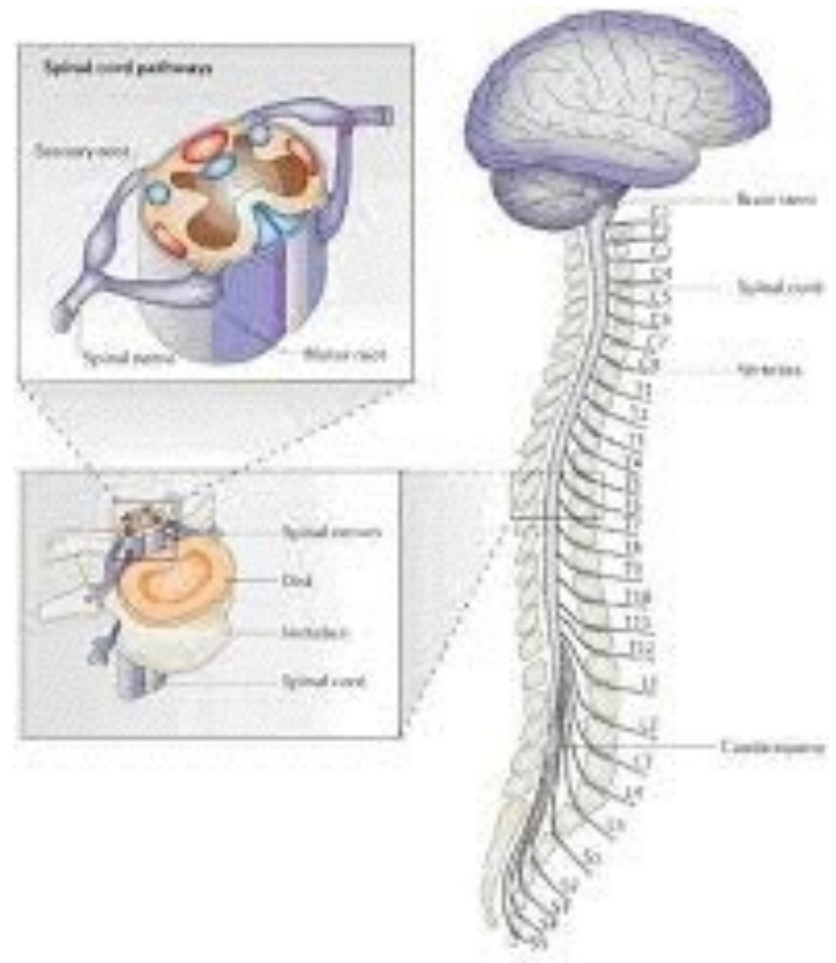


The Central Nervous System I

Chapter 12

The Central Nervous System

- The Brain and Spinal Cord
- Contained within the Axial Skeleton



Brain Regions and Organization

- Medical Scheme (4 regions)
 1. Cerebral Hemispheres
 2. Diencephalon
 3. Brain Stem (midbrain, pons, medulla oblongata)
 4. Cerebellum

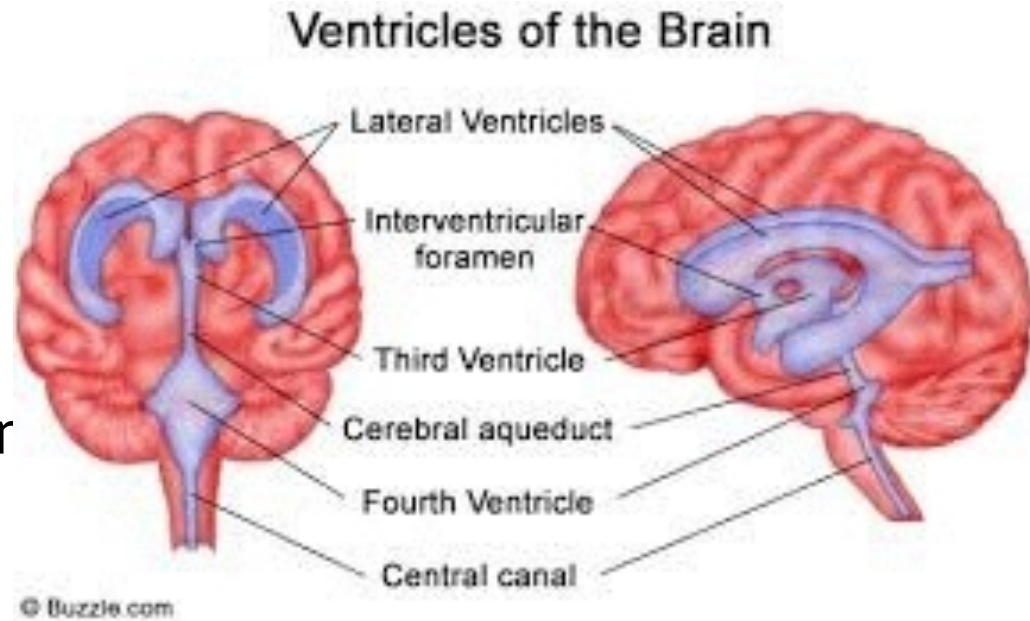
Central cavity, gray matter, white matter



Ventricles

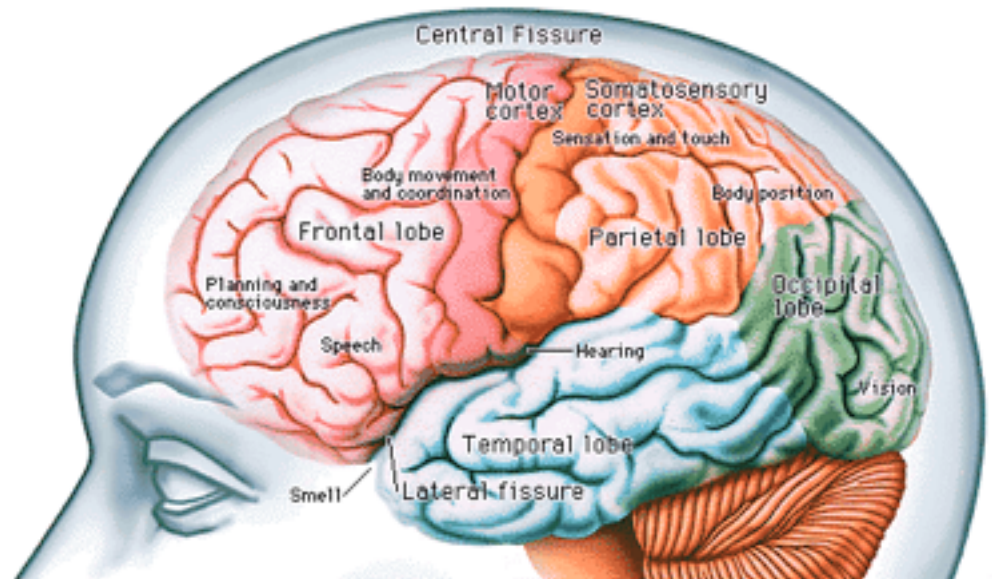
- Continuous with both one another and with the central canal
- Filled with CSF
- Lined with Ependymal cells

- Lateral Ventricles
 - Septum Pellucidum
- Third Ventricle
 - Interventricular foramen
- Fourth Ventricle
 - Cerebral aqueduct
 - Lateral and median aperatures



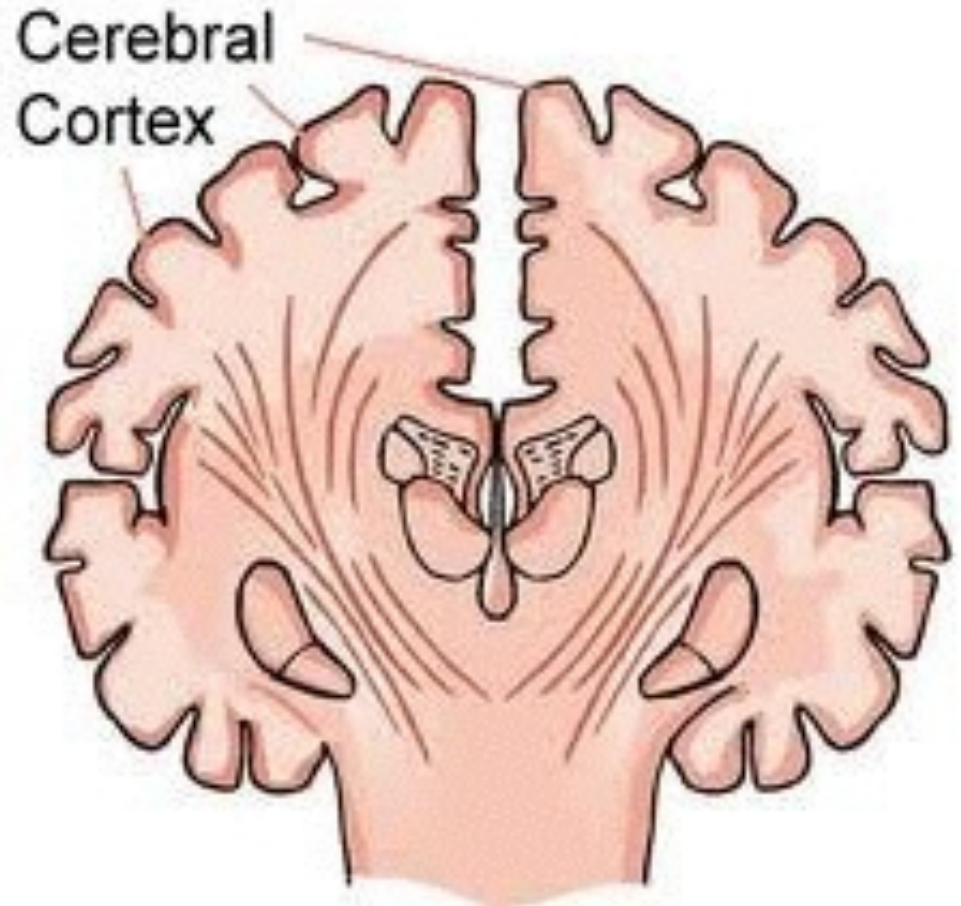
The Cerebral Hemispheres

- Form Superior part of brain (83% of total brain mass)
- Lobes
 - Frontal, Temporal, parietal, occipital, insular
- Gyri
 - Precentral gyrus
 - Postcentral gyrus
- Sulci
 - Central sulcus
 - Lateral sulcus
- Fissures
 - Median longitudinal fissure
 - Transverse cerebral fissure



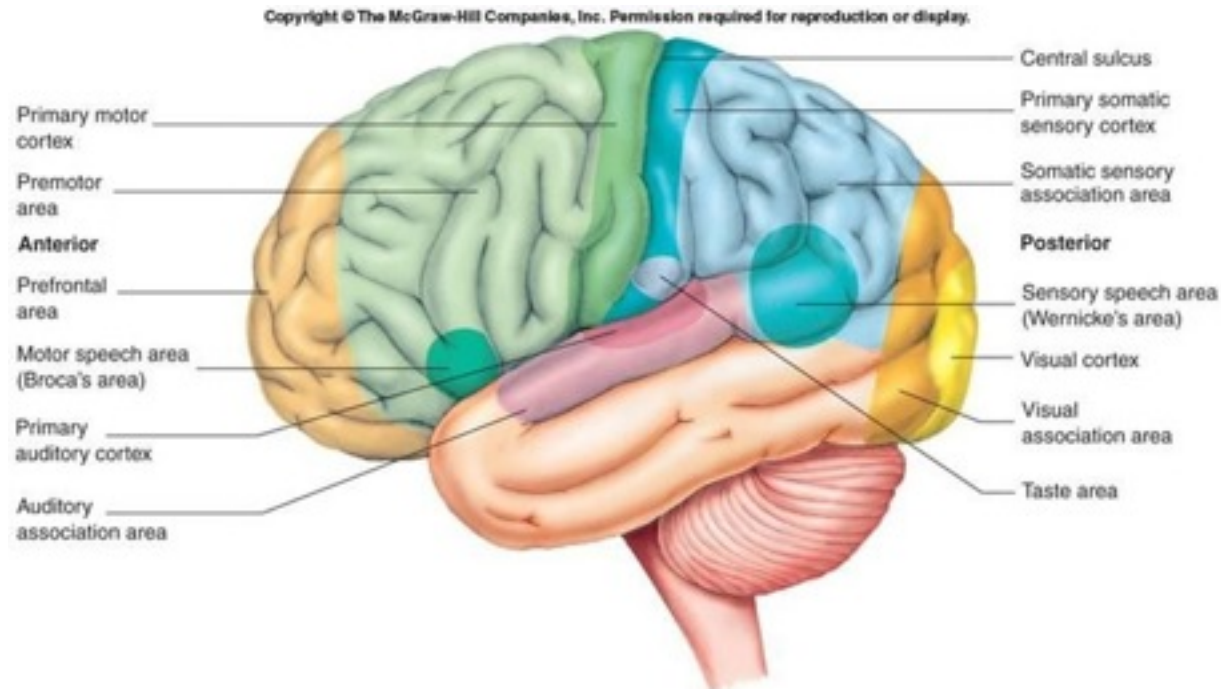
Cerebral Cortex

- The conscious mind
- Gray matter
- Billions of neurons, 6 layers, 40% of brain mass



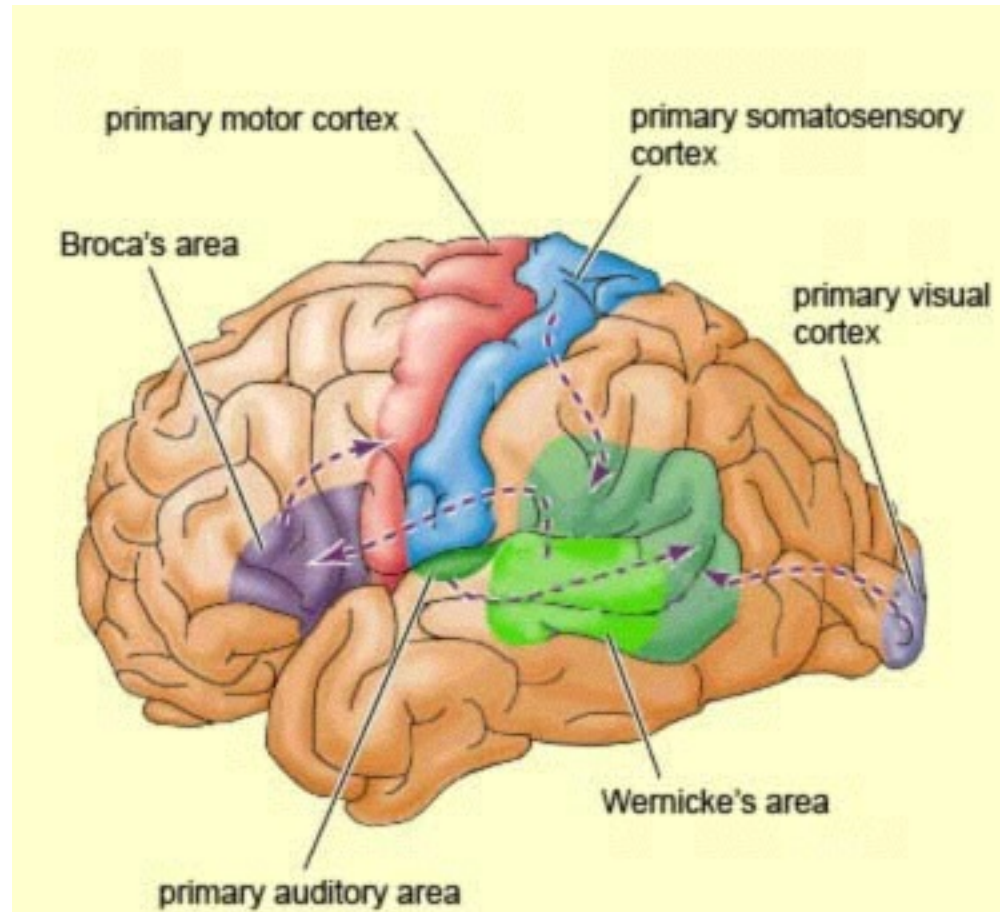
Cerebral Cortex

- 3 types of functional regions: motor, sensory, association.
- Each hemisphere is concerned with the contralateral side of the body
- Although symmetrical, each hemisphere specializes in different functions
- Defining areas is a gross oversimplification, no area of the cortex acts alone during conscious behavior



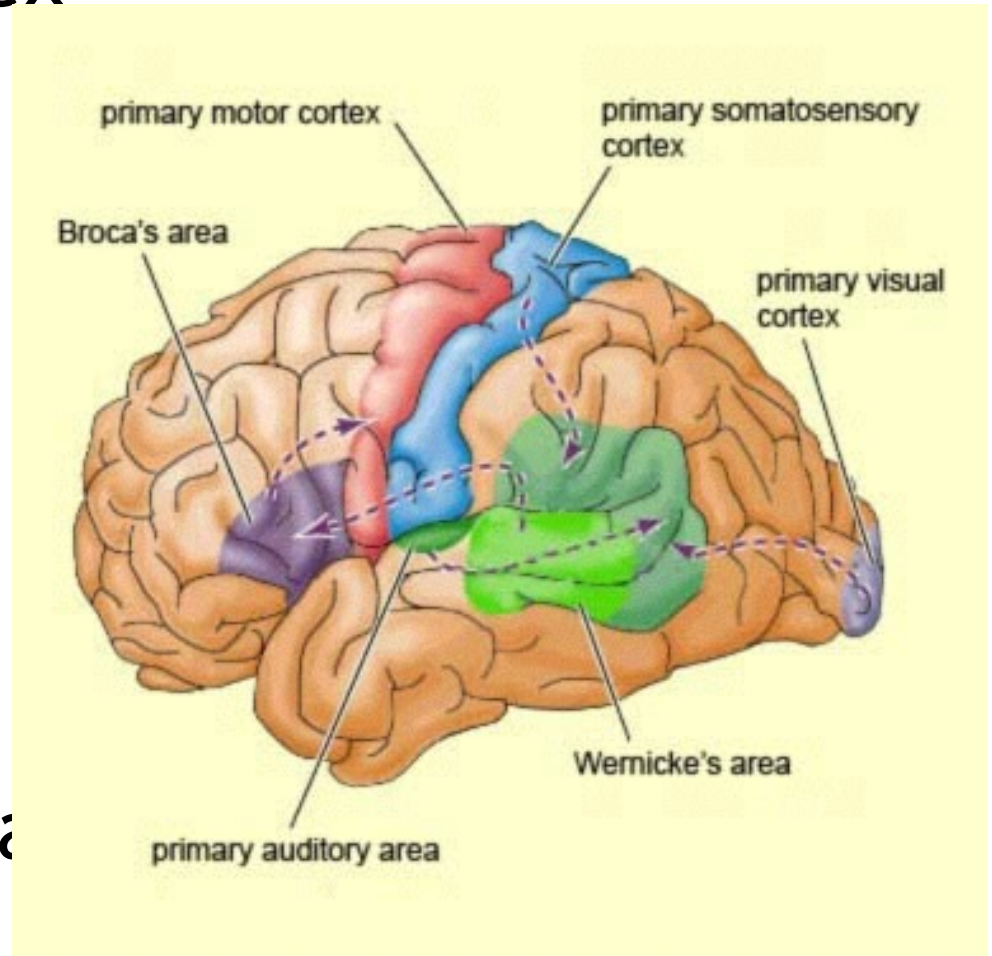
Motor Areas

1. Primary motor cortex
2. Premotor cortex
3. Broca's area
4. Frontal eye field



Sensory Areas

- Primary somatosensory cortex
- Somatosensory association cortex
- Visual areas
- Auditory areas
- Vestibular cortex
- Olfactory cortex
- Gustatory cortex
- Visceral sensory area



Multimodal Association Areas

- Anterior association area
- Posterior association area
- Limbic association area

Lateralization of Cortical Functioning

<i>Left Hemisphere</i>	<i>Right Hemisphere</i>
<i>Language abilities</i>	<i>Better at recognizing faces (in</i>
<i>math</i>	<i>emotion</i>
<i>logic</i>	<i>Artistic/musical skills</i>
<i>Left cerebral dominance = right</i>	<i>Right cerebral dominance = Left</i>

- In 10% of people these roles are reversed or share functions equally
- Individuals with equally functioning hemispheres are typically ambidextrous

Cerebral White Matter

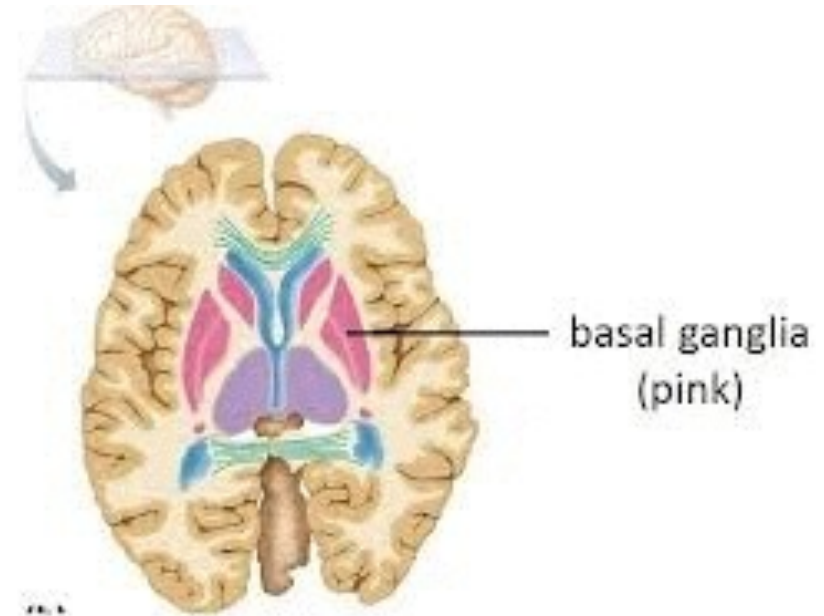
- Myelinated nerve fibers bundled into large tracts named for the direction that they run.
 1. Association fibers
 2. Commissural fibers
 3. Projection fibers
 - Internal capsule
 - Corona Radiata



Basal Nuclei (ganglia)

- Caudate Nucleus
- Putamen
- Globus Pallidus

- Role misunderstood, but thought to act in filtering impulses related to movement, cognition, and emotion.



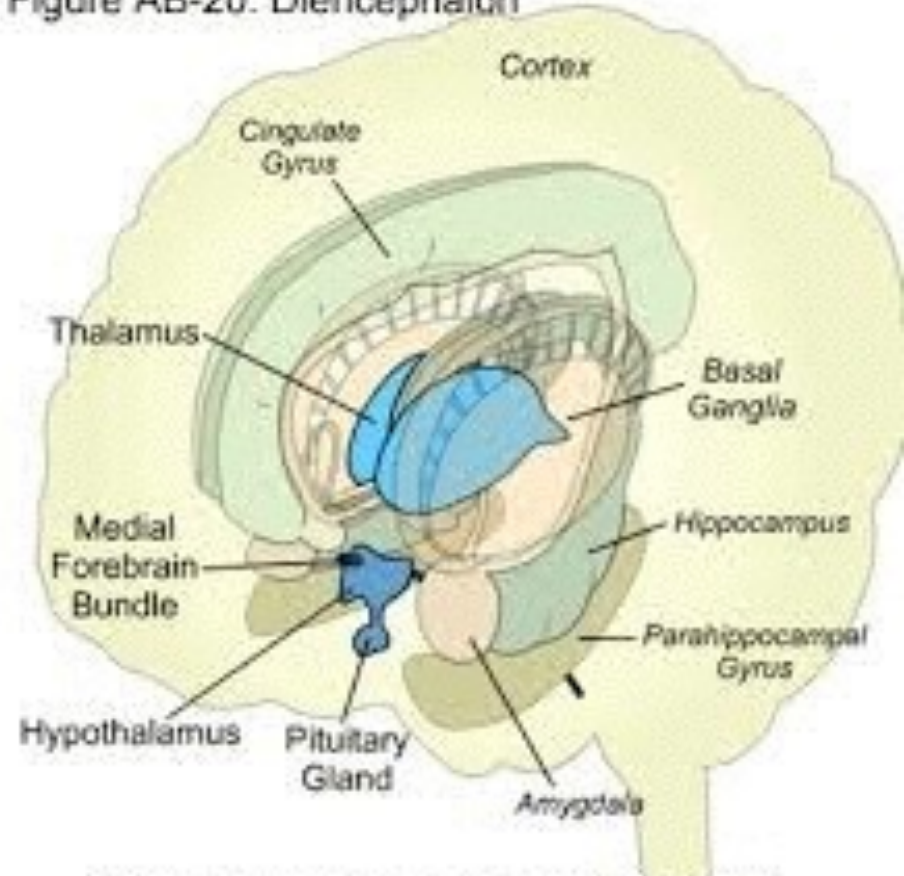
Check your understanding

- Pg. 441

Diencephalon

- Thalamus
- Hypothalamus
- Epithalamus

Figure AB-20: Diencephalon

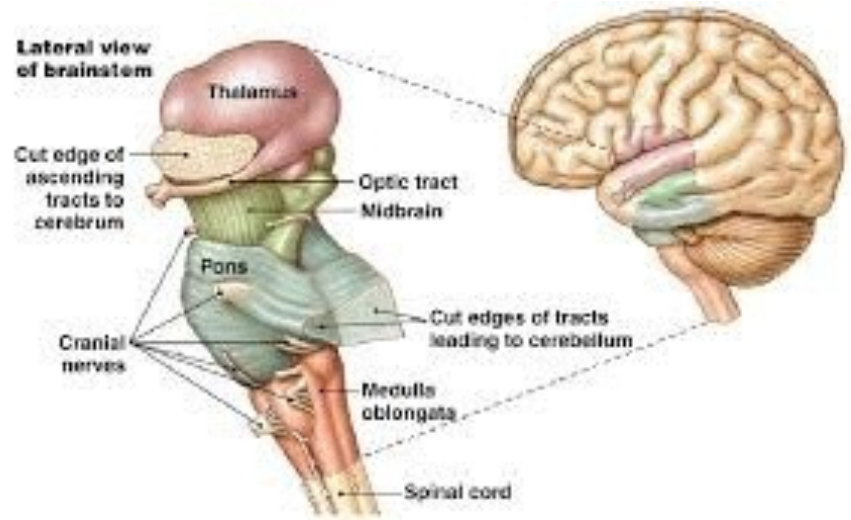


Diencephalon = Thalamus + Hypothalamus + MFB

The Brain Stem

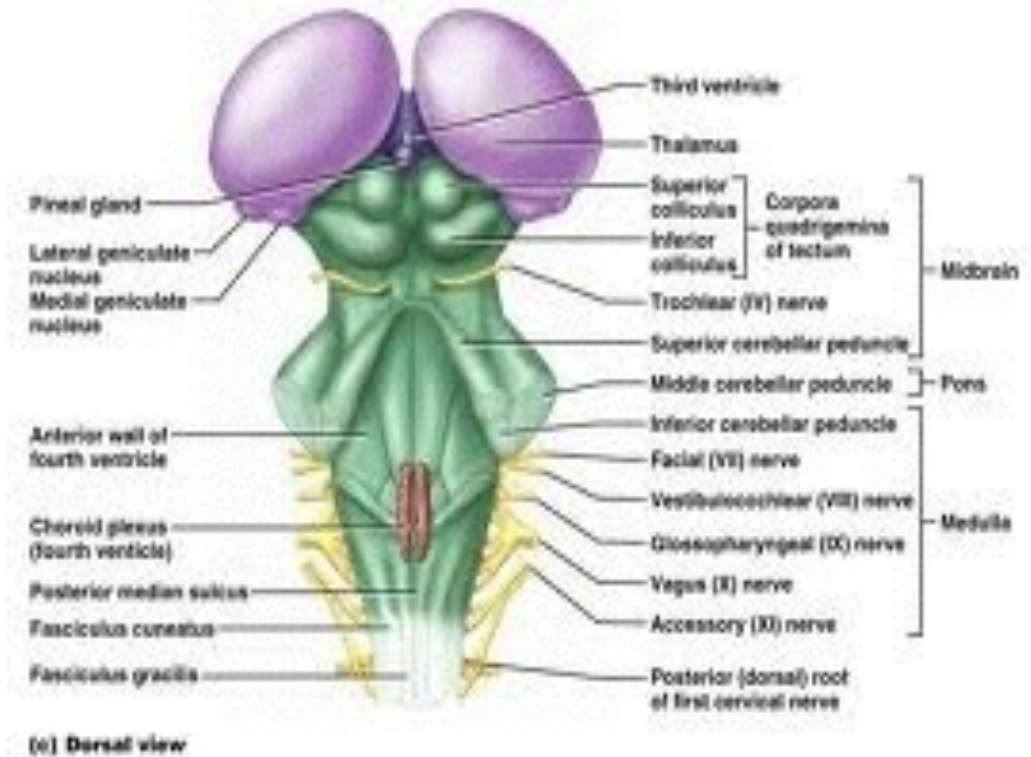
- Mid Brain
- Pons
- Medulla Oblangata

- Histologically similar, but not identical to the spinal cord



Midbrain

- Cerebral Peduncles
- Periaqueductal gray
- Superior Colliculus
- Inferior Colliculi
- Substantia Nigra
- Red Nucleus



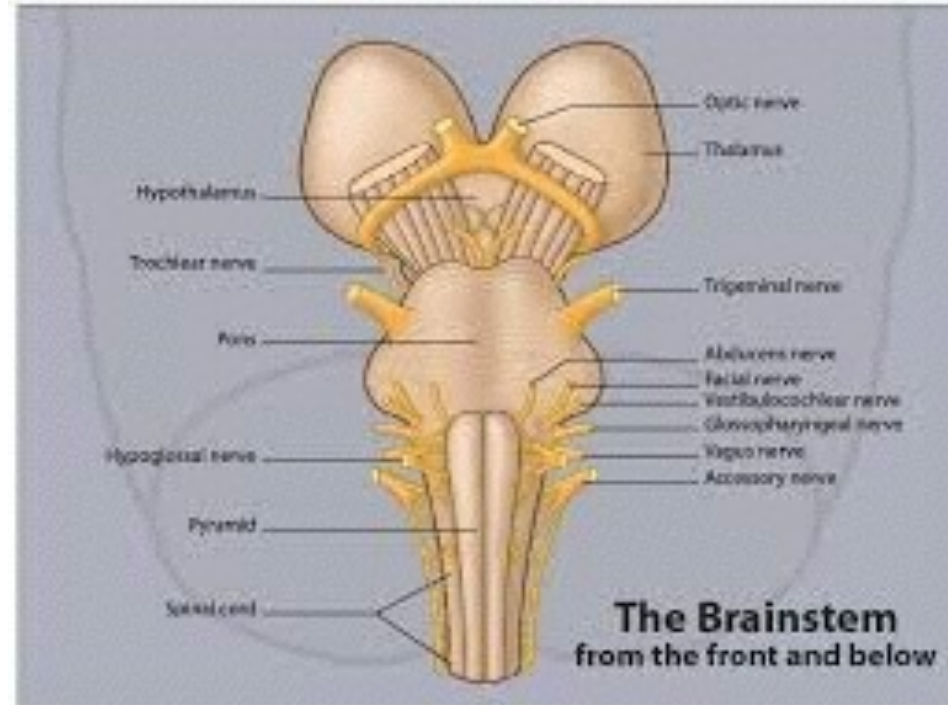
Pons

- Chiefly composed of conduction tracts
 1. Deep projection fibers run longitudinally
 2. Superficial ventral fibers oriented transversely



Medulla Oblongata

- The Pyramids and decussation of the pyramids
- Autonomic Reflex Center
 1. Cardiovascular center
 2. Respiratory centers
 3. Various other centers



The Cerebellum

- Located dorsally to the pons, roughly 11% of brain mass
- Provides the precise timing, and appropriate patterns of skeletal muscle contraction for smooth, coordinated movements and agility needed for daily living



Cerebellar Processing

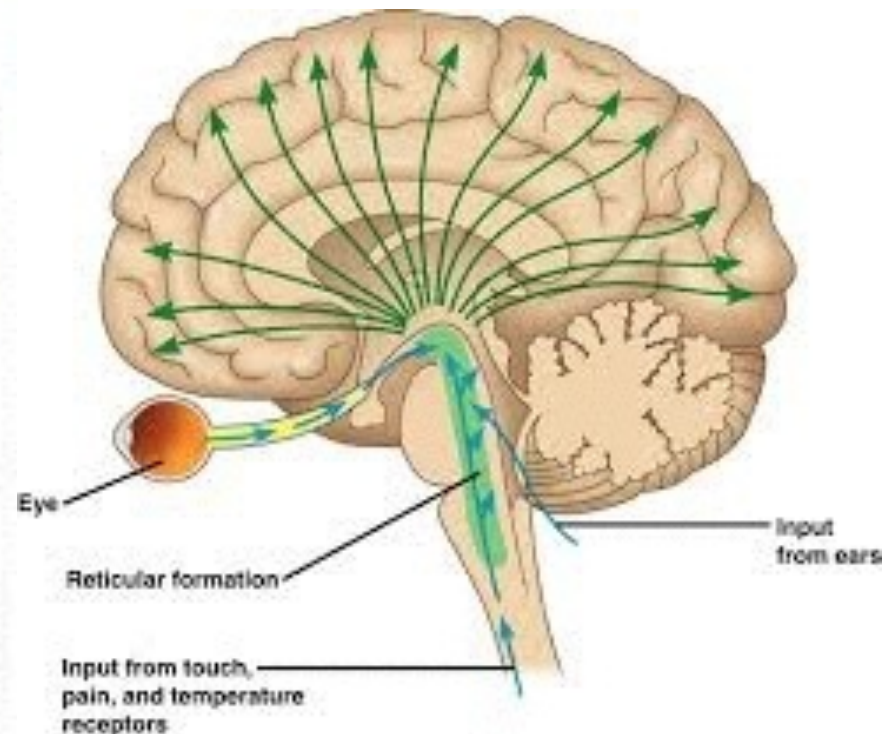
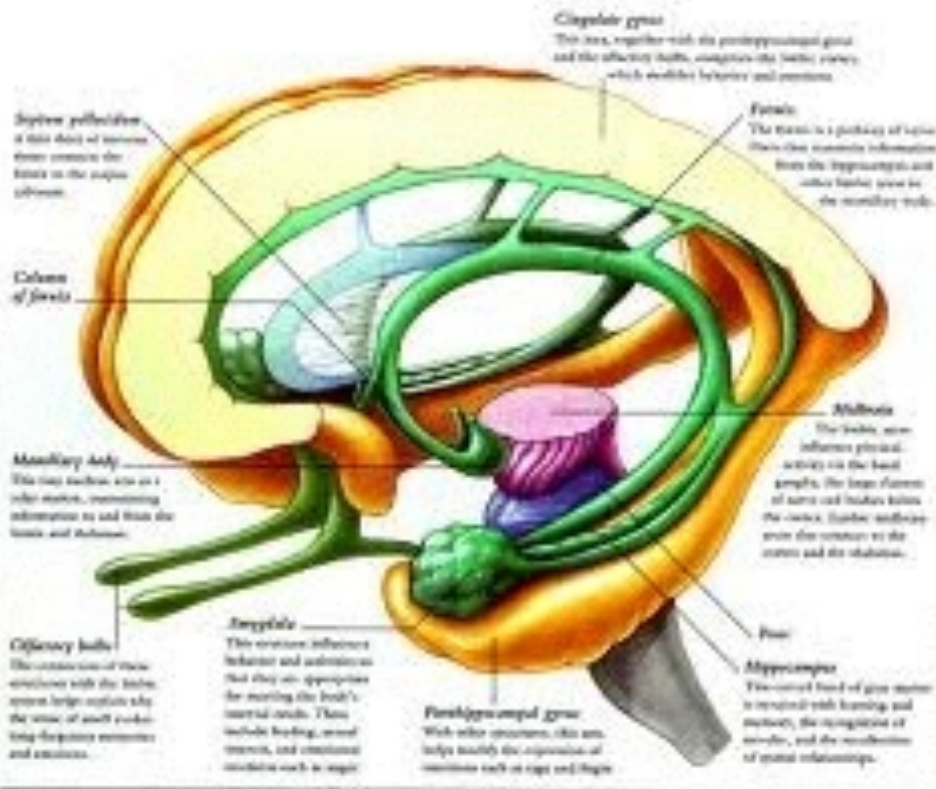
1. The cerebral cortex notifies the cerebellum of its intent to initiate movement.
2. Simultaneously, the cerebellum receives proprioceptive input from throughout the body.
3. Cerebellar cortex calculates the best way to coordinate the force, direction, and extent of muscle contraction to ensure smooth movements.
4. The blueprint for coordinating movement is sent to the cerebral motor cortex

Check your understanding

- In what ways are the cerebrum and cerebellum similar? In what ways are they different?
-

Functional Brain Systems

- The Limbic System
- The Reticular formation



The Limbic System

- Our emotional or affective brain
- Amygdaloid body responds to perceived threats with fear or aggression
- Cingulate allows us to express our emotions with gestures and resolve mental conflicts when frustrated.
- Our sense of smell is highly linked to limbic system
- Integration with hypothalamus explains psychosomatic illness
- Cognitive and emotional brains highly integrated

The Reticular Formation and RAS

- Group of neurons scattered throughout the brain
- Far flung axonal connections
- A subset of these neurons called the RAS send a continuous stream of impulses to the cerebral cortex.
- All ascending sensory neurons synapse on these RAS neurons further activating them
- Additionally the RAS filters weak stimuli

Check Your Understanding

Pg. 451

Higher Mental Functions

- Consciousness
- Sleep and sleep-wake cycles
- Language
- Memory

Consciousness

- Involves simultaneous activity of large areas of the cerebral cortex
- Is superimposed on other types of neural activity
- Is totally Interconnected

Sleep

- Partial unconsciousness (cortex suppressed, brain stem remains active)
- Environmental monitoring remains active

Types of Sleep

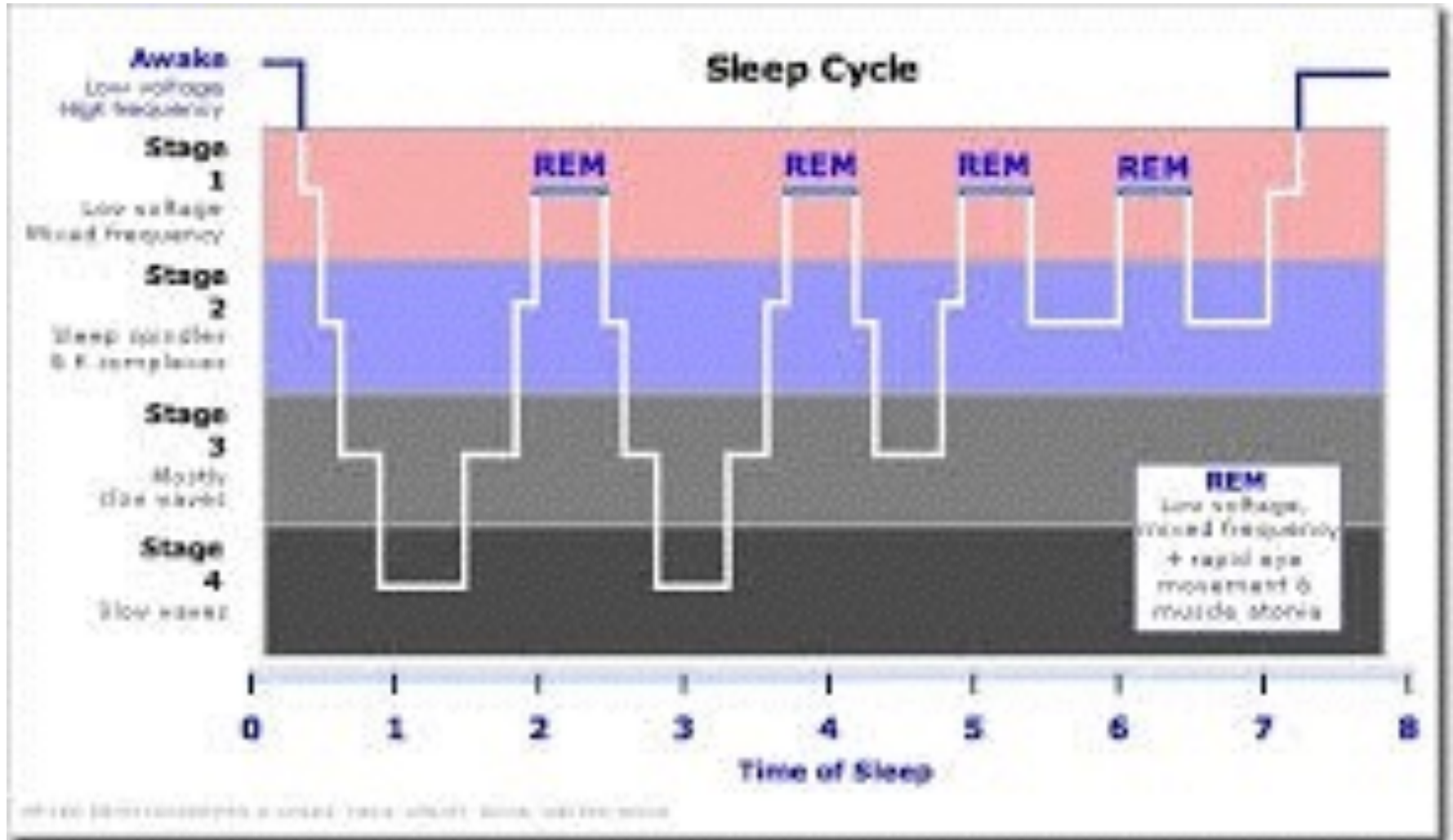
- NREM sleep
- REM sleep

- Figure 12.19

Sleep Patterns

- Alternating 24 hr. sleep wake cycle, or circadian rhythm
- Dictated by the hypothalamus
- Specifically, the suprachiasmatic nucleus inhibits the RAS
- Rem cycles occur every 90 minutes and increase in duration progressively

Sleep Cycle



Importance of Sleep

- NREM sleep is restorative
- REM sleep may give the brain an opportunity to process the days events and work through emotional problems via dream imagery
- Secondary hypothesis: Reverse Learning

Language

- Left Hemisphere
 - Broca's area
 - Wernicke's area
 - Highly integrated with areas of the brain that hold concepts and ideas
- Right Hemisphere
 - Responsible for tone of voice and body language
 - Highly integrated with emotional brain centers

Memory

- The storage and retrieval of information
- Stages of memory
- Categories of Memory
- Structures involved in Memory

Stages of Memory

- Short term (working) memory
 - limited to 7-8 chunks of information.
- Long term memory
 - Seemingly limitless, declines with age
- 5% of incoming sensory information is selected for stm.

STM to LTM Transfer

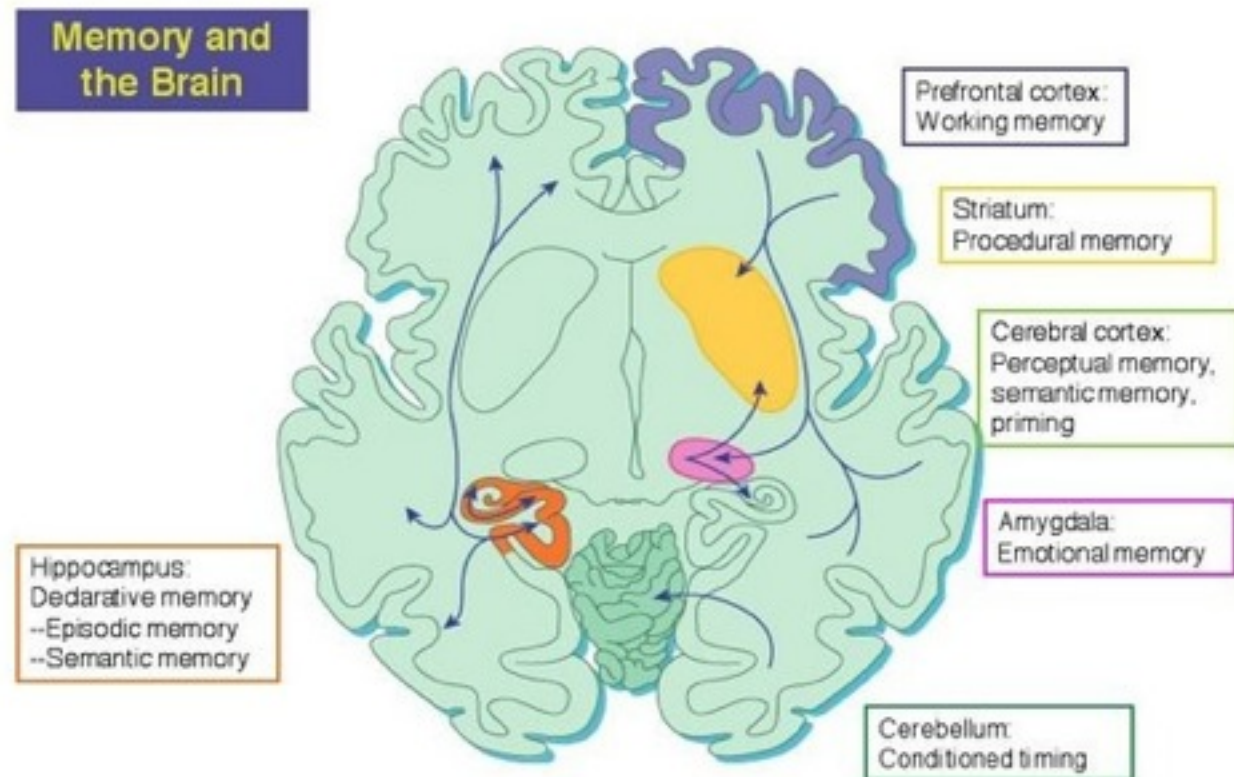
- Depends on various factors
 1. Emotional State
 2. Rehearsal
 3. Association
 4. Automatic Memory

Categories of Memory

- The Brain distinguishes between factual knowledge and skills
- Declarative (fact) memory
- Nondeclarative memory
 - Procedural (skills) memory
 - Motor memory
 - Emotional memory

Brain Structures Involved in Memory

- Memories stored based on regional need
- Fig 12.21



Molecular Basis of Memory

- Notoriously difficult to study
 1. Neuronal RNA is altered, and newly synthesized mRNA's are delivered to axons and dendrites
 2. Dendritic spines change shape
 3. Unique extracellular proteins are deposited at synapses involved in LTM
 4. # and size of presynaptic axon terminals may increase
 5. Presynaptic neurons release more neurotransmitter

Check your understanding

- Pg. 458

Study Guide