

Nervous System

The Central Nervous System

The Central Nervous System Agenda

- Review of Nervous System
- Protective Measures
- Spinal Cord
- Brain
 - Cerebrum
 - Diencephalon
 - Brain Stem & Cerebellum

The Nervous System - Review

- Two Organ Systems Control All the Other Organ Systems
 - Nervous system characteristics
 - Rapid response
 - Brief duration
- Endocrine system characteristics
 - Slower response
 - Long duration

The Nervous System - Review

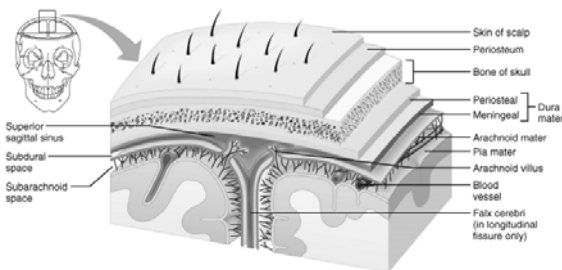
Two Anatomical Divisions

- Central nervous system (CNS)
 - Brain
 - Spinal cord
- Peripheral nervous system (PNS)
 - All the neural tissue outside CNS
 - Afferent division (sensory input)
 - Efferent division (motor output)
 - » Somatic nervous system
 - » Autonomic nervous system

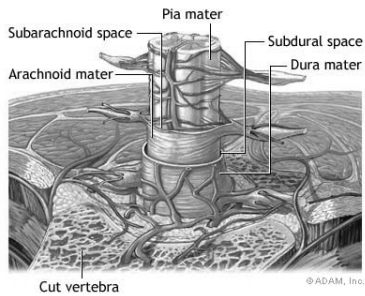
The Central Nervous System Protection

- **Meninges:** Layers that surround and protect the brain and spinal cord (CNS)
 - Dura mater ("tough mother")
 - Tough, fibrous outer layer
 - Epidural space above dura of spinal cord
 - Arachnoid ("spidery")
 - Subarchnoid space
 - Cerebrospinal fluid
 - Pia mater ("delicate mother")
 - Thin inner layer

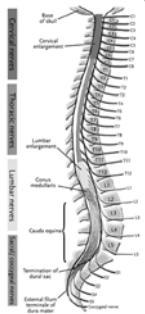
The Central Nervous System Protection



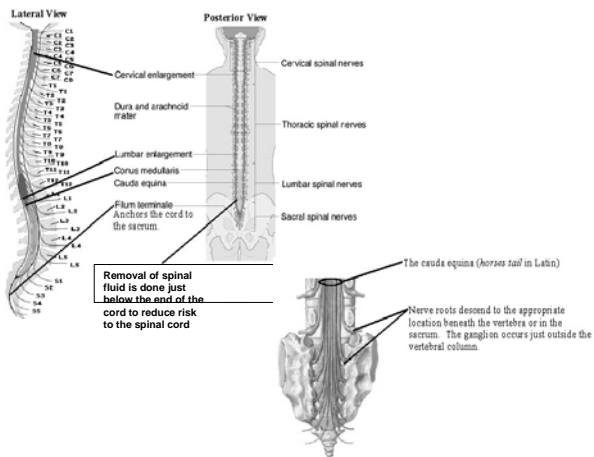
The Central Nervous System Protection



The Central Nervous System Spinal Cord



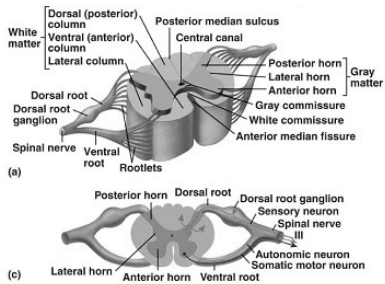
- Spinal Cord Basics
 - Relays information to/from brain
 - Processes some information on its own
 - Starts at end of brain stem (C1)
 - Ends at the *conus medullaris* (around L2)
 - Terminal group of nerves = cauda equina
 - Anchored by the *filum terminale*
 - Extension of the *dura mater* descending to the coccyx



The Central Nervous System Spinal Cord

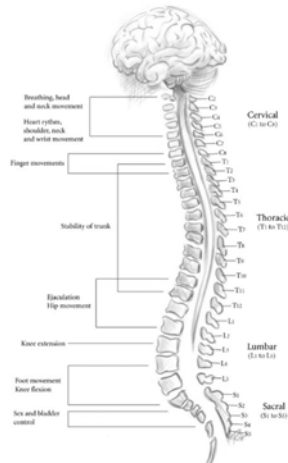
- Spinal Cord Basics
 - Divided into 31 *segments*
 - Each segment has a pair of:
 - Dorsal roots & associated dorsal root *ganglia*
 - Ventral roots
 - Gray matter appears as *horns*
 - *Gray matter* = axon terminals, cell bodies, dendrites
 - Function?
 - White matter organized into *columns*
 - *White matter* = myelinated axons
 - Function?

The Central Nervous System Spinal Cord



The Central Nervous System Spinal Cord

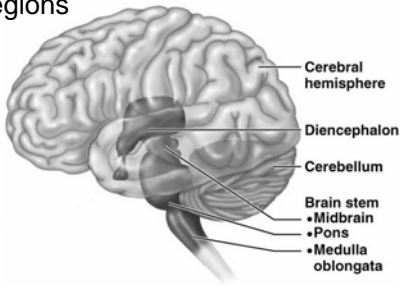
- Functional Anatomy of spinal regions





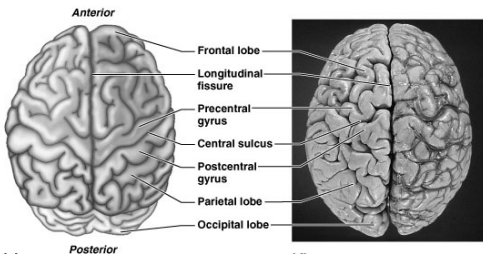
The Central Nervous System Brain

- Brain Regions



The Central Nervous System Brain

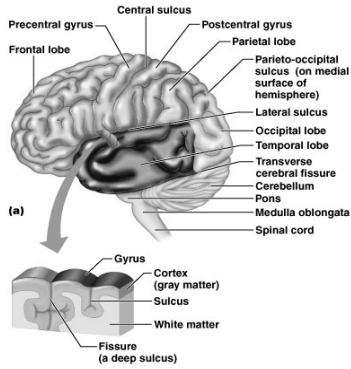
Superficial Anatomy Superior View



The Central Nervous System Brain

Superficial Anatomy

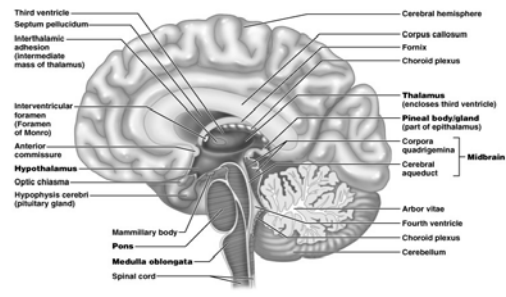
Lateral View



The Central Nervous System Brain

Deep Anatomy

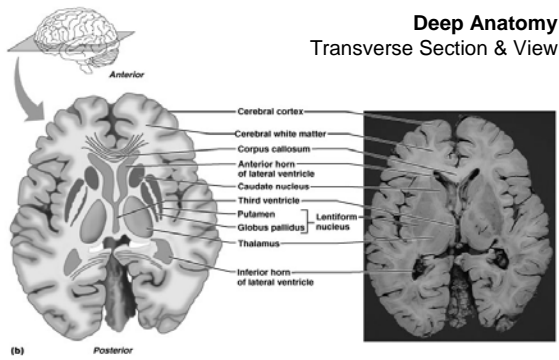
Sagittal View



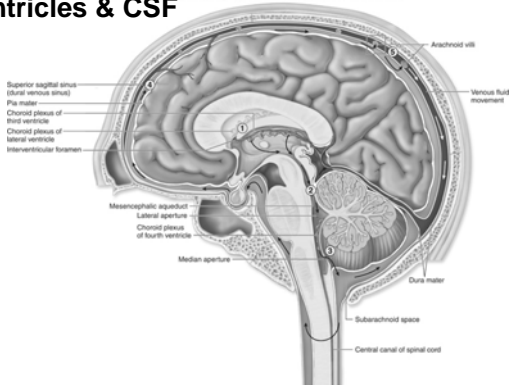
The Central Nervous System Brain

Deep Anatomy

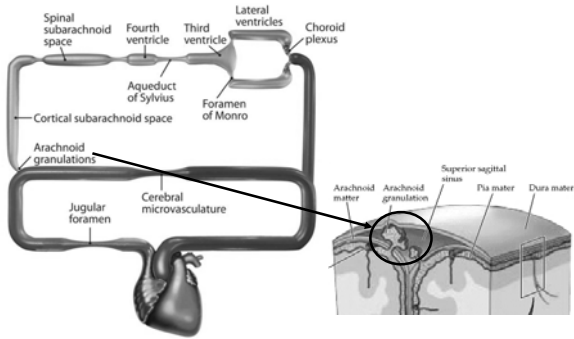
Transverse Section & View



The Central Nervous System Ventricles & CSF



The Central Nervous System Ventricles & CSF



The Central Nervous System CSF Function

- Buoyancy
 - The actual mass of the human brain is about 1400 grams; however the net weight of the brain suspended in the CSF is equivalent to a mass of 25 grams. The brain therefore exists in neutral buoyancy, which allows the brain to maintain its density without being impaired by its own weight, which would cut off blood supply and kill neurons in the lower sections without CSF.
- Protection
 - CSF protects the brain tissue from injury when jolted or hit. In certain situations such as auto accidents or sports injuries, the CSF cannot protect the brain from forced contact with the skull case, causing hemorrhaging, brain damage, and sometimes death.
- Chemical Stability
 - CSF flows throughout the inner ventricular system in the brain and is absorbed back into the bloodstream, rinsing the metabolic waste from the central nervous system through the blood-brain barrier.

The Central Nervous System

The Cerebrum

- Functions of the Cerebrum
 - Conscious thought
 - Intellectual activity
 - Memory
 - Origin of complex patterns of movement

The Central Nervous System

The Cerebrum

- Anatomy of Cerebral Cortex
 - Highly folded surface
 - Elevated ridges (*gyri*)
 - Shallow depressions (*sulci*)
- Cerebral Hemispheres
 - *Longitudinal fissure*
 - *Central sulcus*
 - Boundary between *frontal* and *parietal lobes*
- Other lobes
 - *temporal, occipital, insula*

The Central Nervous System

The Cerebrum

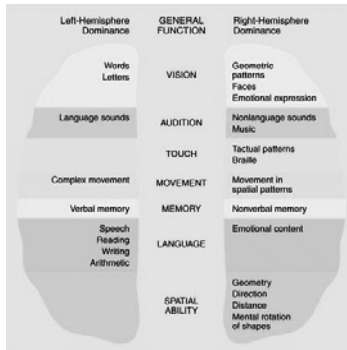
- Functions of the Cerebral Cortex
 - Hemispheres serve opposite body sides
 - *Primary motor cortex (precentral gyrus)*
 - Directs voluntary movement
 - *Primary sensory cortex (postcentral gyrus)*
 - Receives *somatic* sensation (touch, pain, pressure, temperature)
 - *Association areas*
 - Interpret sensation
 - Coordinate movement

The Central Nervous System The Cerebrum

- Hemispheric *Lateralization*
 - *Categorical* hemisphere (usually left)
 - General interpretative and speech centers
 - Language-based skills
 - *Representational* Hemisphere (usually right)
 - Spatial relationships
 - Logical analysis

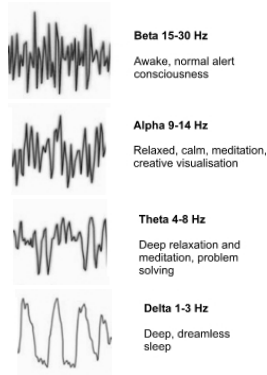
The Central Nervous System The Cerebrum

- Abilities that are characteristic of hemispheric lateralization



The Central Nervous System The Cerebrum

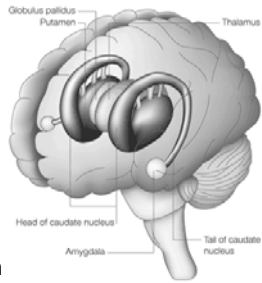
- Brain Waves



The Central Nervous System The Basal Nuclei (ganglia)

- Basal Nuclei

- Lie deep within central white matter of the brain
- Responsible for muscle tone
- Coordinate learned movements
- Coordinate rhythmic movements (e.g., walking)



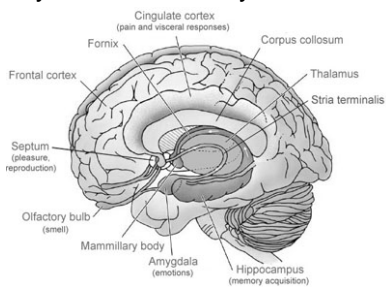
The Central Nervous System The Limbic System

- Functions of the Limbic System

- Establish emotions and related drives
- Link cerebral cortex intellectual functions to brain stem autonomic functions
- Control reflexes associated with eating
- Store and retrieve long-term memories

The Central Nervous System The Limbic System

- Anatomy of the Limbic System



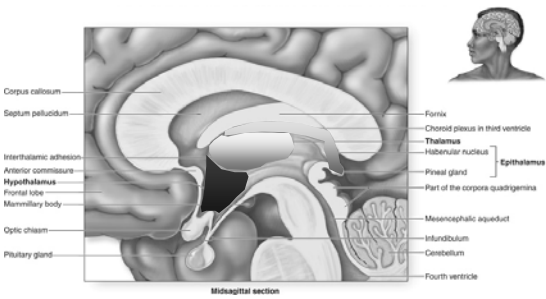
The Central Nervous System

The Diencephalon

- The Diencephalon
 - Switching and relay center
 - Integration of conscious and unconscious motor and sensory pathways
- Components include:
 - *Epithalamus*
 - *Choroid plexus*
 - *Pineal body*
 - *Thalamus*
 - *Hypothalamus*

The Central Nervous System

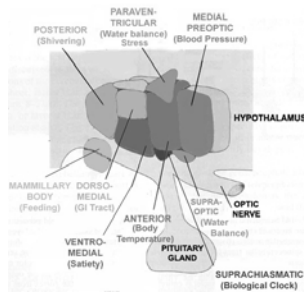
The Diencephalon



The Central Nervous System

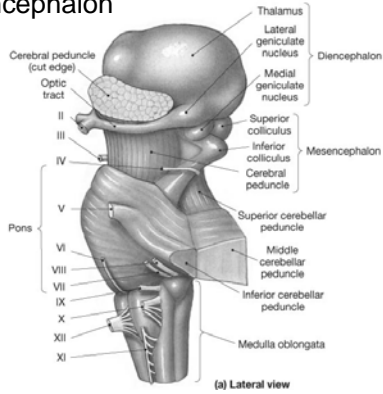
The Diencephalon

- General Hypothalamus Function
 - Produce emotions and behavioral drives
 - Coordinate nervous and endocrine systems
 - Secrete hormones
 - Coordinate voluntary and autonomic functions
 - Regulate body temperature



The Central Nervous System

The Diencephalon



The Central Nervous System

The Thalamus

- Functions of the Thalamus
 - Relay and filter *almost* all ascending (sensory) information
 - Relay a small proportion to cerebral cortex (conscious perception)
 - Relay most to basal nuclei and brain stem centers
 - Coordinate voluntary and involuntary motor behavior

The Central Nervous System

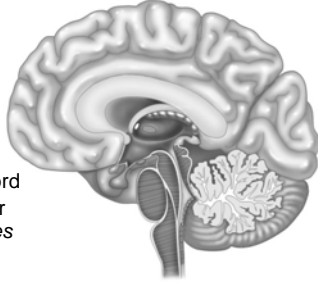
The Brain Stem

- Anatomy and Function of the Brain Stem
 - *Midbrain*
 - Process visual, auditory information
 - Generate involuntary movements
 - *Pons*
 - Links to cerebellum
 - Involved in control of movement
 - *Medulla oblongata*
 - Relay sensory information
 - Regulate autonomic function

The Central Nervous System

The Cerebellum

- Anatomy and Function of the Cerebellum
 - Oversees postural muscles
 - Stores patterns of movement
 - Fine tunes most movements
 - Links to brain stem, cerebrum, spinal cord
 - Communicates over *cerebellar peduncles*



The Central Nervous System

The Medulla Oblongata

- Functions of the Medulla Oblongata
 - Links brain and spinal cord
 - Relays ascending information to cerebral cortex
 - Controls crucial organ systems by reflex
 - Cardiovascular centers
 - Respiratory rhythmicity centers

The Central Nervous System

Key Items

The brain, a large mass of neural tissue, contains internal passageways and chambers filled with CSF. The six major regions of the brain have specific functions. As you ascend from the medulla oblongata to the cerebrum, those functions become more complex and variable. Conscious thought and intelligence are provided by the cerebral cortex.
