



THE NERVOUS SYSTEM

The nervous system is the master coordinating system of the body. Every thought, action, and sensation reflects its activity. 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 (brain and spinal cord) interprets incoming sensory information and issues instructions based on past experience. The PNS (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 understanding 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
- B. Central nervous system (CNS)
- C. Peripheral nervous system (PNS)
- 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. Axon 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 the 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 the 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
- B. Association neuron (or interneuron)
- C. Cutaneous sense organs
- D. Efferent neuron
- E. Ganglion
- F. Neuroglia
- G. Neurotransmitters
- H. Nerve
- I. Nodes of Ranvier
- J. Nuclei
- K. Proprioceptors
- L. Schwann cells
- M. Synapse
- N. Stimuli
- 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

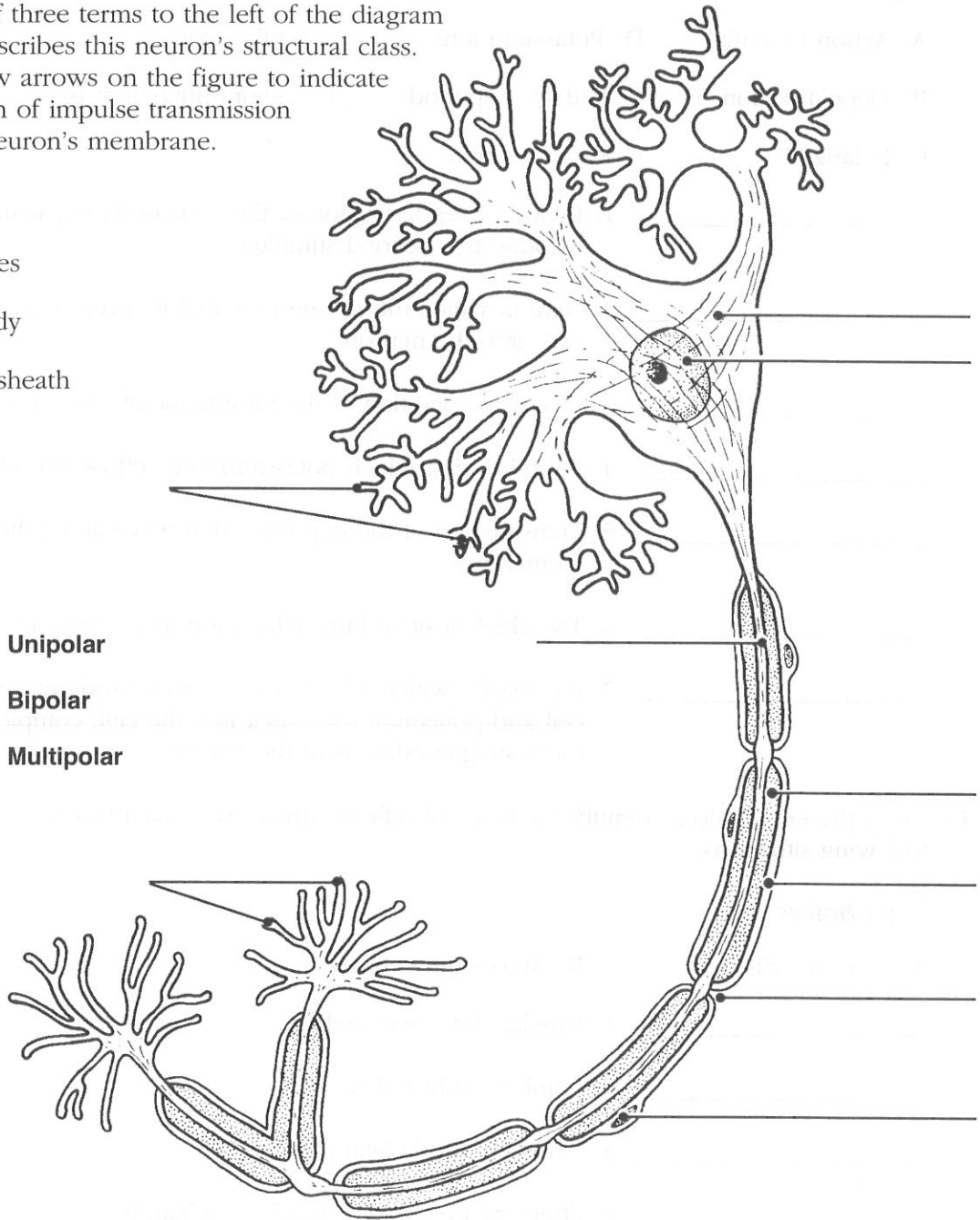


Figure 7-1

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

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"/> Interneuron |
| <input type="radio"/> Afferent neuron | <input type="radio"/> Efferent neuron |
| <input type="radio"/> Effector | |

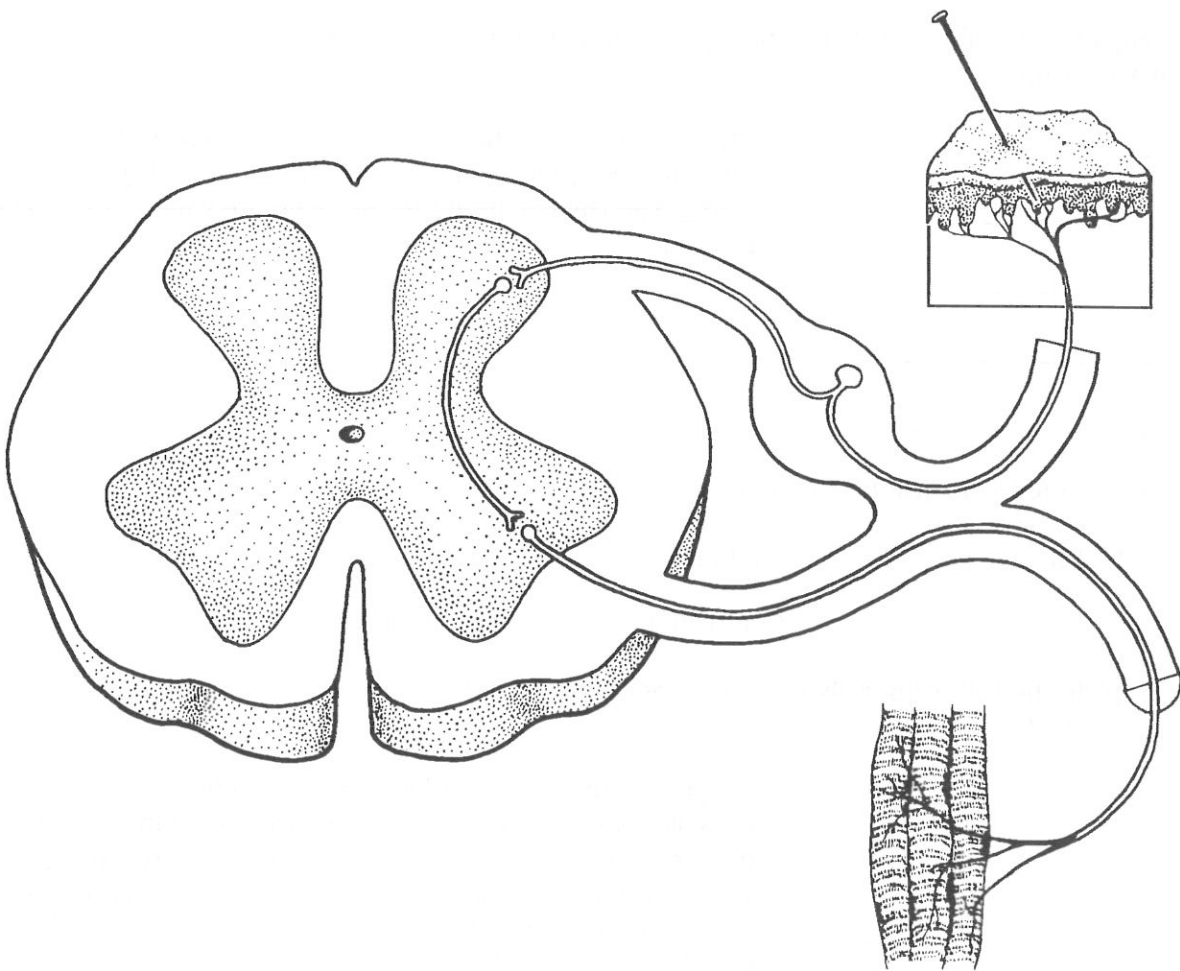


Figure 7-2

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 | Umyelinated | 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. _____
 2. _____
 3. _____
 4. _____
 5. _____
- 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).

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. _____
 2. _____
 3. _____
 4. _____
 5. _____
- 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).

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 |

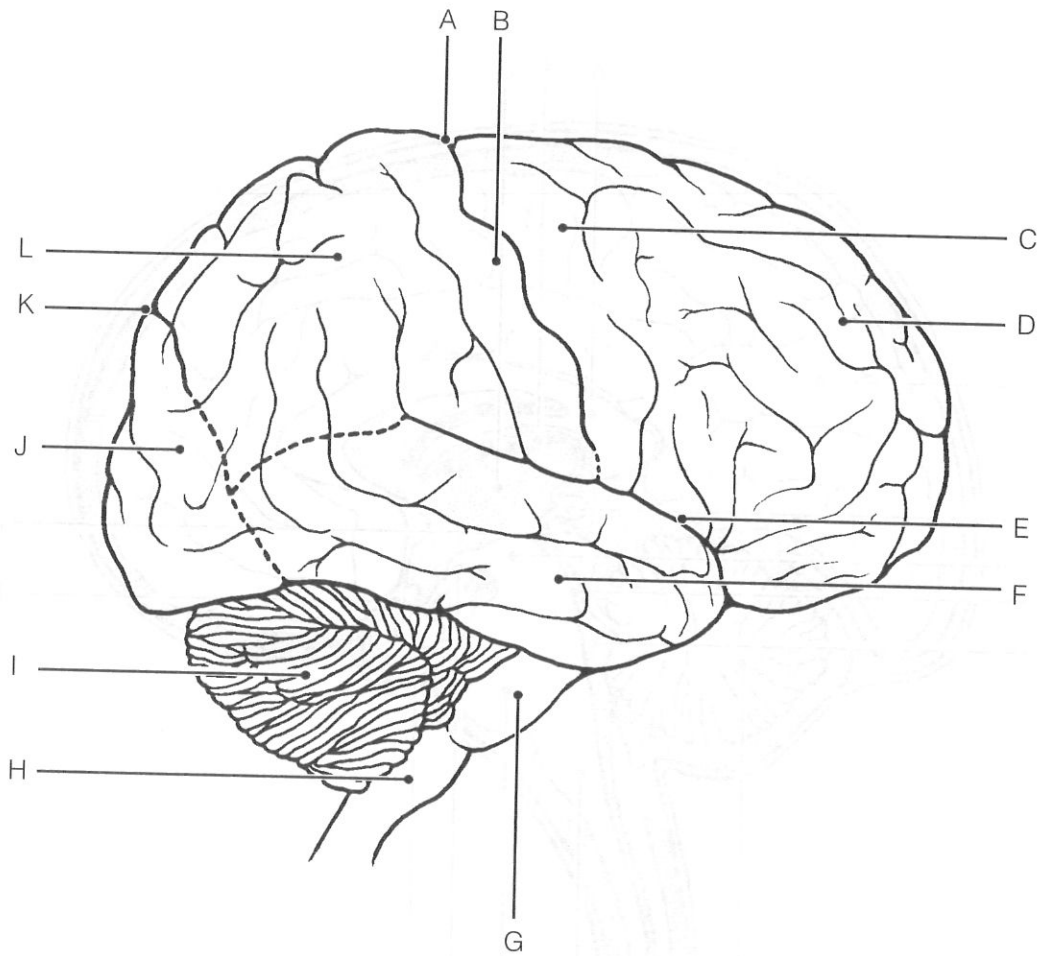


Figure 7-3

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

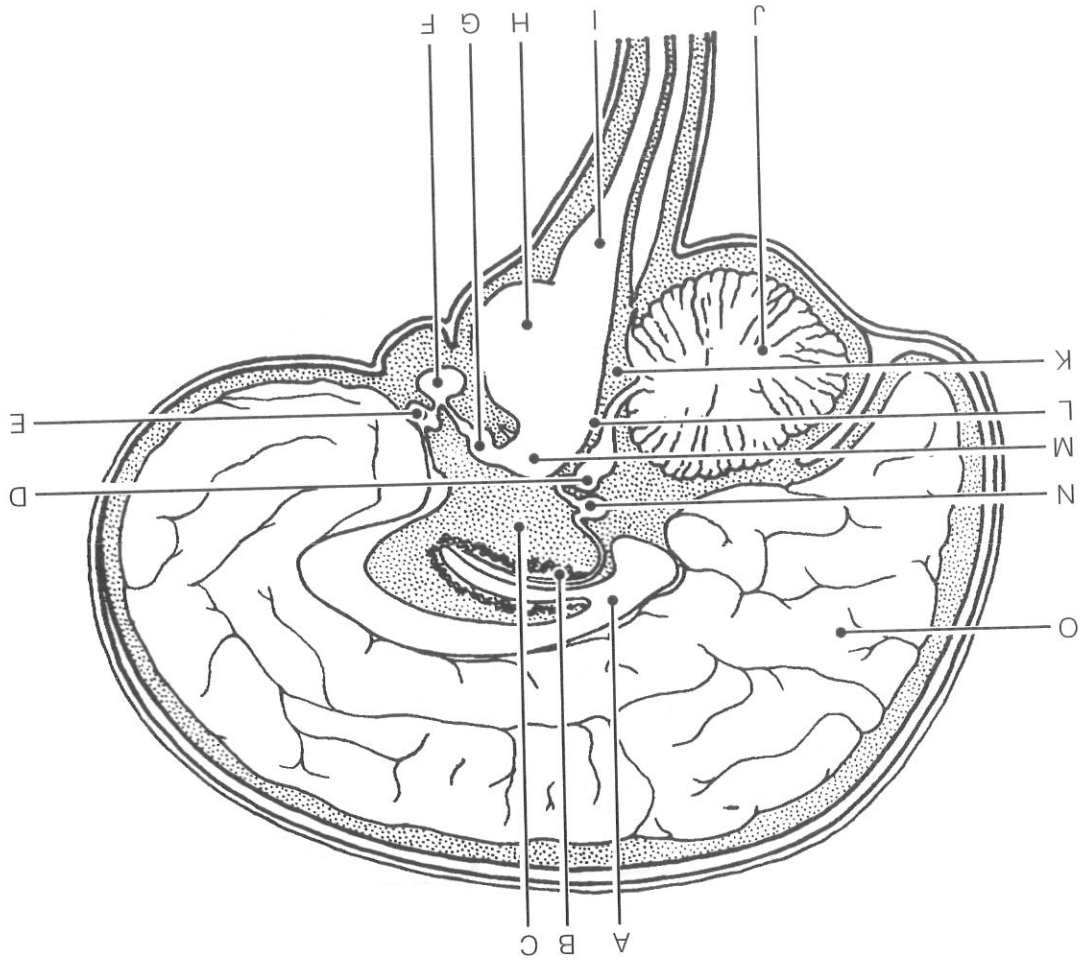


Figure 7-4

- 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.)

- 19.** Some of the following brain structures consist of gray matter; others are white matter. Write G (for gray) or W (for white) as appropriate.

- | | |
|-------------------------------|------------------------------|
| _____ 1. Cortex of cerebellum | _____ 5. Pyramids |
| _____ 2. Basal nuclei | _____ 6. Thalamic nuclei |
| _____ 3. Anterior commissure | _____ 7. Cerebellar peduncle |
| _____ 4. Corpus callosum | |

20. Figure 7-5 illustrates a "see-through" brain showing the positioning of the ventricles and connecting canals or apertures. Correctly identify all structures having leader lines by using the key choices provided below. One of the lateral ventricles has already been identified. Color the spaces filled with cerebrospinal fluid blue.

Key Choices

- A. Anterior horn
- B. Central canal
- C. Cerebral aqueduct
- D. Fourth ventricle
- E. Inferior horn
- F. Interventricular foramen
- G. Lateral aperture
- H. Third ventricle

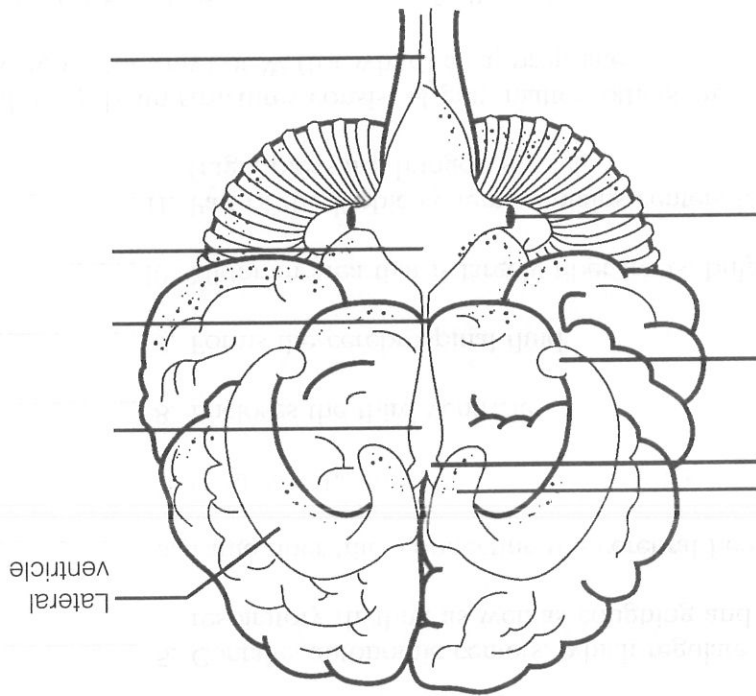


Figure 7-5

21. If a statement is true, write the letter *T* in the answer blank. If a statement is false, correct the underlined word(s) and write the correct word(s) in the answer blank.
- _____ 1. The primary somatosensory 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.
- _____ 7. The primary motor cortex is located in the postcentral gyrus.
- _____ 8. Centers for control of repetitious or stereotyped motor skills are found in the primary motor cortex.
- _____ 9. The largest parts of the motor homunculi are the lips, tongue, and toes.
- _____ 10. Sensations such as touch and pain are integrated in the primary sensory cortex.
- _____ 11. The primary visual cortex is in the frontal lobe of each cerebral hemisphere.
- _____ 12. In most humans, the area that controls the comprehension of language is located in the left cerebral hemisphere.
- _____ 13. A flat EEG is evidence of clinical death.
- _____ 14. Beta waves are recorded when an individual is awake and relaxed.

Protection of the CNS

22. 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 perosteum of the skull _____

23. Figure 7-6 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
- Arachnoid mater
- Pia mater
- Subarachnoid space

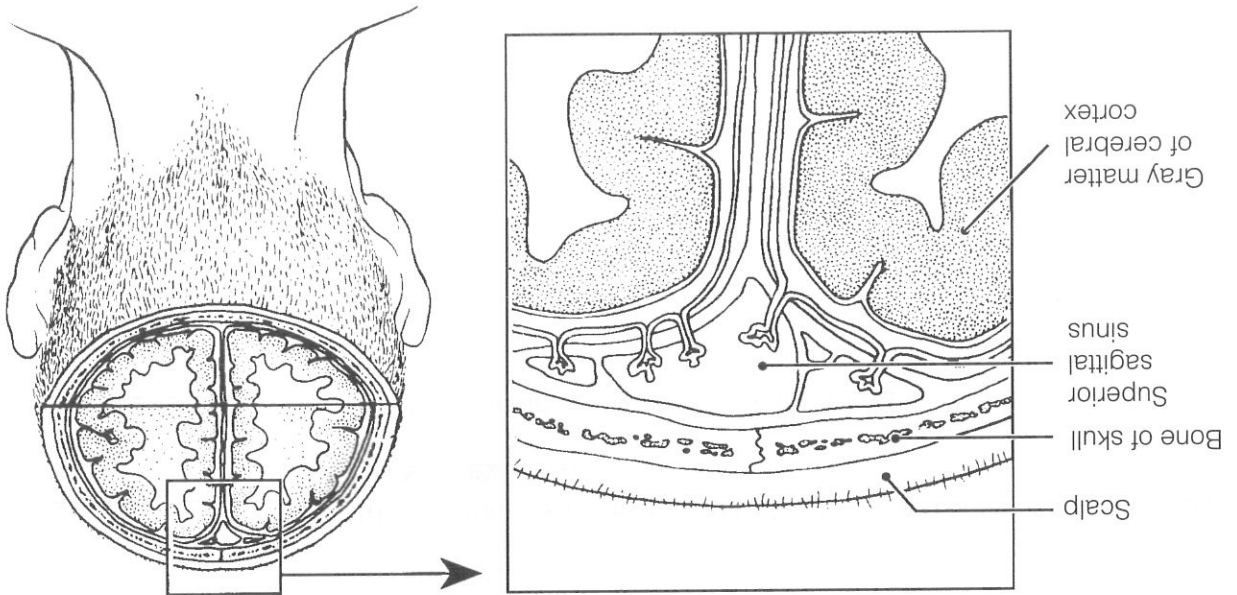


Figure 7-6

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

- _____ 1. Cerebrospinal fluid is formed by capillary knots called (1),
 _____ 2. which hang into the (2) of the brain. Ordinarily, cerebro-
 _____ 3. spinal fluid flows from the lateral ventricles to the third
 _____ 4. ventricle and then through the (3) to the fourth ventricle.
 _____ 5. Some of the fluid continues down the (4) of the spinal
 _____ 6. cord, but most of it circulates into the (5) by passing
 _____ 7. 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.

Brain Dysfunctions

25. 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	Column B
_____ 1. Slight and transient brain injury	A. Alzheimer's disease
_____ 2. Traumatic injury that destroys brain tissue	B. Cerebral edema
_____ 3. Total nonresponsiveness to stimulation	C. Cerebrovascular accident (CVA)
_____ 4. May cause medulla oblongata to be wedged into foramen magnum by pressure of blood	D. Coma
_____ 5. After head injury, retention of water by brain	E. Concussion
_____ 6. Results when a brain region is deprived of blood or exposed to prolonged ischemia	F. Contusion
_____ 7. Progressive degeneration of the brain with abnormal protein deposits	G. Intracranial hemorrhage
_____ 8. Autoimmune disorder with extensive demyelination	H. Multiple sclerosis
_____ 9. A ministroke; fleeting symptoms of a CVA	I. Transient ischemic attack (TIA)

Spinal Cord

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

27. Using the 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
- B. Efferent
- C. Both afferent and efferent
- 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 _____
7. Fiber type in the anterior ramus _____
8. Damage to this fiber type would lead to a loss of sensory function _____
9. Damage to this fiber type results in a loss of motor function _____

28. Figure 7-7 is a cross-sectional view of the spinal cord. First identify the areas listed in the key choices by inserting the correct letters next to the appropriate leader lines on parts A and B of the figure. Then, color the bones of the vertebral column in part B gold.

Key Choices

- | | | |
|----------------------------|-------------------------|-----------------|
| A. Central canal | E. Dorsal root | I. Ventral horn |
| B. Columns of white matter | F. Dorsal root ganglion | J. Ventral root |
| C. Conus medullaris | G. Filum terminale | |
| D. Dorsal horn | H. Spinal nerve | |

On part A, color the butterfly-shaped gray matter gray, and color the spinal nerves and roots yellow. Finally, select different colors to identify the following structures and use them to color the figure.

- | | | |
|---------------------------------|----------------------------------|---------------------------------------|
| <input type="radio"/> Pia mater | <input type="radio"/> Dura mater | <input type="radio"/> Arachnoid mater |
|---------------------------------|----------------------------------|---------------------------------------|

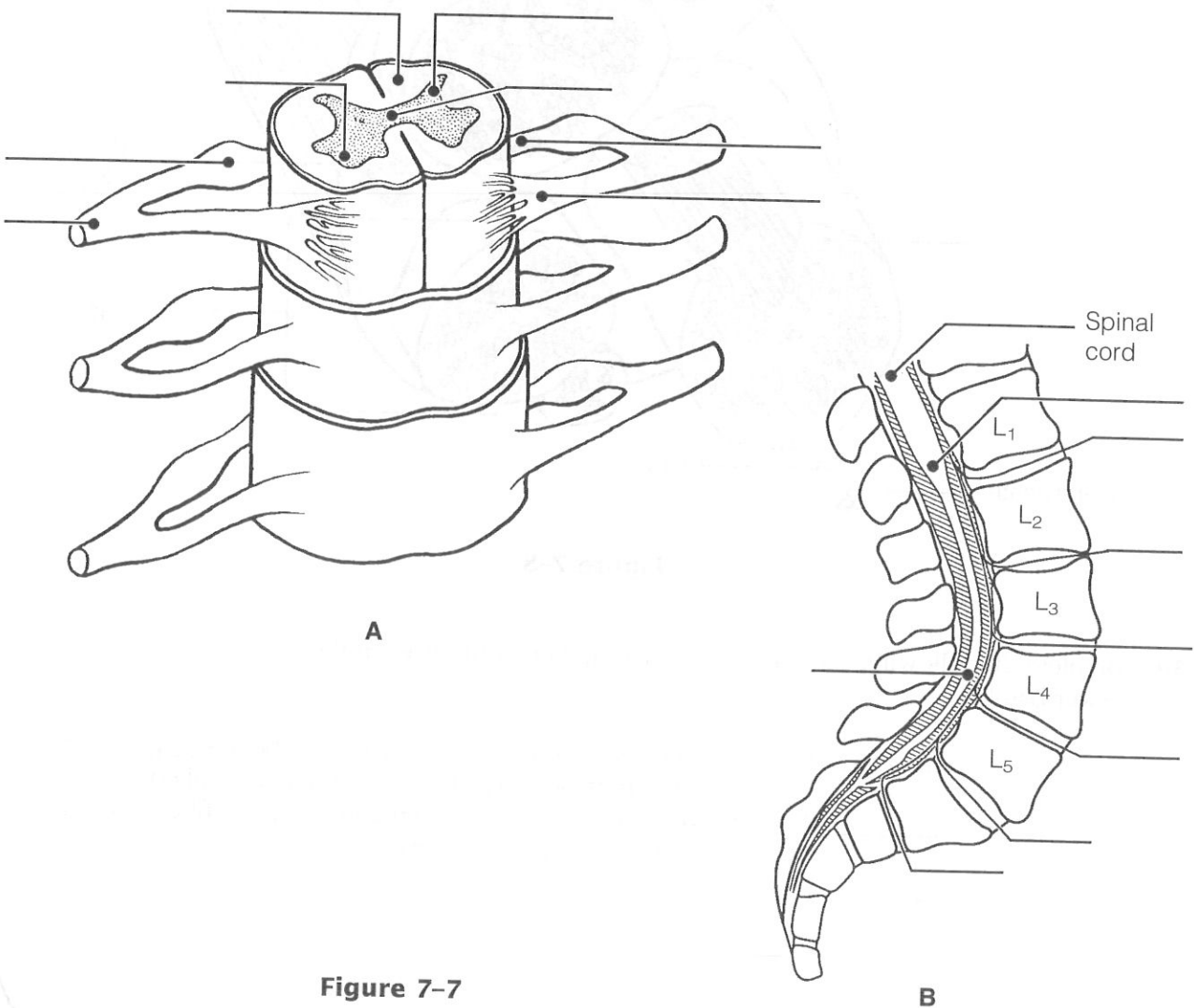


Figure 7-7

B

PERIPHERAL NERVOUS SYSTEM

Structure of a Nerve

29. Figure 7-8 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

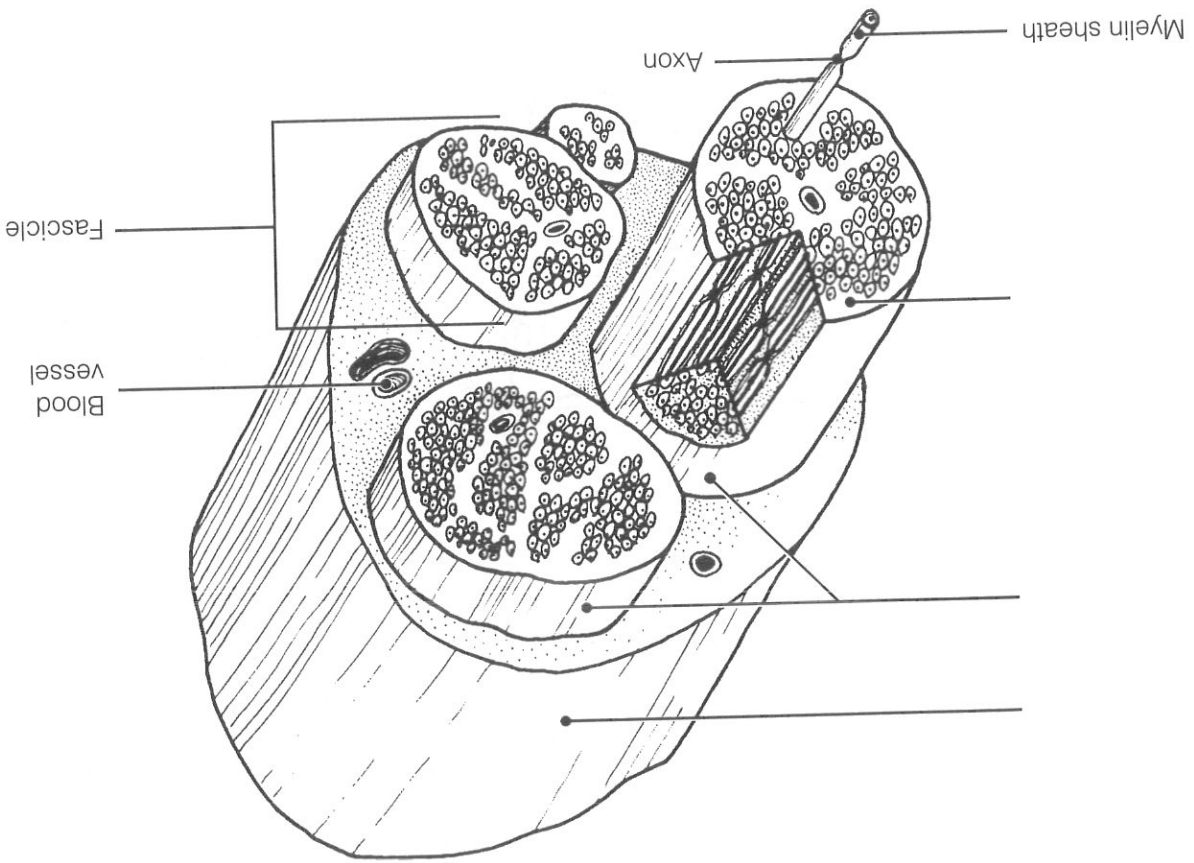


Figure 7-8

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

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

1. _____
2. _____
3. _____

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.

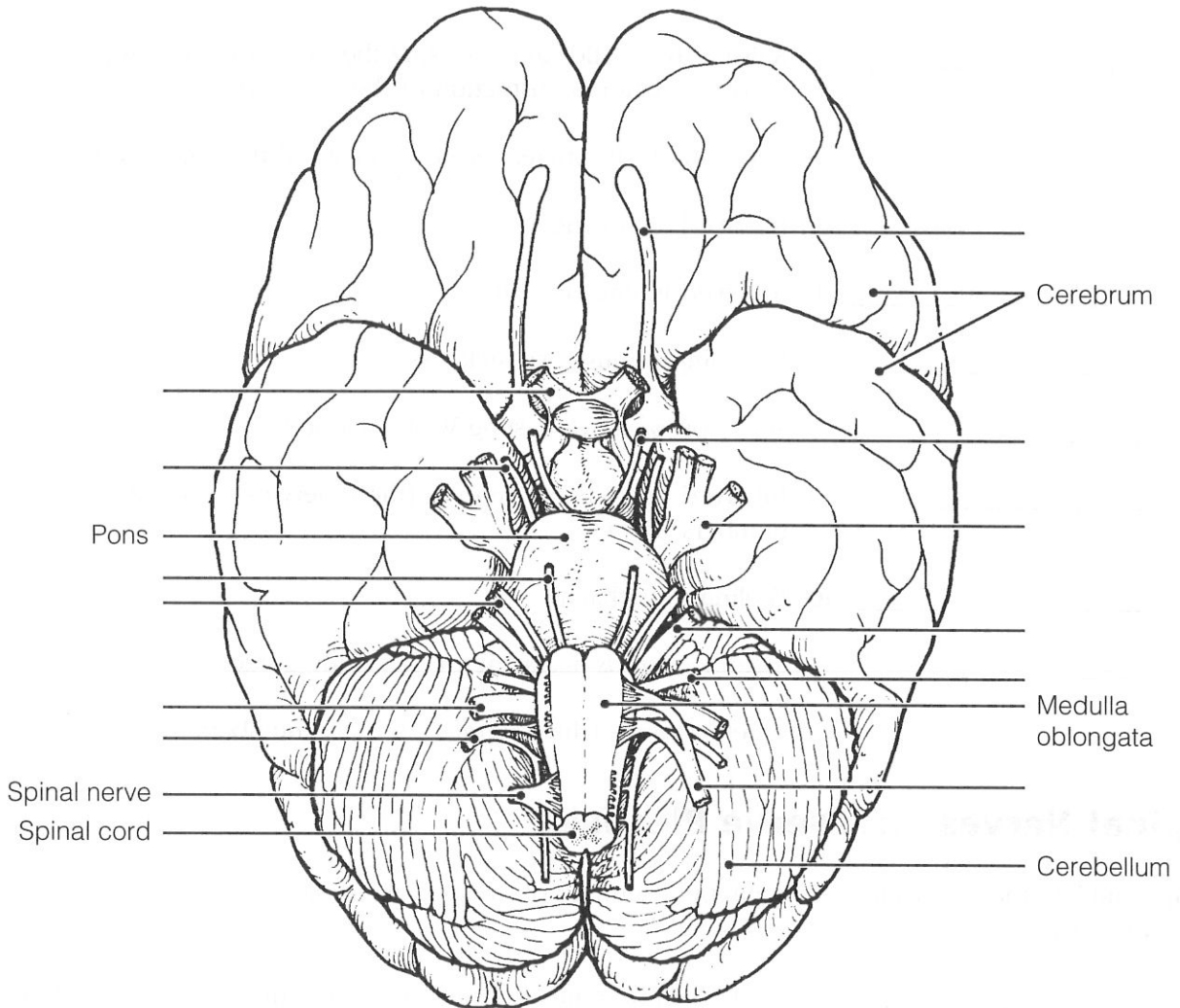


Figure 7-9

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 gum
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 C₁ through T₁ and L₁ through S₄ take part in forming (1), which serve the (2) of the body. The ventral rami of T₁ through T₁₂ run between the ribs to serve the (3). The posterior rami of the spinal nerves serve the (4).
2. _____
3. _____
4. _____

34. Figure 7-10 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

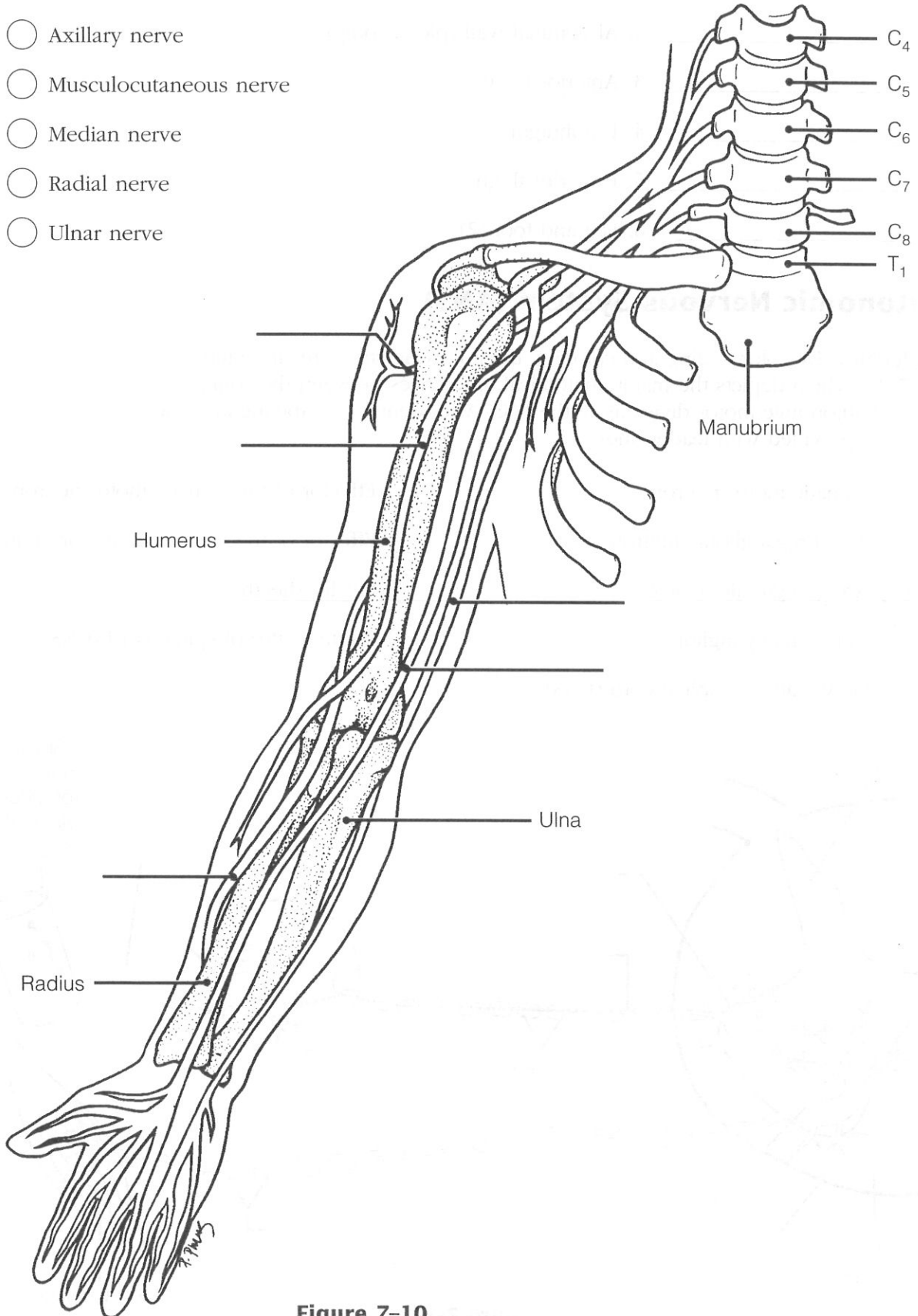


Figure 7-10

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

1. Neck and shoulders (plexus only) _____

2. Abdominal wall (plexus only) _____

3. Anterior thigh _____

4. Diaphragm _____

5. Posterior thigh _____

6. Leg and foot (2) _____

Autonomic Nervous System (ANS)

36. Identify, by color coding and coloring, the following structures in Figure 7-11, 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.

- Somatic motor neuron
- ANS preganglionic neuron
- ANS ganglionic neuron
- Autonomic ganglion
- Gray matter of spinal cord (CNS)
- Effector of the somatic motor neuron
- Effector of the autonomic motor neuron
- Myelin sheath
- White matter of spinal cord (CNS)

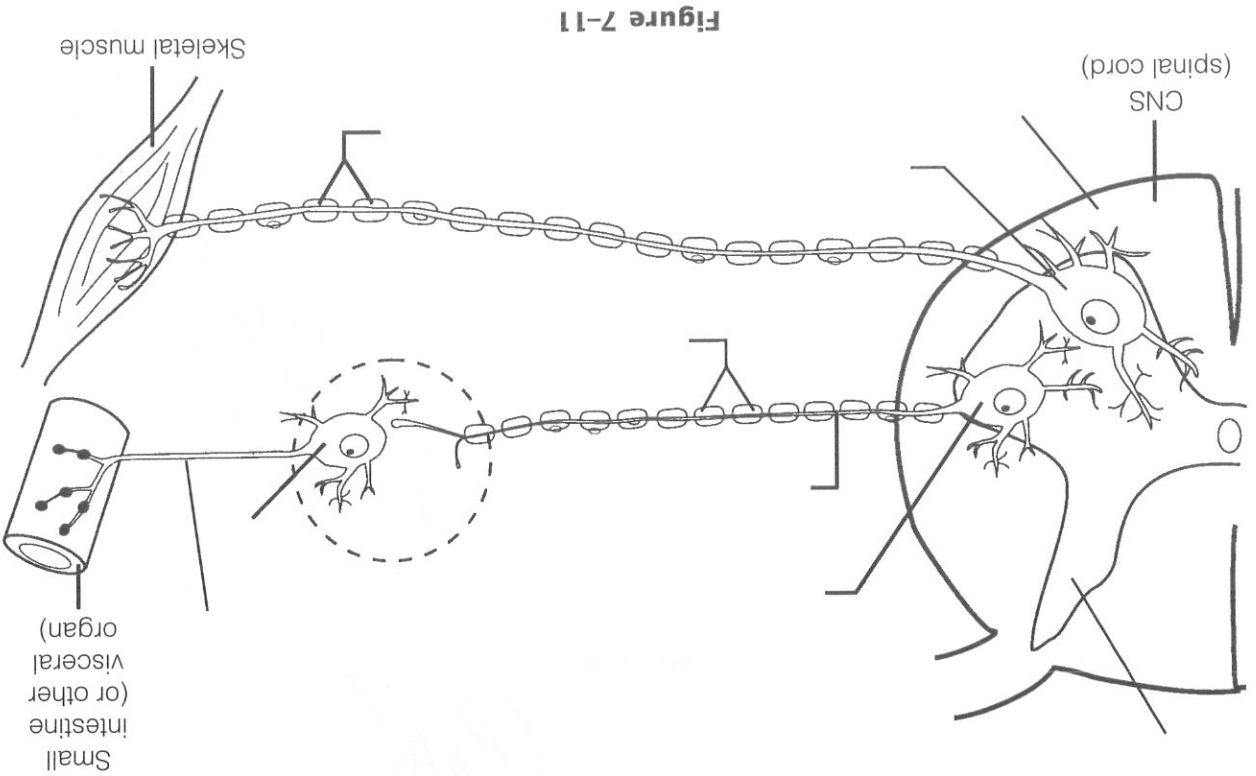


Figure 7-11

37. 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. Then, respond to the true-to-life situation below the chart.

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		

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 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) _____ direction, and fine control occurs much later than (4) _____ muscle control. The sympathetic nervous system becomes less efficient as aging occurs, resulting in an inability to prevent 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 caused by a gradual decrease in oxygen delivery to brain cells is called (7) _____. Death of brain neurons, which results from a sudden cessation of oxygen delivery, is called a (8) _____.
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
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) _____.

- _____ 2. At the next computer room, you hear, "Blood pressure to head is falling; increase sympathetic nervous system stimulation of the blood vessels." Then, as it becomes apparent that your host has not only stood up but is going to run, you hear,
- _____ 3. "Increase rate of impulses to the heart and respiratory muscles. We are going to need more oxygen and a faster blood flow to the skeletal muscles of the legs." You recognize that this second stop must be the (2).
- _____ 4. Computer room 3 presents a problem. There is no
- _____ 5. loudspeaker here. Instead, incoming messages keep flashing across the wall, giving only bits and pieces of information.
- _____ 6. "Four hours since last meal: stimulate appetite center. Slight decrease in body temperature: initiate skin vasoconstriction.
- _____ 7. Mouth dry: stimulate thirst center. Oh, a stroke on the arm: stimulate pleasure center." Looking at what has been recorded
- _____ 8. here—appetite, temperature, thirst, and pleasure—you
- _____ 9. conclude that this has to be the (3).
- _____ 10. Continuing your journey upward toward the higher brain centers, finally you are certain that you have reached the cerebral cortex. The first center you visit is quiet, like a library with millions of "encyclopedias" of facts and recordings of past
- _____ 11. input. You conclude that this must be the area where (4) are stored and that you are in the
- _____ 12. (5) lobe. The next stop is close-by. As you enter the computer center, you once again hear a loudspeaker: "Let's have the motor instructions to say 'tintinnabulation.' Hurry, we don't want them to think we're tongue-tied." This area is obviously (6). Your final stop in the cerebral cortex is a very hectic center. Electrical impulses are traveling back and forth between giant neurons, sometimes in different directions and sometimes back and forth between a small number of neurons. Watching intently, you try to make some sense out of these interactions and suddenly realize that this *is* what is happening here. The neurons *are* trying to make some sense out of something, and this helps you decide that this must be the brain area where (7) occurs in the

(8) lobe.

You hurry out of this center and retrace your steps back to the cerebrospinal fluid, deciding en route to observe a cranial nerve. You decide to pick one randomly and follow it to the organ it serves. You climb on to the first cranial nerve you see and slide down past the throat. Picking up speed, you quickly pass the heart and lungs and see the stomach and small intestine coming up fast. A moment later you land on the stomach and now you know that this wandering nerve has to be the (9). As you look upward, you see that the nerve is traveling almost straight up and that you'll have to find an alternative route back to the cerebrospinal fluid. You begin to walk posteriorly until you find a spinal nerve, which you follow until you reach the vertebral column. You squeeze between two adjacent vertebrae to follow the nerve to the spinal cord. With your pocket knife you cut away the tough connective tissue covering the cord. Thinking that the (10) covering deserves its name, you finally manage to cut an opening large enough to get through, and you return to the warm bath of cerebrospinal fluid that it encloses. At this point you are in the (11), and from here you swim upward until you get to the lower brain stem. Once there, it should be an easy task to find the holes leading into the (12) ventricle, where your journey began.

45. Marie Nolin exhibits slow, tentative movements and a very unstable gait. Examination reveals she cannot touch her finger to her nose with eyes closed. What is the name of this condition and what part of her brain is damaged?

46. Which would be the more likely result of injury to the posterior side of the spinal cord only—paralysis or paresthesia (loss of sensory input)? Explain your answer.

47. While jogging in Riverside Park, Susan was confronted by an angry dog. What division of her ANS was activated as she turned tail and ran from the dog?

48. During action potential transmission, many ions cross the neuronal membrane at right angles to the membrane. What is it that travels *along* the membrane and acts as the signal?



THE FINALE: MULTIPLE CHOICE

49. Select the best answer or answers from the choices given.
- Bipolar neurons:
 - are found in the head
 - are always part of an afferent pathway
 - have two dendrites
 - have two axons
 - Which of the following skin cells would form a junction with a motor neuron?
 - Keratinocyte
 - Sudoriferous glandular epithelial cell
 - Arrector pili muscle cell
 - Fibroblast
 - A synapse between an axon terminal and a neuron cell body is called:
 - axodendritic
 - axoaxonic
 - axosomatic
 - axoneuronic
 - Which is an incorrect association of brain region and ventricle?
 - Mesencephalon—third ventricle
 - Cerebral hemispheres—lateral ventricles
 - Pons—fourth ventricle
 - Medulla—fourth ventricle
 - The pineal gland is located in the:
 - hypophysis cerebri
 - mesencephalon
 - epithalamus
 - corpus callosum
 - Which of the following is not part of the brain stem?
 - Medulla
 - Cerebellum
 - Pons
 - Midbrain
 - When neurons in Wernicke's area send impulses to neurons in Broca's area, the white matter tracts utilized are:
 - commissural fibers
 - projection fibers
 - association fibers
 - anterior funiculus
 - Functions that are at least partially overseen by the medulla are:
 - regulation of the heart
 - maintaining equilibrium
 - regulation of respiration
 - visceral motor function
 - Which structures are directly involved with formation, circulation, and drainage of CSF?
 - Ependymal cilia
 - Ventricular choroid plexuses
 - Arachnoid villi
 - Serous layers of the dura mater
 - In an earthquake, which type of sensory receptor is most likely to sound the *first* alarm?
 - Exteroceptor
 - Visceroceptor
 - Mechanoreceptor
 - Proprioceptor

Use the following choices to respond to questions 17-28:

- _____ 17. Typically has long preganglionic and short postganglionic fibers
- _____ 18. Some fibers utilize gray rami communicantes
- _____ 19. Courses through spinal nerves
- _____ 20. Has splanchnic nerves
- _____ 21. Courses through cranial nerves
- _____ 22. Originates in cranial nerves
- _____ 23. Effects enhanced by direct stimulation of a hormonal mechanism
- _____ 24. Includes otic ganglion
- _____ 25. Includes celiac ganglion
- _____ 26. Hypoactivity of this division would lead to decrease in metabolic rate
- _____ 27. Has widespread, long-lasting effects
- _____ 28. Sets the tone for the heart

- A. sympathetic division
- B. parasympathetic division
- C. both sympathetic and parasympathetic
- D. neither sympathetic nor parasympathetic

11. Cranial nerves that have some function in vision include the:

- A. trochlear
- C. abducens
- B. trigeminal
- D. facial

12. Eating difficulties would result from damage to the:

- A. mandibular division of trigeminal nerve
- B. facial nerve
- C. glossopharyngeal nerve
- D. vagus nerve

13. If the right trapezius and sternocleidomastoid muscles were atrophied, you would suspect damage to the:

- A. vagus nerve
- B. motor branches of the cervical plexus
- C. facial nerve
- D. accessory nerve

14. Which nerve stimulates muscles that flex the forearm?

- A. Ulnar
- C. Radial
- B. Musculocutaneous
- D. Median

15. Motor functions of arm, forearm, and fingers would be affected by damage to which one of these nerves?

- A. Radial
- C. Ulnar
- B. Axillary
- D. Median

16. An inability to extend the leg would result from a loss of function of the:

- A. lateral femoral cutaneous nerve
- B. ilioinguinal nerve
- C. saphenous branch of femoral nerve
- D. femoral nerve