

The Nervous System

The nervous system is the master coordinating system of the body. Every thought, action, and sensation reflects its activity. Because of its complexity, the structures of the nervous system are described in terms of two principal divisions—the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS, consisting of the brain and spinal cord, interprets incoming sensory information and issues instructions based on past experience. The PNS, consisting of cranial and spinal nerves and ganglia, provides the communication lines between the CNS and the body's muscles, glands, and sensory receptors. The nervous system is also divided functionally in terms of motor activities into the somatic and autonomic divisions. It is important, however, to recognize that these classifications are made for the sake of convenience and that the nervous system acts in an integrated manner both structurally and functionally.

Student activities provided in this chapter review neuron anatomy and physiology, identify the various structures of the central and peripheral nervous system, consider reflex and sensory physiology, and summarize autonomic nervous system anatomy and physiology. Because every body system is controlled, at least in part, by the nervous system, these understandings are extremely important to comprehending how the body functions as a whole.

1. List the three major functions of the nervous system.

1. _____

2. _____

3. _____

ORGANIZATION OF THE NERVOUS SYSTEM

2. Choose the key responses that best correspond to the descriptions provided in the following statements. Insert the appropriate letter or term in the answer blanks.

Key Choices

A. Autonomic nervous system

C. Peripheral nervous system (PNS)

B. Central nervous system (CNS)

D. Somatic nervous system

- _____ 1. Nervous system subdivision that is composed of the brain and spinal cord
- _____ 2. Subdivision of the PNS that controls voluntary activities such as the activation of skeletal muscles
- _____ 3. Nervous system subdivision that is composed of the cranial and spinal nerves and ganglia
- _____ 4. Subdivision of the PNS that regulates the activity of the heart and smooth muscle, and of glands; it is also called the involuntary nervous system
- _____ 5. A major subdivision of the nervous system that interprets incoming information and issues orders
- _____ 6. A major subdivision of the nervous system that serves as communication lines, linking all parts of the body to the CNS

NERVOUS TISSUE—STRUCTURE AND FUNCTION

3. This exercise emphasizes the difference between neurons and neuroglia. Indicate which cell type is identified by the following descriptions. Insert the appropriate letter or term in the answer blanks.

Key Choices

A. Neurons

B. Neuroglia

- _____ 1. Support, insulate, and protect cells
- _____ 2. Demonstrate irritability and conductivity, and thus transmit electrical messages from one area of the body to another area
- _____ 3. Release neurotransmitters
- _____ 4. Are amitotic
- _____ 5. Able to divide; therefore are responsible for most brain neoplasms

4. Relative to neuron anatomy, match the anatomical terms given in Column B with the appropriate descriptions of functions provided in Column A. Place the correct term or letter response in the answer blanks.

Column A**Column B**

- | | |
|--|--------------------|
| _____ 1. Releases neurotransmitters | A. Axon |
| _____ 2. Conducts electrical currents toward the cell body | B. Axonal terminal |
| _____ 3. Increases the speed of impulse transmission | C. Dendrite |
| _____ 4. Location of the nucleus | D. Myelin sheath |
| _____ 5. Generally conducts impulses away from the cell body | E. Cell body |

5. Certain activities or sensations are listed below. Using key choices, select the specific receptor type that would be activated by the activity or sensation described. Insert the correct term(s) or letter response(s) in the answer blanks. Note that more than one receptor type may be activated in some cases.

Key Choices

- | | | |
|------------------------------|-------------------------|-----------------------|
| A. Bare nerve endings (pain) | C. Meissner's corpuscle | E. Pacinian corpuscle |
| B. Golgi tendon organ | D. Muscle spindle | |

Activity or Sensation**Receptor Type**

Walking on hot pavement

1. (Identify two) _____
and _____

Feeling a pinch

2. (Identify two) _____
and _____

Leaning on a shovel

3. _____

Muscle sensations when rowing a boat

4. (Identify two) _____
and _____

Feeling a caress

5. _____

6. Using key choices, select the terms identified in the following descriptions by inserting the appropriate letter or term in the spaces provided.

Key Choices

A. Afferent neuron

F. Neuroglia

K. Proprioceptors

B. Association neuron

G. Neurotransmitters

L. Schwann cells

C. Cutaneous sense organs

H. Nerve

M. Synapse

D. Efferent neuron

I. Nodes of Ranvier

N. Stimuli

E. Ganglion

J. Nuclei

O. Tract

- _____ 1. Sensory receptors found in the skin, which are specialized to detect temperature, pressure changes, and pain
- _____ 2. Specialized cells that myelinate the fibers of neurons found in the PNS
- _____ 3. Junction or point of close contact between neurons
- _____ 4. Bundle of nerve processes inside the CNS
- _____ 5. Neuron, serving as part of the conduction pathway between sensory and motor neurons
- _____ 6. Gaps in a myelin sheath
- _____ 7. Collection of nerve cell bodies found outside the CNS
- _____ 8. Neuron that conducts impulses away from the CNS to muscles and glands
- _____ 9. Sensory receptors found in muscle and tendons that detect their degree of stretch
- _____ 10. Changes, occurring within or outside the body, that affect nervous system functioning
- _____ 11. Neuron that conducts impulses toward the CNS from the body periphery
- _____ 12. Chemicals released by neurons that stimulate other neurons, muscles, or glands

7. Figure 7-1 is a diagram of a neuron. First, label the parts indicated on the illustration by leader lines. Then choose different colors for each of the structures listed below and use them to color in the coding circles and corresponding structures in the illustration. Next, circle the term in the list of three terms to the left of the diagram that best describes this neuron's structural class. Finally, draw arrows on the figure to indicate the direction of impulse transmission along the neuron's membrane.

- ☐ Axon
☐ Dendrites
☐ Cell body
☐ Myelin sheath

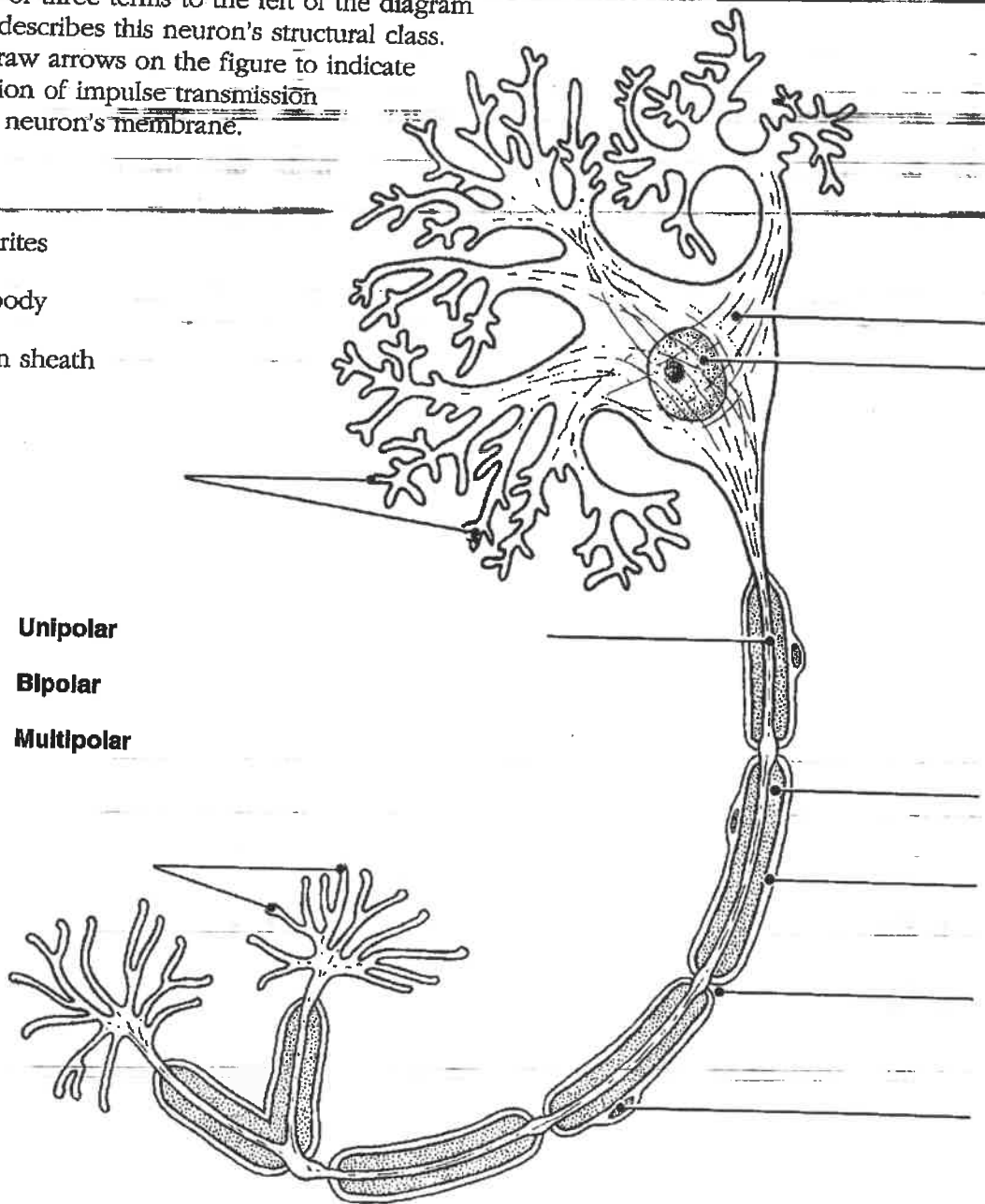


Figure 7-1

8. List in order the *minimum* elements in a reflex arc from the stimulus to the activity of the effector. Place your responses in the answer blanks.

1. Stimulus

4. _____

2. _____

5. Effector organ

3. _____

9. Using the key choices, identify the terms defined in the following statements. Place the correct term or letter response in the answer blanks.

Key Choices

- | | | |
|---------------------|----------------------|--------------------------|
| A. Action potential | D. Potassium ions | G. Sodium ions |
| B. Depolarization | E. Refractory period | H. Sodium-potassium pump |
| C. Polarized | F. Repolarization | |

- _____ 1. Period of repolarization of the neuron during which it cannot respond to a second stimulus
- _____ 2. State in which the resting potential is reversed as sodium ions rush into the neuron
- _____ 3. Electrical condition of the plasma membrane of a resting neuron
- _____ 4. Period during which potassium ions diffuse out of the neuron
- _____ 5. Transmission of the depolarization wave along the neuron's membrane
- _____ 6. The chief positive intracellular ion in a resting neuron
- _____ 7. Process by which ATP is used to move sodium ions out of the cell and potassium ions back into the cell; completely restores the resting conditions of the neuron

10. Using the key choices, identify the types of reflexes involved in each of the following situations.

Key Choices

- | | |
|-----------------------|-------------------------|
| A. Somatic reflex(es) | B. Autonomic reflex(es) |
|-----------------------|-------------------------|

- _____ 1. Patellar (knee-jerk) reflex
- _____ 2. Pupillary light reflex
- _____ 3. Effectors are skeletal muscles
- _____ 4. Effectors are smooth muscle and glands
- _____ 5. Flexor reflex
- _____ 6. Regulation of blood pressure
- _____ 7. Salivary reflex

11. Refer to Figure 7-2, showing a reflex arc, as you complete this 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 coding circles and corresponding structures 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 | |

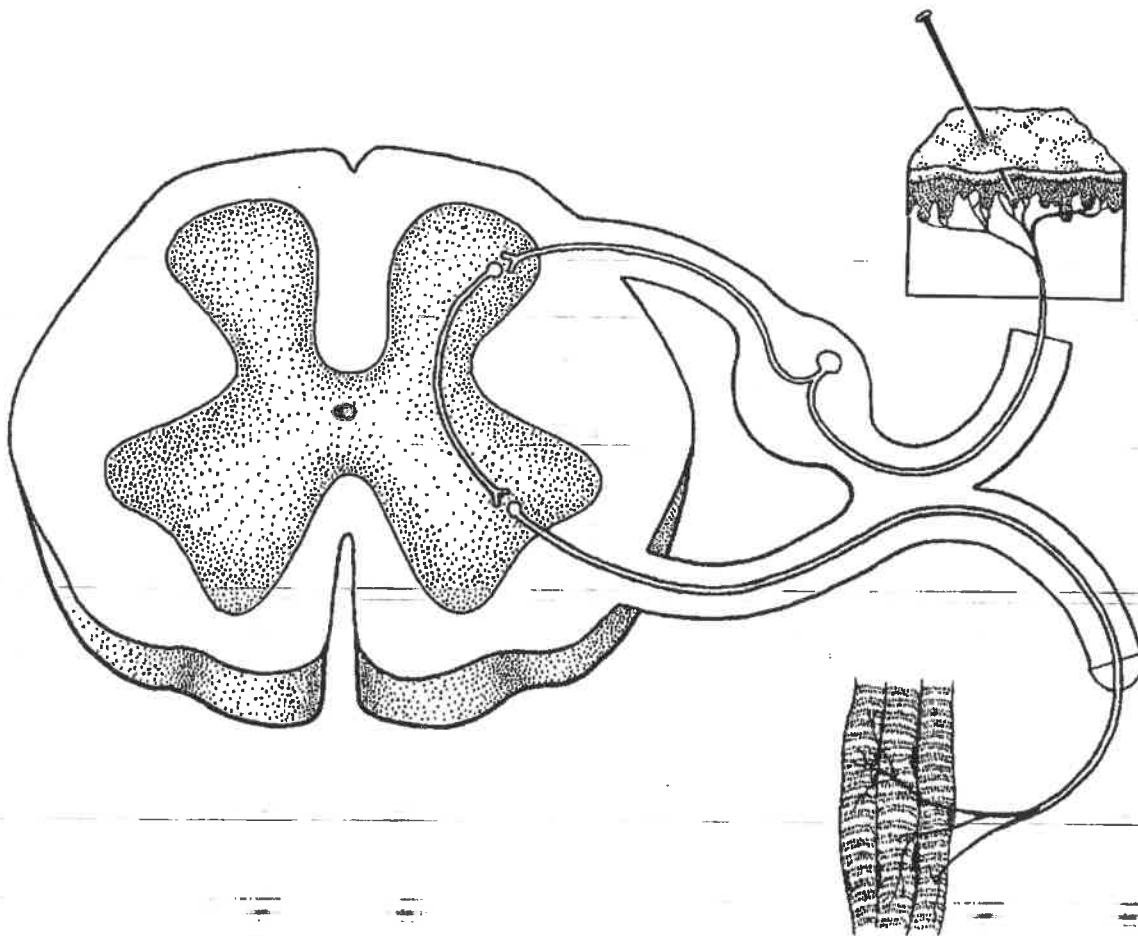


Figure 7-2

12. Circle the term that does not belong in each of the following groupings.

1. Astrocytes Neurons Oligodendrocytes Microglia
2. K^+ enters the cell K^+ leaves the cell Repolarization Refractory period
3. Nodes of Ranvier Myelin sheath Unmyelinated Saltatory conduction
4. Predictable response Voluntary act Involuntary act Reflex
5. Oligodendrocytes Schwann cells Myelin Microglia
6. Cutaneous receptors Free dendritic endings Stretch Pain and touch
7. Cell interior High Na^+ Low Na^+ High K^+

CENTRAL NERVOUS SYSTEM

Brain

13. Complete the following statements by inserting your answers in the answer blanks.

- _____ 1. The largest part of the human brain is the (paired) (1). The other major subdivisions of the brain are the (2) and the (3). The cavities found in the brain are called (4). They contain (5).
- _____ 2.
- _____ 3.
- _____ 4.
- _____ 5.

14. Circle the terms indicating structures that are *not* part of the brain stem.

- Cerebral hemispheres Midbrain Medulla
- Pons Cerebellum Diencephalon

15. Complete the following statements by inserting your answers in the answer blanks.

- _____ 1. A (1) is an elevated ridge of cerebral cortex tissue. The convolutions seen in the cerebrum are important because they increase the (2). Gray matter is composed of (3). White matter is composed of (4), which provide for communication between different parts of the brain as well as with lower CNS centers. The lentiform nucleus, the caudate, and other nuclei are collectively called the (5).
- _____ 2.
- _____ 3.
- _____ 4.
- _____ 5.

16. 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 coding circles and corresponding structures 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 sulcus |
| _____ 2. <input type="radio"/> Parietal lobe | _____ 8. <input type="radio"/> Central sulcus |
| _____ 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 |

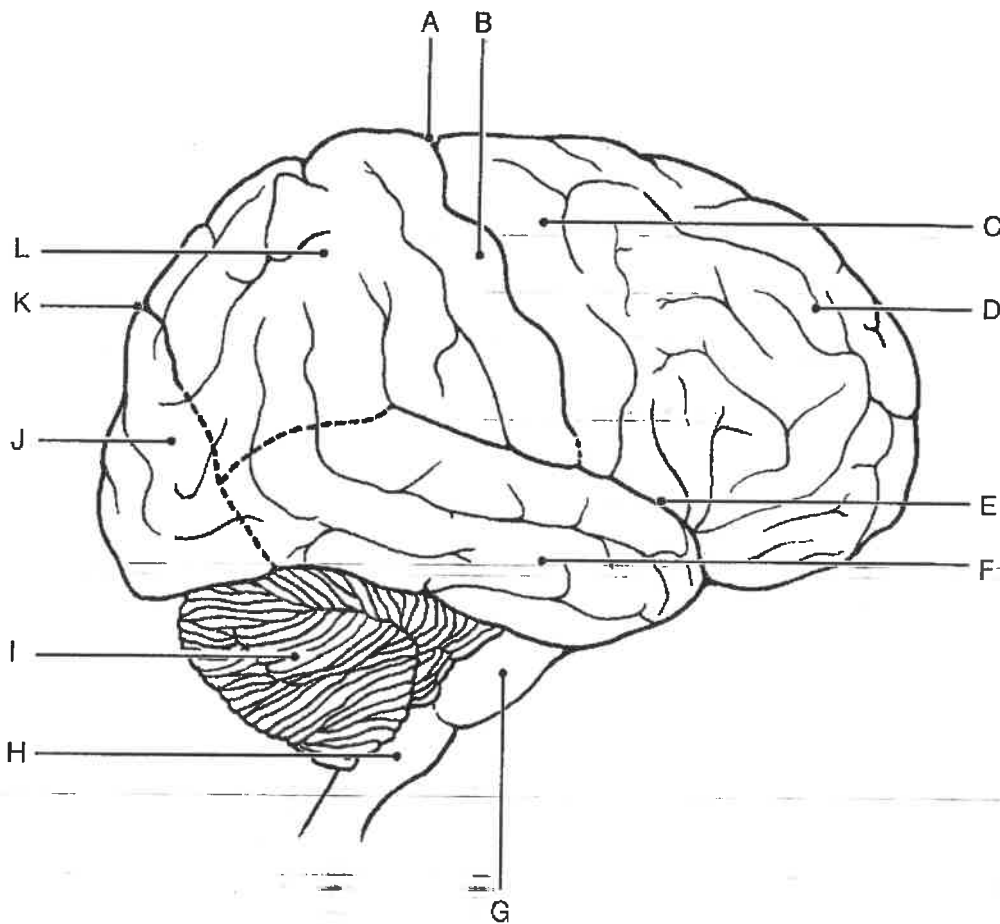


Figure 7-3

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17. Figure 7-4 is a diagram of the sagittal view of the human brain. First, match the letters on the diagram with the following list of terms and insert the appropriate letter in each answer blank. Then, color the brain-stem areas blue and the areas where cerebrospinal fluid is found yellow.

- | | |
|-------------------------------|-----------------------------|
| _____ 1. Cerebellum | _____ 9. Hypothalamus |
| _____ 2. Cerebral aqueduct | _____ 10. Medulla oblongata |
| _____ 3. Cerebral hemisphere | _____ 11. Optic chiasma |
| _____ 4. Cerebral peduncle | _____ 12. Pineal body |
| _____ 5. Choroid plexus | _____ 13. Pituitary gland |
| _____ 6. Corpora quadrigemina | _____ 14. Pons |
| _____ 7. Corpus callosum | _____ 15. Thalamus |
| _____ 8. Fourth ventricle | |

18. Referring to the brain areas listed in Exercise 17, match the appropriate brain structures with the following descriptions. Insert the correct terms in the answer blanks.

- | | |
|-------|---|
| _____ | 1. Site of regulation of water balance and body temperature |
| _____ | 2. Contains reflex centers involved in regulating respiratory rhythm in conjunction with lower brain-stem centers |
| _____ | 3. Responsible for the regulation of posture and coordination of skeletal muscle movements |
| _____ | 4. Important relay station for afferent fibers traveling to the sensory cortex for interpretation |
| _____ | 5. Contains autonomic centers, which regulate blood pressure and respiratory rhythm, as well as coughing and sneezing centers |
| _____ | 6. Large fiber tract connecting the cerebral hemispheres |
| _____ | 7. Connects the third and fourth ventricles |
| _____ | 8. Encloses the third ventricle |
| _____ | 9. Forms the cerebrospinal fluid |
| _____ | 10. Midbrain area that is largely fiber tracts; bulges anteriorly |
| _____ | 11. Part of the limbic system; contains centers for many drives (rage, pleasure, hunger, sex, etc.) |

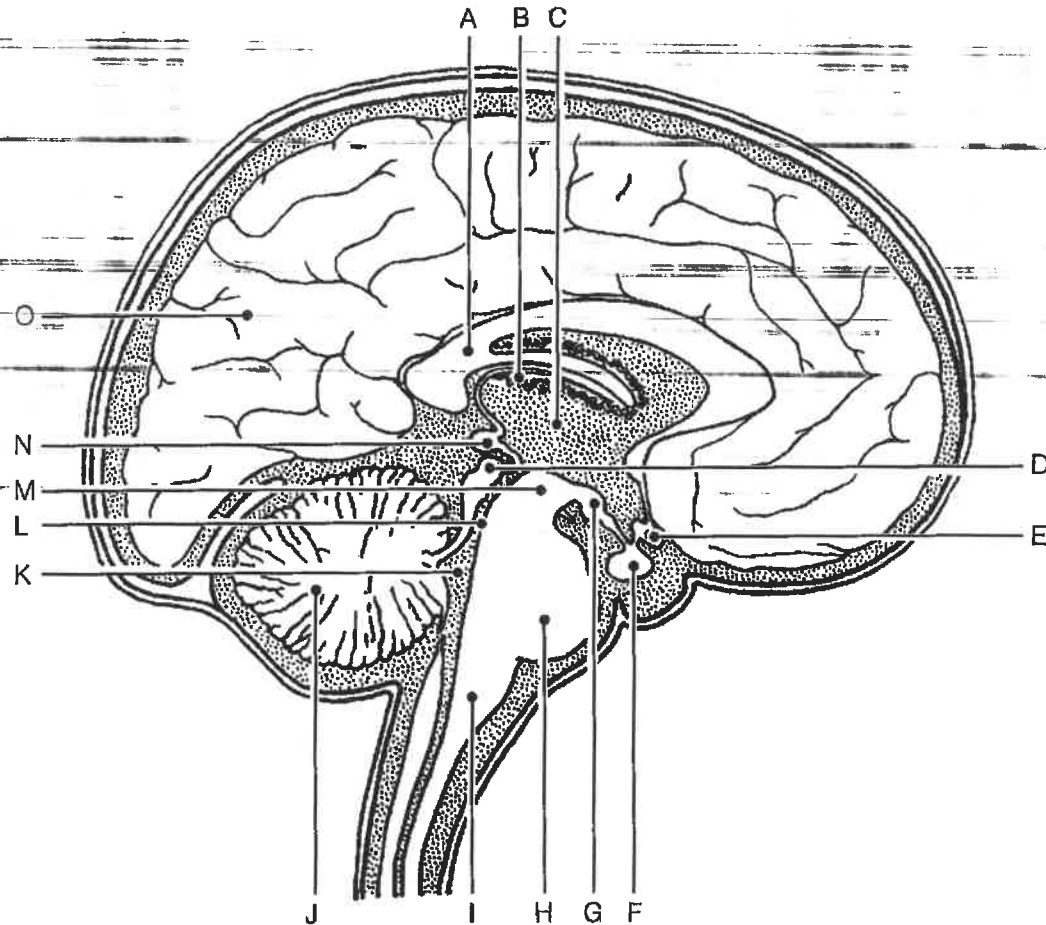


Figure 7-4

19. For each of the following statements that is true, insert *T* in the answer blank. 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. A specialized motor speech area located at the base of the precentral gyrus is 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.
- _____ 7. Damage to the thalamus impairs consciousness and the awake/sleep cycles.

8. A flat EEG is evidence of clinical death.
9. Beta waves are recorded when an individual is awake and relaxed.

Protection of the CNS—Meninges and Cerebrospinal Fluid

20. Identify the meningeal (or associated) structures described here.

- _____ 1. Outermost covering of the brain, composed of tough fibrous connective tissue
- _____ 2. Innermost covering of the brain; delicate and vascular
- _____ 3. Structures that return cerebrospinal fluid to the venous blood in the dural sinuses
- _____ 4. Middle meningeal layer; like a cobweb in structure
- _____ 5. Its outer layer forms the periosteum of the skull

21. Figure 7-5 shows a frontal view of the meninges of the brain at the level of the superior sagittal (dural) sinus. First, label the *arachnoid villi* on the figure. Then, select different colors for each of the following structures and use them to color the coding circles and corresponding structures in the diagram.

☐ Dura mater

☐ Pia mater

☐ Arachnoid mater

☐ Subarachnoid space

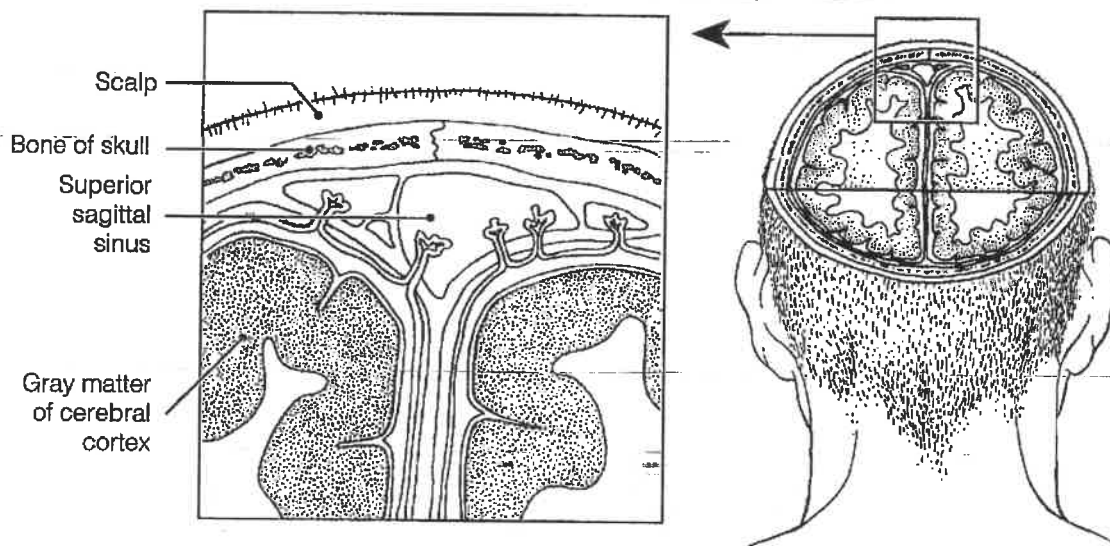


Figure 7-5

22. Complete the following statements by inserting your answers in the answer blanks.

1. Cerebrospinal fluid is formed by capillary knots called (1), which hang into the (2) of the brain. Ordinarily, cerebrospinal fluid flows from the lateral ventricles to the third ventricle and then through the (3) to the fourth ventricle.
2. Some of the fluid continues down the (4) of the spinal cord, but most of it circulates into the (5) by passing through three tiny openings in the walls of the (6). As a rule, cerebrospinal fluid is formed and drained back into the venous blood at the same rate. If its drainage is blocked, a condition called (7) occurs, which results in increased pressure on the brain.
- 3.

Brain Dysfunctions

23. Match the brain disorders listed in Column B with the conditions described in Column A. Place the correct answers in the answer blanks.

Column A

1. Slight and transient brain injury
2. Traumatic injury that destroys brain tissue
3. Total nonresponsiveness to stimulation
4. May cause medulla oblongata to be wedged into foramen magnum by pressure of blood
5. After head injury, retention of water by brain
6. Results when a brain region is deprived of blood or exposed to prolonged ischemia
7. Progressive degeneration of the brain with abnormal protein deposits
8. Autoimmune disorder with extensive demyelination
9. A mini-stroke; fleeting symptoms of a CVA

Column B

- A. Alzheimer's disease
- B. Cerebral edema
- C. Cerebrovascular accident (CVA)
- D. Coma
- E. Concussion
- F. Contusion
- G. Intracranial hemorrhage
- H. Multiple sclerosis
- I. Transient ischemic attack (TIA)

Spinal Cord

24. Complete the following statements by inserting your responses in the answer blanks.

- _____ 1. The spinal cord extends from the (1) _____ of the skull to the
- _____ 2. (2) _____ region of the vertebral column. The meninges, which
- _____ 3. cover the spinal cord, extend more inferiorly to form a sac
- _____ 4. from which cerebrospinal fluid can be withdrawn without
- _____ 5. damage to the spinal cord. This procedure is called a (3) _____
- _____ 6. (4) _____ pairs of spinal nerves arise from the cord. Of these,
- _____ 7. (5) _____ pairs are cervical nerves, (6) _____ pairs are thoracic
- _____ 8. nerves, (7) _____ pairs are lumbar nerves, and (8) _____ pairs are
- _____ 9. sacral nerves. The tail-like collection of spinal nerves at the
- _____ inferior end of the spinal cord is called the (9) _____.

25. Using key choices, select the appropriate terms to respond to the following descriptions referring to spinal cord anatomy. Place the correct term or letter in the answer blanks.

Key Choices

- | | |
|-----------------------|---------------------------------------|
| A. Afferent (sensory) | C. Both afferent and efferent |
| B. Efferent (motor) | D. Association neurons (interneurons) |

- _____ 1. Neuron type found in the dorsal horn
- _____ 2. Neuron type found in the ventral horn
- _____ 3. Neuron type in a dorsal root ganglion
- _____ 4. Fiber type in the ventral root
- _____ 5. Fiber type in the dorsal root
- _____ 6. Fiber type in a spinal nerve

26. Figure 7-6 is a cross-sectional view of the spinal cord. First, select different colors to identify the following structures and use them to color the coding circles and corresponding structures in the figure.

☐ Pia mater ☐ Dura mater ☐ Arachnoid

Then, identify the areas listed in the key choices by inserting the correct choices/letter next to the appropriate leader line on the figure. Color the butterfly-shaped gray matter of the cord gray and the spinal roots and nerves yellow.

Key Choices

- | | | |
|---------------------------|-------------------------|-----------------|
| A. Central canal | D. Dorsal root | G. Ventral horn |
| B. Column of white matter | E. Dorsal root ganglion | H. Ventral root |
| C. Dorsal horn | F. Spinal nerve | |

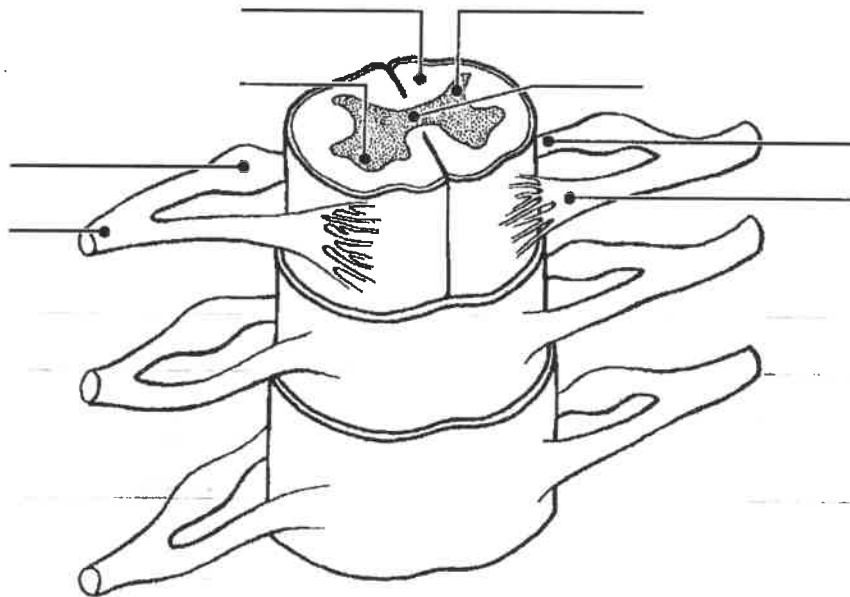


Figure 7-6

27. Using choices from Column B, indicate what would happen if the structures in Column A were damaged or transected. Place the correct letter in the answer blanks.

Column A

- _____ 1. Dorsal root of a spinal nerve
- _____ 2. Ventral root of a spinal nerve
- _____ 3. Anterior ramus of a spinal nerve

Column B

- A. Loss of motor function
- B. Loss of sensory function
- C. Loss of both motor and sensory function

PERIPHERAL NERVOUS SYSTEM

Structure of a Nerve

28. Figure 7-7 is a diagrammatic view of a nerve wrapped in its connective tissue coverings. Select different colors to identify the following structures and use them to color the coding circles and corresponding structures in the figure. Then, label each of the sheaths indicated by leader lines on the figure.

○ Endoneurium ○ Perineurium ○ Epineurium

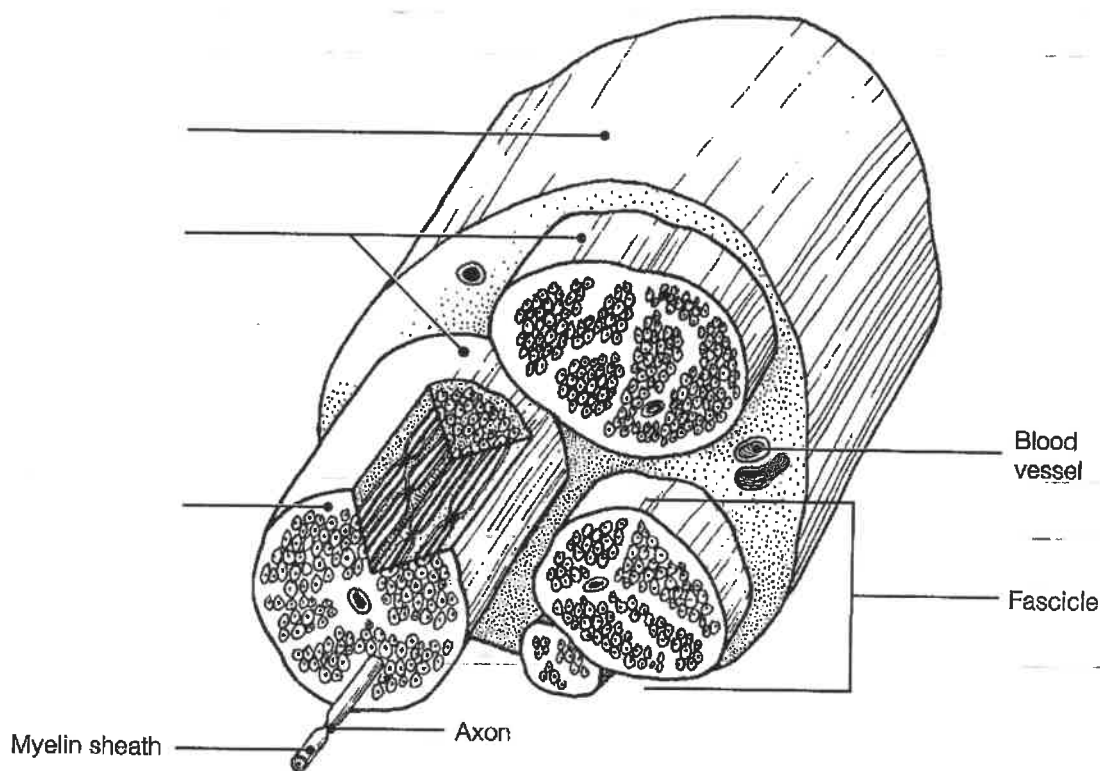


Figure 7-7

29. Complete the following statements by inserting your responses in the answer blanks.

1. Another name for a bundle of nerve fibers is (1). Nerves carrying both sensory and motor fibers are called (2).
2. Nerves, whereas those carrying just sensory fibers are referred to as sensory, or (3), nerves.
- 3.

30. Figure 7-8 is an anterior view of the principal nerves arising from the brachial plexus. Select five different colors and color the coding circles and the nerves listed below. Also, label each nerve by inserting its name at the appropriate leader line.

- ☐ Axillary nerve
- ☐ Musculocutaneous nerve
- ☐ Median nerve
- ☐ Radial nerve
- ☐ Ulnar nerve

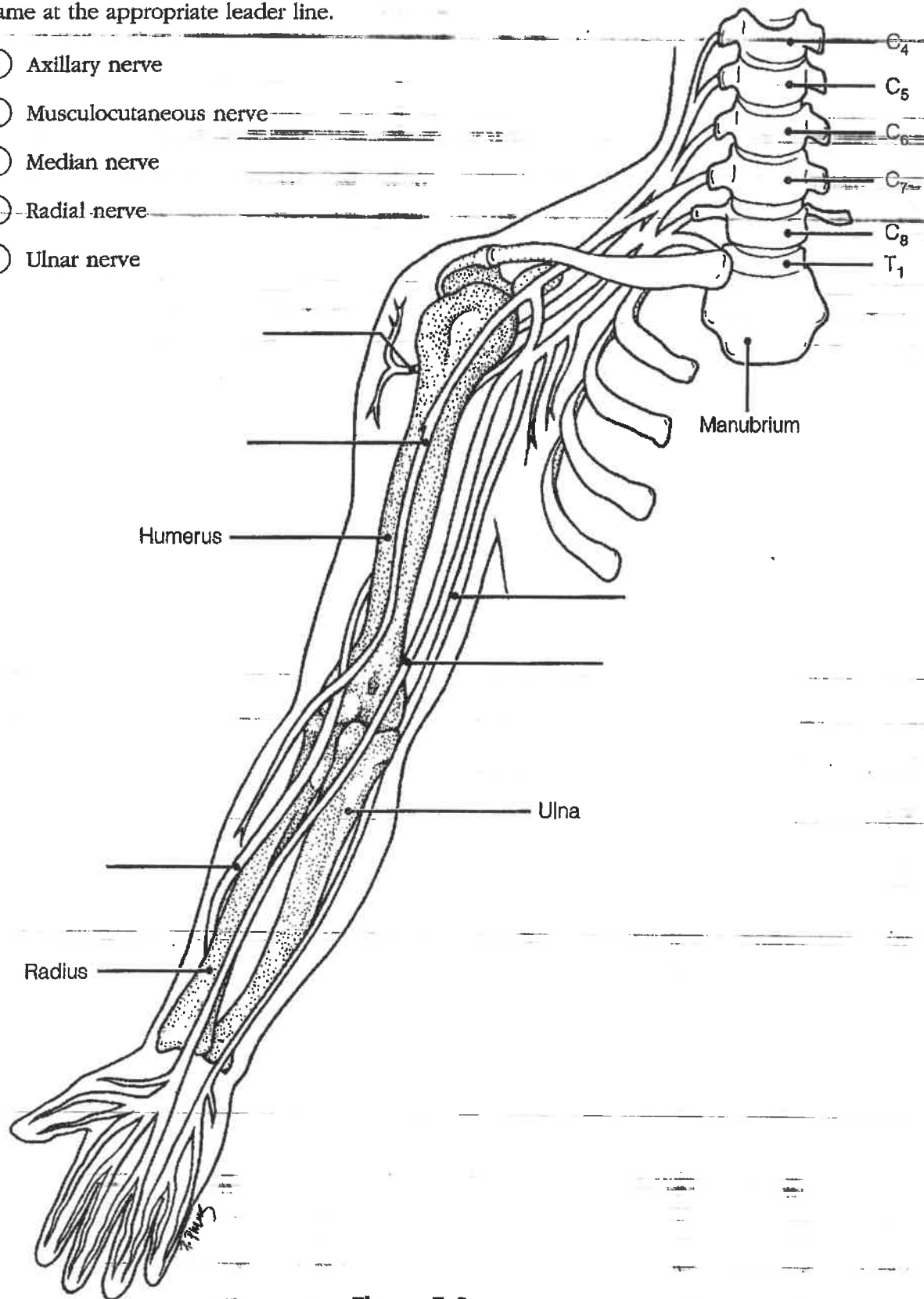


Figure 7-8

Cranial Nerves

31. The 12 pairs of cranial nerves are indicated by leader lines in Figure 7-9. First, label each by name and Roman numeral on the figure and then color each nerve with a different color.

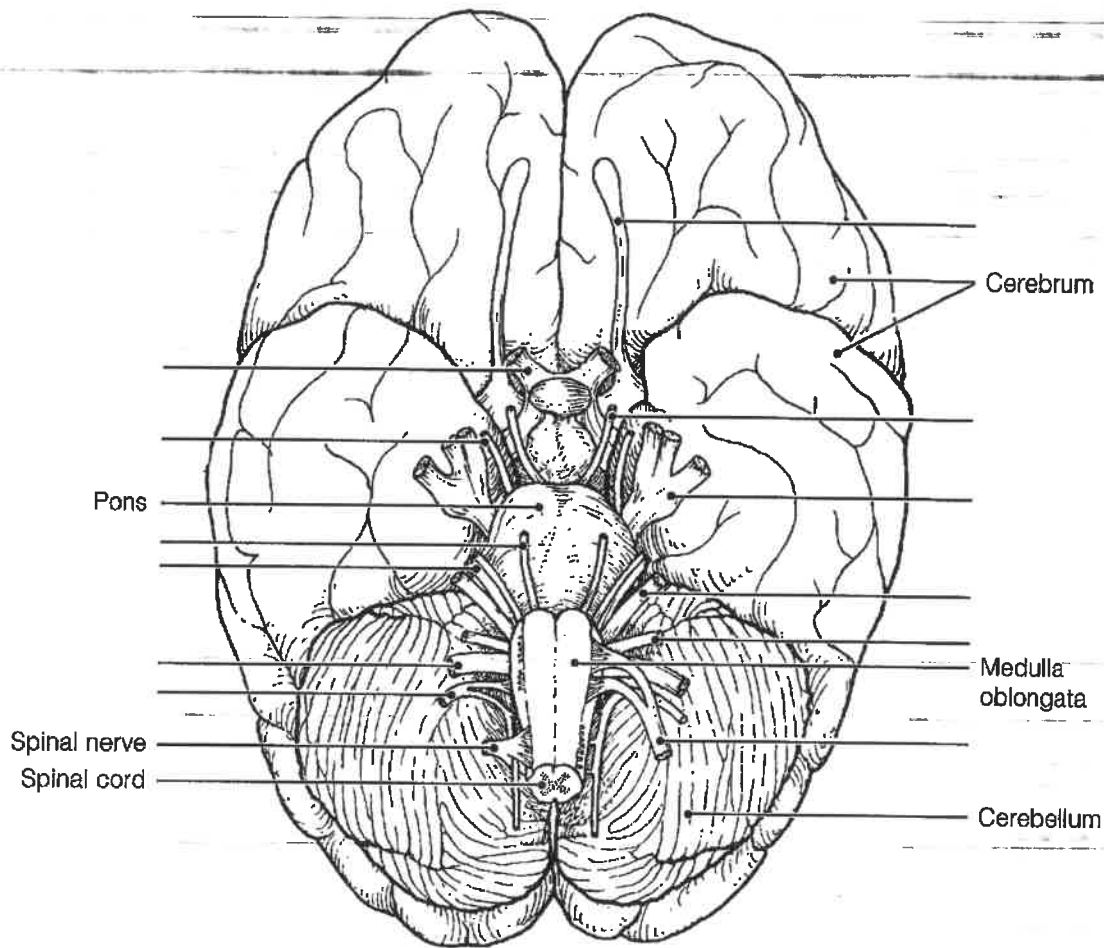


Figure 7-9

32. Provide the name and number of the cranial nerves involved in each of the following activities, sensations, or disorders. Insert your response in the answer blanks.

1. Shrugging the shoulders
2. Smelling a flower
3. Raising the eyelids and focusing the lens of the eye for accommodation; constriction of the eye pupils
4. Slows the heart; increases the mobility of the digestive tract
5. Involved in smiling
6. Involved in chewing food
7. Listening to music; seasickness
8. Secretion of saliva; tasting well-seasoned food
9. Involved in "rolling" the eyes (three nerves—provide numbers only)
10. Feeling a toothache
11. Reading *Tennis* magazine or this study guide
12. Purely sensory (three nerves—provide numbers only)

Spinal Nerves and Nerve Plexuses

33. Complete the following statements by inserting your responses in the answer blanks.

1. The ventral rami of spinal nerves C_1 through T_1 and L_1 through S_4 take part in forming (1), which serve the (2) of the
2. body. The ventral rami of T_1 through T_{12} run between the ribs to serve the (3). The posterior rami of the spinal nerves
3. serve the (4).
- 4.

34. Name the major nerves that serve the following body areas. Insert your responses in the answer blanks.

1. Head, neck, shoulders (name plexus only)
2. Diaphragm
3. Posterior thigh
4. Leg and foot (name two)

5. Most anterior forearm muscles

6. Arm muscles

7. Abdominal wall (name plexus only)

8. Anterior thigh

9. Medial side of the hand

Autonomic Nervous System

35. Identify, by color coding and coloring, the following structures in Figure 7-10, which depicts the major anatomical differences between the somatic and autonomic motor divisions of the PNS. Also identify by labeling all structures provided with leader lines.

- | | |
|--|--|
| <input type="radio"/> Somatic motor neuron | <input type="radio"/> Effector of the somatic motor neuron |
| <input type="radio"/> ANS preganglionic neuron | <input type="radio"/> Effector of the automatic motor neuron |
| <input type="radio"/> ANS ganglionic neuron | <input type="radio"/> Myelin sheath |
| <input type="radio"/> Autonomic ganglion | <input type="radio"/> White matter of spinal cord (CNS) |
| <input type="radio"/> Gray matter of spinal cord (CNA) | |

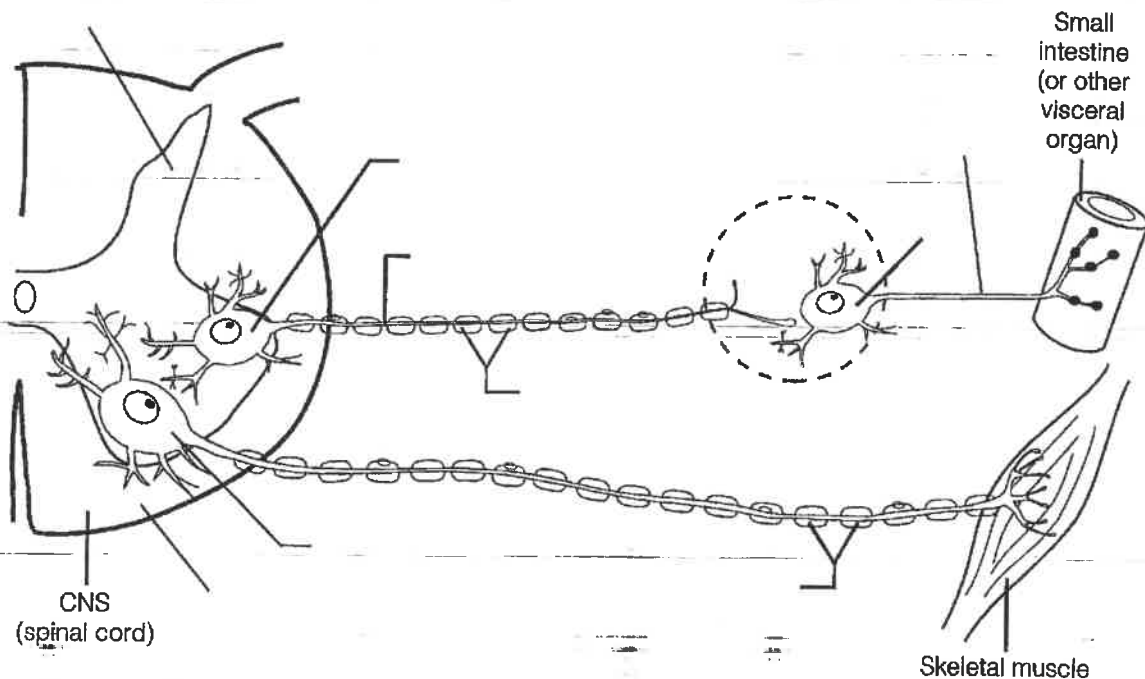


Figure 7-10

36. The following table indicates a number of conditions. Use a check (✓) to show which division of the autonomic nervous system is involved in each condition.

Condition	Sympathetic	Parasympathetic
1. Postganglionic axons secrete norepinephrine; adrenergic fibers		
2. Postganglionic axons secrete acetylcholine; cholinergic fibers		
3. Long preganglionic axon, short postganglionic axon		
4. Short preganglionic axon, long postganglionic axon		
5. Arises from cranial and sacral nerves		
6. Arises from spinal nerves T ₁ to L ₃		
7. Normally in control		
8. Fight-or-flight system		
9. Has more specific control		
10. Causes a dry mouth, dilates bronchioles		
11. Constricts eye pupils, decreases heart rate		

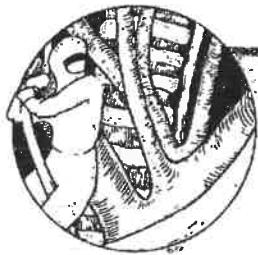
37. You are alone in your home late in the evening, and you hear an unfamiliar sound in your backyard. In the spaces provided, list four physiologic events promoted by the sympathetic nervous system that would help you to cope with this rather frightening situation.

1. _____
2. _____
3. _____
4. _____

DEVELOPMENTAL ASPECTS OF THE NERVOUS SYSTEM

38. Complete the following statements by inserting your responses in the answer blanks.

1. Body temperature regulation is a problem in premature infants because the (1) is not yet fully functional. Cerebral
2. palsy involves crippling neuromuscular problems. It usually is a result of a lack of (2) to the infant's brain during delivery. Normal maturation of the nervous system occurs in a
3. (3) direction, and fine control occurs much later than (4)
4. muscle control. The sympathetic nervous system becomes less efficient as aging occurs, resulting in an inability to prevent
5. sudden changes in (5) when abrupt changes in position are made. The usual cause of decreasing efficiency of the nervous system as a whole is (6). A change in intellect due to
6. a gradual decrease in oxygen delivery to brain cells is called
7. (7). Death of brain neurons, which results from a sudden cessation of oxygen delivery, is called a (8).
- 8.



INCREDIBLE JOURNEY

A Visualization Exercise for the Nervous System

You climb on the first cranial nerve you see...

39. Where necessary, complete statements by inserting the missing words in the answer blanks.

1. Nervous tissue is quite densely packed, and it is difficult to envision strolling through its various regions. Imagine instead that each of the various functional regions of the brain has a computerized room where you can observe what occurs in that particular area. Your assignment is to determine where you are at any given time during your journey through the nervous system.

You begin your journey after being miniaturized and injected into the warm pool of cerebrospinal fluid in your host's fourth ventricle. As you begin your stroll through the nervous tissue, you notice a huge area of branching white matter overhead. As you enter the first computer room you hear an announcement through the loudspeaker, "The pelvis is tipping too far posteriorly. Please correct. We are beginning to fall backward and will soon lose our balance." The computer responds immediately, decreasing impulses to the posterior hip muscles and increasing impulses to the anterior thigh muscles. "How is that, proprioceptor?" From this information, you determine that your first stop is the (1).