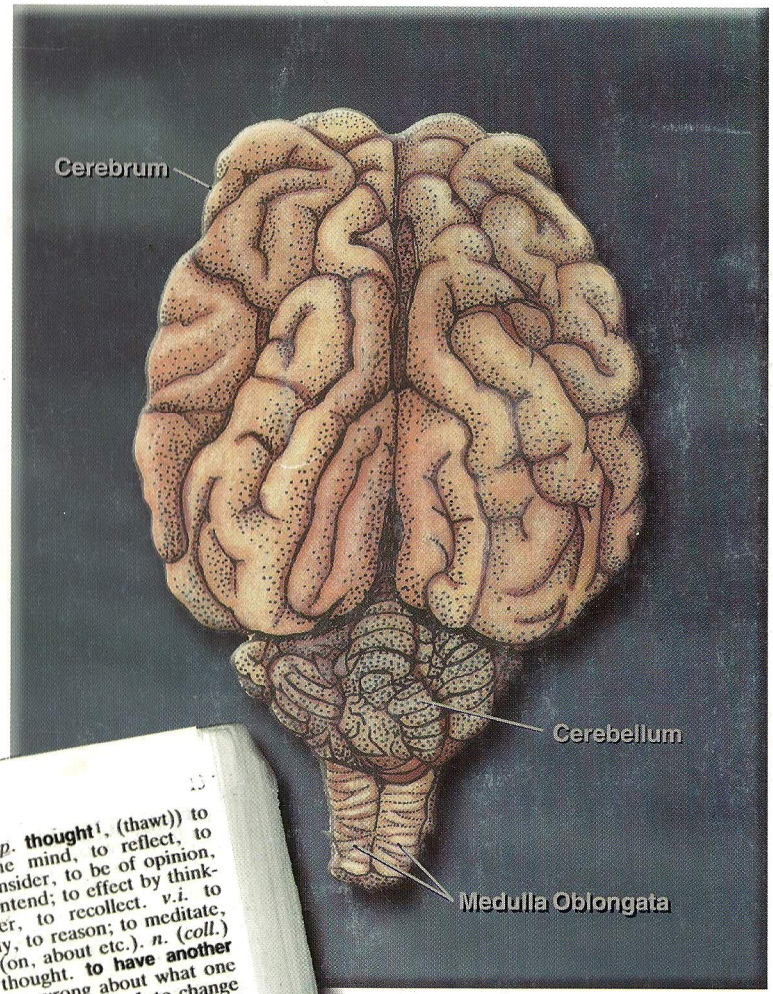
An Illustrated Dissection Guide To The...*Mammalian* Brain



(thingk), *v.t.* (*past, p.p.* **thought**[1], (thawt)) to ard or examine in the mind, to reflect, to nder (over etc.); to consider, to be of opinion, believe; to design, to intend; to effect by think- g; (*coll.*) to remember, to recollect. *v.i.* to xercise the mind actively, to reason; to meditate, o cogitate, to consider (on, about etc.). *n.* (*coll.*) an act of thinking; a thought. **to have another think coming,** (*coll.*) to be wrong about what one assumes will happen. **to think better of,** to change one's mind, to decide not to pursue (a course of action). **to think of,** to have in mind, to conceive, to imagine; to call to mind, to remember; to have a particular opinion or feeling about, to esteem. to devise; to solve by long thought. and consider carefully; of experts in

by David H. Hall

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Introduction

No organ evokes more interest or is considered more mysterious than the brain. The brain is after all, for humans, the organ that defines the mind. That is why a study of a preserved brain is so fascinating and important. The sheep brain is an excellent specimen to study because of its similarity to other mammalian brains including humans.

If your mammalian brain came with the **Dura Mater** intact, your specimen will be enclosed in a tough, bluish-white membrane (*Figure 1*). Beneath the dura mater is an extremely thin and hard to see membrane called the **Arachnoid Membrane**. Below this and tightly covering the surface of the brain is the glassy **Pia Mater**. These membranes taken together form the **Meninges**.

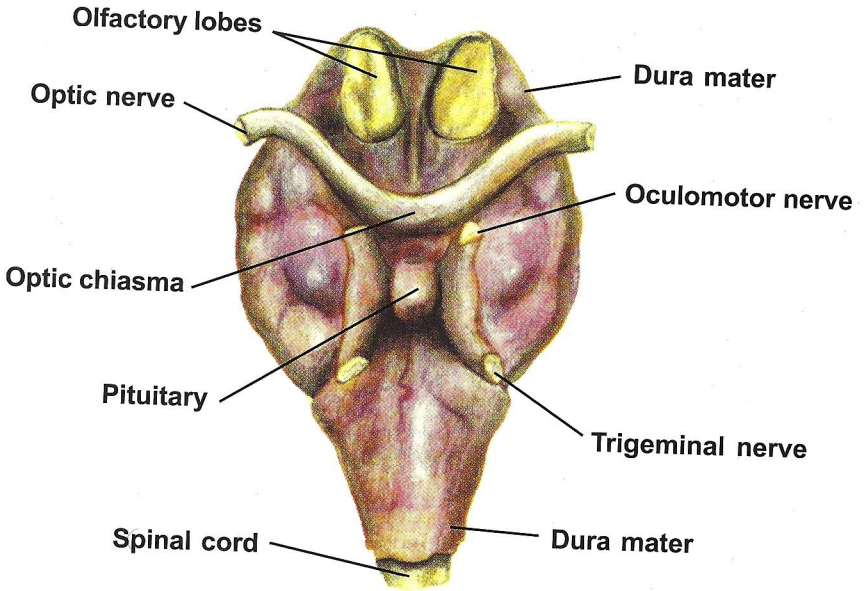

Figure 1
Ventral view of a sheep brain with dura mater intact.

Exterior Anatomy

If your specimen is covered by the dura mater, carefully remove it from the brain. Be extremely careful when removing the membrane from around the optic, oculomotor, and trigeminal nerves and around the hypophysis (pituitary gland). Work slowly and you will end up with a beautiful specimen. Refer to *Figures 1 and 2* for guidance.

At this point there are three distinct areas of the brain: the **Cerebrum**, the **Cerebellum** and the **Medulla Oblongata (brain stem)**. Refer to *Figure 2* and find the following on your specimen:

Cerebrum: The cerebrum is composed of two distinct separated hemispheres (left and right). The hemispheres of the cerebrum have many folds and ridges. The front part (anterior-ventral) of the cerebrum is the frontal lobe, the rear-most lobe (dorsal) is the occipital lobe, the most lateral lobes are the temporal lobes and the anterior-dorsal lobe is the parietal lobe.

Longitudinal Fissure: The longitudinal fissure is the separation between the two cerebral lobes.

Gyri: The gyri (gyrus singular) are the various ridges of the cerebrum.

Sulci: The sulci (suculus singular) are the folds or depressions of the cerebrum.

Cerebellum: Directly behind the cerebrum is this smaller mass that is highly folded.

Medulla Oblongata: This is the brain stem that the cerebellum lies directly upon. It is appreciably thicker than the spinal cord that begins at the foramen magnum and is continuous with the brain stem.

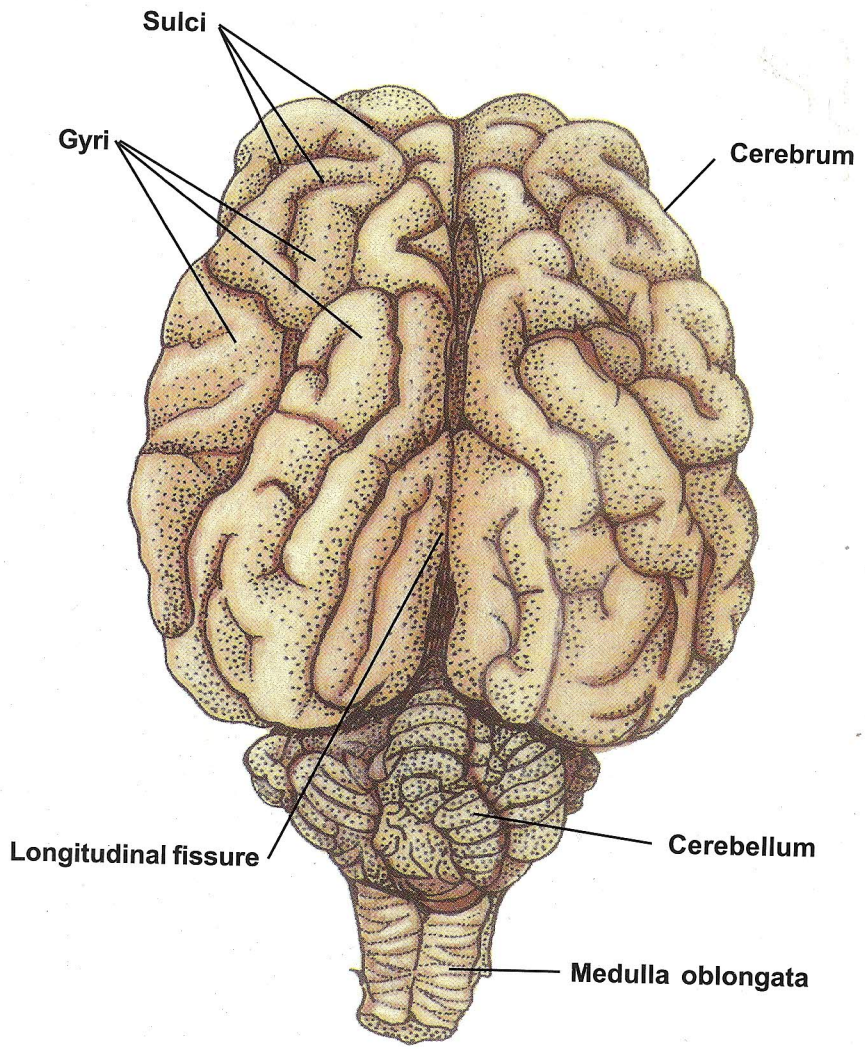

Figure 2.
Dorsal view with Dura Mater removed

Now turn over the brain onto its ventral side. Locate and familiarize yourself with the features listed and shown in *Figure 3*.

Optic Chiasma: This is the bridge between the two optic nerves. It partially mixes images from each eye before they reach the optic centers of the cerebrum.

Pituitary Gland (Hypophysis): A small bulbous mass located just behind the optic chiasma. The pituitary is divided into three separate glands each with a separate function: the anterior, intermediate and posterior pituitary glands. The pituitary has been called the master gland because the hormones it secretes control the secretions of other endocrine glands throughout the body. The pituitary is the interface between the nervous system and the endocrine system.

Temporal Lobes: The temporal lobes are two rounded lobes of the cerebrum located on either side of the hypophysis. In humans they are responsible for information storage and retrieval or memory.

Pons: The pons is forward of the medulla and directly behind the hypophysis. It connects the upper part of the medulla oblongata with the cerebrum and cerebellum.

The Cranial Nerves

The cranial nerves are grouped in 12 pairs and are traditionally designated by Roman Numerals. All cranial nerves except the olfactory originate from the brain stem. The olfactory nerves originate from the cerebrum. Students have long memorized the cranial nerves by remembering the following rhyme: "**O**n **O**ld **O**lympus **T**owering **T**op **A** **F**inn **A**nd **G**erman **V**iewed **S**ome **H**ops". The initial letters of the names of the cranial nerve are the same as the initial letter of the words in the rhyme and are in the correct order. Students and teachers often use some variation of this rhyme – try to make up your own or use whatever works.

Some of the cranial nerves are difficult to locate or see. Use a needle or probe to explore the area of the brain shown in *Figure 3*. With patience and careful examination, you will find them all.

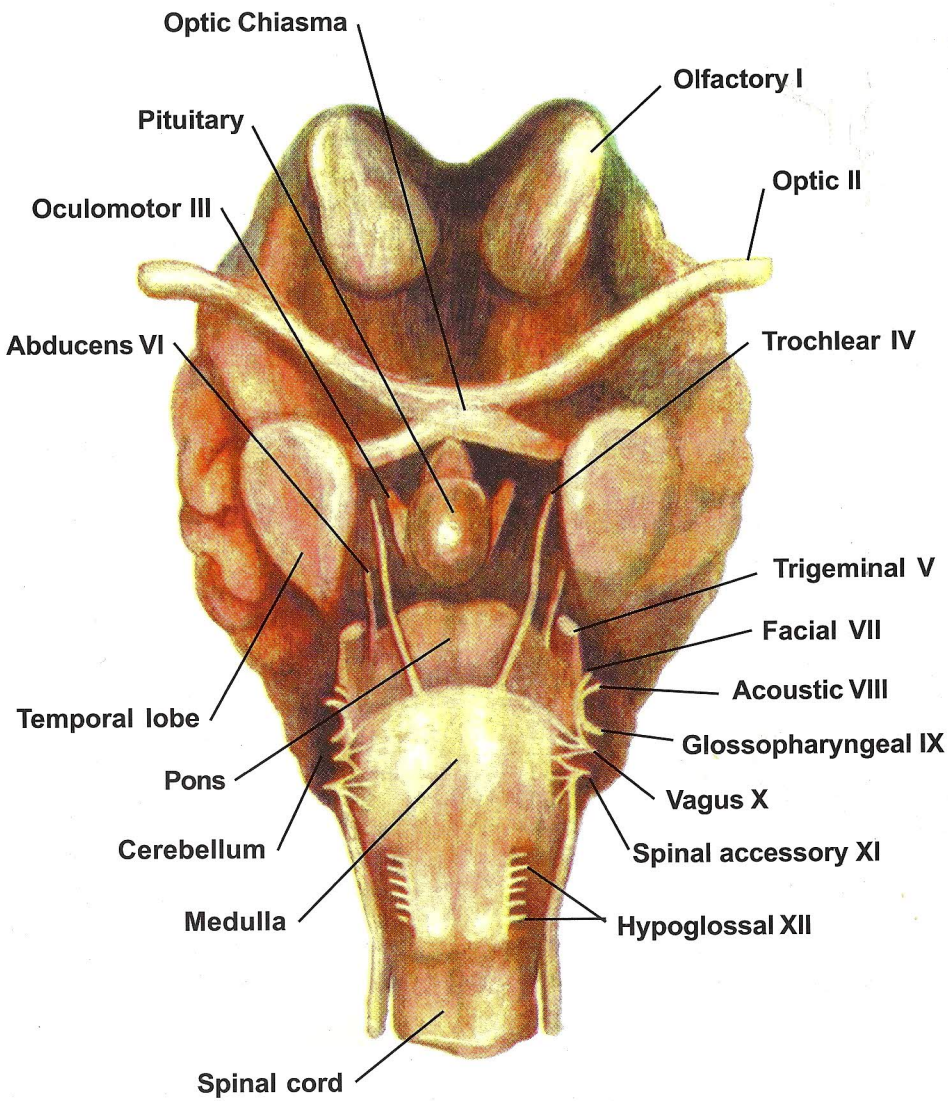

Figure 3.
Ventral view of the brain with Dura mater removed.

The Cranial Nerves
(continued)

I. **Olfactory**: This sensory nerve is associated with smell and goes from the olfactory bulb to the nasal mucosa.

II. **Optic**: A sensory nerve that carries impulses from the retina of the eye to the optic chiasma and to the optic lobe of the brain (diencephalon).

III. **Oculomotor**: A motor nerve associated with movement of the eye and upper eyelid.

IV. **Trochlear**: A motor nerve associated with eye movement (superior oblique muscles).

V. **Trigeminal**: A mixed motor and sensory nerve associated with the jaw, nose, facial skin, scalp, mucus membranes and mouth to the pons. This nerve is composed of three large divisions: Ophthalmic, Maxillary and Mandibular.

VI. **Abducens**: A motor nerve associated with eye movements (lateral rectus muscles to medulla oblongata).

VII. **Facial**: A mixed motor/sensory nerve associated with facial skin and muscles, tongue and some salivary glands and goes to the medulla oblongata.

VIII. **Acoustic**: Also known as the vestibulocochlear, this sensory nerve is associated with the hearing and equilibrium and runs from the ear to the medulla oblongata.

IX. **Glossopharyngeal**: A mixed motor/sensory nerve associated with the throat (pharynx), mucous membranes of the tongue, and salivary glands and goes to the medulla oblongata.

X. **Vagus**: A mixed motor/sensory associated with muscles of the pharynx and larynx and sensory impulses from visceral organs to the medulla oblongata.

XI. **Spinal Accessory**: Also known as the accessory, this mixed motor/ sensory nerve that joins with the vagus and is associated with neck, shoulder and head muscles.

XII. **Hypoglossal**: A motor nerve associated with movement of the tongue and runs to the medulla oblongata.

The brain has three major functional divisions: The Forebrain, the Midbrain and the Hindbrain.

The Forebrain - consists of the cerebrum, thalamus and hypothalamus and is where sensory information is processed. Memories are also stored in the forebrain. The forebrain is where our conscious self is generated and where information is integrated and processed. The thalamus is a relay station directing sensory input to the correct areas of the cerebrum. The hypothalamus regulates basic body needs. See page nine for more information about the thalamus and hypothalamus.

The Midbrain - is at the upper end of the brain stem (above the pons). It controls eye movement and pupil size. In more primitive vertebrates such as fish and amphibians, the midbrain plays a more prominent role in body activity. In mammals, however, much of this role has shifted to the cerebrum.

The Hindbrain - contains the cerebellum, the pons and the medulla oblongata. The medulla and pons form the brain stem. Deep within the brainstem is the reticular formation. This tangle of short axon neurons controls the level of brain activity or consciousness, breathing, blood pressure and a host of other life control functions.

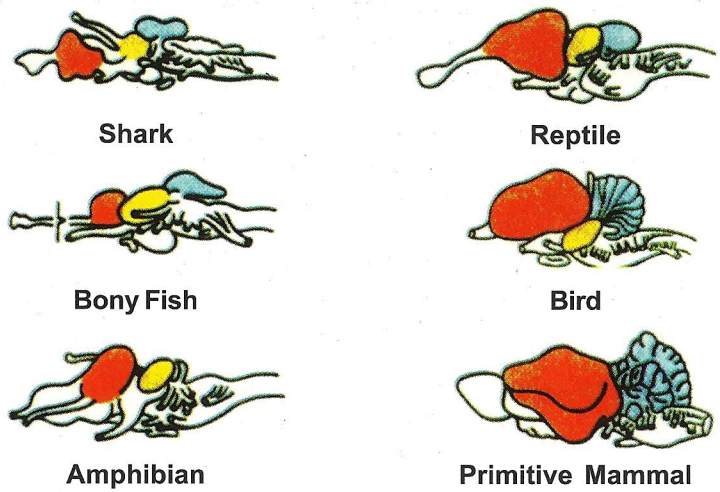

Figure 4.
Lateral views of six vertebrate brains demonstrating the evolutionary development of three areas: Optic lobes (yellow); the cerebellum (blue); and the cerebrum (red).

Sagittal Section of the Brain

Take a large knife with at least a four-inch blade and divide the brain into two halves by cutting along the longitudinal fissure of the cerebrum. Each half should resemble the brain shown in *Figure 5.* Locate the features pointed out in *Figure 5* on your specimen.

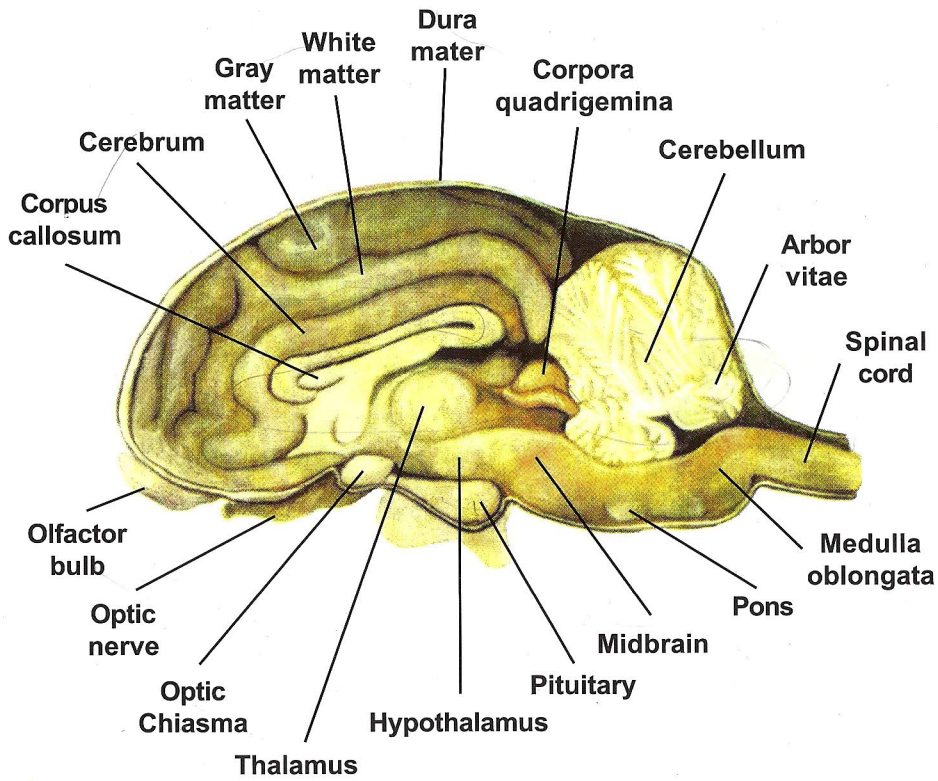

Figure 5.
Sagittal section of the sheep brain.

Thalamus: A gray circular mass above the hypophysis and midbrain. The thalamus acts as a relay station for all sensory pathways except for the signals of smell from the olfactory lobes.

Corpora Quadrigemina: These masses are on the midbrain roof. They are thought to be a relay for auditory signals to the cerebral hemispheres.

Corpus Callosum: This 'white matter' structure is the principal connecting tract between the two cerebral hemispheres.

White Matter: These are whitish areas of the brain. They are composed of the light colored insulating material, myelin. Look for white matter in the corpus callosum, the arbor vitae of the cerebellum and the spinal column.

Gray Matter: The darker areas of the brain that are composed mainly of nerve cell bodies. The surface of the cerebellum and cerebrum are composed of gray matter. Both of these structures deal with processing nerve inputs or 'data'. Mammalian brains have increased the amount of gray matter by increasing the surface area of the cerebellum and cerebrum with folds and grooves called the gyri and sulci. This effectively increases the surface area thirty times. Thus the processing area of the brain is increased without having to expand skull size.

Midbrain: At the upper end of the brain stem, directly below the thalamus. The midbrain controls pupil size and some eye movement.

Hypothalamus: This forebrain area regulates sex drive, body temperature, sleep, hunger and thirst. In addition, the hypothalamus is attached to the pituitary gland and provides a direct link between the brain and the endocrine system.

Arbor Vitae: These are white areas of the cerebellum that convey nerve impulses to and from the cerebellum cortex (the surface of the cerebellum). They are also known as medullary bodies of the cerebellum.