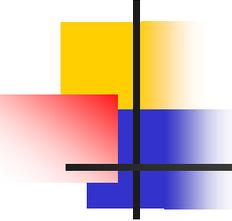
- Pons:
  - Acts as bridge for information to travel to and from brain structures
  - Regulates respiratory rate & rhythm
- Medulla Oblongata:
  - Connects spinal cord with pons
  - Relay for sensory & motor information
  - Called vital center because of control of HR, BP & respiration
  - Area is sensitive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



# Cerebellum

---

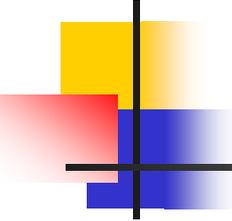
- Protrudes under the occipital lobe at the base of the skull
- Concerned with coordinated voluntary movements
- Receives information from many areas of body, integrates & produces smooth coordinated muscle response
- Trauma to this area results in jerky muscle movement, staggering unsteady gait



# 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

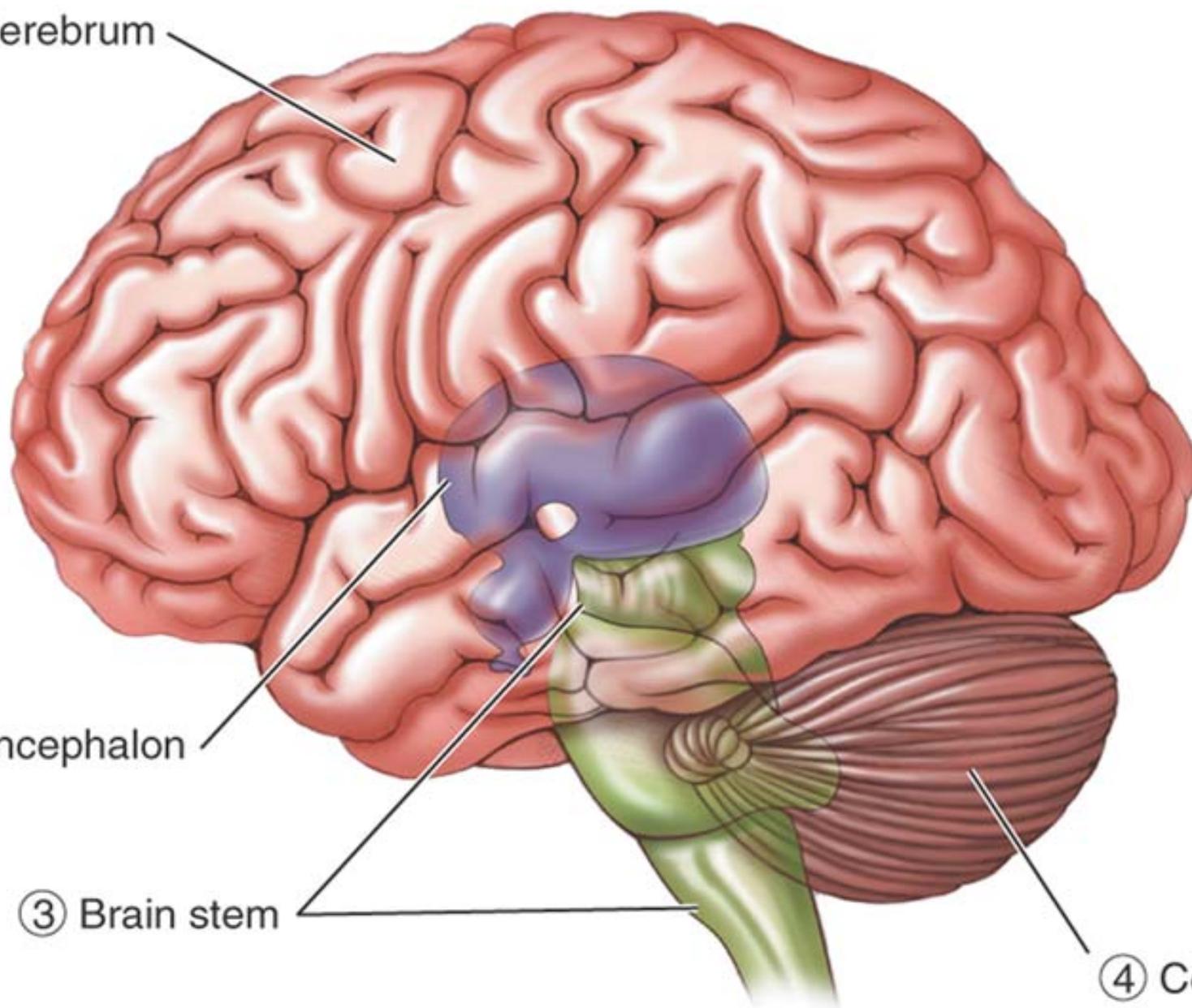


# Reticular Formation

---

- 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

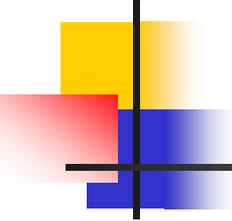
① Cerebrum



② Diencephalon

③ Brain stem

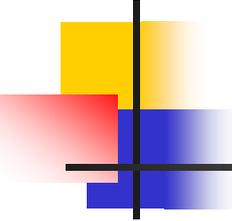
④ Cerebellum



# Consciousness, Sleep & Coma

---

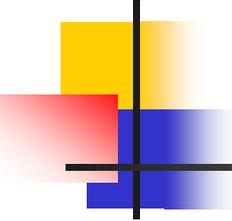
- Consciousness:
  - state of wakefulness that depends on information from the body to the reticular activating system
  - Different levels of consciousness: attentiveness, alertness, relaxation & inattentiveness
- Sleep:
  - occurs when RAS is inhibited or slowed
  - Cause is unknown
- Coma:
  - Several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



# Stages of Sleep

---

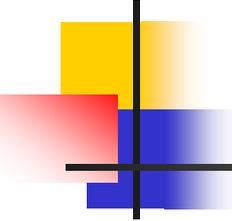
- Two types:
  - Non-rapid eye movements sleep (NREM)
    - 4 stages of NREM from light to deep in cycles from light to deep then deep to light
  - Rapid eye movement sleep (REM)
    - Averages 90 – 120 minutes per night
    - Just as name there is rapid movement of eyes
    - Fluctuating BP, resp rate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



# Protection of the CNS

---

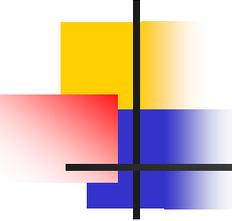
- Bone:
  - First layer of protection
  - Brain in cranium & spinal cord in vertebral column
- Meninges:
  - Second layer
  - Contains three layers of connective tissue



# Protection of the CNS

---

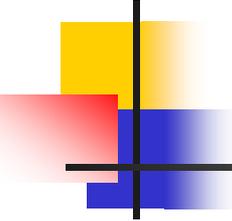
- Meninges:
  - Dura Mater:
    - outermost layer
    - thick & tough
  - Arachnoid layer
    - middle layer
    - Resembles a spider web
    - Contain arachnoid villi which are specialized projections
  - Pia Mater:
    - Innermost layer
    - Soft layer containing many blood vessels



# Protection of the CNS

---

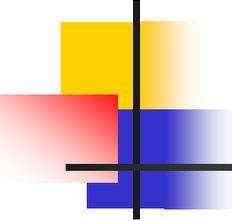
- Subarachnoid space:
  - Located between arachnoid layer & pia mater
  - CSF circulates in this space forming a cushion around the brain & spinal cord
- Inflammation or infection of the meninges is causes meningitis



# Protection of the CNS

---

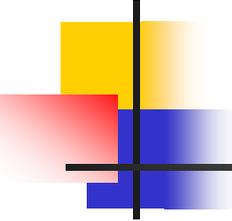
- Cerebrospinal fluid:
  - Third layer of protection
  - Formed from blood within brain within the ventricles by the choroid plexus
  - Clear fluid containing water, glucose, protein & several ions (Na & Cl)
  - Adult circulate ½ cup of CSF



# 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 4<sup>th</sup> 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