

The nervous system organizes and coordinates the millions of impulses received each day to make communication with and enjoyment of our environment possible. The functioning unit of the nervous system is the neuron. Three types of neurons—sensory neurons, motor neurons, and interneurons—exist and are classified according to the direction in which they transmit impulses. Nerve impulses travel over routes made up of neurons and provide the rapid communication that is necessary for maintaining life. The central nervous system is made up of the spinal cord and brain. The spinal cord provides access to and from the brain by means of ascending and descending tracts. In addition, the spinal cord functions as the primary reflex center of the body. The brain can be subdivided for easier learning into the brain stem, cerebellum, diencephalon, and cerebrum. These areas provide the extraordinary network necessary to receive, interpret, and respond to the simplest or most complex impulses.

While you concentrate on this chapter, your body is performing a multitude of functions. Fortunately for us, breathing, the beating of the heart, the digestion of food, and most of our other day-to-day processes do not require our supervision or thought. They function automatically, and the division of the nervous system that regulates these functions is known as the autonomic nervous system.

The autonomic nervous system consists of two divisions called the sympathetic system and the parasympathetic system. The sympathetic system functions as an emergency system and prepares us for “fight” or “flight.” The parasympathetic system dominates control of many visceral effectors under normal everyday conditions. Together, these two divisions regulate the body’s automatic functions in an effort to assist with the maintenance of homeostasis. Your understanding of this chapter will alert you to the complexity and functions of the nervous system and the “automatic pilot” of your body—the autonomic system.

TOPICS FOR REVIEW

Before progressing to Chapter 8, you should review the organs and divisions of the nervous system, the structure and function of the major types of cells in this system, the structure and function of a reflex arc, and the transmission of nerve impulses. Your study should include the anatomy and physiology of the brain and spinal cord and the nerves that extend from these two areas.

Finally, an understanding of the autonomic nervous system and the specific functions of the subdivisions of this system are necessary to complete your review of this chapter.

ORGANS AND DIVISIONS OF THE NERVOUS SYSTEM

CELLS OF THE NERVOUS SYSTEM

NERVES

Match the term on the left with the proper selection on the right.

Group A

- _____ 1. Sense organ
- _____ 2. Central nervous system
- _____ 3. Peripheral nervous system
- _____ 4. Autonomic nervous system

- A. Subdivision of peripheral nervous system
- B. Ear
- C. Brain and spinal cord
- D. Nerves that extend to the outlying parts of the body

Group B

- _____ 5. Dendrite
- _____ 6. Schwann cell.
- _____ 7. Motor neuron
- _____ 8. Nodes of Ranvier
- _____ 9. Fascicles
- _____ 10. Epineurium

- A. Indentations between adjacent Schwann cells
- B. Branching projection of neuron
- C. Also known as "efferent"
- D. Forms myelin outside the central nervous system
- E. Tough sheath that covers the whole nerve
- F. Groups of wrapped axons

CELLS OF NERVOUS SYSTEM

Select the correct term from the choices given and write the letter in the answer blank.

- _____ 11. Axon
- _____ 12. Special type of supporting cells
- _____ 13. Astrocytes
- _____ 14. Sensory
- _____ 15. Conduct impulses
- _____ 16. Forms the myelin sheath around central nerve fibers
- _____ 17. Phagocytosis
- _____ 18. Efferent
- _____ 19. Multiple sclerosis
- _____ 20. Neurilemma

- A. Neurons
- B. Neuroglia



If you have had difficulty with this section, review pages 164-170.

REFLEX ARCS

Fill in the blanks.

21. The simplest kind of reflex arc is a _____.
22. Three-neuron arcs consist of all three kinds of neurons: _____, _____, and _____.
23. Impulse conduction in a reflex arc normally starts in _____.
24. A _____ is the microscopic space that separates the axon of one neuron from the dendrites of another neuron.
25. A _____ is the response to impulse conduction over reflex arcs.
26. Contraction of a muscle that causes it to pull away from an irritating stimulus is known as the _____.
27. A _____ is a group of nerve cell bodies located in the peripheral nervous system.
28. All _____ lie entirely within the gray matter of the central nervous system.
29. In a patellar reflex, the nerve impulses that reach the quadriceps muscle (the effector) result in the classic " _____ " response.
30. _____ forms the H-shaped inner core of the spinal cord.



If you have had difficulty with this section, review pages 168-170.

NERVE IMPULSES THE SYNAPSE

Circle the correct answer.

31. Nerve impulses (do or do not) continually race along every nerve cell's surface.
32. When a stimulus acts on a neuron, it (increases or decreases) the permeability of the stimulated point of its membrane to sodium ions.
33. An inward movement of positive ions leaves (a lack or an excess) of negative ions outside.
34. The plasma membrane of the (presynaptic or postsynaptic) neuron makes up a portion of the synapse.
35. A synaptic knob is a tiny bulge at the end of the (presynaptic or postsynaptic) neuron's axon.
36. Acetylcholine is an example of a (neurotransmitter or protein molecule receptor).
37. Neurotransmitters are chemicals that allow neurons to (communicate or reproduce) with one another.
38. Neurotransmitters are distributed (randomly or specifically) into groups of neurons.
39. Catecholamines may play a role in (sleep or reproduction).
40. Endorphins and enkephalins are neurotransmitters that inhibit the conduction of (fear or pain) impulses.



If you have had difficulty with this section, review pages 171-173.

CENTRAL NERVOUS SYSTEM

DIVISIONS OF THE BRAIN

Circle the correct answer.

41. The portion of the brain stem that joins the spinal cord to the brain is the:
 - A. Pons
 - B. Cerebellum
 - C. Diencephalon
 - D. Hypothalamus
 - E. Medulla
42. Which one of the following is *not* a function of the brain stem?
 - A. Conduction of sensory impulses from the spinal cord to the higher centers of the brain
 - B. Conduction of motor impulses from the cerebrum to the spinal cord
 - C. Control of heartbeat, respiration, and blood vessel diameter
 - D. Containment of centers for speech and memory
43. Which one of the following is *not* part of the diencephalon?
 - A. Cerebrum
 - B. Thalamus
 - C. Hypothalamus
 - D. All of the above are correct
44. ADH is produced by the:
 - A. Pituitary gland
 - B. Medulla
 - C. Mammillary bodies
 - D. Third ventricle
 - E. Hypothalamus
45. Which one of the following is *not* true about the hypothalamus?
 - A. It helps control the rate of heartbeat.
 - B. It helps control the constriction and dilation of blood vessels.
 - C. It helps control the contraction of the stomach and intestines.
 - D. It produces releasing hormones that control the release of certain anterior pituitary hormones.
 - E. All of the above are true
46. Which one of the following parts of the brain helps in the association of sensations with emotions and also aids in the arousal or alerting mechanism?
 - A. Pons
 - B. Hypothalamus
 - C. Cerebellum
 - D. Thalamus
 - E. None of the above
47. Which of the following is *not* true of the cerebrum?
 - A. Its lobes correspond to the bones that lie over them.
 - B. Its grooves are called gyri.
 - C. Most of its gray matter lies on the surface of the cerebrum.
 - D. Its outer region is called the cerebral cortex.
 - E. Its two hemispheres are connected by a structure called the corpus callosum.

48. Which one of the following is *not* a function of the cerebrum?
- A. Willed movement
 - B. Consciousness
 - C. Memory
 - D. Conscious awareness of sensations
 - E. All of the above are functions of the cerebrum
49. The area of the cerebrum responsible for the perception of sound lies in the _____ lobe.
- A. Frontal
 - B. Temporal
 - C. Occipital
 - D. Parietal
50. Visual perception is located in the _____ lobe.
- A. Frontal
 - B. Temporal
 - C. Parietal
 - D. Occipital
 - E. None of the above
51. Which one of the following is *not* a function of the cerebellum?
- A. Maintenance of equilibrium
 - B. Helps with production of smooth, coordinated movements
 - C. Helps maintain normal postures
 - D. Associates sensations with emotions
52. Within the interior of the cerebrum are a few islands of gray matter known as:
- A. Fissures
 - B. Basal ganglia
 - C. Gyri
 - D. Myelin
53. A cerebrovascular accident is commonly referred to as (a):
- A. Stroke
 - B. Parkinson's disease
 - C. Tumor
 - D. Multiple sclerosis
54. Parkinson's disease is a disease of the:
- A. Myelin
 - B. Axons
 - C. Neuroglia
 - D. Cerebral nuclei
55. The largest section of the brain is the:
- A. Cerebellum
 - B. Pons
 - C. Cerebrum
 - D. Midbrain



If you have had difficulty with this section, review pages 174-179.

SPINAL CORD

If the statement is true, write "T" in the answer blank. If the statement is false, correct the statement by circling the incorrect term and writing the correct term in the answer blank.

- _____ 56. The spinal cord is approximately 24 to 25 inches long.
- _____ 57. The spinal cord ends at the bottom of the sacrum.
- _____ 58. The extension of the meninges beyond the cord is convenient for performing CAT scans without danger of injuring the spinal cord.
- _____ 59. Bundles of myelinated nerve fibers (dendrites) make up the white outer columns of the spinal cord.
- _____ 60. Ascending tracts conduct impulses up the cord to the brain and descending tracts conduct impulses down the cord from the brain.
- _____ 61. Tracts are functional organizations in that all the axons that compose a tract serve several functions.
- _____ 62. A loss of sensation caused by a spinal cord injury is called paralysis.



If you have had difficulty with this section, review pages 179-183.

COVERINGS AND FLUID SPACES OF BRAIN AND SPINAL CORD

Circle the one that does not belong.

- | | | | |
|-----------------|--------------------|--------------------|------------------------|
| 63. Meninges | Pia mater | Ventricles | Dura mater |
| 64. Arachnoid | Middle layer | CSF | Cobweb-like |
| 65. CSF | Ventricles | Subarachnoid space | Pia mater |
| 66. Tough | Outer layer | Dura mater | Choroid plexus |
| 67. Brain tumor | Subarachnoid space | CSF | Fourth lumbar vertebra |

PERIPHERAL NERVOUS SYSTEM

CRANIAL NERVES

68. Fill in the missing areas on the chart below.

NERVE	CONDUCT IMPULSES	FUNCTION
I _____	From nose to brain	Sense of smell
II Optic	From eye to brain	_____
III Oculomotor	_____	Eye movements
IV _____	From brain to external eye muscles	Eye movements
V Trigeminal	From skin and mucous membrane of head and from teeth to brain; also from brain to chewing muscles	_____
VI Abducens	_____	Eye movements
VII Facial	From taste buds of tongue to brain; from brain to face muscles	_____
VIII _____	From ear to brain	Hearing; sense of balance
IX Glossopharyngeal	_____	Sensations of throat, taste, swallowing movements, secretion of saliva
X _____	From throat, larynx, and organs in thoracic and abdominal cavities to brain; also from brain to muscles of throat and to organs in thoracic and abdominal cavities	Sensations of throat, larynx, and of thoracic and abdominal organs; swallowing, voice production, slowing of heartbeat, acceleration of peristalsis (gut movements)
XI Accessory	From brain to certain shoulder and neck muscles	_____
XII _____	From brain to muscles of tongue	Tongue movements



If you have had difficulty with this section, review page 188, Table 7-2.

CRANIAL NERVES

SPINAL NERVES

Select the correct term from the choices given and write its letter in the answer blank.

- | | | | |
|-------|-------------------|-------|------------------|
| _____ | A. Cranial nerves | _____ | B. Spinal nerves |
| _____ | 69. 12 pair | | |
| _____ | 70. Dermatome | | |
| _____ | 71. Vagus | | |
| _____ | 72. Shingles | | |
| _____ | 73. 31 pair | | |
| _____ | 74. Optic | | |
| _____ | 75. C1 | | |
| _____ | 76. Plexus | | |



If you have had difficulty with this section, review pages 186-195.

AUTONOMIC NERVOUS SYSTEM

Match the term on the left with the proper selection on the right.

- | | | |
|-------|------------------------------|--|
| _____ | 77. Autonomic nervous system | A. Division of ANS |
| _____ | 78. Autonomic neurons | B. Tissues to which autonomic neurons conduct impulses |
| _____ | 79. Preganglionic neurons | C. Voluntary actions |
| _____ | 80. Visceral effectors | D. Regulates body's involuntary functions |
| _____ | 81. Sympathetic system | E. Motor neurons that make up the ANS |
| _____ | 82. Somatic nervous system | F. Conduct impulses between the spinal cord and a ganglion |

SYMPATHETIC NERVOUS SYSTEM

PARASYMPATHETIC NERVOUS SYSTEM

Circle the correct answer.

83. Dendrites and cell bodies of sympathetic preganglionic neurons are located in the:
- A. Brain stem and sacral portion of the spinal cord
 - B. Sympathetic ganglia
 - C. Gray matter of the thoracic and upper lumbar segments of the spinal cord
 - D. Ganglia close to effectors
84. Which of the following statements is not correct?
- A. Sympathetic preganglionic neurons have their cell bodies located in the lateral gray column of certain parts of the spinal cord.
 - B. Sympathetic preganglionic axons pass along the dorsal root of certain spinal nerves.
 - C. There are synapses within sympathetic ganglia.
 - D. Sympathetic responses are usually widespread, involving many organs.

85. Another name for the parasympathetic nervous system is:
- Thoracolumbar
 - Craniosacral
 - Visceral
 - ANS
 - Cholinergic
86. Which of the following statements is *not* correct?
- Sympathetic postganglionic neurons have their dendrites and cell bodies in sympathetic ganglia or collateral ganglia.
 - Sympathetic ganglions are located in front of and at each side of the spinal column.
 - Separate autonomic nerves distribute many sympathetic postganglionic axons to various internal organs.
 - Very few sympathetic preganglionic axons synapse with postganglionic neurons.
87. Sympathetic stimulation usually results in:
- Response by numerous organs
 - Response by only one organ
 - Increased peristalsis
 - Constriction of pupils
88. Parasympathetic stimulation frequently results in:
- Response by only one organ
 - Responses by numerous organs
 - The fight or flight syndrome
 - Increased heartbeat

Select the correct term from the choices given and write the letter in the answer blank.

- | | | | |
|-------|---|-------|----------------------------|
| _____ | A. Sympathetic control | _____ | B. Parasympathetic control |
| _____ | 89. Constricts pupils | | |
| _____ | 90. Produces "goose pimples" | | |
| _____ | 91. Increases sweat secretion | | |
| _____ | 92. Increases secretion of digestive juices | | |
| _____ | 93. Constricts blood vessels | | |
| _____ | 94. Slows heartbeat | | |
| _____ | 95. Relaxes bladder | | |
| _____ | 96. Increases epinephrine secretion | | |
| _____ | 97. Increases peristalsis | | |
| _____ | 98. Stimulates lens for near vision | | |



If you have had difficulty with this section, review pages 188-193.

APPLYING WHAT YOU KNOW

110. Mr. Wolf suffered a cerebrovascular accident and it was determined that the damage affected the left side of his cerebrum. On which side of his body will he most likely notice any paralysis?
-
111. Baby Dania was born with an excessive accumulation of cerebrospinal fluid in the ventricles. A catheter was placed in the ventricle and the fluid was drained by means of a shunt into the circulatory bloodstream. What condition does this medical history describe?
-
112. Mrs. Muhlenkamp looked out her window to see a man trapped under the wheel of a car. Although slightly built, Mrs. Muhlenkamp rushed to the car, lifted it, and saved the man underneath the wheel. What division of the autonomic nervous system made this seemingly impossible task possible?
-
113. Madison's heart raced and her palms became clammy as she watched the monster movie at the local theater. When the movie was over, however, she told her friends that she was not afraid at all. She appeared to be as calm as before the movie. What division of the autonomic nervous system made this possible?
-
114. Bill is going to his boss for his annual evaluation. He is planning to ask for a raise and hopes the evaluation will be good. Which subdivision of the autonomic nervous system will be active during this conference? Should he have a large meal before his appointment? Support your answer with facts from the chapter.
-

115. WORD FIND

Can you find 14 terms from this chapter? Words may be spelled top to bottom, bottom to top, right to left, left to right, or diagonally.

M C C D Q S Y N A P S E Q G O
E N A Q D W H N W E J N A L W
S R O T P E C E R Y Z N I S M
I D S X E K N O K X G G C Y Y
J O T R A C T D F L O N E N A
R P W E K O H X I D A L H A M
F A L O N A Y O E I I I X P C
C M Z I F D N N L N G Z U T Z
S I N V C G D G Z A N A K I P
G N A T Z R O W V A M Y T C O
K E N D O R P H I N S I L C X
C P Q G C J X F J D Q S N L F
X U L I H I G Q A N S W O E U
A I M H Q E X K D B W Y T F S
A A D A X O C K G B F H B T K

Axon

Catecholamines

Dopamine

Endorphins

Ganglion

Glia

Microglia

Myelin

Oligodendroglia

Receptors

Serotonin

Synapse

Synaptic cleft

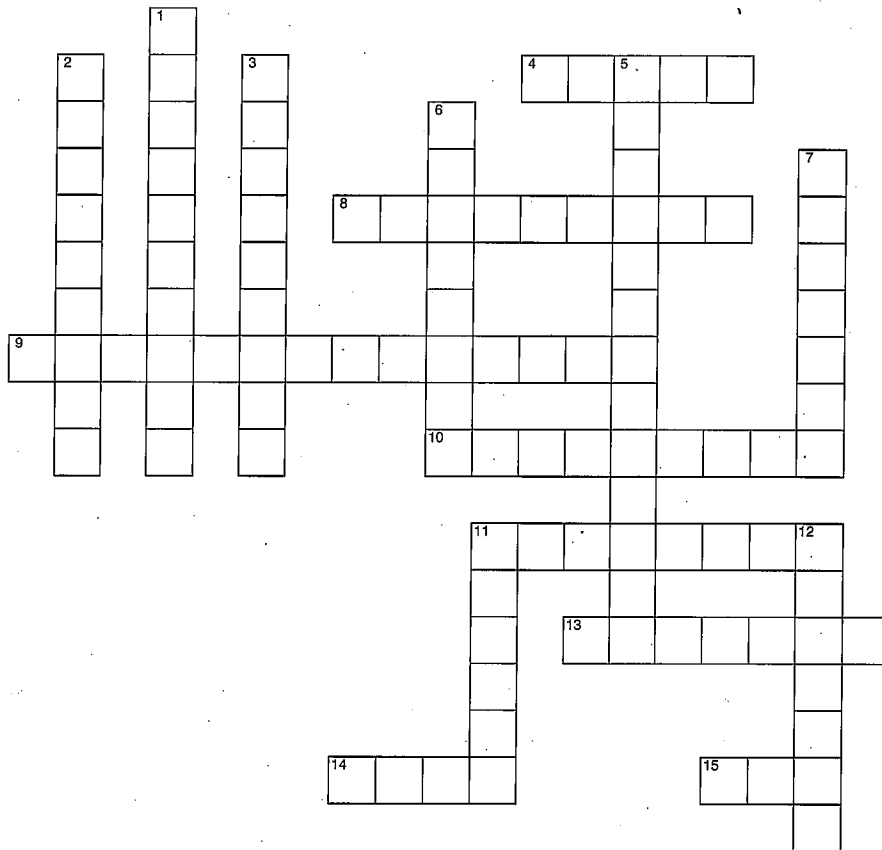
Tract

DID YOU KNOW?

Although all pain is felt and interpreted in the brain, it has no pain sensation itself—even when cut!

THE NERVOUS SYSTEM

Fill in the crossword puzzle.



Across

4. Bundle of axons located within the central nervous system
8. Transmits impulses toward the cell body
9. Neurons that conduct impulses from a ganglion
10. Astrocytes
11. Pia mater
13. Nerve cells
14. Transmits impulses away from the cell body
15. Peripheral nervous system (abbreviation)

Down

1. Neuroglia
2. Peripheral beginning of a sensory neuron's dendrite
3. Two-neuron arc (two words)
5. Neurotransmitter
6. Cluster of nerve cell bodies outside the central nervous system
7. Area of brain stem
11. Fatty substance found around some nerve fibers
12. Where impulses are transmitted from one neuron to another

CHECK YOUR KNOWLEDGE

Multiple Choice

Circle the correct answer.

1. What are neurons that pick up sensations from receptors and carry them into the brain or spinal cord called?
 - A. Motor neurons
 - B. Central neurons
 - C. Interneurons
 - D. Sensory neurons
2. What are brain cavities that are filled with cerebrospinal fluid called?
 - A. Hydrocephalics
 - B. Ventricles
 - C. Mater
 - D. Meninges
3. What is the innermost layer of connective tissue that surrounds the brain and spinal cord?
 - A. Pia mater
 - B. Dura mater
 - C. Arachnoid mater
 - D. Pons mater
4. A nurse is caring for a patient with a tumor of the cerebellum. In view of the functions of this part of the brain, which of the following symptoms should the nurse expect to observe?
 - A. Irregular heartbeat and increased blood pressure
 - B. Inability to coordinate body movements
 - C. Loss of speech
 - D. Inability to control emotions
5. What occurs as a result of stimulation of the sympathetic nervous system?
 - A. Accelerated heart rate
 - B. Constriction of blood vessels in skeletal muscles
 - C. Increased peristalsis
 - D. All of the above
6. The autonomic neurotransmitter called acetylcholine is released by the:
 - A. Sympathetic preganglionic axon
 - B. Parasympathetic preganglionic axon
 - C. Parasympathetic postganglionic axon
 - D. All of the above
7. Which of the following statements about Schwann cells is *true*?
 - A. They are found in the PNS.
 - B. They produce myelin.
 - C. They are separated by nodes of Ranvier.
 - D. All of the above
8. What are areas of the neuron that secrete neurotransmitters called?
 - A. Synapses
 - B. Synaptic clefts
 - C. Synaptic knobs
 - D. Gliomas

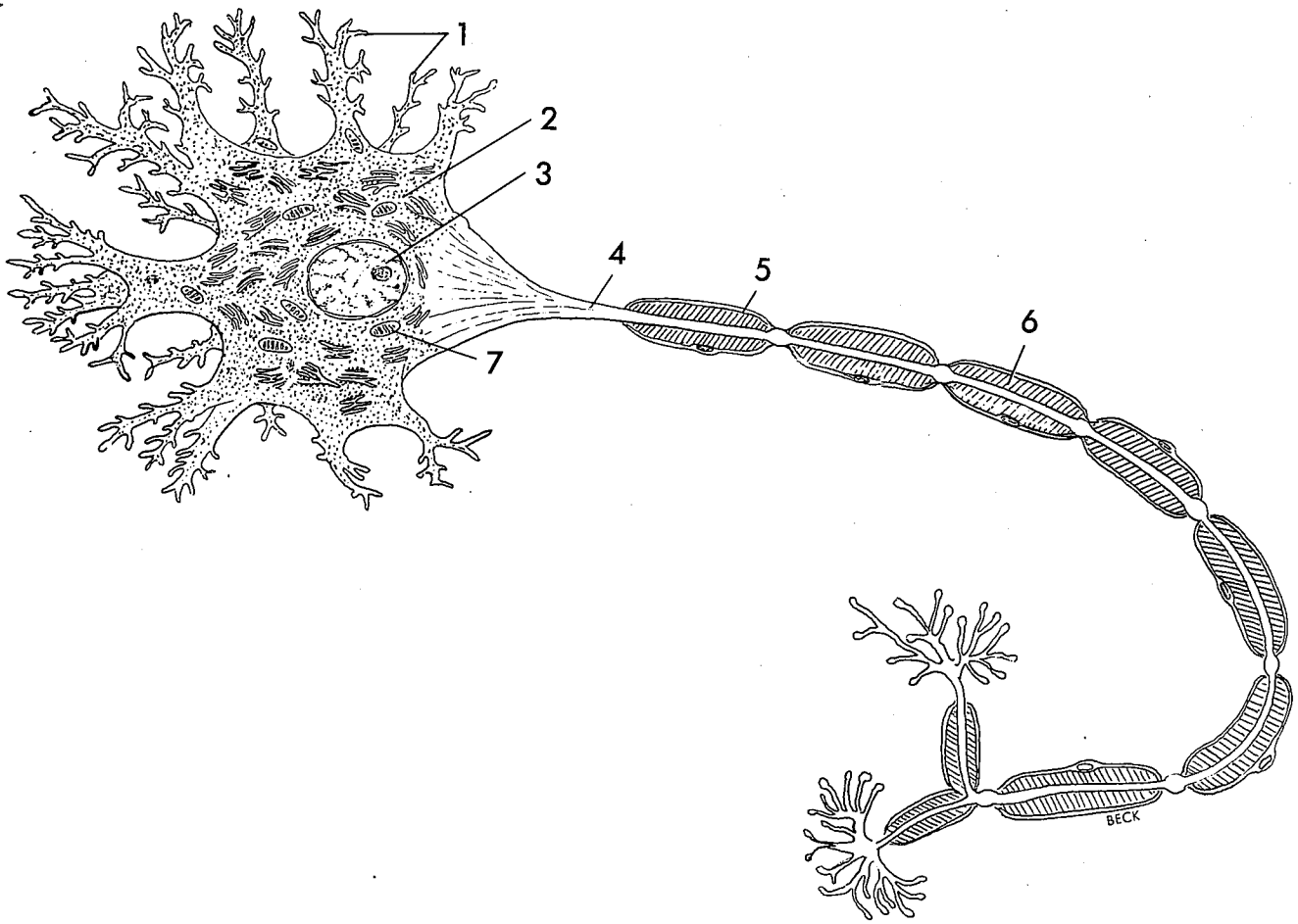
9. Which of the following statements about the neural tissues called tracts is *true*?
- A. They are located outside of the central nervous system.
 - B. They appear gray.
 - C. When carrying messages upward they are called ascending, and when carrying messages downward they are called descending.
 - D. All of the above
10. Which of the following statements about the autonomic division of the nervous system is *true*?
- A. It is composed of two divisions: the sympathetic and parasympathetic.
 - B. Autonomic neurotransmitters assist the system in its effort to elicit responses.
 - C. The system regulates the body's involuntary functions.
 - D. All of the above

Matching

Select the most appropriate answer from column B for each item in column A. There is only one correct answer for each item.

Column A	Column B
_____ 11. Tract	A. Transmits away from cell body
_____ 12. Axon	B. Interneuron
_____ 13. Brain stem	C. White matter
_____ 14. Neurotransmitter	D. Cranial nerve
_____ 15. Reflex arc	E. Thalamus
_____ 16. Skin map	F. Glioma
_____ 17. Brain tumor	G. Parkinson's disease
_____ 18. Diencephalon	H. Acetylcholine
_____ 19. Vagus	I. Dermatome
_____ 20. Dopamine	J. Medulla oblongata

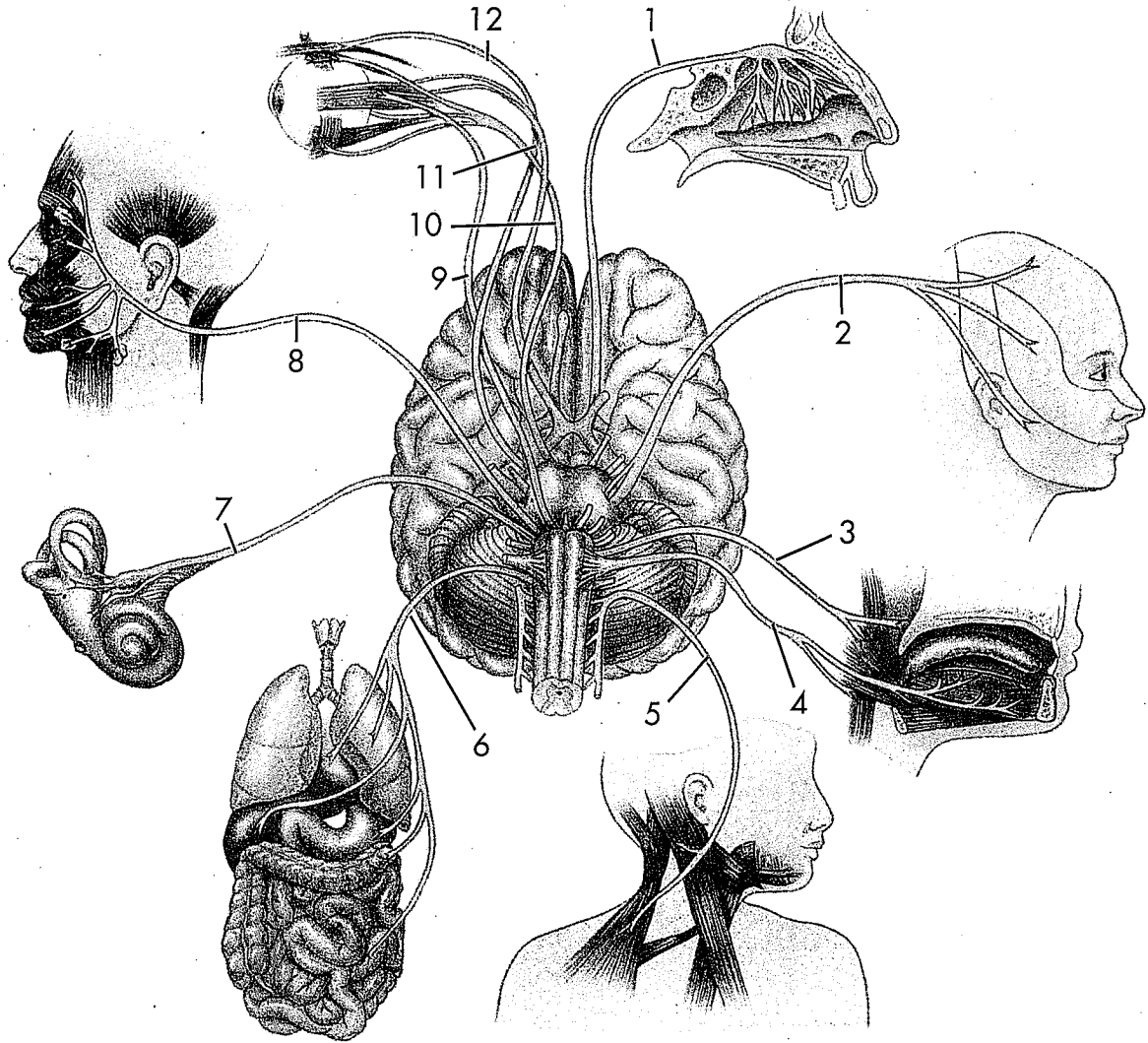
Neuron



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

- 5. _____
- 6. _____
- 7. _____

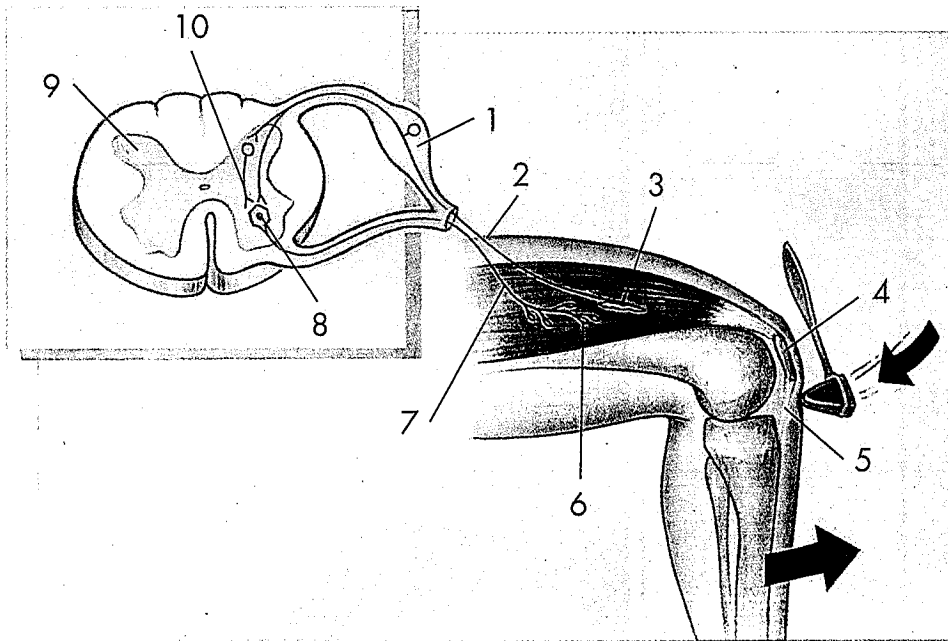
Cranial Nerves



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

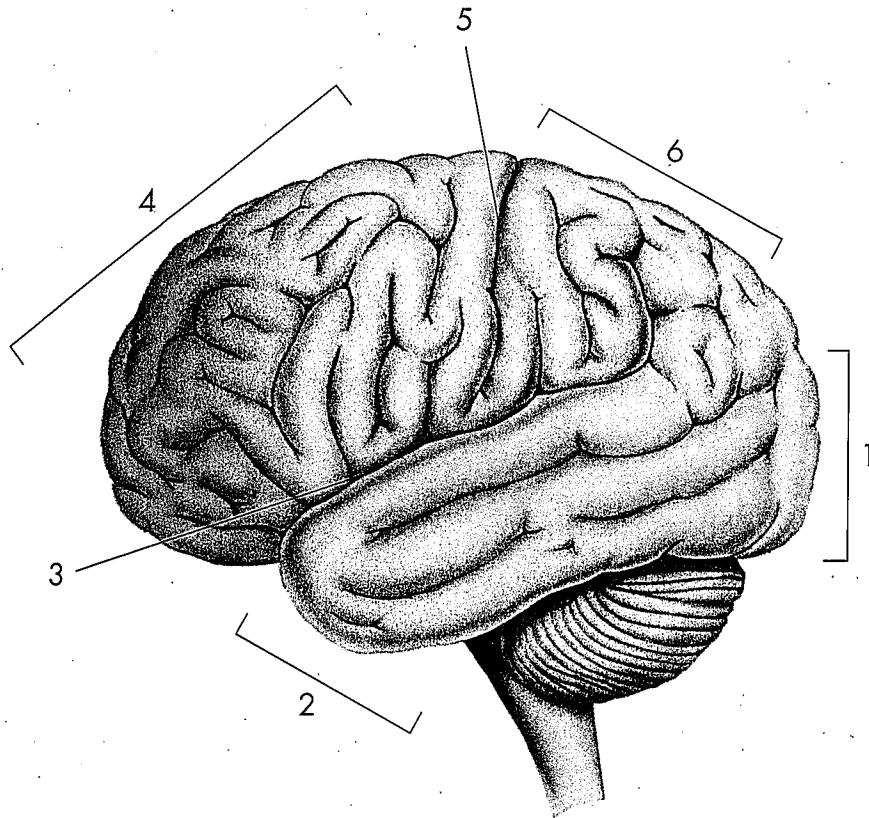
Neural Pathway Involved in the Patellar Reflex



- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

- 6. _____
- 7. _____
- 8. _____
- 9. _____
- 10. _____

The Cerebrum



1. _____

4. _____

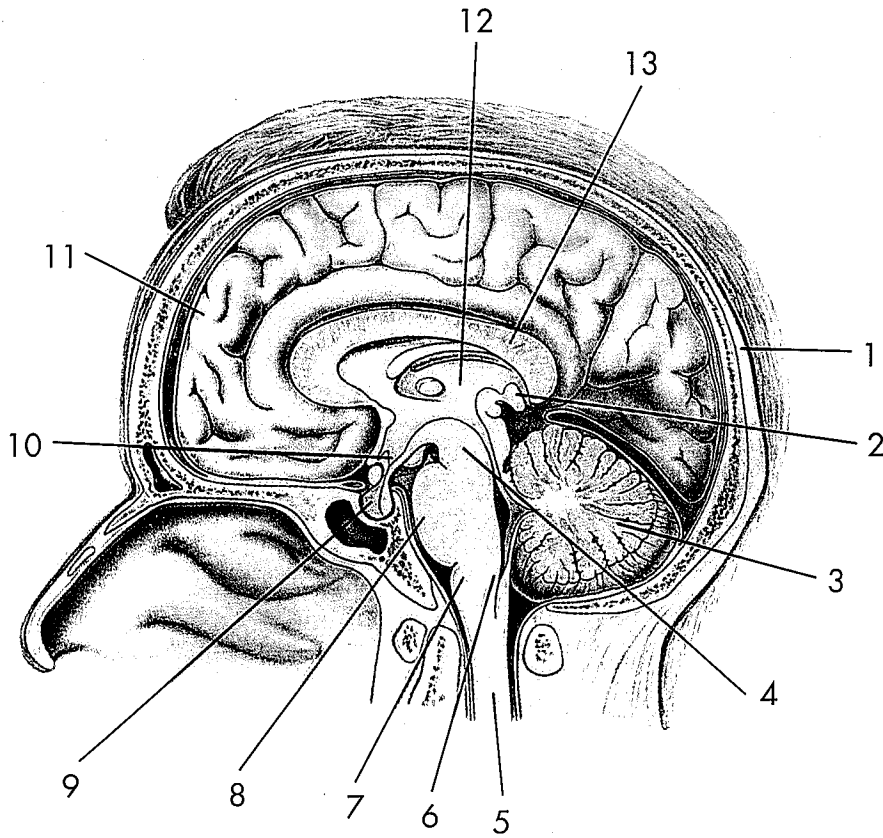
2. _____

5. _____

3. _____

6. _____

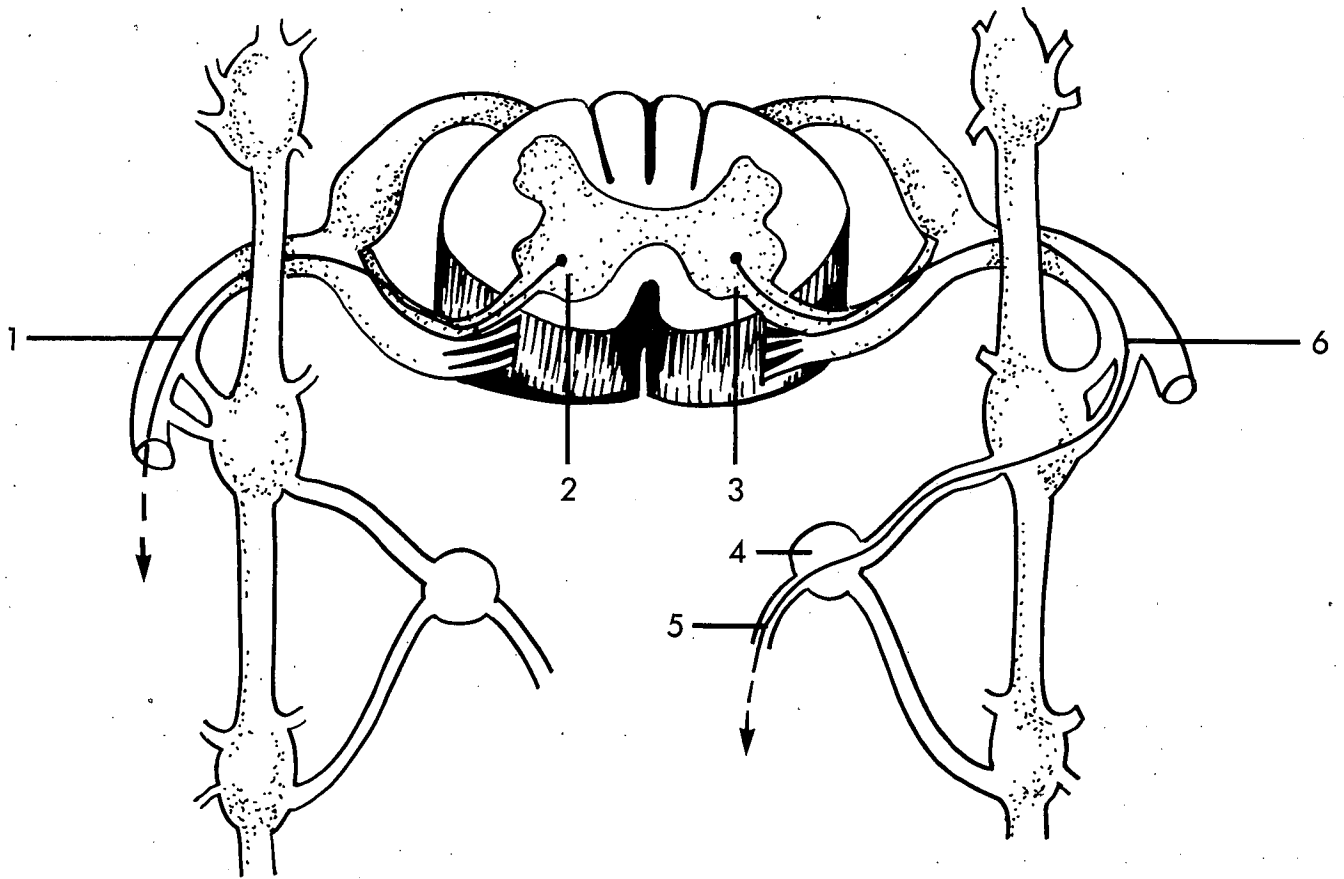
Sagittal Section of the Central Nervous System



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

8. _____
9. _____
10. _____
11. _____
12. _____
13. _____

Neuron Pathways



- 1. _____
- 2. _____
- 3. _____

- 4. _____
- 5. _____
- 6. _____

