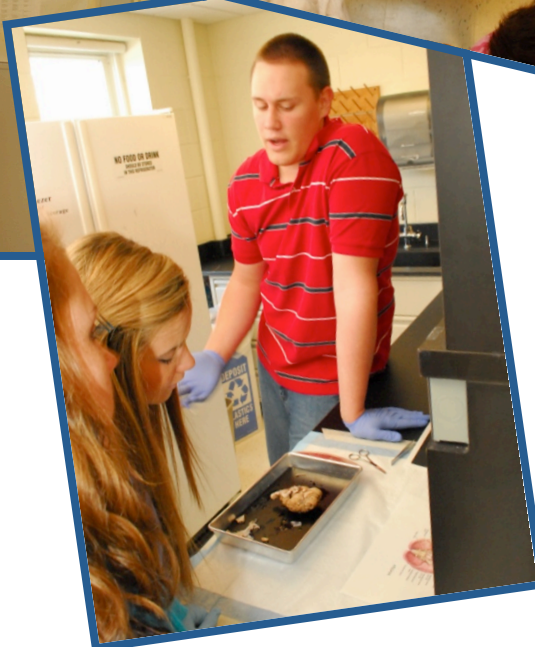




UNIVERSITY OF NEW ENGLAND

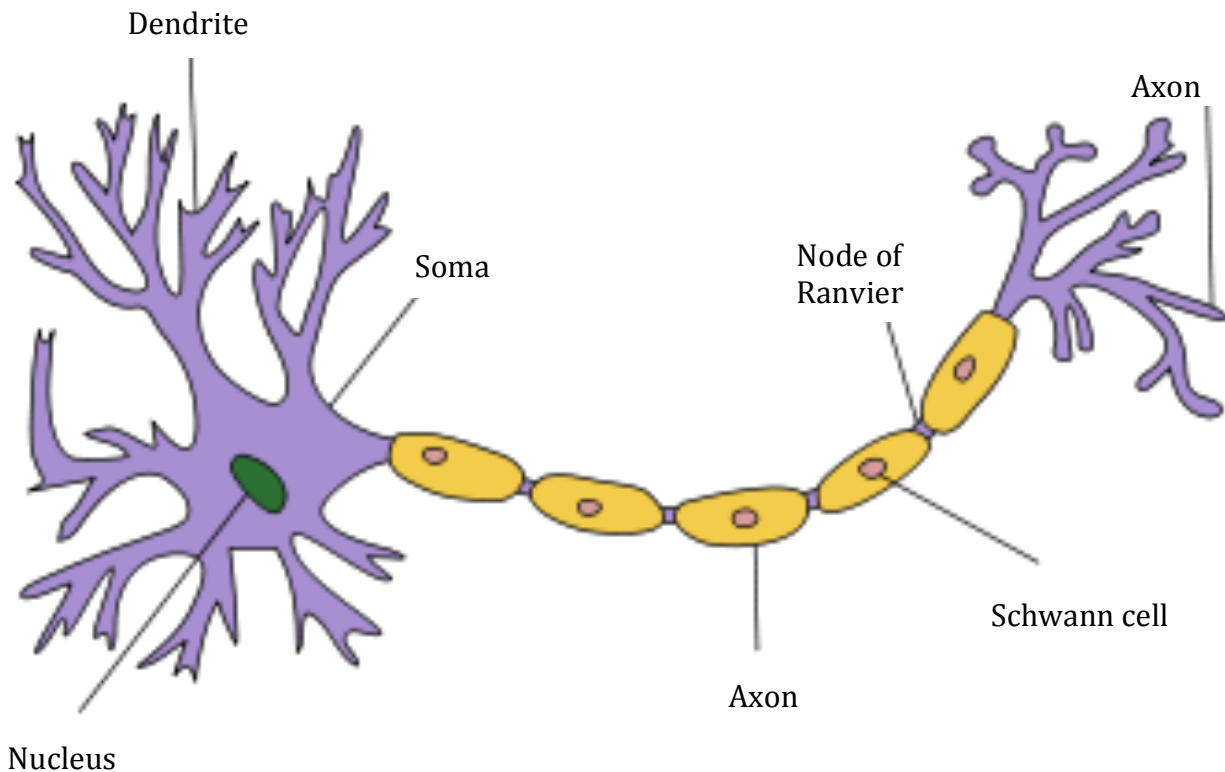
Center for Excellence
in the Neurosciences

CEN Outreach Neuroanatomy & Disease



Neuroanatomy (Grades 6-12)

What does a Neuron look like?



The yellow part of the neuron is called the **myelin sheath**. Its main purpose is to increase the speed of signals that travel across the axon. The signal gets sent from the dendrite through the nucleus, to the axon, and then goes to the axon terminal.

Dendrite- The branching process of a neuron that conducts signals towards the cell.

Soma- The body of an organism, or “cell body”.

Nucleus- Oval shaped, membrane bound structure, also contains genetic material in the form of chromosomes.

Axon- A long, slender projection of a nerve cell, it conducts electrical impulses away from the soma.

Node of Ranvier- A gap occurring at regular intervals between segments of myelin sheath along the nerve axon.

Schwann Cell- A cell of the peripheral nervous system that wraps around a nerve fiber, forming the myelin sheath.

Axon terminal- Endings by which the axons make synaptic contacts with other nerve cells.

Lobes of the Brain

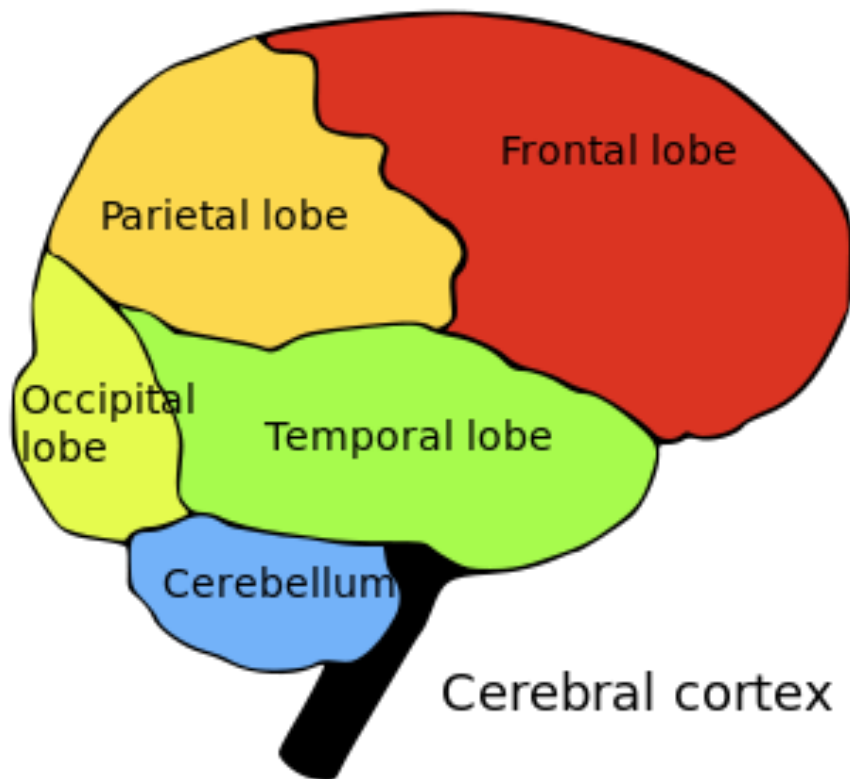
Frontal Lobe– The frontal lobe controls conscious thought, executive thinking, and decision-making. This is most unique to humans and more developed in humans than in animals. If you damage this, you will have trouble working socially and creatively as well as a decreased functioning in problem solving skills.

Parietal Lobe– This lobe plays important roles in integrating sensory information from the various senses (touch, smell, taste, sight, hearing). It is also responsible for visuospatial processing.

Occipital Lobe– This lobe is responsible for sense of sight. Lesions in this area can produce hallucinations and blindness.

Temporal Lobe – Controls senses of smell and sound. It also processes complex stimuli like faces. It is important in processing of semantics in both speech and vision.

Cerebellum – Plays an important role in motor control, it may be involved in some cognitive functions such as attention, language and in regulating fear and pleasure responses. It contributes to coordination, precision and accurate timing.



Cerebrospinal fluid (CSF) – This is the liquid surrounding the brain. It acts as a cushion or buffer for the brain, and allows for the brain to be buoyant. When the brain is suspended in CSF it is much lighter than it would be without the fluid.

If you damage one of your lobes, you can possibly lose the function of that lobe. For example, if you damage the frontal lobe, you can still go on living, but you would have impaired higher-level thinking and poor decision making skills. You may also have personality changes.

Comparative Animal Anatomy

You will have a rat, mouse, sheep brain, and a human brain model.

Compare the olfactory bulbs, the cortex, and size of the brain versus the size of the animal.

Most animals compare to each other except for humans and other ape derivatives

Activity: Sheep Brain Dissection

Please be able to point out the following structures:

All of the lobes

Cerebellum

Brain Stem

Ventricles

Optic Chiasm

Olfactory bulb

Brain Stem – Controls all things required to live. This includes: respiration rate, change of heart rate, etc.

Optic Chiasm – The point at which the signal is sent to the brain. Where optic nerves partially cross.

Ventricles – Provides support for the brain, without the cerebrospinal fluid the brain's weight would close upon itself, it is also the place where blood turns into cerebrospinal fluid.

Olfactory Bulb – Place where the sense of smell is sent to the brain to be identified.

List of Supplies-

- Dissection pan
- Sheep Brain
- Dissection kit- scalpel, probe and scissors
- Gloves

For the sheep brain dissection, please view this video.

<http://www.youtube.com/watch?v=y7gEWzPqm94>

Sheep Brain Dissection

Cerebrum - Split into left and right cerebral hemispheres by a sagittal fissure. This is the “newest” brain evolutionary wise. This is the “thinking” part of your brain; it is where all of our senses are perceived and understood, where we think and solve problems, where our personality comes from, and where our memory and emotions reside. Both hemispheres specialize in different areas:

- **Left Hemisphere** - language, math, and logic; controls the right side of the body
- **Right Hemisphere** - spatial abilities, facial recognition, visual imagery, music; controls the left side of the body

Cerebellum - Primarily a movement control center; receives signals from the cerebrum that the body wants to move to achieve a certain task. The cerebellum calculates and coordinates the muscle activity for smooth, coordinated movements. These signals are then sent back to the cerebrum.

Brain Stem - Serves to relay information from cerebrum and cerebellum to spinal cord and vice versa; also the site where vital functions such as breathing, heart rate, and blood pressure.

Sagittal Section – Splits the brain into left and right components; the following components can be seen from the sagittal cut:

- **Thalamus** - Relay center between the body and the brain where all sensory signals (except smell) first synapse on the thalamus before being transmitted to the cortex.
- **Hypothalamus** - Responsible for controlling various metabolic processes and other autonomic functions; releases neurohormones, which control hormone release from the endocrine organs; also has control over body temperature, hunger, thirst, sleep, and circadian cycles.
- **Hippocampus** - Part of the limbic system; plays a role in long term memory
 - **EXAMPLE:** HM was a patient who suffered from epilepsy. In order to control the epilepsy, surgeons removed both of his medial temporal lobes. This resulted in removal of two-thirds of his hippocampus and amygdala. Following the surgery HM couldn't commit new events to his long-term memory, although he still had full use of his working memory and procedural memory.
- **Amygdala** - Part of the limbic system; involved in memory of emotion, especially fear
 - **EXAMPLE:** (Kluver-Bucy syndrome) Bilateral removal of temporal lobes in monkeys produces bizarre abnormalities in behavior: decreased fear and aggression and decreases in vocalizations and facial expressions related to fear. Humans with this syndrome also showed a decreased recognition in fearful faces.
- **Septum Pellucidum** - A thin sheet that runs from the corpus callosum to the fornix and separates the two lateral ventricles
- **Pineal Gland** - Endocrine gland that produces melatonin; secreted only in dark settings and is inhibited by light. Melatonin levels rise around the time we become sleepy, peak in the early morning, and fall to baseline around the time we wake up, helping to initiate and maintain sleep.
- **Cerebral Aqueduct** - Connects the third and fourth ventricles.
- **Choroid Plexus** - Produces CSF

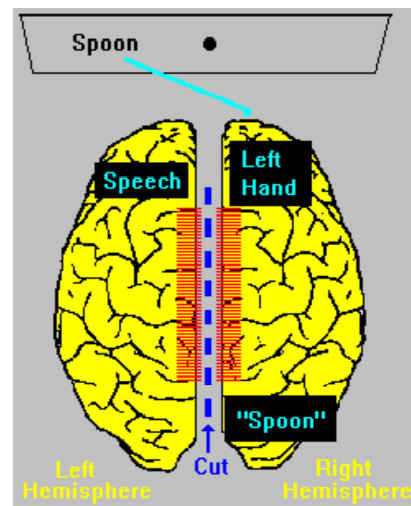
Coronal Section – Splits the brain into front and back components

Gray Matter – Collection of neuronal cell bodies

White Matter – Collection of CNS axons; important white matter tracts in the CNS to include

- **Dorsal Column-Medial Lemniscal Pathway** - Carries signals about touch/vibration from the dorsal column of the spinal cord to the brain (dorsal column nuclei of the medulla).
- **Spinothalamic Pain Pathway** - Carries signals about pain and temperature from the spinal cord to the thalamus
- **Corticospinal Tract** - Longest and one of the largest white matter tracts in the CNS; carries signals about movement from the brain to the body
- **Corpus Callosum** - Collection of white matter tracts that connect the left and right cerebral hemispheres

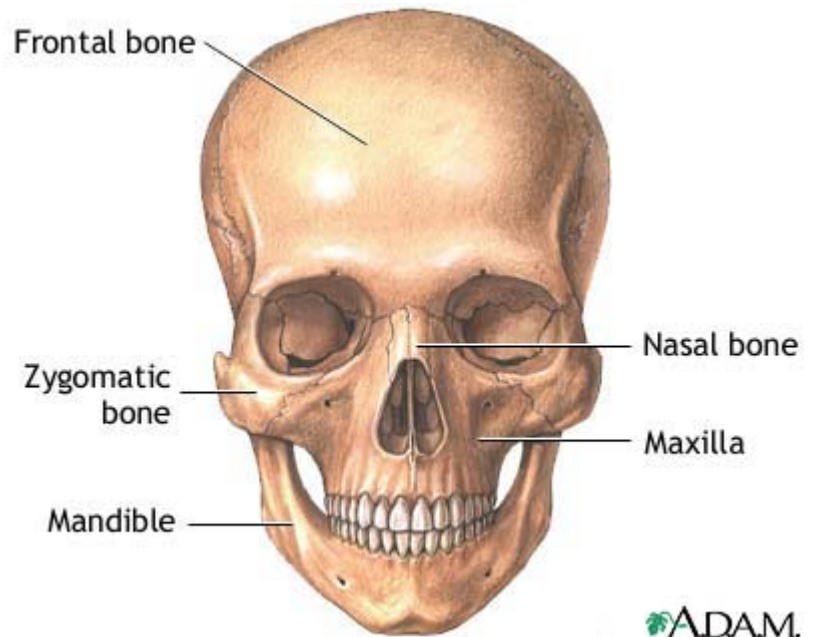
- Split brain surgery relevance:
 - Done to help treat extreme types of epilepsy; corpus callosum is severed
 - **EXAMPLE:** Left hemisphere is specialized for language. If the a picture of a spoon is presented to the right visual field, the signal crosses the optic chiasm and is presented to the left hemisphere and the patient will have no trouble repeating the word “spoon”. However, if the word is presented to the left visual field, the signal will cross the optic chiasm and be presented to the right hemisphere. The patient will say that they saw nothing. However, if the person is asked to pick up the object they just saw with their left hand, they will pick up the spoon. This is because although the right hemisphere can identify the object, it cannot “speak”.
 - **EXAMPLE:** A picture like the one below is presented to a split-brain patient. If the patient focuses on the dot in the center, the picture of the women’s face will go to the patient’s right cerebral hemisphere and the picture of the man’s face will go to the patient’s left cerebral hemisphere. If the patient is asked to point to a whole face, they will point to the women’s face since the right side of the brain is specialized in faces. However, if the patient is asked to identify the face as a male or female face, the patient will identify the face as a male face (language).



Neuroanatomy (Grades 9-12)

Skull Anatomy: Poster/Slideshow and/or Human Skull

- Frontal Bone
- Temporal Bones (2)
- Parietal Bones (2)
- Occipital Bone
- Coronal Suture
- Sagittal Suture
- Squamous Suture



Subcranial Anatomy: Poster/Slideshow

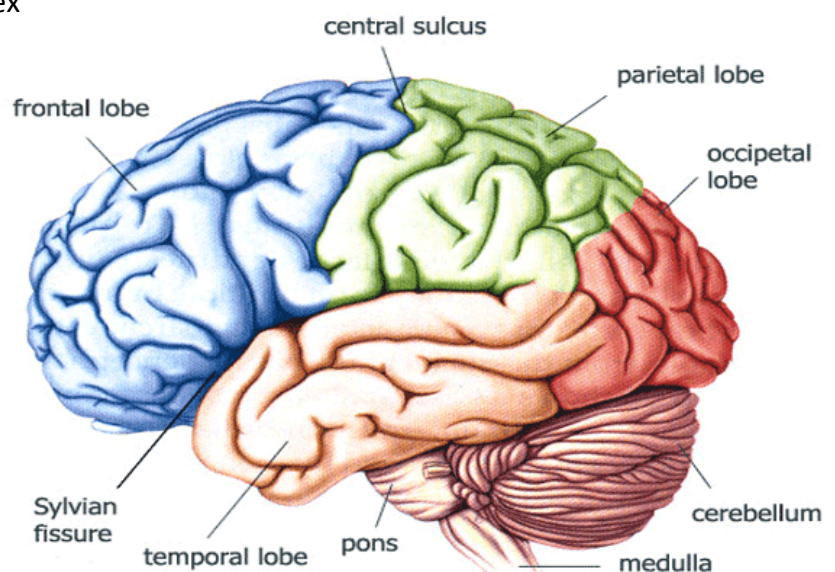
- Dura Mater
- Arachnoid Mater
- Pia Mater

Brain Anatomy: Human Brain

- Hindbrain/Brainstem
- Cerebellum
- Midbrain
- Forebrain
- 4 Cerebral Lobes: Frontal, Parietal, Temporal, Occipital
- Sulci, Central Sulcus
- Gyri

Cerebral Cortex: Poster/Slideshow and/or Model

- Premotor Cortex
- Supplementary Motor Cortex
- Somatic Motor Cortex
- Somatic Sensory Cortex
- Auditory Cortex
- Visual Cortex



Neuroanatomy Continued

Midsagittal Section: Mid-sagittal brain and/or Poster/Slideshow

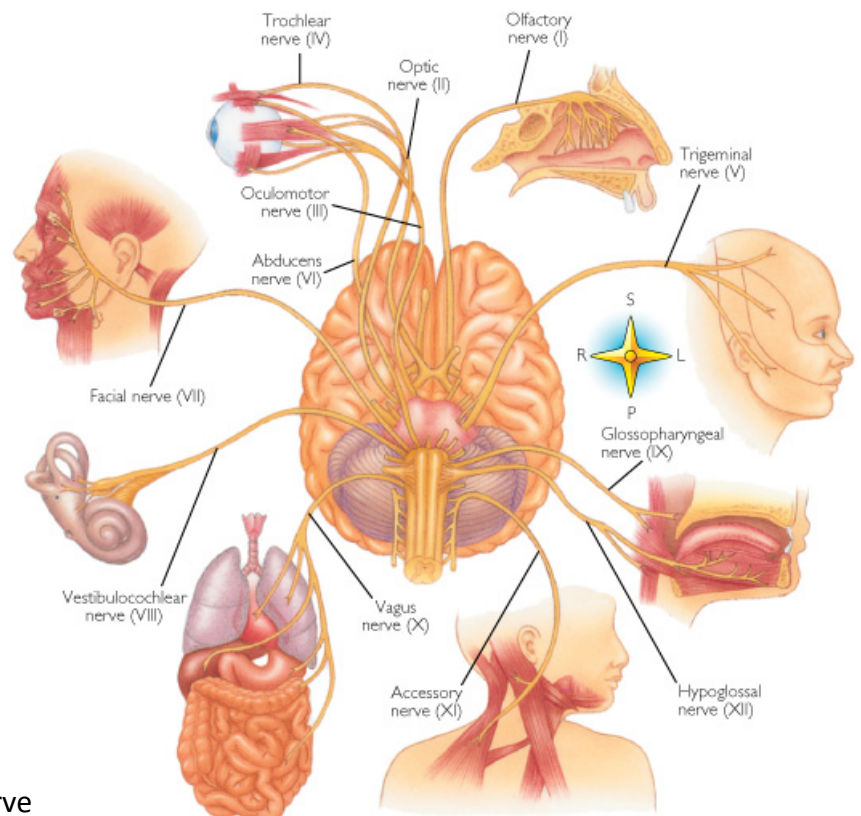
- Cerebral Cortex
- Corpus Callosum
- Lateral Ventricle
- Third Ventricle
- Cerebral Aqueduct
- Fourth Ventricle
- Thalamus
- Hypothalamus
- Limbic System – Hippocampus and Amygdala
- Midbrain
- Pons
- Medulla Oblongata
- Cerebellum

Coronal Section: Poster/Slideshow

- Gyri and Sulci
- Lateral Ventricles
- Third Ventricle
- Longitudinal Fissure
- Lateral Fissure
- Corpus Callosum
- Hippocampus
- Amygdala
- Gray Matter
- White Matter

Brainstem: Human Brain

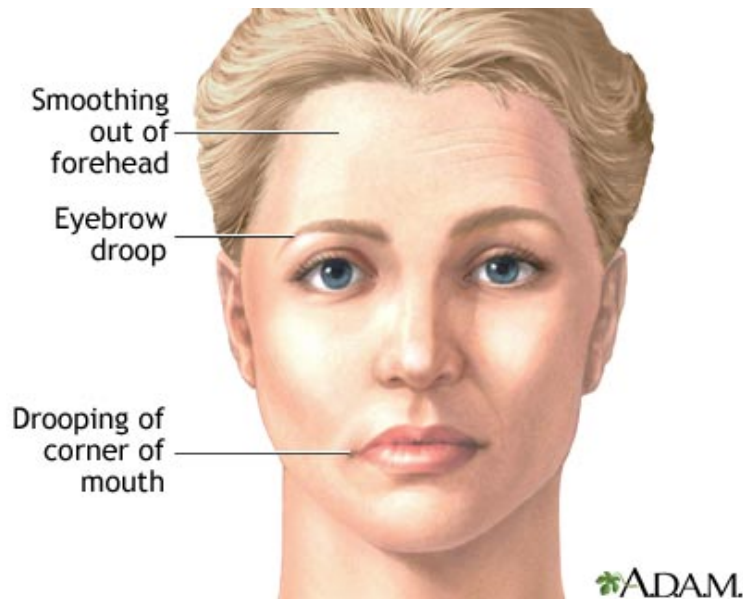
- Midbrain
- Pons
- Medulla
- Cranial Nerve I: Olfactory Nerve
- Cranial Nerve II: Optic Nerve (Optic Canal)
- Cranial Nerve III: Oculomotor Nerve
- Cranial Nerve IV: Trochlear Nerve
- Cranial Nerve V: Trigeminal Nerve
- Cranial Nerve VI: Abducent Nerve
- Cranial Nerve VII: Facial Nerve
- Cranial Nerve VIII: Vestibulocochlear Nerve
- Cranial Nerve IX: Glossopharyngeal Nerve
- Cranial Nerve X: Vagus Nerve
- Cranial Nerve XI: Spinal Accessory Nerve
- Cranial Nerve XII: Hypoglossal Nerve



Neuroanatomy Continued

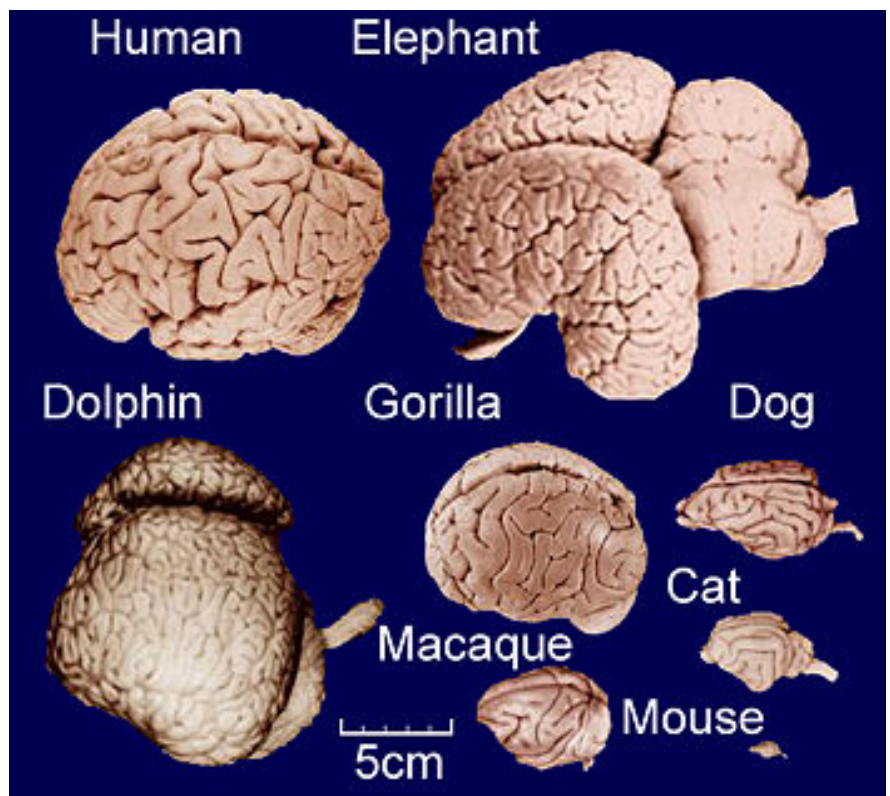
Case study: A patient presents with unilateral facial paralysis. She is unable to close her left eye, and when asked to smile the left corner of her mouth does not rise. Which cranial nerve is implicated?

(Facial Nerve, CNVII)



Compare Mammalian Brains: Poster/Slideshow

- Human
- Elephant
- Dolphin
- Gorilla
- Dog
- Mouse



Pathology

Alzheimer's Disease: Poster/Slideshow

Case Study: A 73-year-old woman was brought in for a neurological evaluation by her brother because of a 3-year history of memory impairment. She had completed high school and worked in a clerical position until her retirement in 1985. She had lived alone and maintained her own home and financial affairs since the death of her husband in 1980. The brother had begun to notice gradually worsening memory impairment and difficulty finding words, but the patient became angry at the suggestion that she may have a progressive impairment. Others had noted a decline in housekeeping and financial affairs, but she had no complaints.

(<http://www.med.harvard.edu/aanlib/cases/case3/case.html>)

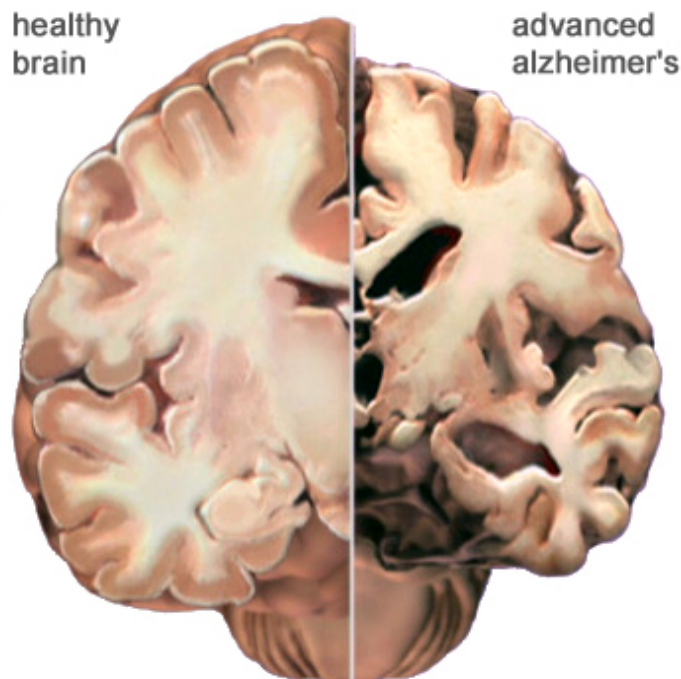
Symptoms:

Dementia symptoms including but not limited to difficulty with:

- Emotional behavior or personality
- Language
- Memory
- Perception
- Thinking and judgment (cognitive skills)

Pathophysiology:

- Loss of neurons and synapses in cerebral cortex
- Gross atrophy
- Degeneration of temporal and parietal lobes
- Microscopy: amyloid deposits and neurofibrillary tangles



Pathology Continued

Hydrocephalus: Poster/Slideshow

“Water on the Brain”

Build-up of fluid (CSF) inside the skull, which causes brain swelling

Causes:

- The flow of CSF is blocked

- Your brain makes too much CSF

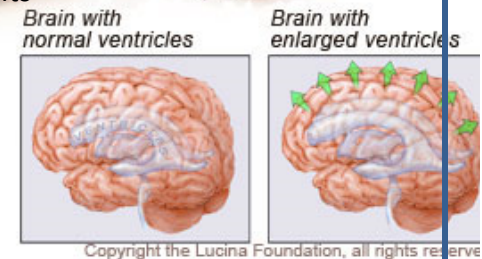
- CSF is not absorbed into the blood properly

Results in increased intracranial pressure

Typically found in infants and children

Without treatment, 60% will die

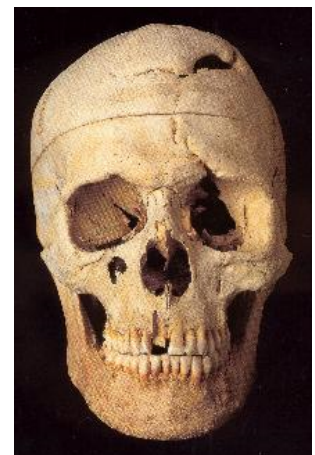
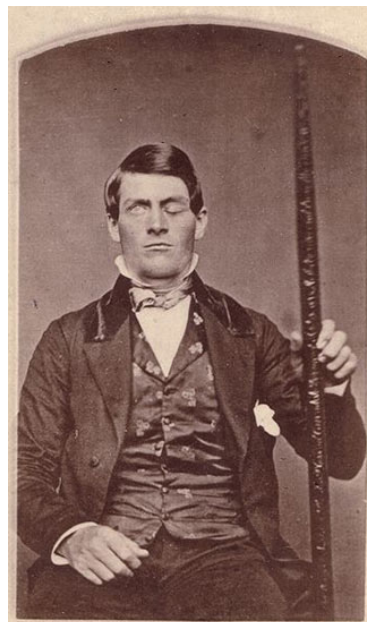
With treatment (surgery, antibiotics) may have intellectual deficits



Phineas Gage: Poster/Slideshow and/or Human Brain to demonstrate frontal lobe

Railroad foreman known for his improbable survival in which an iron rod was driven completely through his head

Damaged much of his frontal lobe - emotion and decision making changes



Pathology Continued

Alcohol: Poster/Slideshow

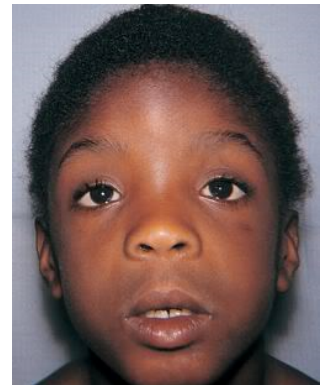
Symptoms:

- Difficulty walking (ataxia)
- Blurred vision
- Slurred Speech
- Slow reaction times
- Memory loss



Wernicke-Korsakoff Syndrome

- Mental confusion
- Ataxia
- Paralysis of oculomotor muscles
- Difficulty with muscle coordination
- Korsakoff's psychosis



Fetal Alcohol Syndrome

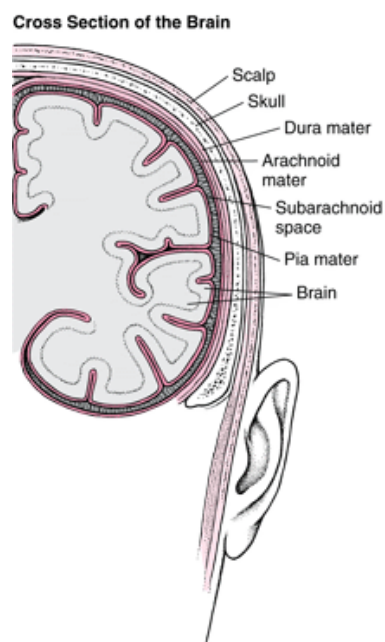
- Damage of alcohol on the developing brain

Subdural Hematoma: Poster/Slideshow

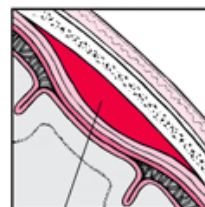
- Bleeding between the dura mater and the brain
- Leads to increased pressure on the brain
- May display neurological symptoms: Slurred speech, confusion, loss of consciousness

Epidural Hematoma: Poster/Slideshow

- Bleeding between the skull and dura mater
- Leads to increased pressure on the brain
- Also may display neurological symptoms
- Treatment: surgery to relieve the pressure and stop the bleeding

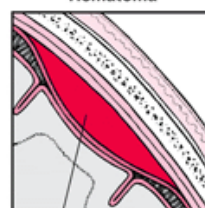


Epidural Hematoma



Bleeding between the dura mater and the skull

Subdural Hematoma



Bleeding between the arachnoid mater and the dura mater