

THE CENTRAL NERVOUS SYSTEM

Spinal Cord

- Functions:

- 1) connection to the peripheral nervous system and brain (both sensory and motor)

- 2) minor coordinating centre for reflex actions

- Structure

- extends from the **foramen magnum** (opening at the base of the skull) through to the 1st and 2nd lumbar vertebrae

- passes through opening in spinal column (31 vertebrae), similar to a string through beads

- contains spinal nerves (paired)

- spinal cord is a compact cylindrical bundle with bulges in two regions

1. neck - cervical area; connects to arms and shoulders

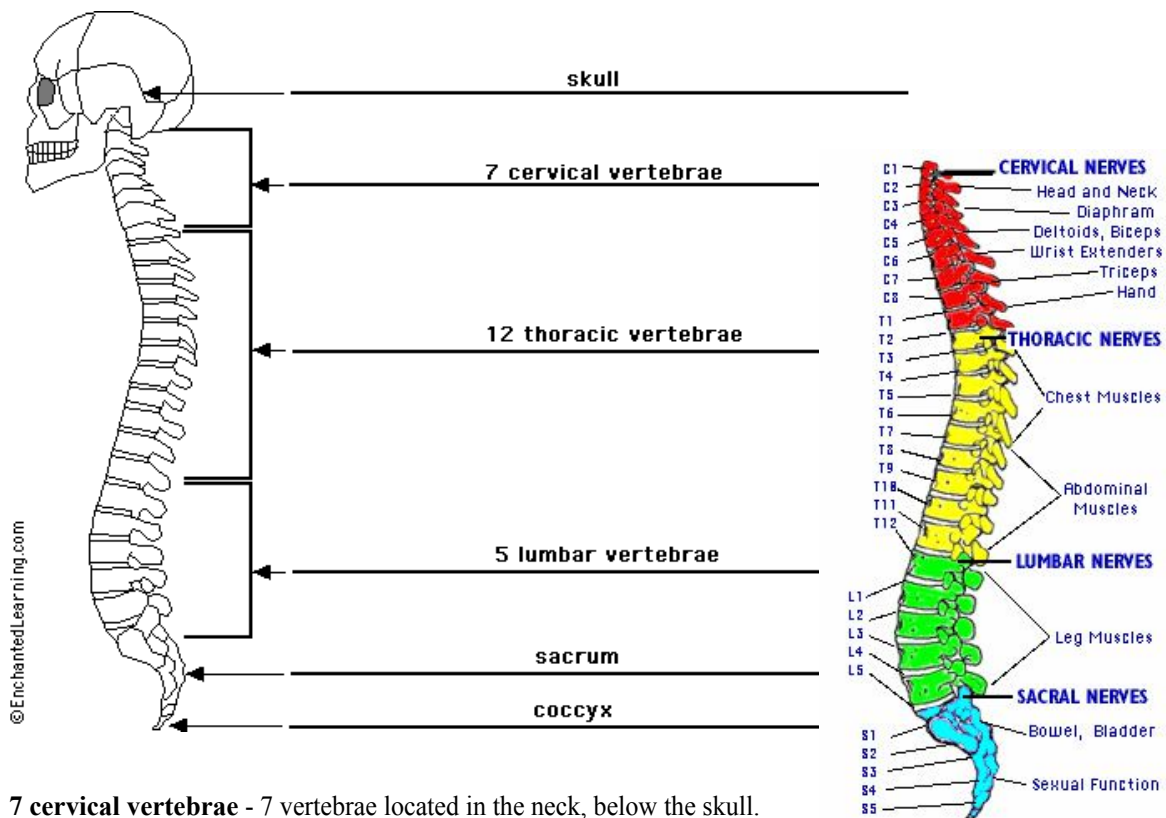
2. lumbar - nerves control pelvis and legs

- at each vertebra spinal nerves leave or enter the spinal cord.

How? - sensory neurons carry impulses to the CNS by the dorsal (posterior) root at the back of the cord

- motor impulses are carried from the CNS by the ventral (anterior) root at the front of the spinal cord

REFER TO HANDOUT



7 cervical vertebrae - 7 vertebrae located in the neck, below the skull.

coccyx - 4 fused vertebrae located below the sacrum.

5 lumbar vertebrae - 5 vertebrae located below the thoracic vertebra and above the sacrum.

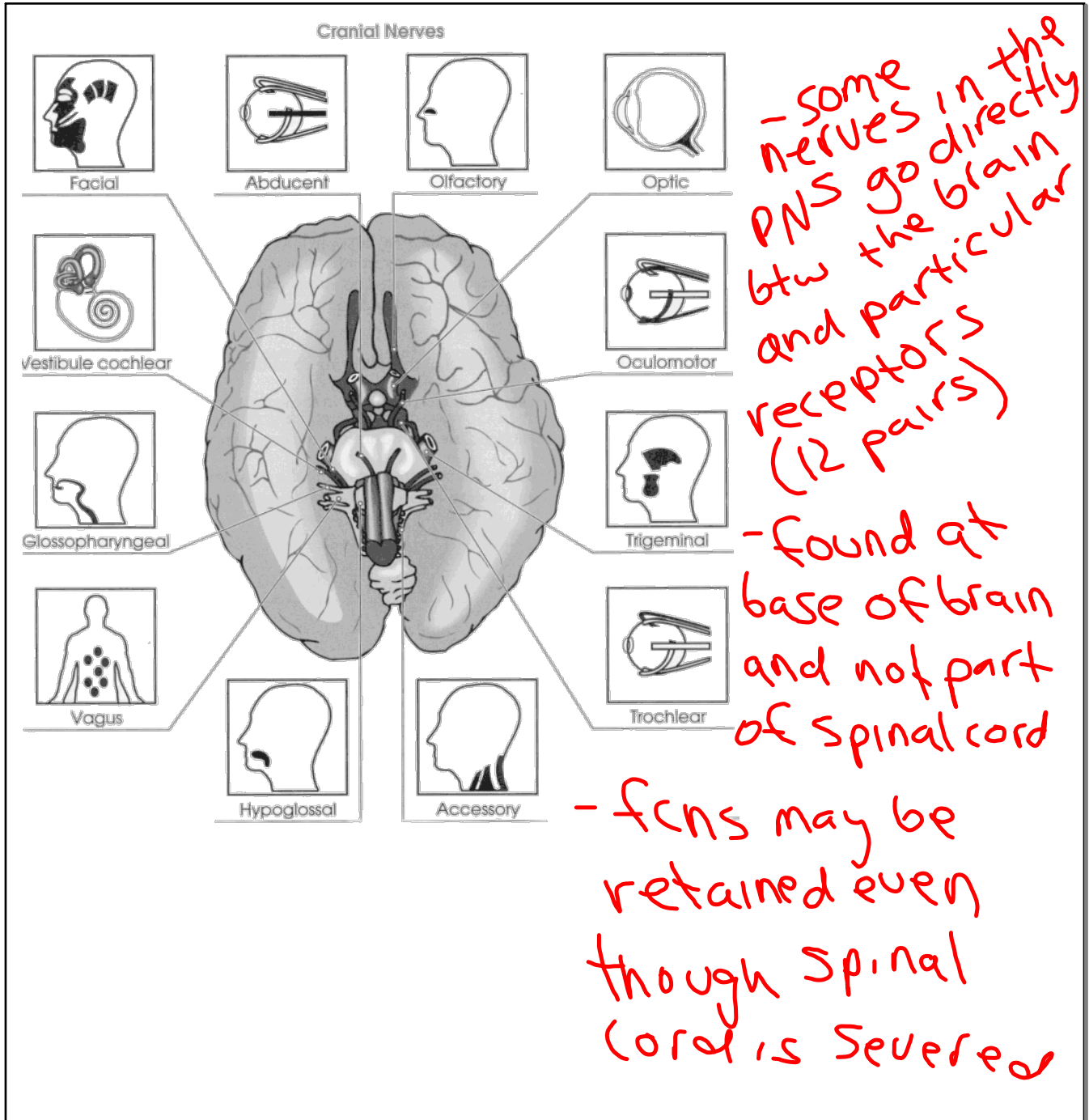
sacrum - 5 fused vertebrae located below the lumbar region and above the coccyx.

skull - the bones in the head that protect the brain.

12 thoracic vertebrae - 12 vertebrae in the mid-back, below the cervical vertebra and above the lumbar vertebrae.

<http://www.youtube.com/watch?v=qigpRFN5o04&NR=1>





The phoneme of the human mind.
According to a research conducted at Cambridge
University, it doesn't matter in what order the letters in a word
are, the only important thing is that the first and last letter be
at the right place. The rest can be a total mess and you can
still read it without a problem.

This is because the human mind does not read every letter by
itself, but the word as a whole.

Inst this amazing!

ACTIVITY - left brain, right brain - with partner interview

1. Please give me your name, home address, and telephone number.
2. Please add the following numbers in your head: 1,2,3,4,5
3. Take this pencil and draw two circles on this piece of paper. Do not look down while you are drawing.
4. Without closing your eyes describe the path you take to get from your house to school.
5. Recite the first half of "Mary Had a Little Lamb."
6. Add the following numbers in your head: 6,7,8,9,10
7. Take this pencil and draw two squares on this piece of paper. Do not look down while you are drawing.
8. Without closing your eyes, describe the outside of the place where you live.

Use the following information to answer the next questions.

Serotonin is a naturally occurring neurotransmitter that plays an important role in a person's mood and emotions. A shortage of serotonin has been associated with phobias, schizophrenia, aggressive behaviour, depression, uncontrolled appetite, and migraine headaches. Synthetic drugs have been developed to enhance or hinder the performance of serotonin in the brain. Some of these drugs include:

I Prozac and Zoloft, which cause serotonin to remain in the brain for longer periods of time.

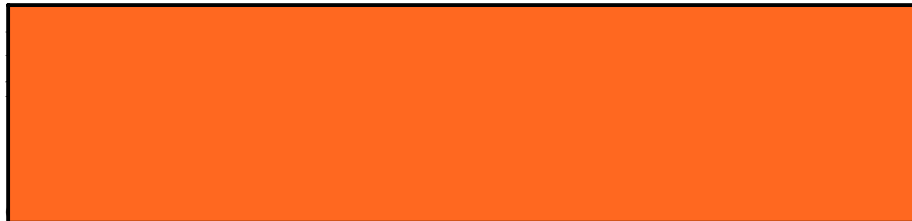
II Drugs, such as Clozapine, that prevent serotonin from binding to post-synaptic membranes.

III Diet drugs, such as Redux and Fenfluramine, that stimulate nerve cells to release more serotonin.

IV Hallucinogens, such as LSD and Ecstasy, that react directly with serotonin receptors to produce the same effect as serotonin.

1. The drugs numbered above that would act as competitive inhibitors to serotonin and the drugs that would slow down the rate of removal of serotonin from the synapse are, respectively,

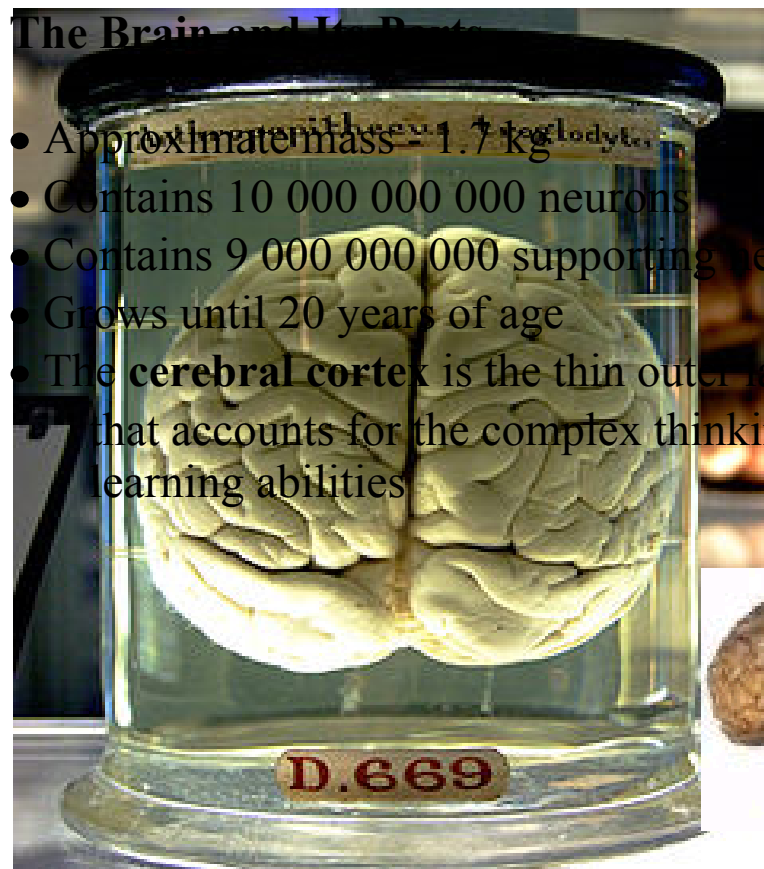
- | | |
|---------------|---------------|
| a. I and III | b. II and I |
| c. II and III | d. III and IV |



2. If a person were suffering from clinical depression, which of the following drugs would not reduce the symptoms of depression?

- | | |
|--------------|-----------------|
| a. LSD | b. Zoloft |
| c. Clozapine | d. Fenfluramine |





- Approximate mass - 1.7 kg
- Contains 10 000 000 000 neurons
- Contains 9 000 000 000 supporting neurons
- Grows until 20 years of age
- The **cerebral cortex** is the thin outer layer of the cerebrum that accounts for the complex thinking, reasoning, and learning abilities



Protection of the Brain

- Well protected
- Skull
- Has three protective membranes, or **meninges**, found between the bony case and the actual nerve tissue of the brain

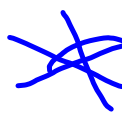
Dura Mater - Outer membrane; closely attached to the inside of the bones of the skull

Arachnoid - middle membrane; between the outer membrane and the inner membrane

Pia mater - inner membrane; covers the brain directly

Note: The **CSF (cerebrospinal fluid)** fills the space (ventricles) between the arachnoid and the dura mater.

- Its functions are:

- 
1. carries nutrients
 2. removes wastes
 3. bathes and cushions cells (acts as a shock absorber)

Demo with eggs and containers.

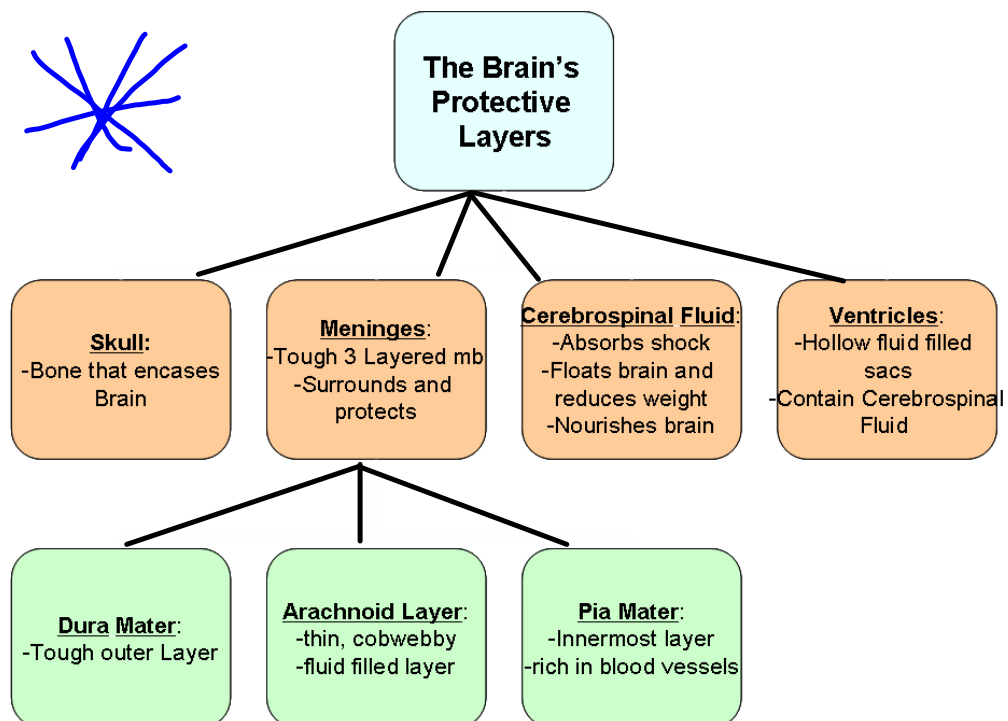
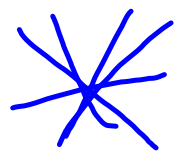
Are You "Left-Brained" or "Right-Brained"?

The brain is divided into two hemispheres, each "pre-programmed" to perform certain activities better than the other hemisphere. The left hemisphere tends to be analytical, responsible for language, and logical. The right hemisphere tends to be more imaginative, visual, and creative. In most people one hemisphere is dominant over the other. The following activity will help you decide if you are "left-brained" or "right-brained". In the diagram below place an X next to those activities you prefer.

Remember, this is only a crude test. Hemisphere dominance is much more complex than implied here.

<p>Left Brain</p> <p>School Subjects</p> <p>Math _____</p> <p>Science _____</p> <p>History _____</p> <p>Reading _____</p> <p>Careers</p> <p>Lawyer _____</p> <p>Accountant _____</p> <p>Computer _____</p> <p>programmer _____</p> <p>Personal Characteristics</p> <p>Factual _____</p> <p>Logical _____</p> <p>Organized _____</p>	<p>Right Brain</p> <p>School Subjects</p> <p>Music _____</p> <p>Art _____</p> <p>Philosophy _____</p> <p>Shop _____</p> <p>Careers</p> <p>Actor _____</p> <p>Dancer _____</p> <p>Writer _____</p> <p>Personal Characteristics</p> <p>Imaginative _____</p> <p>Spontaneous _____</p> <p>Intuitive _____</p>
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Do you tend to be 'left brained' or 'right brained'?
How might your motivation and previous experience affect your choices?



Parts of the Brain

- Hindbrain
- Midbrain
- Forebrain

Hindbrain

- includes the medulla oblongata and the cerebellum

a) **Medulla Oblongata**

connection btw
peripheral + CNS

- small, swollen extension of the spinal cord
- controls vital functions - also coordinating center for ANS

Functions

1. send nerve impulses that stimulate the diaphragm and muscles for breathing

2. control heartbeat and diameter of blood vessels

3. serves as a pathway to higher areas of the brain and the motor nerves and muscles

b) **Cerebellum**

muscle coordination
+ balance

- located just above the medulla
- curved grooves running over it, gives it a furrowed appearance
- contains white matter squeezed in between the grey

Activity - Uncontrollable foot

Functions:

1. balance
2. co-ordination of movement
3. muscle tone

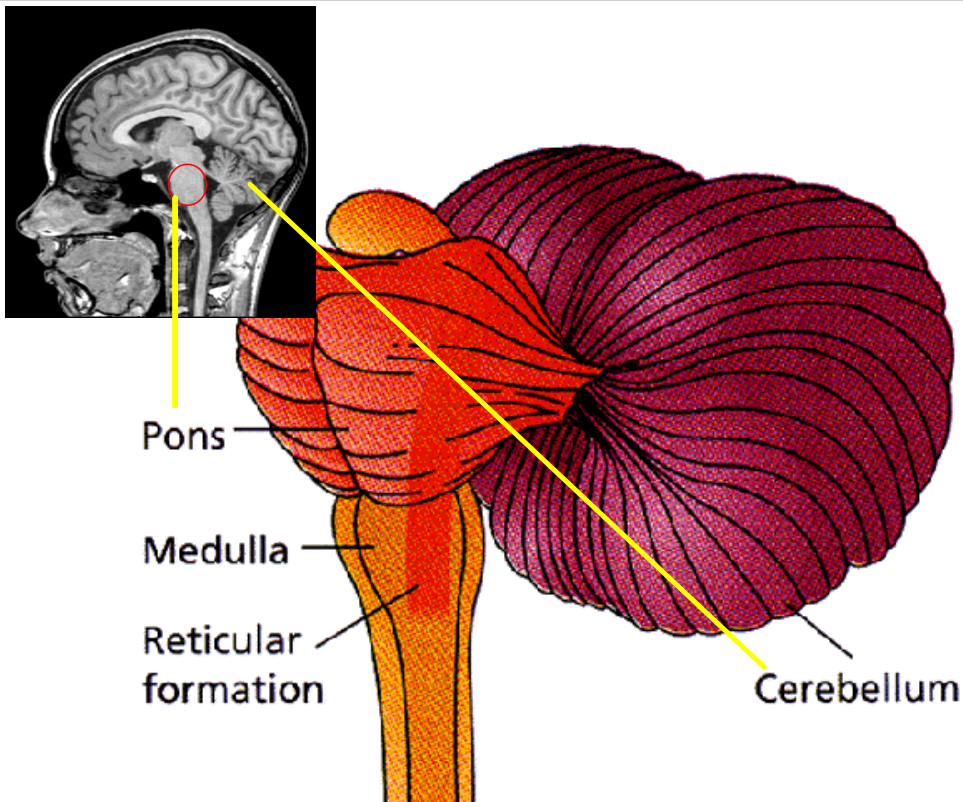
It organizes impulses originating in the cerebrum and integrates these with the stream of signals coming in from sensory organs (body movement)

c) **Pons**

- act as a bridge
- located between medulla and midbrain

Functions:

1. **spheres** - relay center for eye and ear reflexes
2. below the spheres are conducting tissues of white matter connecting the higher centers of cerebrum with pons, cerebellum, and spinal cord



The **reticular formation** is a part of the brain which is involved in stereotypical actions, such as walking, sleeping, and lying down. It is absolutely essential for the basic functions of life.

Midbrain

- contains grey matter (unmyelinated fibers) and white matter (myelinated fibers)
- located below the cerebrum above the pons
- forms part of the brainstem
- relays visual and auditory information between areas of the hindbrain and forebrain.
- plays important role in eye movement and control of skeletal muscles

Forebrain

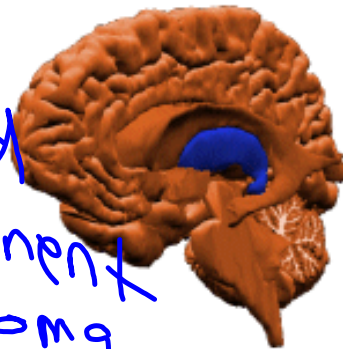
- contains the thalamus and hypothalamus

a) Thalamus

- grey matter
- located above the hypothalamus and below the cerebrum

Functions:

- affects consciousness
- body temperature
 - relays sensory info to the cerebrum
- degree of awareness of pain
 - relays motor info from the cerebrum to the spinal cord



* damage
could lead
to permanent
coma

play s important
role in regulating
state of sleep +
wakefulness,
arousal, level of
awareness +
activity

b) Hypothalamus

- grey matter
- connected to the pituitary (links endocrine system to nervous system)

plays a large role in maintaining bodies internal equil.

Functions:

1. controls the ANS and internal organs of the body
 - Hunger, Thirst, Aggression, Sex-drive, Rage, Pleasure & Body Temperature.
2. directs production of:
 - special secretions
 - activities of the intestinal tract
 - blood pressure
 - regulation of water balance and control of urine output

synthesizes and secretes hypothalamic releasing hormones (neurohormones)

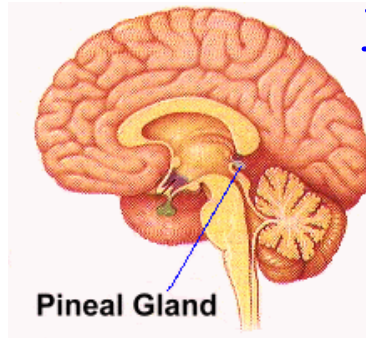


Stimulate or inhibit the secretion of pituitary hormones

- **Pineal Gland**

— part of endocrine system
— produces melatonin

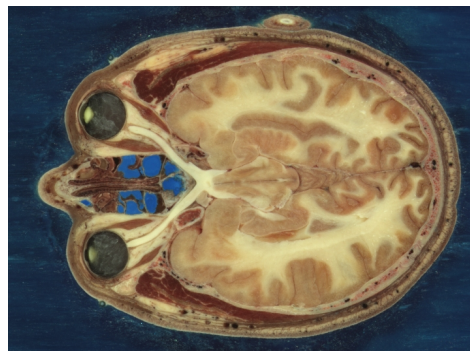
- Internal clock: controls sleep/wake pattern
- Responds to light



↳ hormone
that affects
the modulation
of wake/sleep
patterns and
photo periodic
(seasonal fn)

- **Optic Chiasma**

- Allows eyes to work together
- Where the optic nerves crossover.



Cerebrum

- largest part of the human brain
- contains billions of neurons and synapses
- highest center of nervous control

Cerebral cortex

- surface of cerebrum (2-4 mm thick)
- coats over the surface
- has folds to increase the surface area
 - deep folds - fissures
 - shallow folds - sulci

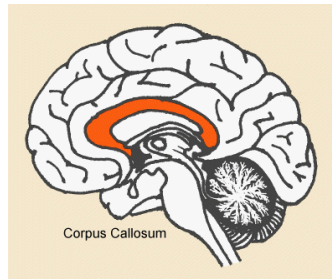


Cerebral hemispheres

- divides the brain into two halves
- has a deep longitudinal fissure

Corpus callosum

- a bundle of fibers which cross from one hemisphere to the other, connects cerebral hemisphere internally



- surgical isolation of layers is sometimes used to treat epilepsy
- Scientists believe epilepsy can be caused by an overload of neurological electrical activities
- o corpus callosum is cut to prevent spread of seizures from one hemisphere to other

The brain can be divided into four lobes:

1. **Parietal** - top, back; senses touch, temperature, emotions, speech interpretation
2. **Frontal** - front; motor control (walking, speech), intellectual activities, personality
3. **Temporal** - sides; vision and hearing
4. **Occipital** - low, back; vision

olfactory bulb - bottom of temporal lobe

- receives and interprets info. about smell

Frontal Lobe

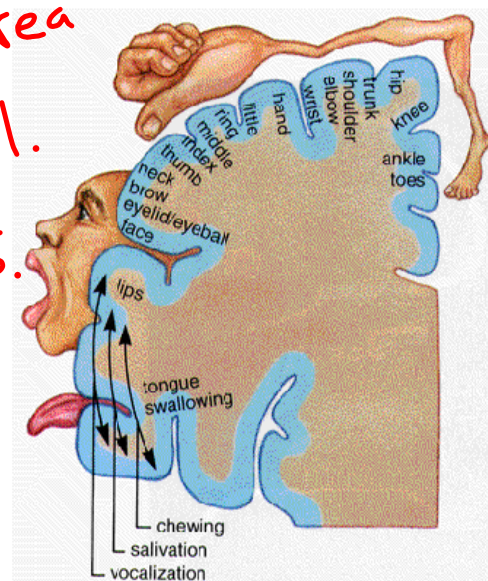
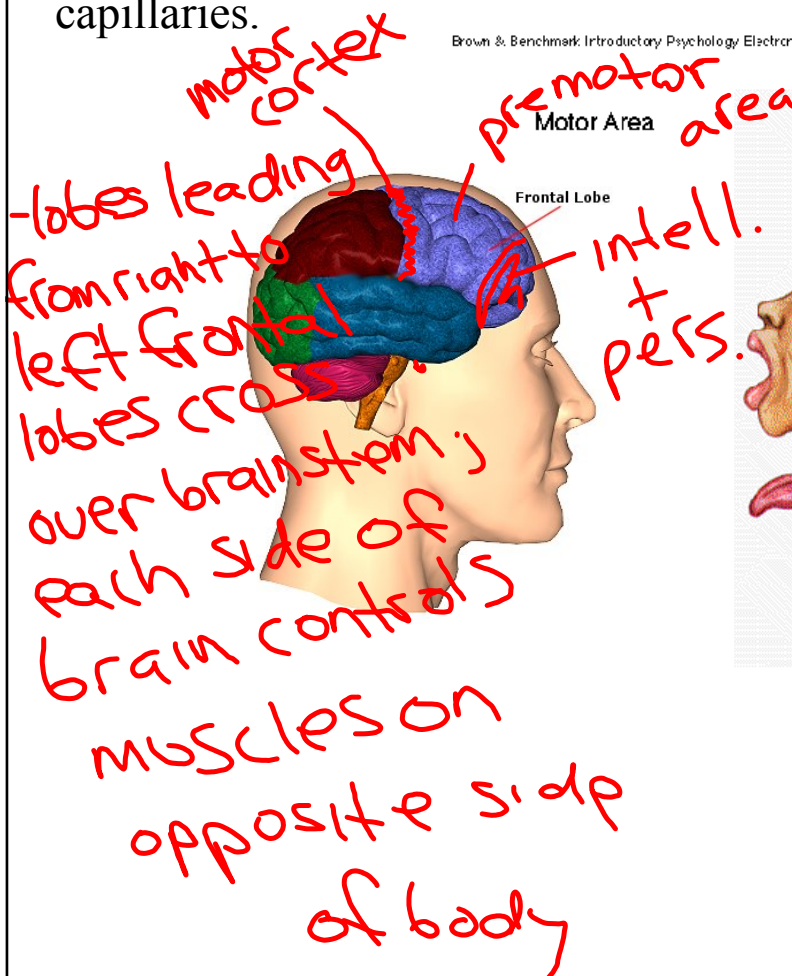
- Greatly developed in humans.
- Controls all voluntary movement.

ex., regular walking, running, speech, arm movement

Contains the MOTOR CORTEX

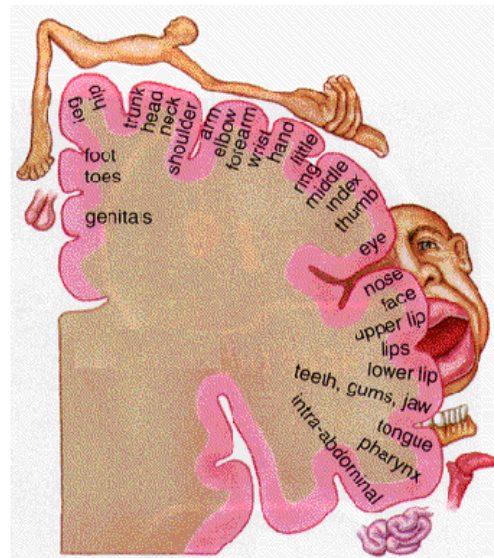
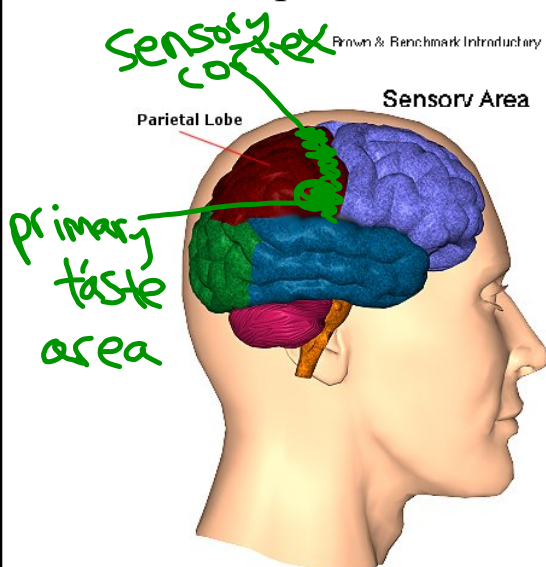
- Front of frontal lobe - area that controls our basic intelligence and personality.
- Has glial cells that support and nourish the brain; these tightly packed neurons are fed by a network of blood vessels and capillaries.

Brown & Benchmark: Introductory Psychology Electronic Image Bank copyright © 1995 Times Mirror Higher Education Group, Inc.



Parietal Lobe

- Contains the SENSORY CORTEX
- Sensation of touch: skin
- Internal sensation (pressures like bloating)
- Comprehension of senses (velvet vs. sandpaper)

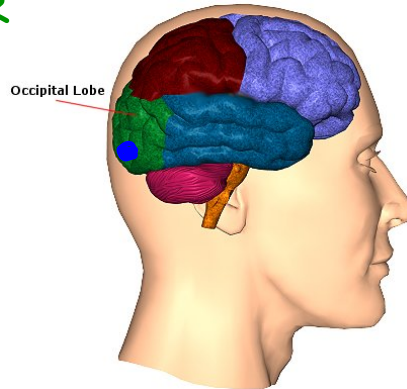


- parietal lobes
also help process
info. about body's
position + orientation

damage could result in person being able to see but not recognize objects

Occipital Lobe:

- Receives info from the eyes
- Responsible for reading, vision, visual association



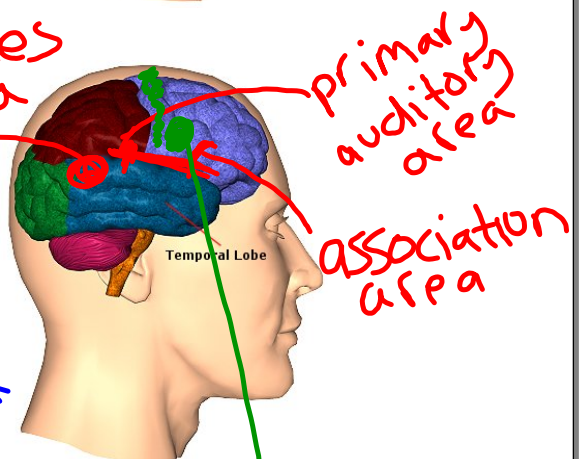
Temporal Lobe:

- Responsible for hearing, music, some speech, some smell and fear!

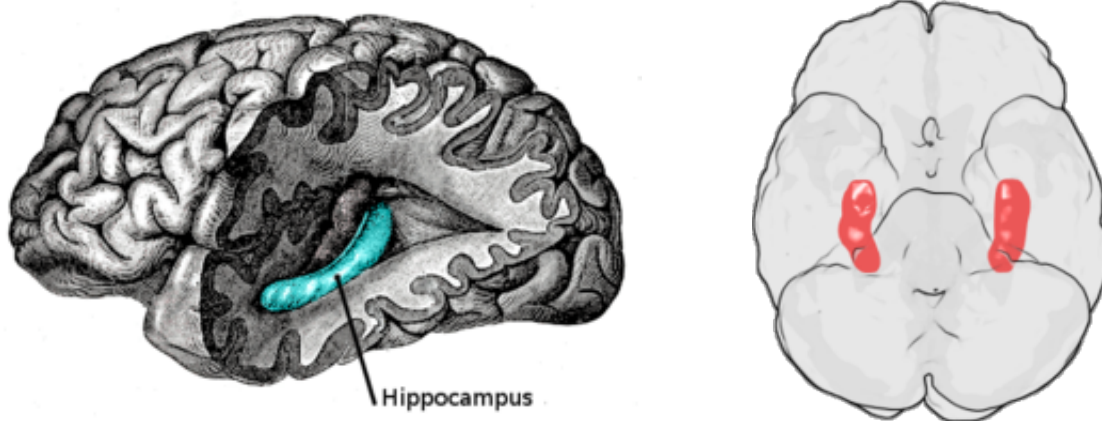
Shares in the process of visualization but main function is auditory reception.

- also linked to understanding speech + retrieving visual + verbal memories

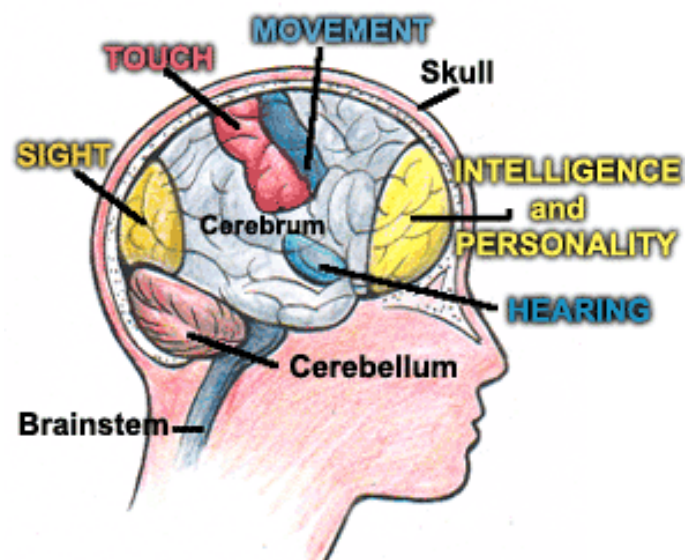
(sensory) speech Wernickes area



Brocas area (motor speech)



Plays major role in short term memory and spatial navigation.



<http://www.youtube.com/watch?v=Li5nMsXg1Lk>



PET

Positron emission tomography

- more active areas of brain have higher energy demands
- person receives injection of radioactive labelled glucose and then scanner monitors glucose consumption in brain
- different colours represent different activity levels
- used to diagnose a stroke, Alzheimers disease

MRI

Magnetic resonance imaging

- produces clear images of brain
- giant magnet surrounds persons head and changes in direction of magnetic field induced hydrogen atoms in brain to emit radio signals which can be detected, translated and displayed as structural or functional image
- identify brain tumors

Evaluation

1. List the four regions of the cerebral cortex and state the functions of each.
2. A physician makes an incision completely through the corpus callosum. How might this affect the patient?
3. Identify the four lobes of the cerebrum, and describe the function of each.
4. Describe the primary areas of the brain that are responsible for the fine motor control of the muscles, as well as the area that processes sensory information from the skin.
5. Complete the case study on p 374 - Pineas Gage

Next class ~~Activity~~

P430
1-3
P432
1-8