

Nervous Coordination: Structure

Introduction

The brain is the master organ of our body and the nervous system is the network of nerves through which the brain receives and sends out nerve impulses. The brain is well protected by a number of membranes, as well as fluid, bone, and skin. There are three membranes that surround the brain; the *pia mater* is the membrane next to the brain and it is richly supplied with blood vessels, the middle membrane is the *arachnoid mater*, while the outermost membrane is the *dura mater*. Located between the arachnoid mater and the pia mater is the *cerebrospinal fluid*, which provides a cushioning effect for the brain. The three membranes are known collectively as the *meninges*. Further protection for the brain is provided by the bony cranium.

The spinal cord, also part of our central nervous system (CNS), extends from the base of the brain down through the vertebrae. Peripheral nerves, composed of many neurons, attach directly to the brain or to the spinal cord. Cranial nerves are those that extend from the brain, while spinal nerves extend from the spinal cord. Nerves can be further subdivided according to the type of message they carry. *Sensory (afferent) nerves* carry messages to the CNS, while *motor (efferent) nerves* carry messages to the organs of the body. Occasionally, some nerves carry both sensory and motor neurons, and are known as *mixed nerves*.

Purpose

To study the external and internal structure of a mammalian brain.

Materials
and
Equipment

materials
sheep brain
Equipment
dissecting tray

scalpel
scissors
forceps
probe

Procedure

A. External structure

Obtain a whole sheep brain and identify the *cerebrum*, *cerebellum*, *medulla oblongata*, *midbrain* and *pons*. The largest portion of the brain is the cerebrum, which is composed of two cerebral hemispheres. Describe the appearance of the left and right hemispheres. The convolutions are comprised of *gyri* (crests) and fissures or *sulci* (dips). Note any membranes surrounding the two hemispheres. Grasp the membranes with a pair of forceps and, using a scalpel, remove a 2-cm² piece of tissue to expose the surface of the brain. Compare the three membranes and describe them.

Observe the dorsal surface of the brain and note the longitudinal fissure which separates the two cerebral hemispheres. Move the two hemispheres apart to expose the *corpus callosum*. What is its function? The structure that lies posteriorly to the cerebral hemispheres is called the cerebellum. Describe this structure. Locate the medulla oblongata, which is the portion of the brain that is continuous with the spinal cord. Gently separate the occipital lobes of the cerebrum and pull back on the cerebellum. The anterior protrusion represents the *pineal body* of the forebrain and the posterior swelling represents the *corpora quadrigemina* of the midbrain.

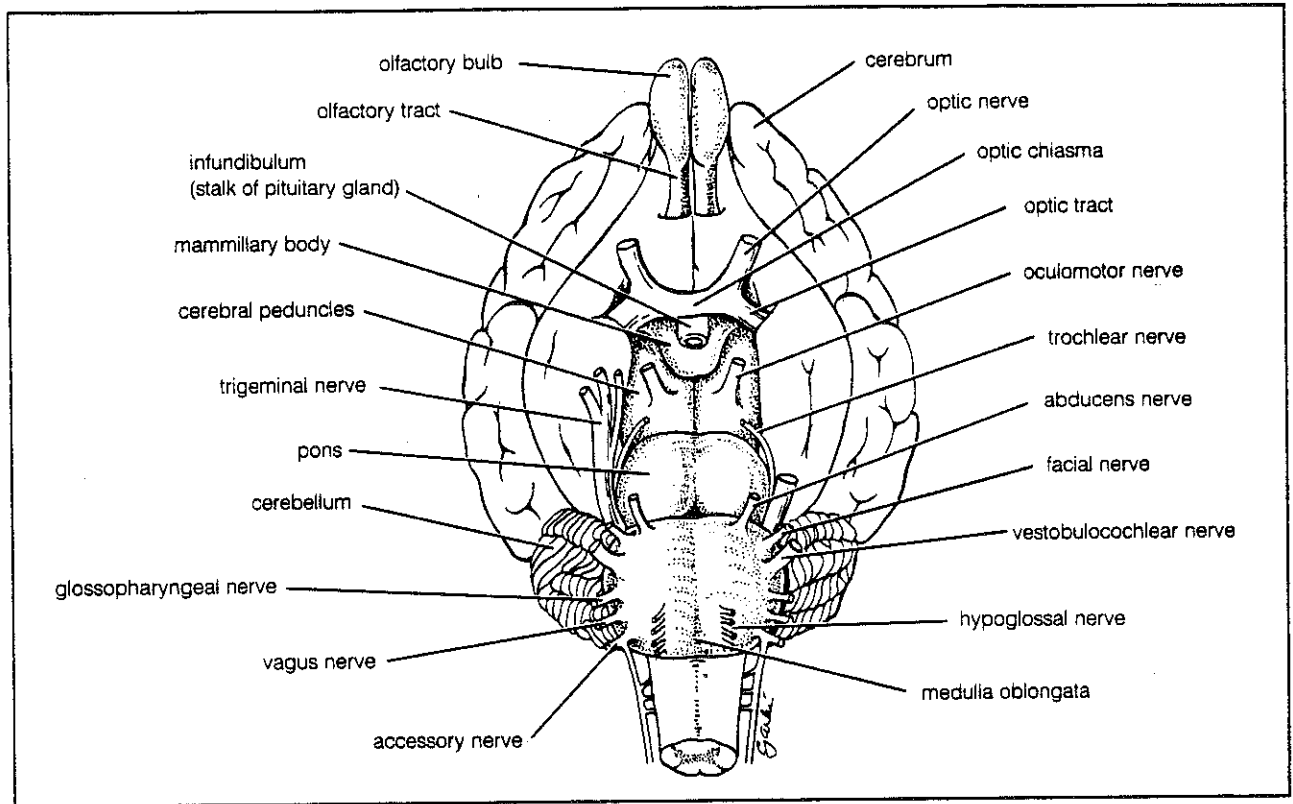
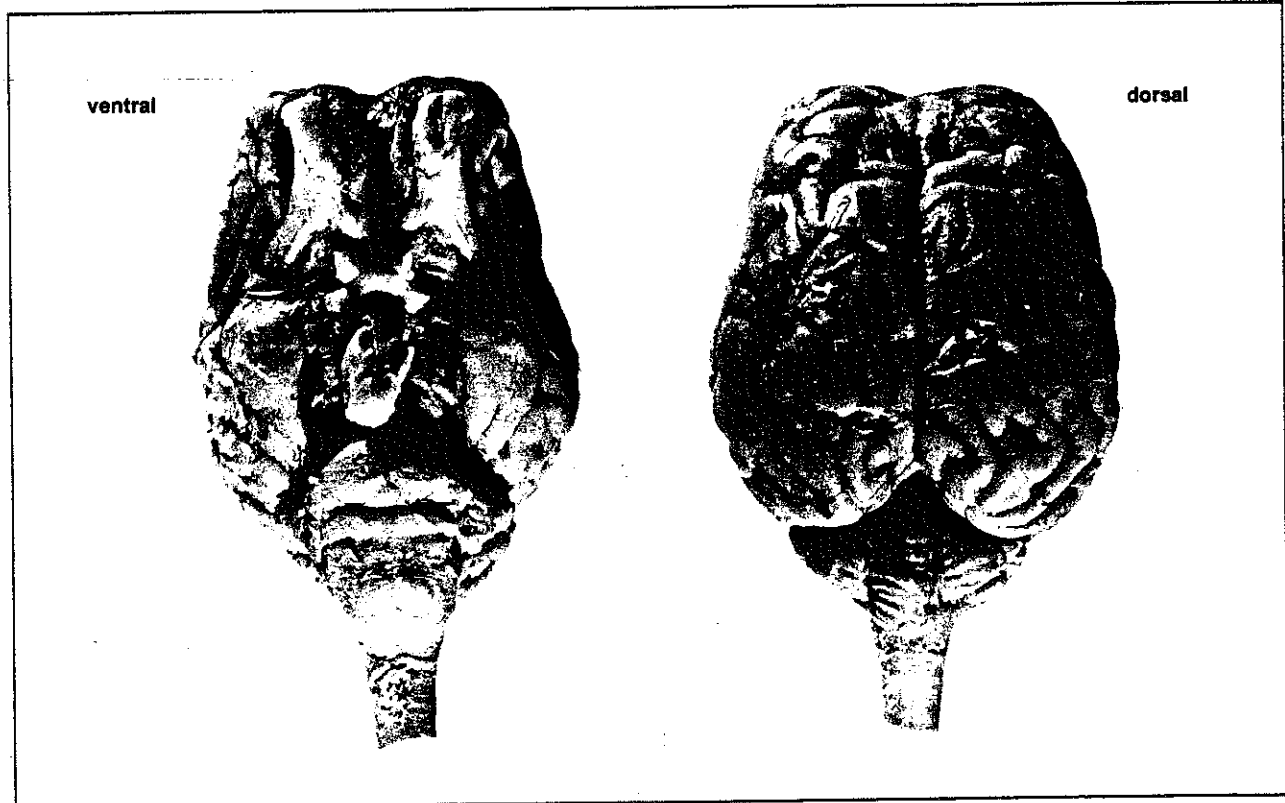


Figure 1. Sheep brain, ventral view.



Examine the ventral surface of the brain. Locate the pons, found ventrally to the division between the posterior portion of the cerebral hemispheres and the anterior portion of the cerebellum. Note the stumps of a number of cranial nerves which attach to the pons and the medulla. Examine the anterior portion of the ventral surface of the brain and locate a pair of bulbous structures projecting forward. These are the *olfactory bulbs*. These structures are responsible for the transmission of impulses to the temporal and frontal lobes where the olfactory areas are located. What type of nerve conducts impulses to the olfactory bulbs? What is the specific name of this nerve?

Move posteriorly along the longitudinal fissure until a white, X-shaped structure is seen. This is called the *optic chiasma*; it is the remnant of nerves coming from each eye. The *occipital lobes* are the portion of the brain that receives the impulses from the optic nerves. What is the function of the occipital lobes? Posterior to the optic chiasma is the pituitary gland. Sometimes a piece of the sphenoid bone is left attached to the brain near this gland. If the gland is still attached to the brain, there is a short stalk called the *infundibulum* by which the gland is suspended from the brain.

B. Sagittal view of the sheep brain

Observe one half of a sheep brain that has been dissected in the sagittal plane by your instructor and locate the following structures.

Note the corpus callosum, the large white commissure which is located between the cerebral hemispheres. Insert a probe into the hollow areas of the corpus callosum. Where does it lead? This is one of the lateral ventricles. Notice the colour of the cerebral cortex in comparison to the colour of the corpus callosum. The thalamus is a nerve centre located just beneath the round commissure which is the region just posterior and ventral to the corpus callosum. The round commissure connects the right and left thalamic areas of the brain. Locate the pituitary gland (if present) on its stalked infundibulum, just ventral to the round commissure. The stalk of the pituitary is attached to the hypothalamus.

The optic chiasma lies anterior to the infundibulum. The third ventricle appears as a groove extending posteriorly from the middle of the round commissure. Run a probe along the groove posteriorly until a constriction occurs. This constriction is referred to as the *aqueduct of Sylvius*. This duct connects the third ventricle to the fourth ventricle. Follow the aqueduct of Sylvius until it widens and becomes the fourth ventricle. What constitutes the first and second ventricles? The large, convoluted structure just above the fourth ventricle is the cerebellum. Describe the sagittal view of this structure. Follow the fourth ventricle posteriorly. It becomes narrow and is called the cerebrospinal canal of the spinal cord. Are all the ventricles continuous? What do the ventricles and cerebrospinal canal contain? The area ventral to the fourth ventricle is the medulla oblongata, and the area immediately anterior to the medulla is known as the pons. The *cerebral peduncles*, representing the ventral portion of the midbrain, are just anterior to the pons.

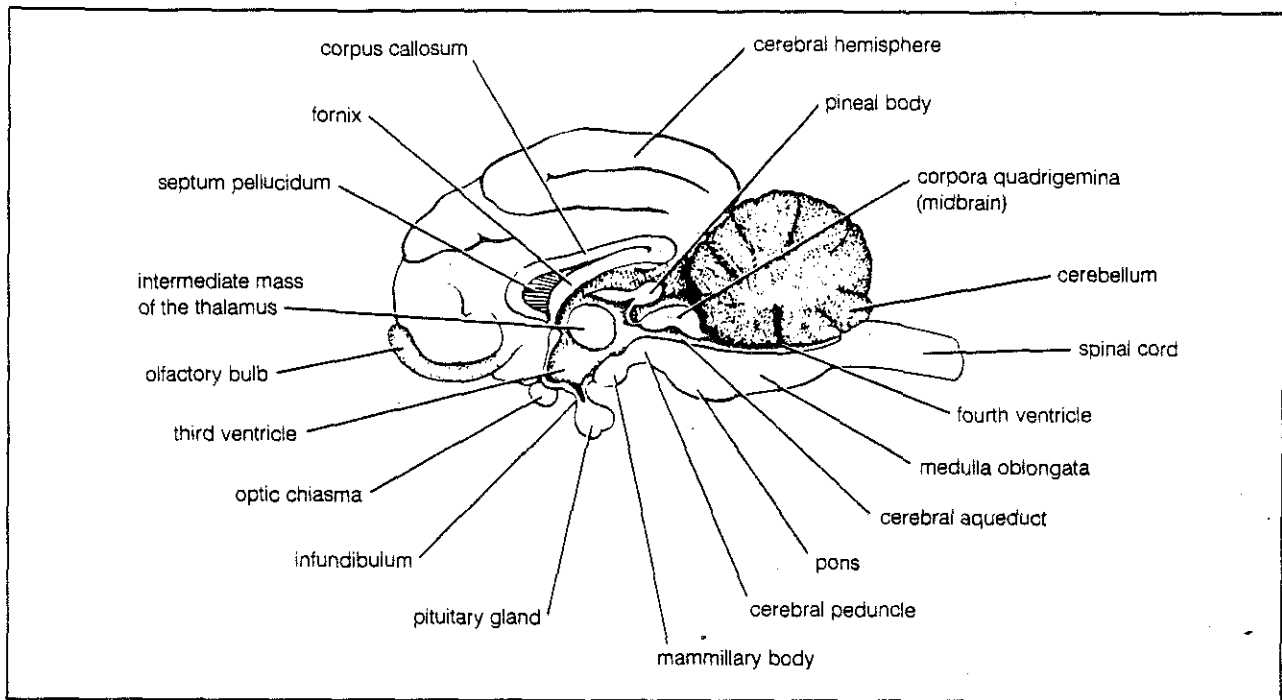


Figure 2. Sheep brain, sagittal section.



Questions

1. What might be expected to be the primary signs of damage to the temporal lobe, the cerebellum, and the medulla oblongata?
2. Name the three membranes surrounding the brain. What collective term is used to refer to these membranes?
3. How is the surface area of the cerebrum increased without an increase in the total volume of the brain?
4. Give two functions of the cerebrospinal fluid.
5. Explain hydrocephalus. What treatment may be implemented?