Objective
To examine the structures of a mammalian brain and relate those structures to the functions of the human brain.

Background Information
An examination of the brain of a preserved sheep or any other mammal will provide enough similarities to be useful for structural and general functional comparisons to be made between it and the human brain. The main difference between the human and most other mammalian brains is the larger human cerebrum.

Materials
safety goggles
lab apron
latex gloves
dissecting tray
sheep brain
forceps

scalpel
probe
model of human brain or diagrams showing different views

Procedure
Part 1: External Structure

1. Obtain a sheep brain, examine the dorsal, lateral, and ventral views and identify the three major structures that are easily seen:
   - The large cerebrum is composed of the two cerebral hemispheres. They form the largest part of the brain and also make up the largest part of the forebrain.
   - The cerebellum is the highly convoluted structure behind the cerebrum and above the brain stem. The cerebellum is part of the hindbrain.
   - The brain stem extends from the spinal cord (the cut region) through the base and part of the central interior of the brain. Because the brain stem extends the length of the brain, it includes a portion of the hindbrain, the forebrain, and all of the midbrain.

2. Examine the cerebrum and note the convoluted appearance of its surface. A membrane called the meninges covers the surface of the cerebrum.
   (Depending on the preservation technique, the meninges may or may not be present.)

(a) Name and describe the functions of the three membranes that make up the meninges.
3. The convolutions are formed by the raised areas or ridges, called gyri, and the depressed areas, called fissures. The major fissures divide the important lobes of the cerebrum. The mammalian cerebrum is much more convoluted than the brains of other vertebrates, such as birds, reptiles, amphibians, and fish.

(b) What is the significance of these convolutions? How do they provide mammals with an advantage?

![Sheep Brain, Ventral View](image)

4. Refer to a model or diagrams of the human brain to help you locate the corresponding fissures and lobes of the sheep cerebrum. Note any differences and similarities in the cerebrums.
   - The longitudinal fissure divides the two cerebral (right and left) hemispheres.
   - The central fissure extends from the top of each cerebral hemisphere to the lateral fissure.
   - The parieto-occipital fissure is not visible externally, but is found near the back of the cerebrum deep in each cerebral hemisphere.
   - The frontal lobe is in front of the central fissure and the parietal lobe is behind this fissure, extending to the region of the parieto-occipital fissure.
   - Behind the parieto-occipital fissure is the occipital lobe.
   - Below the lateral fissure and extending to the occipital lobe is the temporal lobe.

(continued)
(c) List the cerebral lobes and describe the major human functions located in each.

Gently move the cerebral hemispheres apart to expose the corpus callosum.

(d) Describe the function of the corpus callosum.

5. Locate the highly convoluted cerebellum, which lies posterior to the cerebral hemispheres. Compare the cerebellum of the sheep brain with a model or diagrams of the human brain. Note that the sheep brain is not divided longitudinally, as is the human cerebellum.

(e) What is the function of the cerebellum?

6. Examine the ventral surface of the sheep brain and locate the medulla oblongata, which begins where the spinal cord widens, just below the cerebellum. The medulla oblongata contains regions where motor nerves from the right side of the cerebrum cross over to the left side of the spinal cord, and vice versa. Some sensory nerves travelling to the brain also cross over in the medulla, and others cross over where the nerve enters the spinal cord.

(f) What centers that control vital autonomic functions are located in the medulla oblongata?

7. While holding the occipital lobes, gently pull down and back on the cerebellum. In the cavity toward the center of the brain a small, bulbous mass will be seen. This is the pineal gland of the forebrain, which secretes the hormone melatonin. The pineal gland has nerve connections with the eyes. Melatonin regulates reproductive functions related to light and changes in the seasons, marked by the amount of daylight. The precise role of melatonin and the pineal gland and how they regulate biological rhythms associated with reproduction in humans is uncertain.
(g) Research the role of melatonin and the pineal gland in their regulation of biological rhythms in other vertebrates.

8. Just below the pineal gland are four rounded structures of the midbrain called the corpora quadrigemina. The two upper structures carry nerve impulses from the eyes and are involved with reflex responses to visual stimuli. The lower two structures relay impulses from the ears to the auditory areas of the cerebrum.

9. Examine the ventral surface of the brain. Moving forward from the spinal cord, note that just in front of the medulla oblongata is a rounded structure called the pons.

(h) What is the function of the pons?

Anterior to the pons are the rounded cerebral peduncles, which carry nerve tracts to and from the medulla oblongata and the cerebral hemispheres. The mammillary body is a rounded structure in front of the cerebral peduncles and below the hypothalamus. In the sheep brain, the mammillary body is a single structure, whereas in humans it is double. The mammillary body is a relay station for olfactory neurons.

(i) Describe the functions of the hypothalamus.

Below the hypothalamus and in front of the mammillary body is the infundibulum, the stalk to which the pituitary gland is attached. The pituitary gland may not be present, as it is sometimes broken off during preparation of the brain.

10. The optic chiasma forms an X in front of the infundibulum.

(j) Explain the significance of the optic chiasma in relation to the right and left retinas and the right and left occipital lobes.

Locate the olfactory bulbs in front of the optic chiasma, at the base of the frontal lobes of the cerebrum.

(k) Describe the function of the olfactory bulbs.
Part 2: Internal Structure

11. Observe the internal view of a sheep brain that has been dissected in the sagittal plane and locate the following structures that were seen in the dorsal and ventral views of the whole brain:
   cerebrum, corpus callosum, cerebellum, medulla oblongata, spinal cord;
   pineal gland, corpora quadrigemina; pons, cerebral peduncle, mammillary body, infundibulum, optic chiasma, and olfactory bulb.

12. Note the difference in color of the outer and inner regions of the cerebellum. Note also how this color difference follows the convolutions. This is also characteristic of the cerebrum.

(l) Explain the significance of the difference in color and its relationship to the convolutions.

(m) Explain why the corpus callosum is only one color.

13. Locate the four ventricles of the brain. These ventricles develop from an enlargement of the cavity in the embryonic neural tube. The ventricles are filled with cerebrospinal fluid, which also surrounds the brain and the spinal cord beneath the meninges.
(n) Describe the composition of the cerebrospinal fluid.

The two lateral ventricles (the first and second ventricles) extend mostly into the parietal lobe and partly into the frontal and occipital lobes of the cerebral hemispheres, beginning from a region beneath the corpus callosum. Insert a blunt probe into the small opening below the corpus callosum to explore one of the lateral ventricles. A thin membrane on the surface of each ventricle contains a network of capillaries called the choroid plexus. These membranes and the choroid plexus capillaries produce the cerebrospinal fluid. This fluid drains from the lateral ventricles into the third ventricle, which is between the right and left masses of the thalamus. The thalamus is above the mammillary body and the hypothalamus. The hypothalamus forms the floor of the third ventricle. The third ventricle drains posteriorly through a narrow canal above the cerebral peduncle. This canal enlarges between the medulla oblongata and the cerebellum to form the fourth ventricle. Continuing posteriorly, the fourth ventricle forms a narrow canal called the central spinal canal. Where this canal begins is considered to be the beginning of the spinal cord. The cerebrospinal fluid also flows from the fourth ventricle along the dorsal surface of the spinal cord and around to its ventral surface. From the ventral surface it then begins to flow anteriorly until it reaches the brain. As the cerebrospinal fluid flows over the brain it is reabsorbed into blood capillaries in the arachnoid layer of the meninges.

(o) Describe the functions of the ventricles and the cerebrospinal fluid.