

DETAILS of the SPINAL CORD and NERVE

The spinal cord is located within the vertebral canal of the vertebral column. The cord is surrounded by vertebral ligaments, meninges, and cerebrospinal fluid. We examine the details of the spinal cord in this plate and study the anatomy of the spinal nerves arising from it. These nerves convey impulses to the skin and visceral organs and carry impulses from them in the direction of the spinal cord. Motor nerves accomplish the former function, sensory nerves the latter.

This plate contains two diagrams. A cross section of the spinal cord is presented in the first diagram, and details of the spinal cord are presented in the second. Each part should be considered separately as you proceed. Begin by coloring the main title Details of the Spinal Cord and Nerve, then focus on the first diagram as you read below. Many arrows are used to point out certain regions and only two colors are required. They should be light, pale yellow or tan colors.

At its central region, the spinal cord contains **gray matter (A)**, which is shaped somewhat like the letter H. A single color should be used for the entire area of gray matter within the spinal cord and extending laterally left and right. The region closer to the back of the spinal cord constitutes the **dorsal gray horn (A₁)**, and the arrow should be colored boldly. Toward the front of the spinal cord are the **ventral gray horns (A₂)**, and an arrow points to their location. Lying between the dorsal and ventral gray horns is the region called the **lateral gray horn (A₃)**.

The gray matter consists primarily of the cell bodies of neurons together with supporting cells. The central portion of the gray matter dividing the lateral halves is the **gray commissure (A₄)**, designated by an arrow. Arising from the dorsal gray horn is the **dorsal root (A₅)**. An enlargement called the **dorsal root ganglion (A₆)** is seen on both lateral halves. This is the site of nerve cell bodies. Arising from the ventral horn is the **ventral root (A₇)**. This root combines with the dorsal root to form the **spinal nerve (A₈)**.

The white matter of the spinal cord (B) should be colored a different light color. At the ventral aspect is a broad area called the **ventral white columns (B₁)**, which are designated by arrows. On the other side of the gray commissure is an area known as the **dorsal white columns (B₂)**. The dorsal and ventral horns divide the white matter and set off the third broad region called the **lateral white columns (B₃)**. A small area called the **anterior white commissure (B₄)** is located near the gray commissure.

At the center of the gray commissure is the **central canal (C)** of the spinal cord. This canal continues with the fourth ventricle of the brain and contains cerebrospinal fluid to nourish the tissue of the spinal cord.

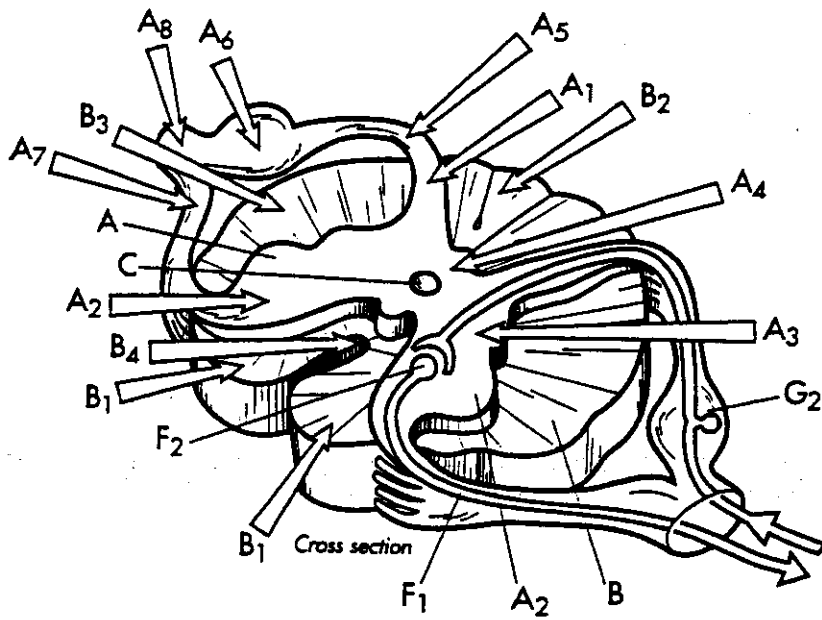
We now focus briefly on the nerve cells within the spinal cord to note how they relate to the gray matter. You may use dark colors to overcolor the lines represented by the cells. Read below as you color and color the titles as you encounter them. Then locate and color the structures with the appropriate colors.

The gray matter contains the nerve tissue of the brain, while the white matter consists primarily of the myelinated axons of the cell bodies. Sensory impulses enter the brain through the axons of sensory neurons. These are the sensory axons. The cell body of the sensory neuron is located in the **dorsal root ganglion (G₂)**, as the plate shows. Impulses are carried away from the spinal cord by the motor neurons. The cell body of the **motor neuron (F₂)** is located in the gray matter, and the axons of the motor neurons, the **motor axons (F₁)**, extend away from the cell body and out the spinal cord.

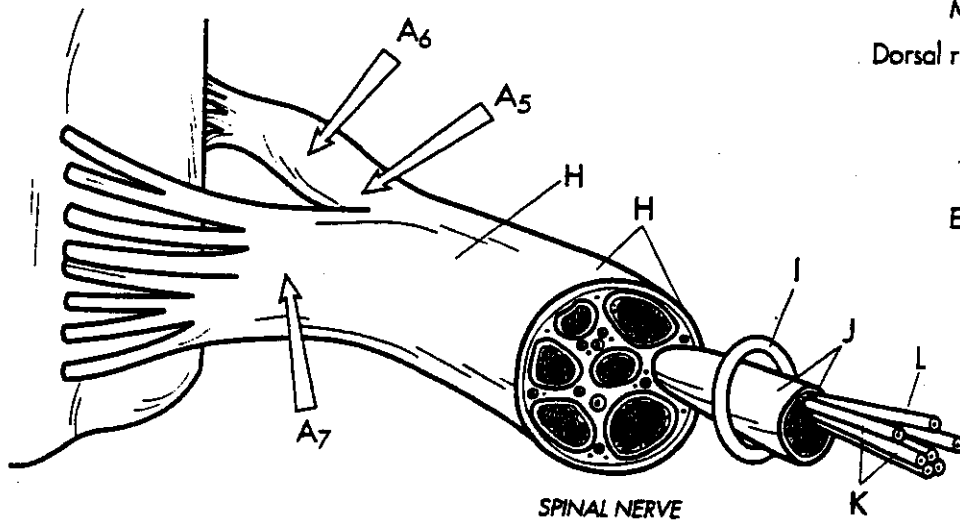
In the second part of this plate, we focus on some of the structures of the spinal nerve. Axons travel together in the spinal nerves to and from the spinal cord. The diagram indicates their organization as they travel through the spinal nerve. Read about this concept in the following paragraphs, and color the titles and structures appropriately.

The spinal nerve begins at the junction of the dorsal and ventral root. The nerve is covered by a superficial wrapping called the **epineurium (H)**. The entire spinal nerve can be colored with a single color, beginning at the junction of the dorsal and ventral roots. Beneath the epineurium, groups of axons are bundled together to form a **fascicle (I)** should be colored boldly. The fascicle is covered with a wrapping called the **perineurium (J)**. The perineurium encloses several axons. Each axon is wrapped in a covering called the **endoneurium (K)**. An endoneurium exists whether the axon is myelinated or unmyelinated. The individual **axon (L)** can be indicated with a spot of color.

DETAILS OF THE SPINAL CORD AND NERVE



- Gray matter A ○
- Dorsal gray horn A1 ○
- Ventral gray horns A2 ○
- Lateral gray horn A3 ○
- Gray commissure A4 ○
- Dorsal root A5 ○
- Dorsal root ganglion A6 ○
- Ventral root A7 ○
- Spinal nerve A8 ○
- Spinal cord B ○
- Ventral white columns B1 ○
- Dorsal white columns B2 ○
- Lateral white columns B3 ○
- Anterior white commissure B4 ○
- Central canal C ○
- Motor axons F1 ○
- Motor neuron F2 ○
- Dorsal root ganglion G2 ○
- Epineurium H ○
- Fascicle I ○
- Perineurium J ○
- Endoneurium K ○
- Axon L ○



OVERVIEW of the BRAIN

The brain is the center of human behavior. It embodies memory, understanding, and a number of higher order functions. In the following plates we examine some of the details of the anatomy of the brain, but to set the stage, we present an overview of the brain in this plate.

This plate presents three views of the brain to provide an overall orientation to this organ. We see the brain in place in the skull; we observe a sagittal section of the brain, also in the skull; and we observe the floor of the brain from below. Our objective in this plate is to point out the major portions of the brain as a prelude to the discussions ahead. Darker colors may be used for the various parts, or you may choose lighter shades to avoid obscuring the folds and details of the brain. As you read about the brain below, color the titles then locate the structures in all three views and color them in the appropriate diagram.

We learn about our environment by means of signals received in the brain. Our responses consist of signals allowing us to conduct responsive activities such as talking and moving. The brain is thus the center of nervous activity in the body and is an exceedingly complex organ with many components.

By far, the largest part of the human brain is the **cerebrum (A)**. All conscious processes occur in the cerebrum seen in whole, sectioned, and inferior views. The surface of the cerebrum is greatly folded with upward folds called gyri and downward grooves called sulci. Fissures divide the cerebrum into two hemispheres, as the view from below indicates.

The second major part of the brain is the **diencephalon (B)**, indicated by a bracket. This portion of the brain surrounds an enlarged space called the third ventricle, which is discussed in a future plate. The diencephalon consists of the **thalamus (B₁)**, the **hypothalamus (B₂)**, and the **epithalamus (B₃)**. The thalamus contains paired masses of gray matter organized into bodies called nuclei. It is a relay station for sensory impulses to the cerebral cortex. The hypothalamus is inferior to the thalamus and composed of a dozen or more nuclei. Homeostasis is regulated in this region, and receptors receive impulses from numerous senses and visceral areas of the body. Hormones stored in the posterior pituitary gland are produced in the hypothalamus. The epithalamus lies at the roof of the third ventricle.

The second largest portion of the human brain is the **cerebellum (C)**. Seen in all three diagrams, the cerebellum is located under the occipital bones posterior and inferior to the cerebrum. It has two hemispheres and small surface folds. The cerebellum helps coordinate and control movements initiated by the cerebrum.

The last region we survey is the **brain stem (D)**, which is outlined by a bracket. The bracket may be colored in a bold color. The brain stem is continuous with the **spinal cord (E)** and variations of the same color should be used for it and the brain stem. One of the important parts of the brain stem is the **midbrain (D₁)**. The midbrain has fibers that carry sensory impulses from the spinal cord to the thalamus and motor impulses from the cerebral cortex back to the spinal cord.

We now move to the two remaining regions of the brain and examine them briefly. Because these regions are discussed in more depth in other plates, our review is limited to the general functions performed. Continue your coloring as before, indicating the important structures and their location. You may wish to select variations of the same color to indicate where one area of a structure begins and another ends.

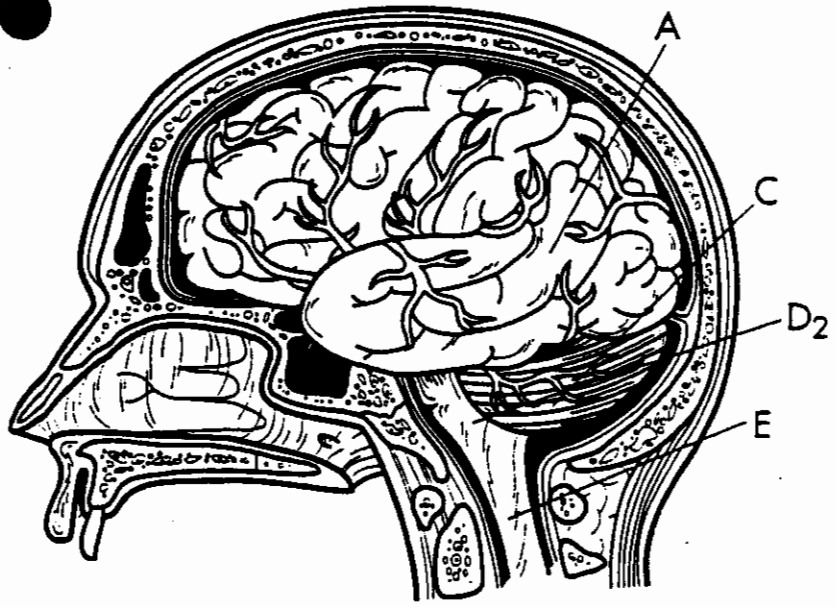
Also in the brain stem is the **pons (D₂)**. The pons is a bridge-like structure containing many fibers carrying signals between various regions of the brain. For example, signals from the spinal cord extend to the superior brain regions, while others passing through the pons are concerned with the coordination of voluntary movements.

The actual portion of the brain continuous with the spinal cord is the **medulla oblongata (D₃)**. This structure contains the gray matter carrying signals from the spinal cord and other parts of the brain.

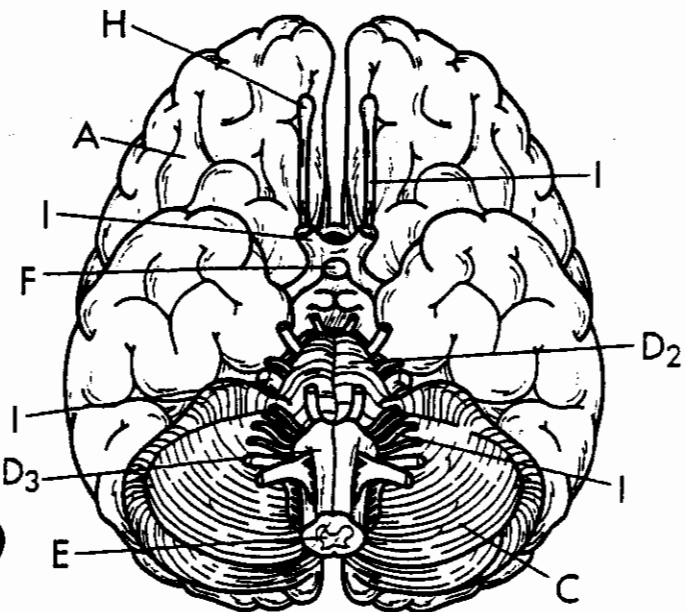
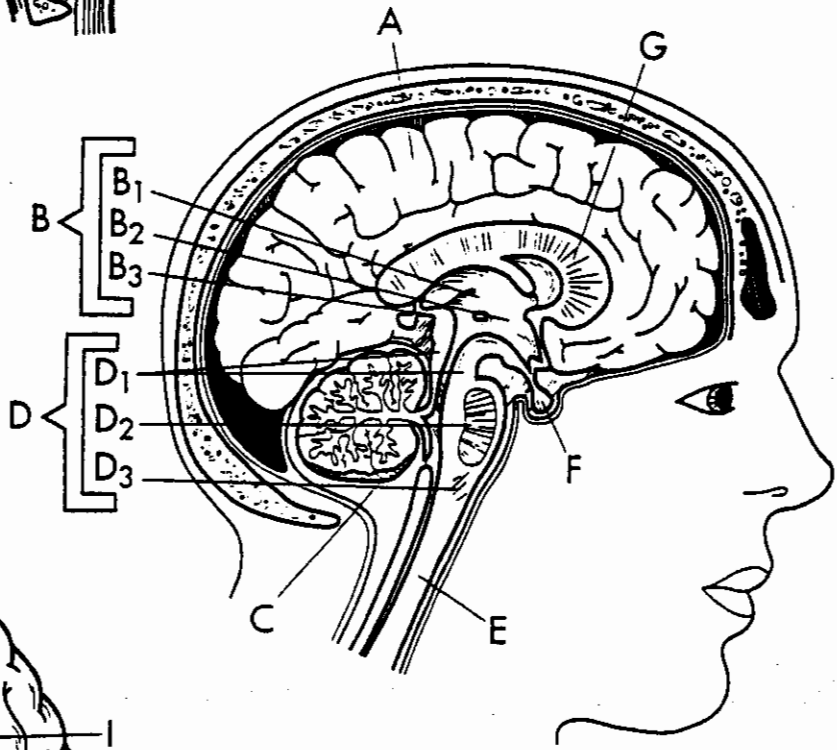
Certain nuclei in the medulla coordinate activities by integrating signals from sensory neurons and sending responses on to the cerebellum or thalamus. Other signals are sent out to various visceral organs. The cardiac center is a mass of neurons located in the medulla for the regulation of the heart rate, and other vasomotor centers regulate the diameters of blood vessels. The depth and rate of breathing are regulated in the respiratory center, also in the medulla.

Various other structures may be seen in the plate, and you should identify and color them in. For example, the **pituitary gland (F)** is seen together with the **corpus callosum (G)** and the **olfactory bulbs (H)**. The corpus callosum is a mass of fibers carrying signals between the two cerebral hemispheres, while the olfactory bulb is associated with the sense of smell. Various **cranial nerves (I)** may be seen at the base of the brain.

OVERVIEW OF THE BRAIN



- Cerebrum A
- Diencephalon B
- Thalamus B₁
- Hypothalamus B₂
- Epithalamus B₃
- Cerebellum C
- Brain stem D
- Midbrain D₁
- Pons D₂



- Medulla oblongata D₃
- Spinal cord E
- Pituitary gland F
- Corpus callosum G
- Olfactory bulbs H
- Cranial nerves I

10. Refer to Figure 7-2, showing a reflex arc, as you complete the following exercise. First, briefly answer the following questions by inserting your responses in the spaces provided.

1. What is the stimulus? _____
2. What tissue is the effector? _____
3. How many synapses occur in this reflex arc? _____

Next, select different colors for each of the following structures and use them to color in the diagram. Finally, draw arrows on the figure indicating the direction of impulse transmission through this reflex pathway.

- | | |
|---------------------------------------|--|
| <input type="radio"/> Receptor region | <input type="radio"/> Association neuron |
| <input type="radio"/> Afferent neuron | <input type="radio"/> Efferent neuron |
| <input type="radio"/> Effector | |

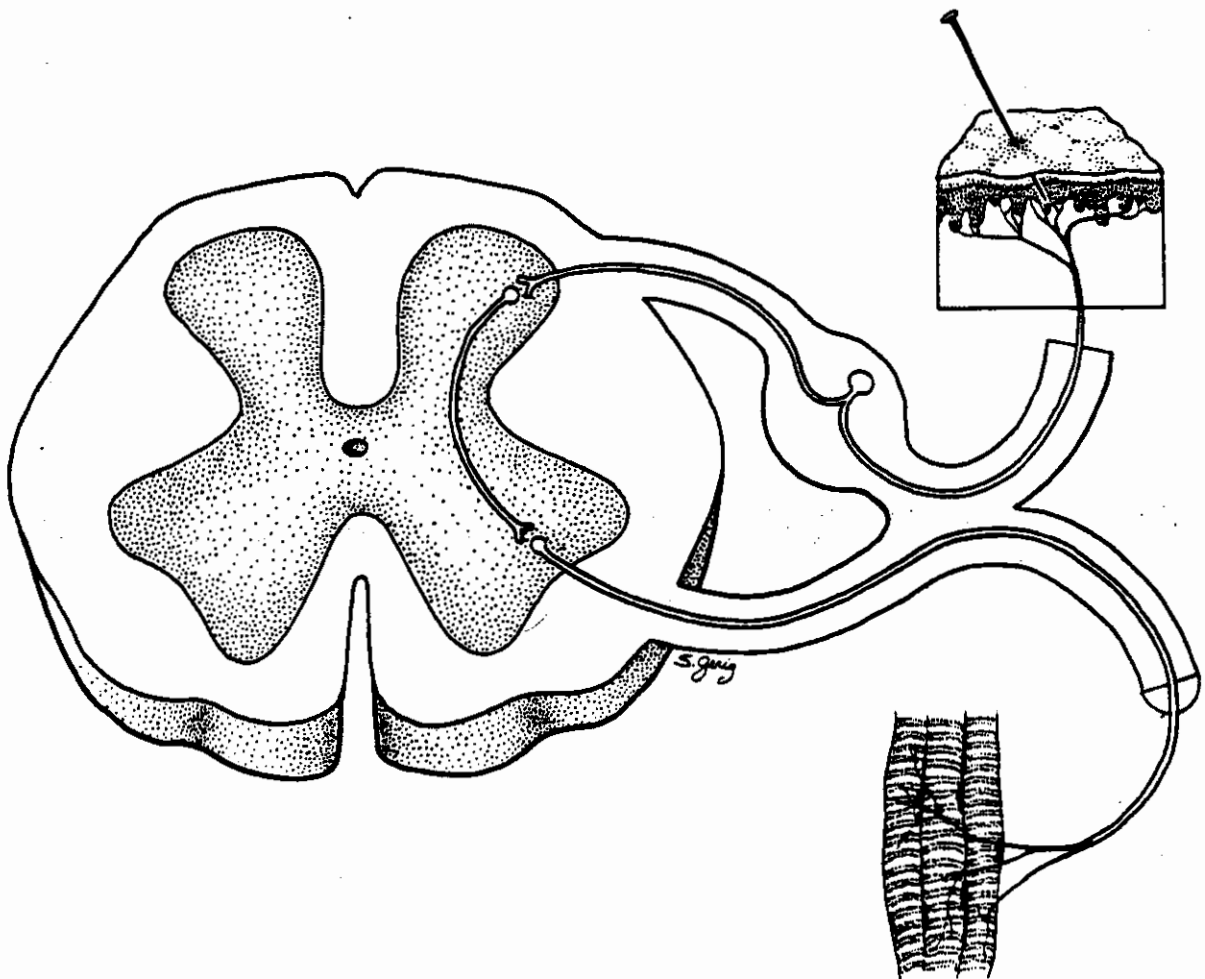


Figure 7-2

15. Figure 7-3 is a diagram of the right lateral view of the human brain. First, match the letters on the diagram with the following list of terms and insert the appropriate letters in the answer blanks. Then, select different colors for each of the areas of the brain provided with a color-coding circle and use them to color in the diagram. If an identified area is part of a lobe, use the color you selected for the lobe but use *stripes* for that area.

- | | | | |
|------------------------------|---------------------------|-------------------------------|-----------------|
| ___ 1. <input type="radio"/> | Frontal lobe | ___ 7. <input type="radio"/> | Lateral fissure |
| ___ 2. <input type="radio"/> | Parietal lobe | ___ 8. <input type="radio"/> | Central fissure |
| ___ 3. <input type="radio"/> | Temporal lobe | ___ 9. <input type="radio"/> | Cerebellum |
| ___ 4. <input type="radio"/> | Precentral gyrus | ___ 10. <input type="radio"/> | Medulla |
| ___ 5. <input type="radio"/> | Parieto-occipital fissure | ___ 11. <input type="radio"/> | Occipital lobe |
| ___ 6. <input type="radio"/> | Postcentral gyrus | ___ 12. <input type="radio"/> | Pons |

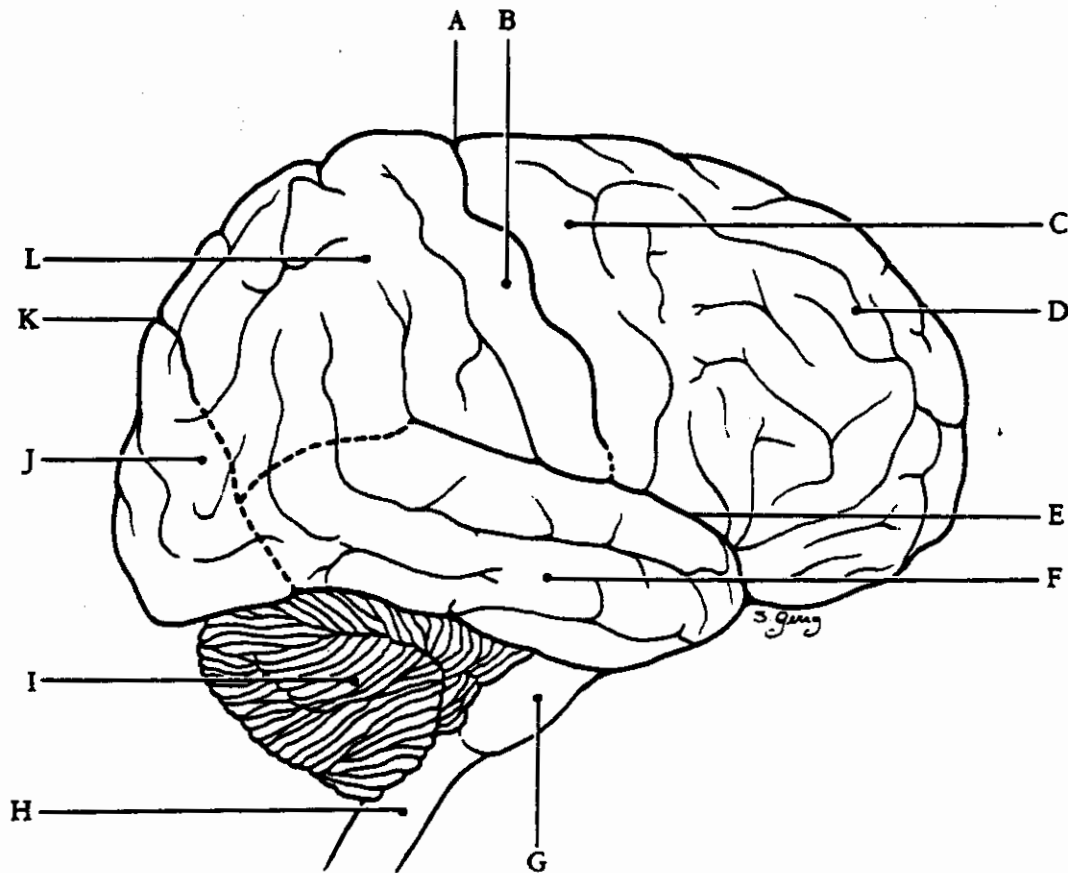


Figure 7-3

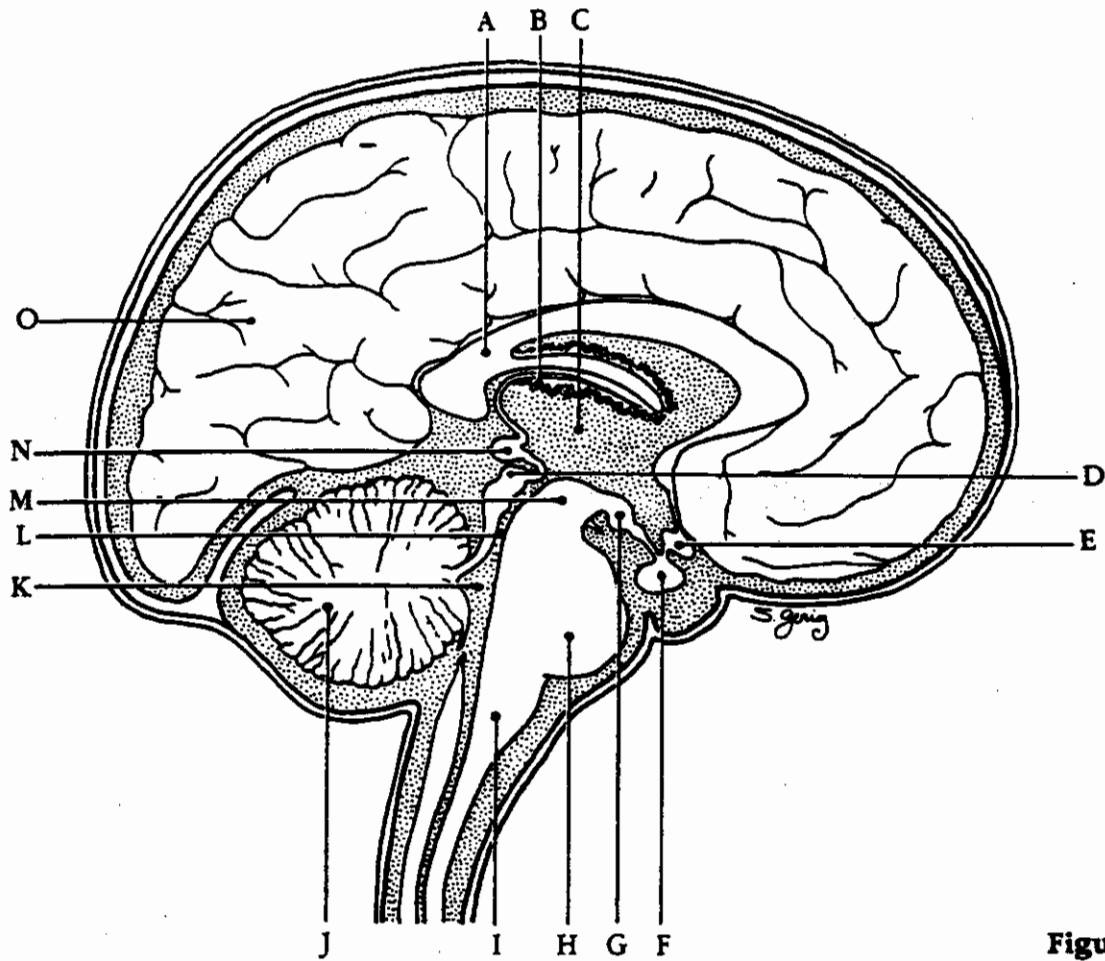


Figure 7-4

18. If the following statements are true, insert *T* in the answer blanks. If any of the statements are false, correct the underlined term by inserting the correct term in the answer blank.

- _____ 1. The primary sensory area of the cerebral hemisphere(s) is found in the precentral gyrus.
- _____ 2. Cortical areas involved in audition are found in the occipital lobe.
- _____ 3. The primary motor area in the temporal lobe is involved in the initiation of voluntary movements.
- _____ 4. The specialized motor speech area is located at the base of the precentral gyrus in an area called Wernicke's area.
- _____ 5. The right cerebral hemisphere receives sensory input from the right side of the body.
- _____ 6. The pyramidal tract is the major descending voluntary motor tract.