Brain Anatomy

HASPI Medical Anatomy & Physiology 11c

Lab Activity

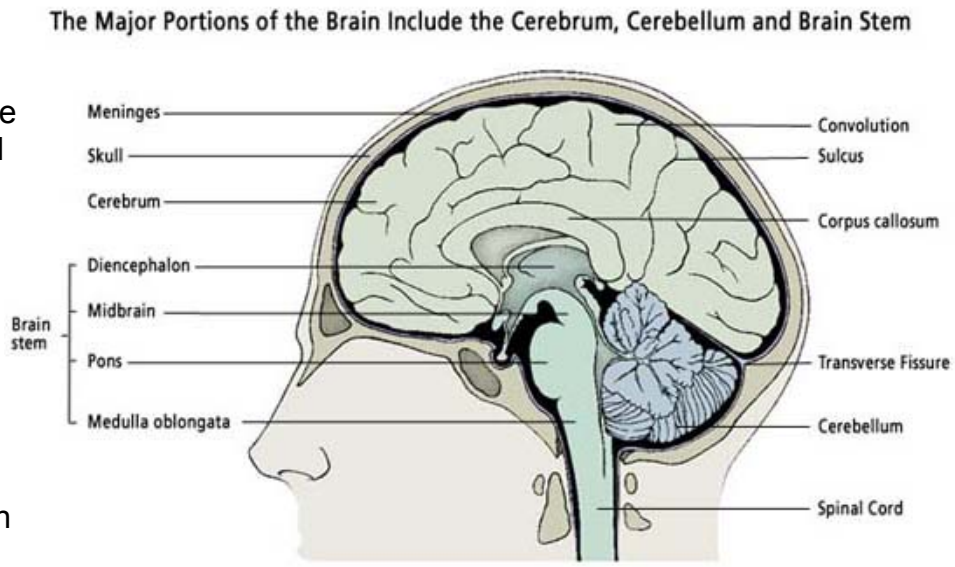
Name(s): _____

Period: _____ Date: _____

Background

The Brain

The brain is the control center of the body and is housed within the protective hard skull, layers of tissue called meninges, and cerebrospinal fluid. The male adult brain weighs approximately 1400 g, while the female adult brain is approximately 1300 g, with a consistency similar to tofu. As we age, we lose more than a gram of brain tissue each year. The brain uses 20% of the oxygen and 25% of the glucose in our bodies. The brain is not fully developed until 16-17 years old with dramatic changes in the front lobes occurring through puberty. This is an important area for decision-making and judgment. Perhaps the next time your parents are mad at you for poor decision-making, you may try to blame it on your underdeveloped brain!

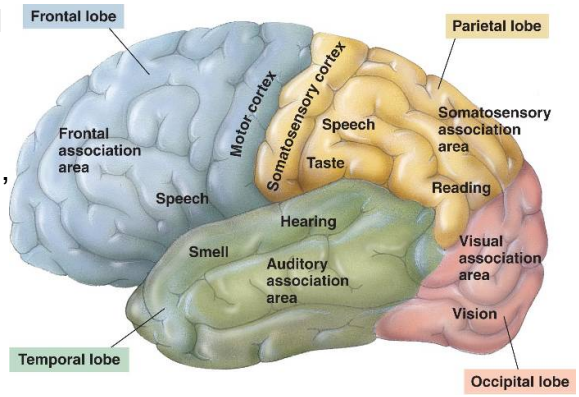


http://www.princetonbrainandspine.com/photos/brain_anat/brain_portions_illus20a.jpg

The brain has neurons arranged into either white or grey matter. White matter is only made up of the axon portion of the neuron and relays messages from different portions of the grey matter. Grey matter is made up of the cell bodies of the neurons and is capable of storing and receiving nerve impulses from the body and other parts of the brain. The brain has different regions that are responsible for different functions. There are three principle parts:

- **Cerebrum** – this makes up most of the brain and is divided into a left and right hemisphere. The cerebrum functions in learning, speech, emotion, reasoning, vision, hearing, touch, and fine movements. The surface of the cerebrum is called the cortex and is covered with grey matter arranged in folds. A fold in the brain is called a gyrus, and lines in between the folds are called the sulcus. This folding increases the overall surface area of the brain, providing more space for neurons.
- **Cerebellum** – Located under the cerebrum, the cerebellum maintains posture, balance, and is responsible for movement.
- **Brainstem** – Located at the base of the cerebrum and just anterior to the cerebellum. The brain stem is made up of the medulla, midbrain, and pons, which are responsible for maintaining important functions of the body including respiration, circulation, body temperature, sleep, digestion, and swallowing.

Each of these parts of the brain are broken up into smaller areas based on the function they perform. For example, the cerebrum is broken up into several lobes. The figure to the right identifies some of these lobes. The inner brain houses important endocrine glands and structures.



http://bio1152.nicerweb.com/Locked/media/ch49/49_15CerebralCortex-L.jpg

Neurotransmitters

Neurotransmitters are chemicals that move between synapses and continue to relay impulses between neurons. Different types of neurotransmitters relay different messages. For example, serotonin can relay messages about mood, while dopamine relays messages about movement. The following table summarizes a few common neurotransmitters and their functions.

Neurotransmitters and Their Effects				
Name	Primary Function	Locations	Receptors	Notes
Acetylcholine	Muscle control, memory formation, sensory response. Excitatory.	Neuromuscular junctions, CNS	Nicotinic, muscarinic	One of the most common, very well studied. A major player in memory. Imbalances cause twitching or paralysis.
Serotonin	Intestinal movement control, mood regulation, apetite, sleep, muscle control	Gut, CNS	5-HT	Most antidepressants mimic the effect of serotonin. Most narcotics affect its release or reuptake
Dopamine	Reward pathways, cognition, voluntary motion	Hypothalamus	D1, D2, D3, D4, D5	Imbalances cause Parkinsons. Cocaine and opiates have a significant effect on its release.
Norepinephrine	Fight or Flight response (increased heart rate, increased glucose in bloodstream, increased oxygen to brain and muscles)	Adrenal medulla	Andrenergic	Produced from Dopamine in the adrenal glands (on kidneys)
L-DOPA	Precursor to dopamine	Hypothalamus	N/A	Able to cross the blood-brain barrier making it an excellent pharmaceutical for treatment of Parkinsons or depression.
Tryptophan	Precursor to Serotonin	Blood	N/A	essential amino acid
GABA	Inhibits CNS	Brain	GABAA, GABAB	Mediates muscle tone, Receptors susceptible to alcohol which creates CNS depression
Glycine	Inhibits signals	Spinal Cord, Brainstem	NMDA	amino acid
Tyramine	Blood Pressure regulation	CNS, Kidney	TA1	amino acid, minor neurotransmitter that is largely not understood
Glutamate	Long-term potentiation, memory	CNS, PNS	NMDA, others	Most common

http://brainyinfo.com/home/wp-content/uploads/2011/03/Neurotransmittersandeffects.jpg

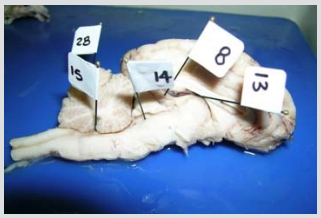
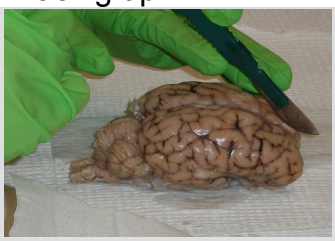
Materials

Sheep brain	Forceps	Masking tape
Dissecting pins (22)	Dissecting pan	Marker/pen
Scalpel	Paper towels	Textbook/internet

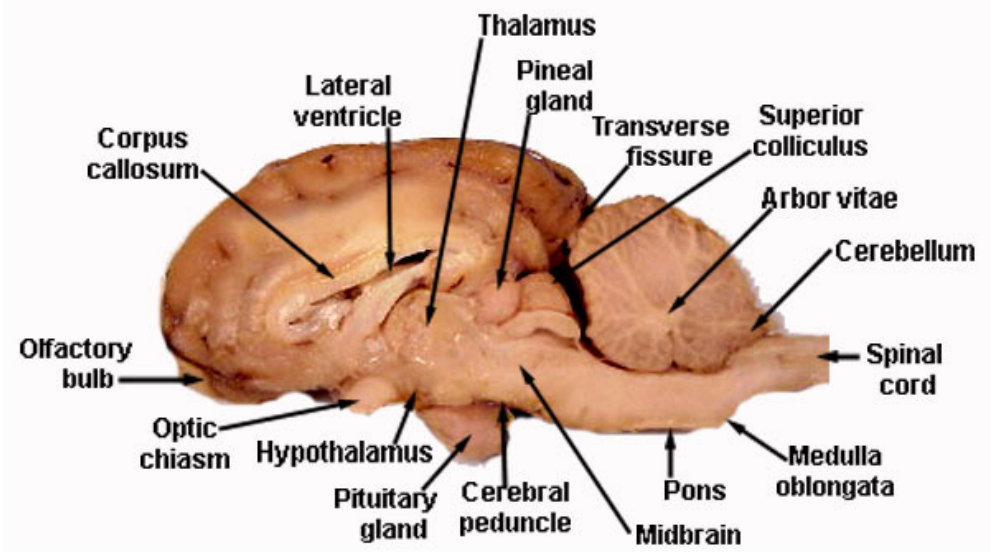
Procedure

In this lab you will identify and label different portions of a sheep brain to help memorize and identify similar portions within the human brain. Sheep brains are smaller than the human brain, but remain very similar in structure.

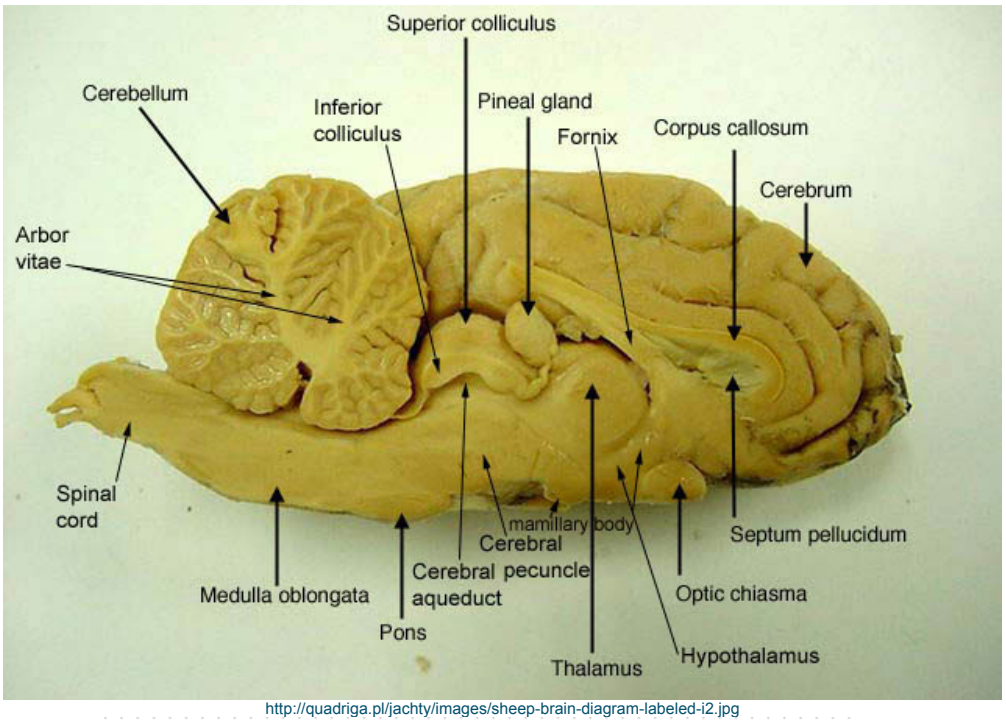
Directions

		✔when complete
Step 1	Obtain 22 dissecting pins, a marker/pen, and a long piece of masking tape.	
Step 2	Tear a 2 to 3-inch piece of masking tape from the long piece of tape. Wrap it around the dull end of one of the dissecting pins and push the sticky sides together. Repeat this process for all 22 of the dissecting pins.	
Step 3	Using the marker/pen, write each of the brain structures listed in Table 1 on the tape wrapped around the dissecting pins. The labeled pins will eventually be placed into the structure of the sheep brain listed on each pin. See the diagram for an example. 	
Step 4	Obtain a dissecting pan, scalpel, forceps, sheep brain, and paper towels.	
Step 5	There may be a cloudy layer of skin covering your brain. This is the protective meninges. If your brain still has the meninges, use the forceps and scalpel to remove this layer.	
Step 6	Place the brain flat on the dissecting pan with the cerebrum facing up.	
Step 7	Notice that there is a line down the center of the brain separating it into two halves, also known as the hemispheres. Use the scalpel to cut the brain exactly in half down the center of the cerebrum into its right and left hemisphere.  http://farm4.static.flickr.com/3264/3172773999_b329b23e4f.jpg	
Step 8	Lay one half of the brain with the internal structures facing up in the dissecting pan. Lay the other half down so the external structures face up. 	
Step 9	Use the comparison diagrams of sheep brains on the next page to place the 22 labeled dissecting pins into the sheep brain.	
Step 10	Once all of the pins are placed, call your instructor over to check your work. Incorrectly placed pins will be marked with an "X" in Table 1 by your instructor.	
Step 11	Practice memorizing the parts of the brain by turning the label around and identifying the location of each pin aloud in your group. Continue until you are able to identify all 22 pins without looking.	
Step 12	Remove the pins from your brain and discard the brain according to your instructor's directions.	
Step 13	Use a textbook or internet search to look up the function of each structure.	

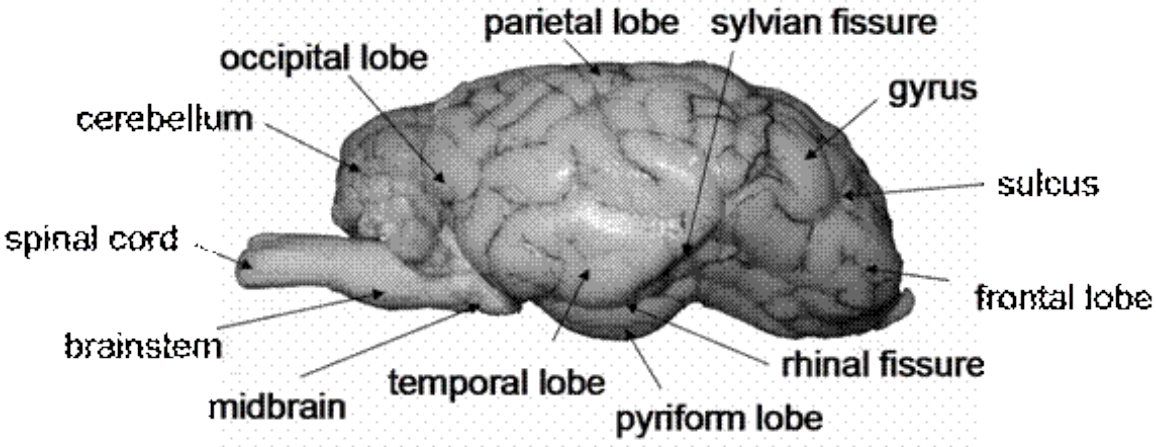
Comparison Diagrams – *Use the following diagrams to place the labeled dissecting pins.*



http://www.biologyjunction.com/images/sheep-brain-sagittal.jpg



http://quadriga.pl/jachty/images/sheep-brain-diagram-labeled-i2.jpg



http://www.its.caltech.edu/~cnchiu/teaching/sheepbrainlab_files/image020.gif

Table 1. Structure and Function of the Brain			
Brain Structure		**Correct Placement** *(Your instructor will check and X any structure that was incorrectly placed on your sheep brain)*	**Function**
1	Cerebrum		
2	Cerebellum		
3	Spinal cord		
4	Medulla oblongata		
5	Pons		
6	Midbrain		
7	Lateral ventricle		
8	Frontal lobe		
9	Parietal lobe		
10	Occipital lobe		
11	Temporal lobe		
12	Corpos callosum		
13	Thalamus		
14	Optic chiasma		
15	Pineal gland		
16	Superior colliculi		
17	Inferior colliculi		
18	Pituitary gland		
19	Hypothalamus		
20	Arbor vitae		
21	Fornix		
22	Olfactory bulb		

Analysis – Label all of the structures listed in Table 1 on the following diagrams. Draw lines/arrows to mark the correct location.

http://www.profelis.org/amc/ap1/jpegs/schafgehirn_0444-ssc_50c.jpeg

http://bio.rutgers.edu/~gb102/lab_5/brain/brain_side_du.jpg

Review Questions - *on a separate sheet of paper complete the following*

1. What are the three structures that protect the brain?
2. What is the function of the brain?
3. (Approximately) how much does the male and female brain weigh?
4. Explain why a teenage brain may contribute to poor decision-making or judgment.
5. What is the difference between grey and white matter?
6. What is the function of the cerebrum?
7. In terms of the folds in the brain, what are gyrus and sulcus?
8. What is the function of the cerebellum?
9. What is the function of the brainstem?
10. List the four lobes of the cerebrum and at least one function of each lobe.
11. What is a neurotransmitter?
12. What is the function of acetylcholine?
13. What is the function of serotonin?
14. What is the function of dopamine?
15. What is the function of glutamate?