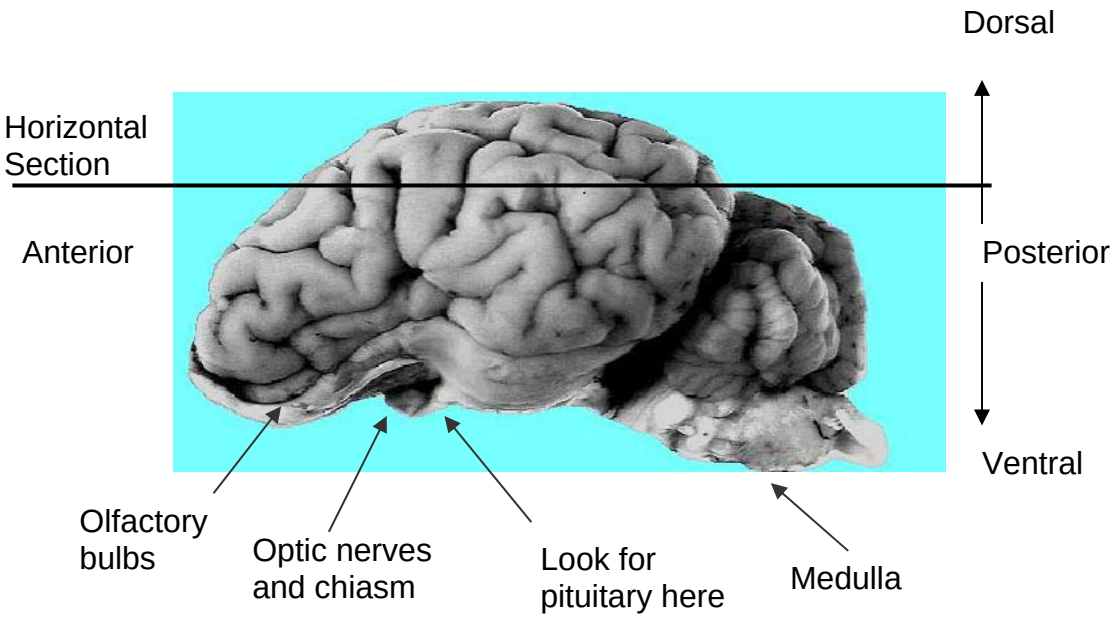
Neuroanatomy:
Dissection of the Sheep Brain

The basic neuroanatomy of the mammalian brain is similar for all species. Instead of using a rodent brain (too small) or a human brain (no volunteer donors), we will study neuroanatomy by examining the brain of the sheep. We will be looking as several structures within the central nervous system (CNS), which is composed of the brain and spinal cord. You will learn individual structures now; later you will be looking at brain systems to see how different parts of the brain form functional units.

Just as we differ with respect to individual characteristics, brains also differ slightly in the size, coloration, and shape of some structures. Carefully examine the brain you and your group are dissecting and try to look around the room at some other brains so you can see how the structures may vary. This is especially important when examining the cranial nerves, since rarely will all 12 nerve pairs be preserved on any one brain.

This handout will guide you through the dissection and identification of structures. Refer to your text and the accompanying CD for additional information about comparative structures and functions. The last page of this handout lists all the structures you should be prepared to identify for the test. If the structure is marked with *, you should be prepared to identify the function of that structure. Check out the terrific tutorial of a sheep brain dissection on the web site at the University of Scranton (http://academic.uofs.edu/department/psych/sheep/).

Lateral View of the Sheep Brain

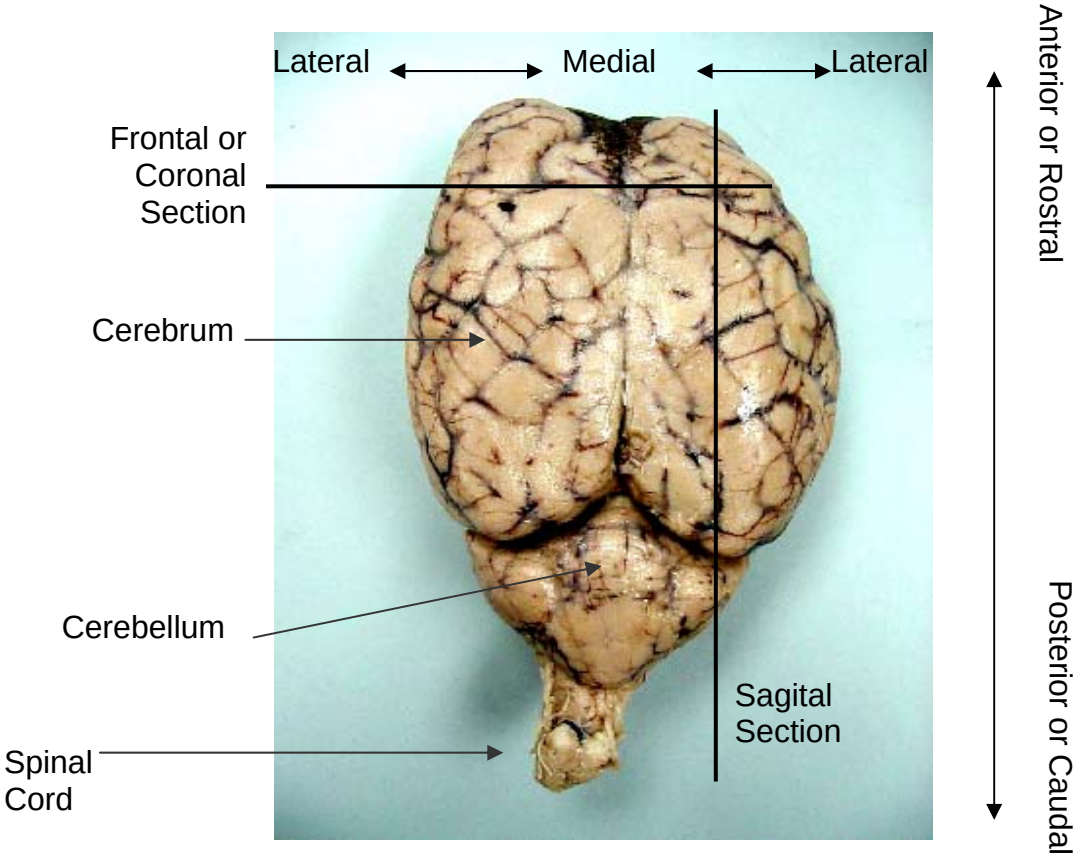


External and Midline Anatomy

Examine the sheep brain with the membranes intact. You should be able to identify and use the following directional terms:

Anterior / Posterior	front / back
Rostral / Caudal	towards the beak / towards the tail
Medial / Lateral	towards the middle / towards the side
Dorsal / Ventral	top / bottom (on the CNS of a quadruped)
Superior / Inferior	on top of / underneath
Frontal or Coronal section	parallel to rostral/caudal axis
Horizontal section	parallel to dorsal/ventral axis
Sagital section	parallel to medial/lateral axis
Mid-sagital section	bisects the brain into symmetrical halves

Dorsal View of the Sheep Brain

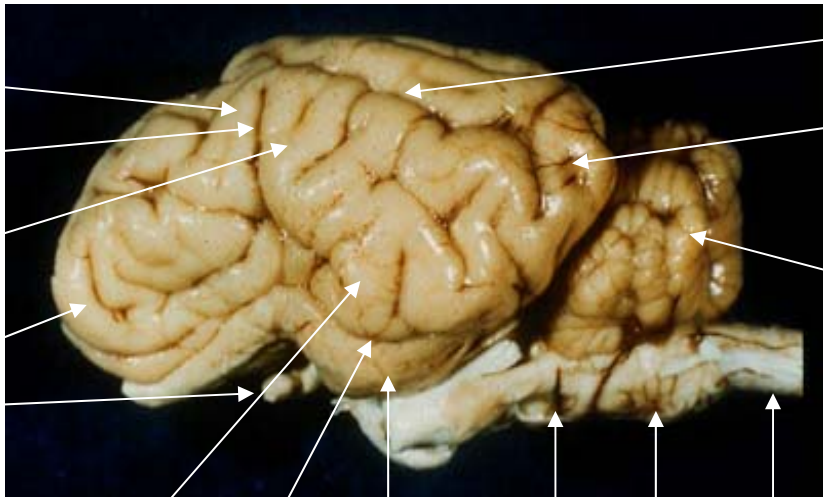


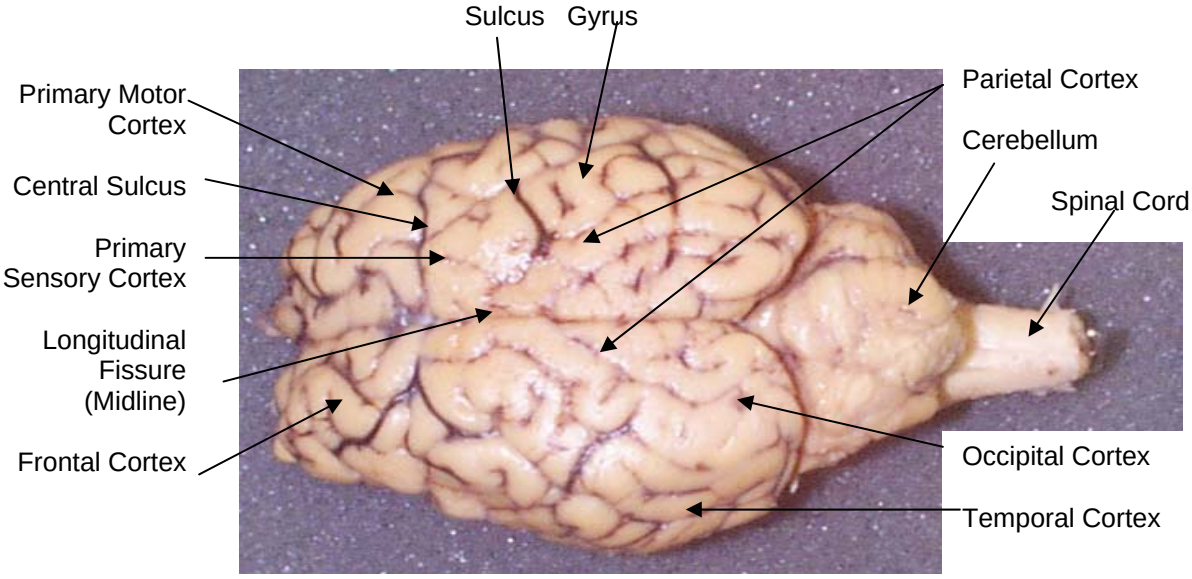
Dorsal and Lateral Structures

The largest structure in the dorsal view is the **cerebral cortex**, the covering of the cerebrum. The cortex is folded upon itself, with a number of **gyri** (hills, one is called a **gyrus**) and **sulci** (valleys, one is called a **sulcus**). The **dura mater** is the toughest layer of the meninges, and has been removed from these specimens. The **pia mater**, another layer of the meninges, is the thin membrane that adheres tightly to the surface of the brain, dipping into each sulcus. If you pull away a small amount of the pia mater, you can see the depth of the sulci. The **arachnoid**, another layer of the meninges, is an ultra-thin spongy layer that is very difficult to see without a microscope.

Locate the four lobes of the cerebral cortex: **frontal, parietal, temporal,** and **occipital**. The **rhinal fissure** separates the **pyriform cortex** from the temporal lobe. To distinguish between these lobes, the temporal lobe has many more sulci and gyri compared to the relatively smooth and (in evolutionary terms) older pyriform cortex. The **central** or **ansate sulcus** runs from the midline almost all the way to the ventral surface. (This can be a little tricky to find on the sheep brain – let me know if you need help.) Anterior to the central sulcus is the **primary motor cortex**, posterior is the **primary sensory cortex**. Identify the **cerebellum**, which is attached to the **medulla oblongata** (often referred simply as the **medulla**). If you bend the cerebellum down gently, you can peek under the cerebral cortex and see the **tectum**, consisting of the superior **colliculus** and the **inferior colliculus**.

Lateral View of the Sheep Brain

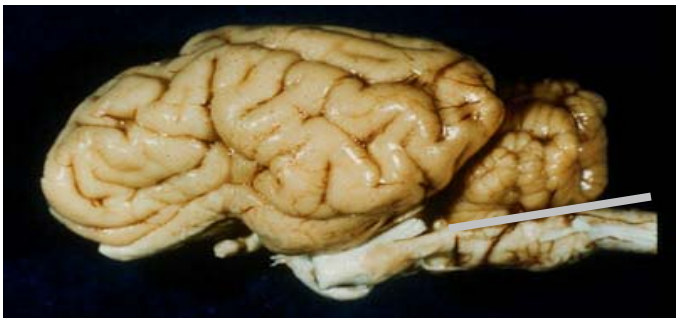




Dorsal View of the Sheep Brain

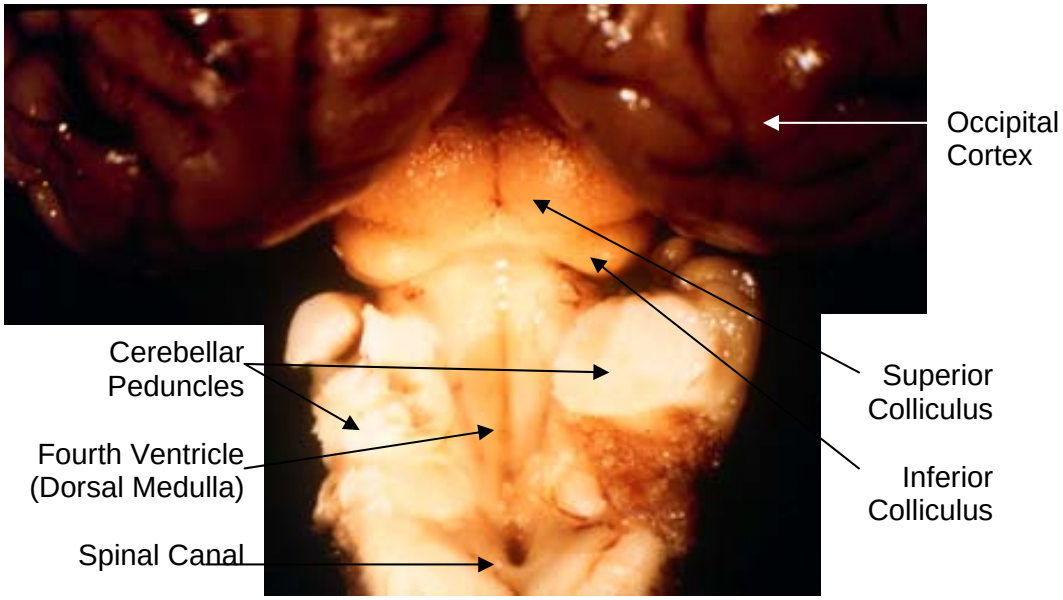
Cerebellar Dissection

Use the knife to cut the cerebellum off of the medulla. From the posterior end, gently lift the cerebellum and make a horizontal cut through the **cerebellar peduncles**, large fiber tracts from the spinal cord to the cerebellum. Do not cut through the medulla.

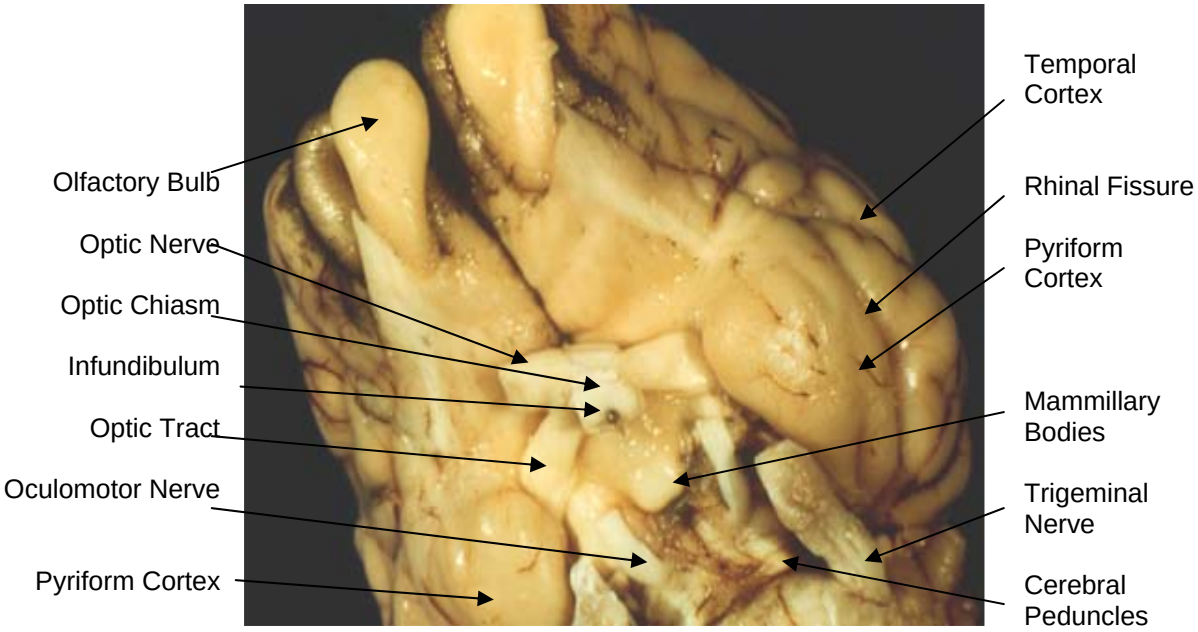


Cut the cerebellum from the brain stem according to the orientation indicated by the gray line

The dorsal surface of the medulla forms the floor of the **fourth ventricle**. The cerebellum, with the attached anterior and posterior membranes forms the roof of the fourth ventricle. The fourth ventricle is continuous posterior with the **spinal canal**, and anterior with the **third ventricle** via the **cerebral aqueduct**. The third ventricle and the cerebral aqueduct will be more easily visualized from the midline perspective. The ventricular system in the brain is an important means of rapid communication. It is continuous within the central nervous system (CNS). Bisect the cerebellum from anterior to posterior (cut it in half). Notice the white "lines" running through. The fiber tracts sending information from one area to another appear white due to the presence of myelin. Myelin surrounds the axon and speeds the electrical signal passing down the axon. The darker gray matter is the cerebellar cortex, and is made up of cell bodies, unmyelinated projections, and glia.

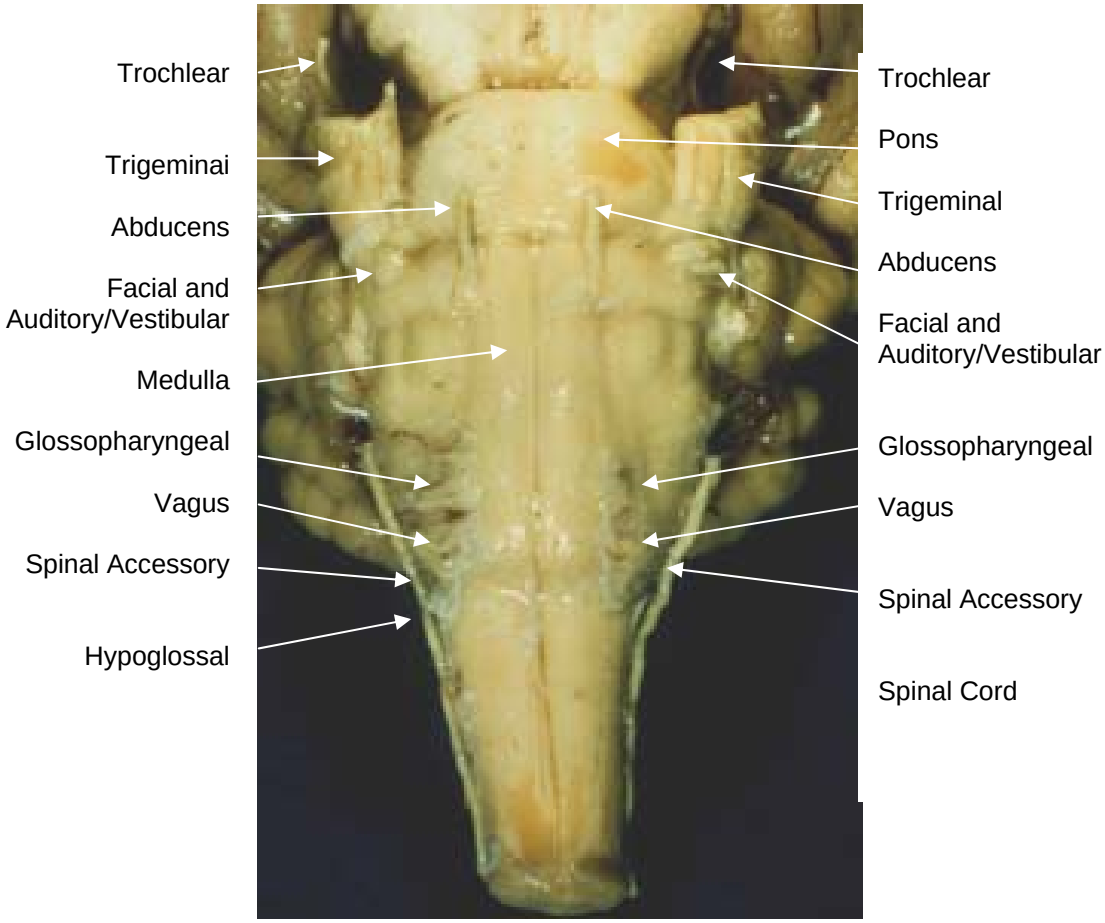


Ventral Surface Structures and Cranial Nerves

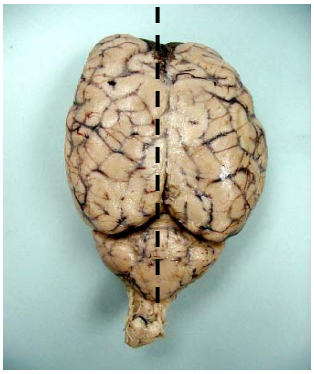


Identify each of the 12 cranial nerve pairs. You probably won't have all 12 on your sheep brain – look at other brains, look at the demonstration brain at the front of the room and see if you can find examples of each pair.

Identify the **olfactory bulbs**. Why is this larger in sheep than humans? The **optic nerves**, **optic chiasm** and **optic tracts** are prominent and will serve to orient you for the following structures. The pituitary was connected at the **infundibulum,** a small opening posterior to the optic chiasm that is the portal from the hypothalamus. Caudal to the infundibulum you will find the **mammillary bodies**, which look like slightly rounded bumps. On either side of the mammillary bodies and continuing further lateral and caudal are the **cerebral peduncles**, the connection and the route for fiber tracts from the lower brain to the cerebral cortex. At the caudal border of the cerebral peduncles, you will find the **pons**, followed caudal by the **medulla**. The **pyriform cortex** is found lateral to the peduncles. You identified this same structure from the dorsal view. Finally, the **spinal cord** extends from the posterior portion of the medulla. The medulla ends (roughly) at the edge of the slightly rounded area, and at the beginning of the **spinal canal** (identified in the dorsal view).



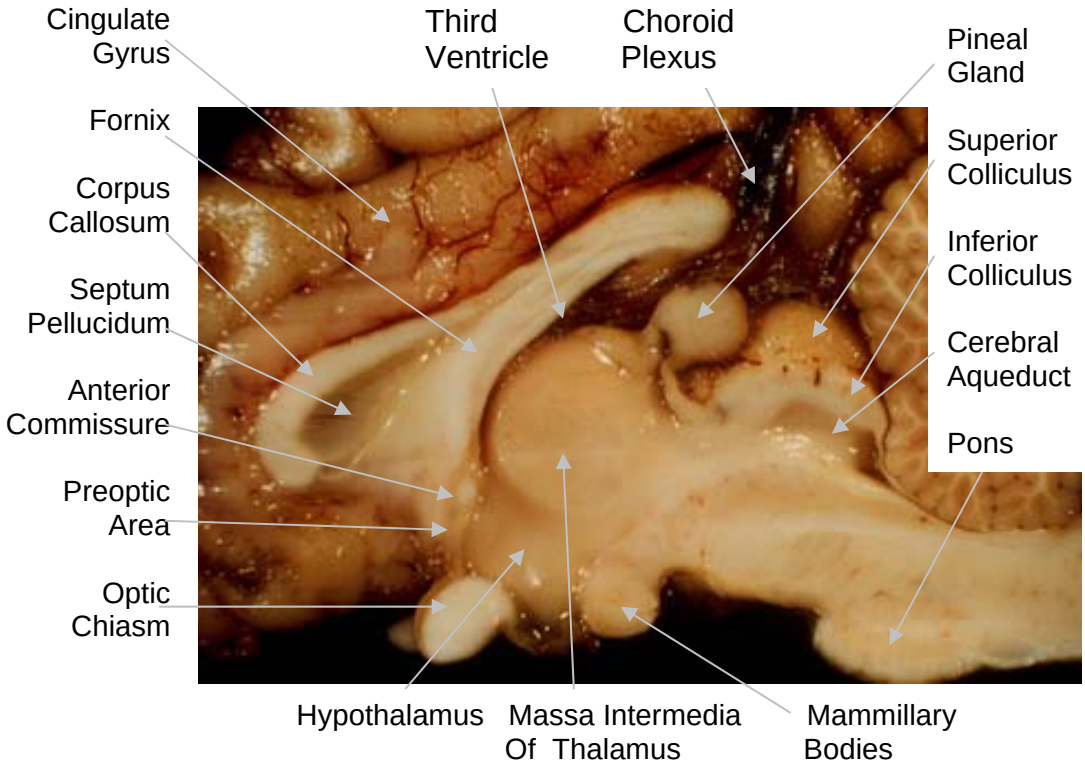
Nerves: On Old Olympus Towering Top A Fin And German Vend Snowy Hops
Functions: Some Say Marry Money But My Mother Say Bad Business Marry Money



Midline Anatomy

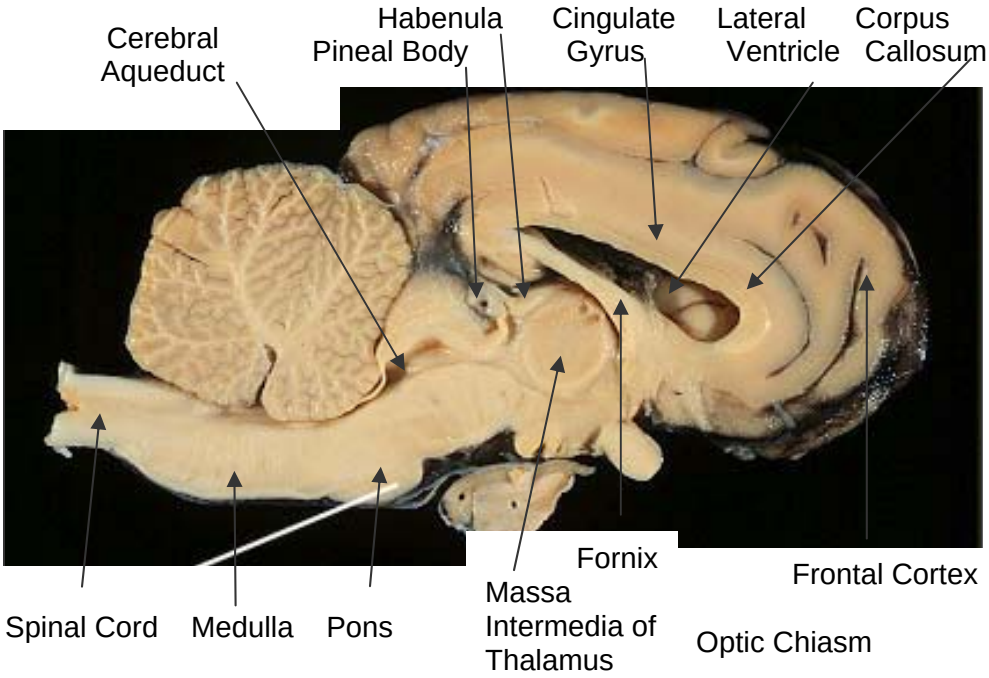
Making the midline cut: Once you can identify all the external structures, we will begin to look at some of the internal structures. Use your probe and gently tear the pia mater along the **longitudinal fissure**, the sulcus that marks the separation of the right and left cerebral hemispheres. If you gently pull on the two halves of the cortex and peer down the cavity, you will see tissue connecting one hemisphere to the other. This is the **corpus callosum**, the main relay for information passing from one hemisphere to the other. Remove the brain from the pan and place it dorsal side down on some paper towels. You are going to bisect the brain along the orientation of the longitudinal fissure. Align the brain so that it is not angled and you will achieve a symmetrical cut. Bisect the frontal lobes, optic chiasm, the mammillary bodies, the pons and the medulla. Try to cut with one smooth slice, using enough pressure to cut with one smooth pass of the blade. If you do not see identical halves, ask for help to clean up the cut.

Midline Anatomy: Find the **corpus callosum** again. The **septum pellucidum** is a thin membrane beneath the corpus callosum, which separates the right and left **lateral ventricles**. The **fornix**, another fiber tract, forms the floor of the lateral ventricle. Gently pull the corpus



callosum from the fornix, using the probe to poke through part of the septum pellucidum, and see how far the lateral ventricle extends. Be careful not to rip any other tissues. Inside the lateral ventricle, you may see some spongy, pinkish-brown tissue. That is the **choroid plexus**, where the cerebro-spinal fluid (CSF) is made. Dorsal to the corpus callosum is the **cingulate gyrus**. Ventral to the fornix and within the **third ventricle** is the **massa intermedia of the**

thalamus. The massa intermedia of the thalamus is the set of fibers connecting the right and left thalamic nuclei. (you will see the thalamus next week when you make your coronal sections.) When you made the bisecting midline cut, you cut through the third ventricle, but you might be able to see it as a slight depression around the thalamus. Find the optic chiasm and the **anterior commissure**, another major source of information passage between the hemispheres. The corpus callosum and the anterior commissure account for the most of the information flowing between the hemispheres of the cerebral cortex. The region ventral to the massa intermedia towards the infundibulum is the **hypothalamus**. This does not appear as a distinct structure, but is a general area bounded by other structures (thalamus, optic chiasm, and mammillary bodies). Rostral to the hypothalamus and lying between the anterior commissure and the optic chiasm is the **preoptic area**, a sexually dimorphic area that is larger in males than in females. The **mammillary body** lies on the ventral surface, posterior to the hypothalamus. Locate the **pineal body**, rostral to the tectum, made up of the **superior colliculus**, one of the visual processing areas, and the **inferior colliculus,** one of the main pre-cortical processing areas for auditory information. The **pineal body** appears as a distinct tissue, darker than the surrounding tissues. Rostral to the pineal is the **habenula**. Find the **cerebral aqueduct**, which connects the third and fourth ventricles.

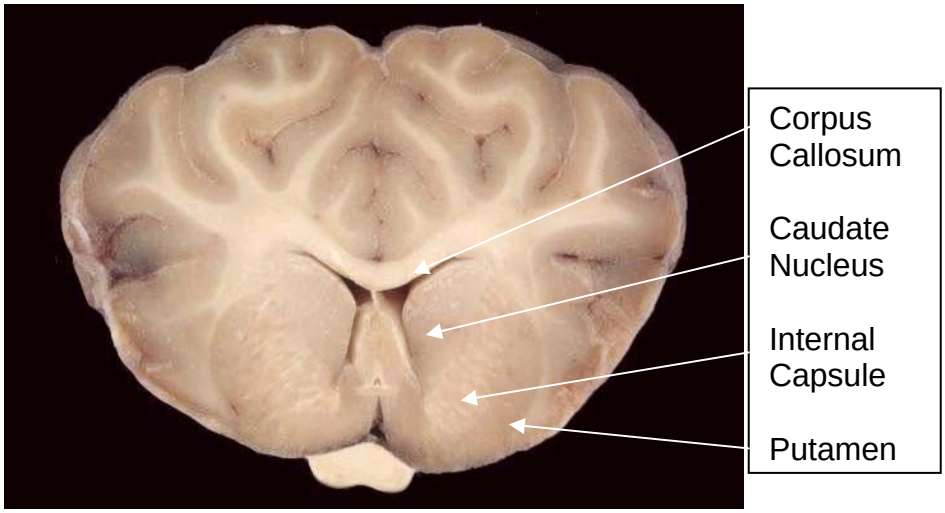


Coronal Sections

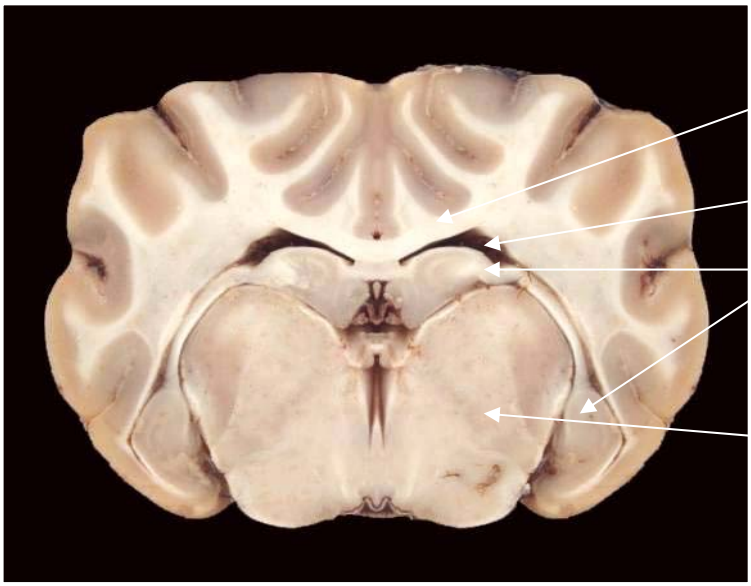
Make three coronal slices through half of the sheep brain. Depending on where you slice, you will see different views of structures. Make the first slice through the frontal cortex and corpus callosum.

Cut #1 Cut #2 Cut #3

First Slice: Through anterior portion of corpus callosum



Second Slice: Through massa intermedia



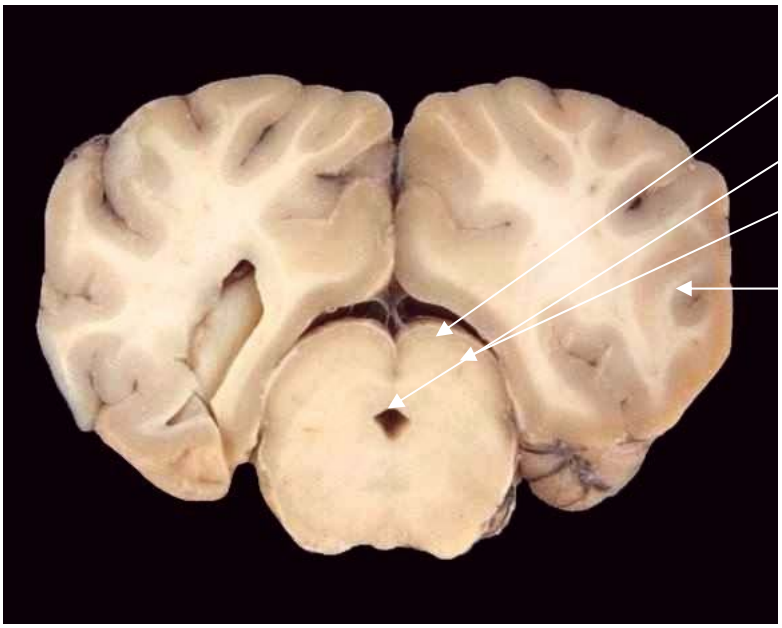
Corpus Callosum

Lateral Ventricle

Hipppocampus

Thalamus

Third Slice: Through massa intermedia



Superior Colliculus

Cerebral Aquaduct

Midbrain

Occipital Cortex

Below is a list of structures you may be asked to recognize on an exam or quiz. You should be prepared to define the functions any structure marked with an *.

- Caudate nucleus
- Central (ansate) sulcus
- Cerebellum*
- Cerebral cortex
  - Frontal cortex
  - Parietal cortex
  - Temporal cortex
  - Occipital cortex
- Cerebrum
- Corpus callosum*
- Directional terms:
  - Anterior / Posterior
  - Rostral / Caudal
  - Medial / Lateral
  - Dorsal / Ventral
  - Superior / Inferior
- Hippocampus*
- Hypothalamus*
- Inferior colliculus*
- Massa intermedia of the thalamus*
- Medulla oblongata
- Meninges*
  - Dura mater
  - Pia mater
  - arachnoid
- Optic chiasm
- Optic tracts
- Pons
- Primary motor cortex*
- Primary sensory cortex*
- Pyriform cortex
- Rhinal fissure
- Sections:
  - Frontal or coronal section
  - Horizontal section
  - Sagital section
  - Mid-sagital section
- Spinal cord*
- Superior colliculus*
- Temporal cortex
- Thalamus*
- Ventricular system*
  - Lateral ventricle
  - Third ventricle
  - Cerebral aqueduct