The Nervous System
Central Nervous system

Regions of the Brain
- Cerebral hemispheres (cerebrum)
- Diencephalon
- Brain stem
- Cerebellum

Regions of the Brain: Cerebrum
- Cerebral Hemispheres (Cerebrum)
  - Paired (left and right) superior parts of the brain
  - Includes more than half of the brain mass
  - The surface is made of ridges (gyri pl. gyrus sing.) and grooves (sulci pl. sulcus sing.)

Cerebrum (Cerebral Hemispheres)
- Cerebral cortex is gray matter overlying white matter
  - 2-4 mm thick containing billions of cells
  - grows so quickly formed folds (gyri) and grooves (sulci or fissures)
- Longitudinal fissure separates left & right cerebral hemispheres
- Corpus callosum is band of white matter connecting left and right cerebral hemispheres
- Each hemisphere is subdivided into 4 lobes

Gray and White Matter
- White matter = myelinated processes (white in color)
- Gray matter = nerve cell bodies, dendrites, axon terminals, bundles of unmyelinated axons and neuroglia (gray color)
  - In the spinal cord = gray matter forms an H-shaped inner core surrounded by white matter
  - In the brain = a thin outer shell of gray matter covers the surface & is found in clusters called nuclei inside the CNS

Cerebral White Matter
- Association fibers between gyri in same hemisphere
- Commissural fibers from one hemisphere to other
- Projection fibers form descending & ascending tracts

Regions of the Brain: Cerebrum

Regions of the Brain: Cerebrum
- Lobes of the cerebrum
  - Fissures (deep grooves) divide the cerebrum into lobes
  - Surface lobes of the cerebrum
    - Frontal lobe
    - Parietal lobe
    - Occipital lobe
    - Temporal lobe
Regions of the Brain: Cerebrum

Activities in each lobe
- Frontal lobe
  - Motor impulses for voluntary movement
  - Intellect
  - Speech and understanding language
- Parietal
  - General sensory area
  - Taste
- Temporal
  - Olfaction
  - Auditory areas
- Occipital lobe
  - Visual areas

Regions of the Brain: Cerebrum  motor and sensory
- Specialized areas of the cerebrum
  - Primary somatic sensory area
    - Receives impulses from the body’s sensory receptors
    - Located in parietal lobe
  - Primary motor area
    - Sends impulses to skeletal muscles
    - Located in frontal lobe
  - Broca’s area and Wernicke’s area
    - Involved in our ability to speak, interpret language

Regions of the Brain: Cerebrum
- Cerebral areas involved in special senses
  - Gustatory area (taste)
  - Visual area
  - Auditory area
  - Olfactory area

Regions of the Brain: Cerebrum
- Interpretation areas of the cerebrum
  - Speech/language region
  - Language comprehension region
  - General interpretation area

Regions of the Brain: Cerebrum
- Hemispheric Lateralization
  - Functional specialization of each hemisphere. This is more pronounced in men
  - Females have larger connections between 2 sides via corpus callosum
  - Damage to left side produces aphasia
Damage to same area on right side produces speech with little emotional inflection

18 **Regions of the Brain: Diencephalon**

19 **Regions of the Brain: Diencephalon**

20 **Regions of the Brain: Diencephalon**

- Sits on top of the brain stem
- Enclosed by the cerebral hemispheres
- Made of three parts
  - Thalamus
  - Hypothalamus
  - Epithalamus

21 **Regions of the Brain: Diencephalon**

- Thalamus
  - Surrounds the third ventricle
  - The relay station for sensory impulses
  - Transfers impulses to the correct part of the cortex for localization and interpretation

22 **Thalamus**

- 1 inch long mass of gray matter in each half of brain (connected across the 3rd ventricle by intermediate mass)
- Relay station for sensory information on way to cortex
- Crude perception of some sensations

23 **Regions of the Brain: Diencephalon**

- Hypothalamus
  - Under the thalamus
  - Important autonomic nervous system center
    - Helps regulate body temperature
    - Controls water balance
    - Regulates metabolism

24 **Regions of the Brain: Diencephalon**

- Hypothalamus (continued)
  - An important part of the limbic system (emotions)

  - The pituitary gland is attached to the hypothalamus

25 **Functions of Hypothalamus**

- Controls and integrates activities of the ANS which regulates smooth, cardiac muscle and glands
- Synthesizes regulatory hormones that control the anterior pituitary
- Contains cell bodies of axons that end in posterior pituitary where they secrete hormones
- Regulates rage, aggression, pain, pleasure & arousal
- Feeding, thirst & satiety centers
- Controls body temperature
- Regulates daily patterns of sleep

26 **Hypothalamus**
infundibulum suspends the pituitary gland
  ▪ Major regulator of homeostasis
    ▪ receives somatic and visceral input, taste, smell & hearing information; monitors osmotic
      pressure, temperature of blood

27 Regions of the Brain: Diencephalon
  ▪ Epithalamus
    ▪ Forms the roof of the third ventricle
    ▪ Houses the pineal body (an endocrine gland)
    ▪ Includes the choroid plexus—forms cerebrospinal fluid

28 Regions of the Brain: Brain Stem
  ▪ Attaches to the spinal cord
  ▪ Parts of the brain stem
    ▪ Midbrain
    ▪ Pons
    ▪ Medulla oblongata

29 Regions of the Brain: Brain Stem

30 Regions of the Brain: Brain Stem
  ▪ Midbrain
    ▪ Mostly composed of tracts of nerve fibers
    ▪ Has two bulging fiber tracts—
      cerebral peduncles
    ▪ Has four rounded protrusions—
      corpora quadrigemina
      ▪ Reflex centers for vision and hearing

31 Midbrain
  ▪ One inch in length
  ▪ Extends from pons to diencephalon
  ▪ Cerebral aqueduct connects 3rd ventricle above to 4th ventricle below

32 Regions of the Brain: Brain Stem
  ▪ Pons
    ▪ The bulging center part of the brain stem
    ▪ Mostly composed of fiber tracts
    ▪ Includes nuclei involved in the control of breathing

33 Pons
  ▪ One inch long
  ▪ White fiber tracts ascend and descend
  ▪ Pneumotaxic & apneustic areas help control breathing

34 Regions of the Brain: Brain Stem
  ▪ Medulla Oblongata
    ▪ The lowest part of the brain stem
    ▪ Merges into the spinal cord
    ▪ Includes important fiber tracts
    ▪ Contains important control centers
- Heart rate control
- Blood pressure regulation
- Breathing
- Swallowing
- Vomiting

### Medulla Oblongata
- Continuation of spinal cord
- Ascending sensory tracts
- Descending motor tracts
- Cardiovascular center
  - force & rate of heart beat
  - diameter of blood vessels
- Respiratory center
  - medullary rhythmicity area sets basic rhythm of breathing
- Information in & out of cerebellum
- Reflex centers for coughing, sneezing, swallowing etc

### Injury to the Medulla
- Hard blow to the back of the head may be fatal
- Cranial nerve malfunctions on same side as injury; loss of sensation or paralysis of throat or tongue; irregularities in breathing and heart rhythm

### Regions of the Brain: Brain Stem
- Reticular Formation
  - Diffuse mass of gray matter along the brain stem
  - Involved in motor control of visceral organs
  - Reticular activating system (RAS) plays a role in awake/sleep cycles and consciousness

### Reticular Formation of the Brain Stem

### Regions of the Brain: Cerebellum
- Two hemispheres with convoluted surfaces
- Provides involuntary coordination of body movements

### Regions of the Brain: Cerebellum

### Cerebellum
- 2 cerebellar hemispheres and vermis (central area)
- Function
  - correct voluntary muscle contraction and posture based on sensory data from body about actual movements
  - sense of equilibrium

### Cerebellum
- Arbor vitae = tree of life = white matter

### Protection of the Central Nervous System
- Scalp and skin
Protection of the Central Nervous System

Meninges
- Dura mater
  - Double-layered external covering
    - Periosteum—attached to inner surface of the skull
    - Meningeal layer—outer covering of the brain
    - Folds inward in several areas

Meninges
- Arachnoid layer
  - Middle layer
  - Web-like
- Pia mater
  - Internal layer
  - Clings to the surface of the brain

Cerebrospinal Fluid (CSF)
- Similar to blood plasma composition
- Formed by the choroid plexus
- Forms a watery cushion to protect the brain
- Circulated in arachnoid space, ventricles, and central canal of the spinal cord

Ventricles and Location of the Cerebrospinal Fluid

Hydrocephalus in a Newborn
- Hydrocephalus
  - CSF accumulates and exerts pressure on the brain if not allowed to drain

Blood-Brain Barrier
- Includes the least permeable capillaries of the body
- Excludes many potentially harmful substances
- Useless as a barrier against some substances
  - Fats and fat soluble molecules
  - Respiratory gases
  - Alcohol
  - Nicotine
  - Anesthesia