Central Nervous System

Brain

- 4 main parts
    1) Cerebrum
    2) Diencephalon
    3) Brain stem
    4) Cerebellum

White vs Gray

- **White Matter = myelinated tracts or nerves**
- **Gray Matter = unmyelinated tracts or nerves**

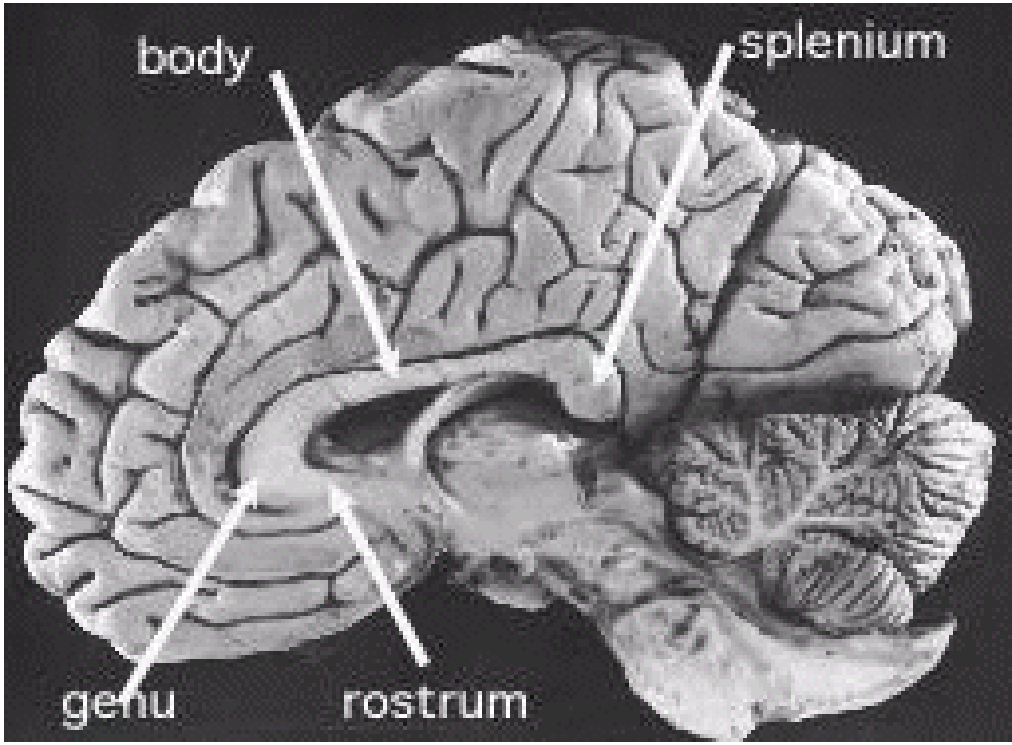
- Brain: gray matter on outside, white matter inside
- Spinal cord: white matter outside, gray matter inside

- White matter can possibly regenerate; Gray matter can't regenerate

Cerebrum

- Cerebral hemispheres – most superior part

- Parts
  1) gyri – ridges
  2) sulci – grooves
  3) fissures – deep grooves



Lobes of Cerebrum

- Lobes – cerebral functions occur in outermost gray matter

1) Occipital – vision

2) Temporal – auditory, memory, cognition, and olfactory (smell)

3) Parietal – somatic sensory area

- interprets signals from sensory receptors (except for special senses)
- receptors: cold, pain, and light touch
- more receptors in lips and fingertips
- sensory cortex is crossed – signals from right side of body are interpreted in left hemisphere
- speech/language and taste

4) Frontal – motor cortex

- move skeletal muscles
- finest motor control is face, mouth, and hands
- motor area for speech, language comprehension, and memory (only in 1 hemisphere)

Other parts of cerebrum

- White matter – deeper to gray matter
  - carries impulses to and from the outer cortex
- Corpus callosum – structure that lines the ventricles in the middle of the brain and connects the two hemispheres of the cerebrum
- Basal nuclei – areas of gray matter found within the white matter
  - Controls voluntary motor activities

Nervous System Disorders

- Huntington's Chorea – damage or problems with basal nuclei
  - Causes abrupt, jerky, continuous muscle movements
- Parkinson's disease – trouble initiating movement due to lack of neurotransmitter dopamine
  - Causes persistent hand tremor

Diencephalon

- Thalamus – relay station for sensory impulses going to sensory cortex
  - Get a crude idea if sensation will be pleasant or unpleasant
- Epithalamus
  - Pineal body – endocrine system
  - Choroid plexus – clusters of capillaries in ventricles that form cerebrospinal fluid

- Hypothalamus
  - ANS center that regulates body temperature, water balance, and metabolism
  - Limbic Center: center for drives and emotions
    - EX) thirst, appetite, sex, pain, and pleasure
    - Controls emotion (anger and fear)
    - Also, involved with addiction
  - Regulates pituitary gland and produces 2 hormones
  - Olfactory center

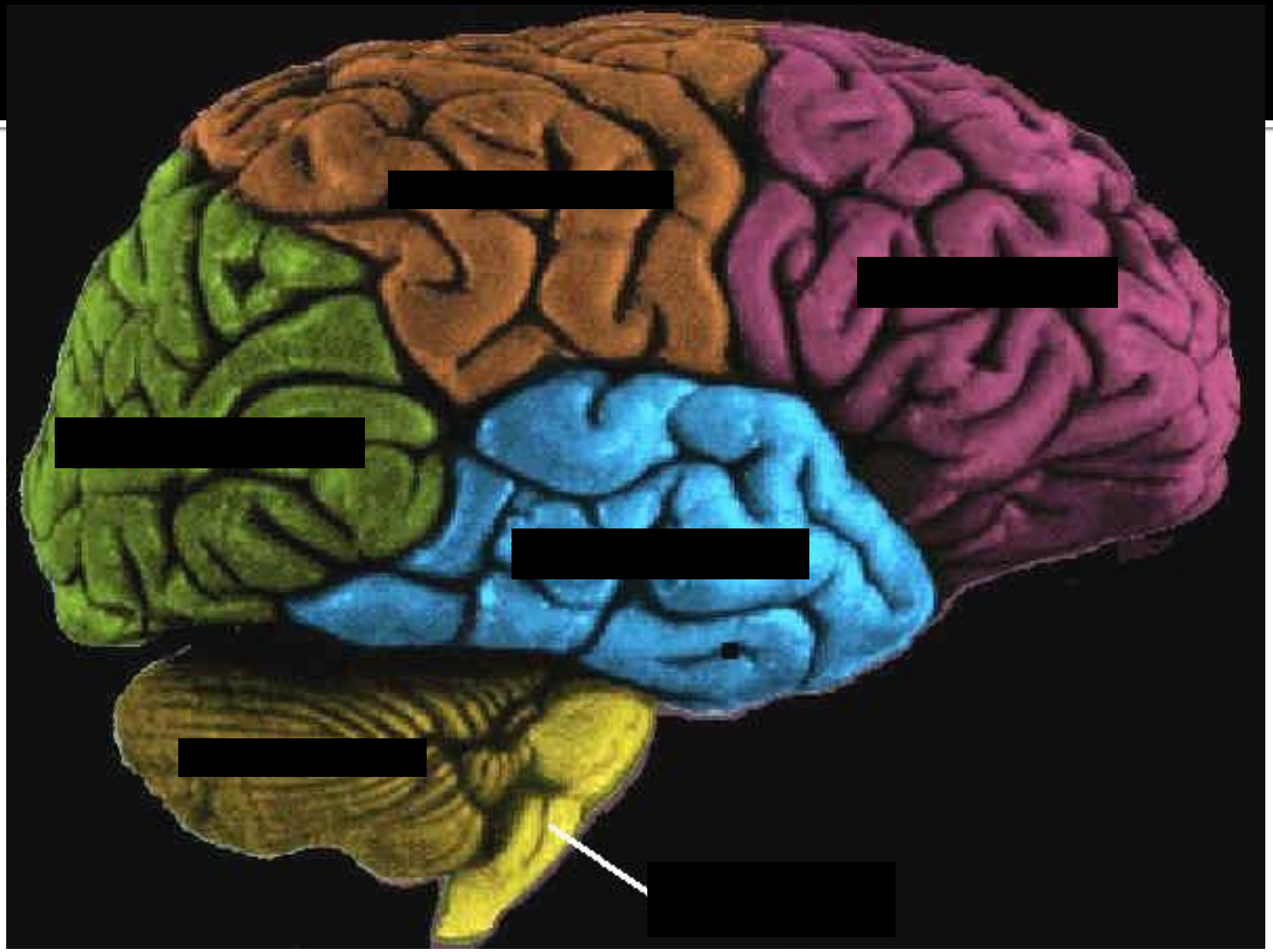
Brain Stem

- Provides pathways for ascending and descending tracts
- Has small areas of gray matter – form cranial nerves
- Gray matter that extends the entire length of the brain stem contains neurons involved in motor control of visceral organs and consciousness
  - Damage to this area can result in a coma

- Midbrain – connects 3rd and 4th ventricle
  - Convey ascending and descending impulses
  - Reflex centers for vision and hearing
- Pons
  - Mostly fiber tracts
  - Control of breathing
- Medulla Oblongata
  - Controls heart rate, blood pressure, breathing, swallowing, and vomiting

Cerebellum

- Outer cortex of gray matter just like cerebrum
- Provides timing of skeletal muscles – smooth and coordinated
- Controls balance and equilibrium
  - receives nerve fibers from ears, eyes, and proprioceptors in skeletal muscles and tendons



Spinal Cord

- Continuation of brain stem
- About 17 inches long
- Conduction pathway to and from the brain
- Cushioned and protected by meninges
- 31 pairs of spinal nerves exit spinal cord
- Spinal cord ends at start of lumbar vertebrae

- Gray matter in spinal cord looks like a butterfly or letter H
- Surrounds central canal that contains CSF

- Parts
  - Dorsal (posterior) horns – contain interneurons
    - Sensory neurons enter this horn
  - Ventral (anterior) horns
    - Motor neurons exit this horn

Nervous System Disorders

- Quadriplegic – spinal cord injury high in the cord that affects all four limbs
- Paraplegic – only legs are paralyzed

Review

- What type of supporting cell breaks down debris and is spider-like?
  - Microglia
- What type of supporting cell moves fluid around the brain and spinal cord using cilia?
  - Endendymal
- What types of supporting cell in the Peripheral nervous system?
  - Schwann

Protection of CNS

- Soft, delicate, irreplaceable nerve tissue needs to be protected
- Enclosed in bone, membranes (meninges), and watery (cerebrospinal fluid) cushion

Meninges

- Three layers
  - Dura mater – tough outer layer
  - Arachnoid mater – web-like middle layer
  - Pia mater – inner layer

  - Blood vessels and cerebrospinal fluid run between arachnoid and pia mater layers

Cerebrospinal Fluid (CSF)

- Watery mixture similar to blood plasma
- Continuously formed from blood by choroid plexus of epithalamus
- Continuously moving
- Moves throughout brain and spinal cord to provide a watery cushion of delicate nerve fibers

Problems with CSF

- Changes in CSF (appearance of blood cells, increase in amount) can be a sign of a nervous system pathology
  - Indicate meningitis, tumors, or multiple sclerosis
- Can test CSF by withdrawing fluid from spinal cord

Nervous System Disorders

- Meningitis
  - Inflammation of meninges
  - Bacterial or viral meningitis may spread into nervous tissue of CNS
- Encephalitis
  - Inflammation of the brain

Nervous System Disorders

- Hydrocephalus – obstructing drainage of CSF which increases the pressure on the brain
  - Can lead to an enlarged head in infants or brain damage in adults
  - Treated by inserting a shunt (tube running from brain to stomach or vein in neck to release pressure)

Blood-Brain Barrier

- Brain can not withstand small chemical changes that occur in blood – hormones, ions, and nutrients
  - EX) after eating and exercise body chemical balance changes slightly
  - Could result in uncontrolled nervous activity
- Barrier contains the least permeable capillaries in the whole body
  - only lets in water, glucose and essential amino acids

Blood-Brain Barrier

- Keeps out metabolic wastes, proteins, and certain types of drugs
- However, fats, respiratory gases, and other fat-soluble molecules can diffuse through any plasma membrane in the body
  - Alcohol, nicotine, and anesthetics can affect brain

Nervous System Disorders

- Concussion – impairment of brain functioning following trauma to head

- Epidural hematoma – arterial bleeding between skull and dura mater
- Subdural hematoma – venous bleeding between dura mater and brain

Cranial Nerves

- 12 pairs that innervate head and neck (only one does thoracic and abdominal cavities)

- I Olfactory – smell / sniff or smell something
- II Optic – vision / ask person if they can read a sign or see an object far away
- III Oculomotor – eye muscle movement / pen light test for pupils
- IV Trochlear – eye muscle movement / ask person to follow finger as you make outline of a bow tie

- V Trigeminal – sensation in face / lightly touch cheeks and ask if they can feel it
- VI Abducens - eye muscle movement / ask person to follow finger as you make outline of a bow tie
- VII Facial – muscles of face / smile and clench eyes shut
- VIII Vestibulocochlear – sense of balance and hearing / stand on one leg and then lightly rub 2 fingers together by ear

- IX Glossopharynegeal – motor fibers to throat and taste / ask person to swallow
- X Vagus – fibers to and from digestic tract and throat/ pharynx / say “ah”
- XI Accessory – activate sternocleidomastoid and trapezius / shrug shoulders against resistance
- XII Hypoglossal – tongue movements / stick out tongue

Concussion Tests

- Orientation – month, date, time of day, where they are
- Immediate memory – give 5 unrelated words (dog, smile, rock, cup, and bridge) and have them repeat them back in order
- Neurological Screening – recollection of injury, strength, sensation, coordination, and loss of consciousness

- Concentration – months of the year in reverse and saying a series of numbers backwards (3, 4 and 5 number series)
- Delayed Memory – repeat words from beginning in order

Concussion Grading Scale

- *Cantu Grading Scale*

- Grade I – mild
  - No loss of consciousness
  - Post traumatic amnesia (PTA) < 1 hour
- Grade II – moderate
  - Loss of consciousness < 5 min
  - PTA 1- 24 hours
- Grade III – severe
  - Loss of consciousness > 5 min
  - PTA > 24 hours