

16 The Nervous System

I. Chapter Outline

- A. Neurons
 - 1. Neuron Structure: Three Parts
 - 2. Nerve Impulse: Same for All Neurons
- B. Transmission across a Synapse
 - 1. Neurotransmitters: Quick Acting
 - 2. Summation and Integration: On the Receiving End
- C. The Peripheral Nervous System
 - 1. Nerves: Only Long Fibers
 - 2. Somatic Nervous System: For Muscles
 - 3. Autonomic Nervous System: For Internal Organs
- D. The Central Nervous System
 - 1. Spinal Cord: Two Main Functions
 - 2. Brain: Subconscious and Conscious
- E. Drug Abuse
 - 1. Alcohol: Most Abused Drug
 - 2. Marijuana: May Act on Serotonin
 - 3. Cocaine: Affects Dopamine in the Brain
 - 4. Heroin: Mimics Body's Endorphins
 - 5. Methamphetamine (Ice): Acts Like Cocaine
 - 6. Designer Drugs: Slightly Altered Structure

II. Chapter Review

- | Page | Questions |
|------|---|
| 279 | 1. What are the 2 main divisions of the nervous system? What do they include? |
| | 2. What are the 3 main parts of all neurons? Distinguish between an axon and a dendrite. |
| | 3. Distinguish between the 3 types of neurons. What is another name for the sensory and motor neurons? |
| | 4. What are dendrites and axons of neurons sometimes called? Schwann cells lay down several layers of cellular membrane containing _____, and are covered by an outermost sheath called the _____, which plays an important role in nerve _____ in the PNS. |
| 281 | 5. Name the type of cells that support and nourish the neuron. |
| 282 | 6. Define voltage. How is the change in voltage displayed? |
| | 7. What is meant by the resting membrane potential? What is its value? Is it positive or negative? |
| | 8. Describe the distribution of sodium and potassium ions on either side of the axon membrane. What is this unequal distribution of ions due to? In which direction will the ions be pumped? |
| | 9. Why are there always more positive ions outside the axon membrane than inside? What accounts for the polarity recorded on the oscilloscope? What contributes toward the negative charge in the axoplasm? |
| 284 | 10. If an axon is stimulated, the trace that appears on an oscilloscope screen is called the _____. |
| | 11. During the upswing of the action potential, what ion will flow into the axon? What happens to the charge on the inside of the axon? What is this termed? |
| | 12. What happens when the potassium gates open? What term is used to describe this? |
| | 13. Why is the sodium-potassium pump important after repolarization has occurred? The time period in which the neuron is unable to conduct a nerve impulse is termed the _____ period. |
| | 14. Why is the speed of conduction much faster in myelinated fibers than unmyelinated nerve fibers? What is this type of conduction called? |
| | 15. What is the difference between the presynaptic membrane, synapse, synaptic cleft, and the postsynaptic membrane? |
| | 16. What happens when a nerve impulse reaches the axon's presynaptic membrane? The substances that are released are termed _____. |
| 285 | 17. What happens to the postsynaptic membrane if a neurotransmitter substance is excitatory? If inhibitory? |
| | 18. List 2 excitatory neurotransmitters and the enzymes that break them down. |
| 286 | 19. What will determine whether a neuron will fire? This is called _____. |
| | 20. Name the part of our body that integrates the information it receives from all over our body in order to make decisions. |
| | 21. What is the peripheral nervous system made up of? Where are the cell bodies found within the PNS? |
| | 22. Define the all-or-none law. Why doesn't a nerve obey this law? |

- 286 23. Distinguish between the 3 types of nerves.
- 287 24. State the number of cranial and spinal nerves in humans. What type are the spinal nerves?
- 288 25. What type of nerves are found in the dorsal and ventral roots? What does the somatic nervous system do?
- 289 26. What is a reflex? List the path in a simple reflex arc.
27. What is the function of the autonomic nervous system?
28. Where does the sympathetic nervous system arise? Describe the length of the preganglionic and postganglionic fibers. Why is this system important? What neurotransmitter is released by the postganglionic axon?
29. Where does the parasympathetic nervous system arise? Describe the length of the preganglionic and postganglionic fibers. Why is this system important? What neurotransmitter is released?
- 291 30. What are the 2 parts of the central nervous system? What is the function of the meninges and the cerebrospinal fluid?
31. The cerebrospinal fluid is contained within the _____ of the brain and the _____ of the spinal cord. What are the 2 main functions of the spinal cord? Where is the gray matter found in the spinal cord?
- 292 32. Which part of the unconscious brain lies closest to the spinal cord and contains centers for the heartbeat, respiration, vasoconstriction, and various reflex centers?
33. Which part of the brain functions to:
- maintain homeostasis and control the pituitary gland?
 - regulate breathing rate along with the medulla?
 - act as a central relay station for incoming sensory impulses traveling to the cerebrum?
 - act as a gatekeeper to the cerebrum? Name the specific part that achieves this function.
 - coordinate muscle activity, muscle tone, and maintain posture?
- 293 34. Name the largest part of the human brain that is responsible for consciousness. What is the outer gray layer called? List the lobes of the brain. What is the cerebrum responsible for?
- 294 35. What is the role of association areas? What is the function of the corpus callosum?
36. Describe what takes place during epilepsy.
37. What is an electroencephalogram?
38. Which type of brain wave takes place when an individual is awake and has their eyes open? If closed?
39. What takes place during REM sleep? What is it believed to be needed for?
- 295 40. Stimulation of the limbic system will cause the individual to experience _____.
41. What is the relationship between learning and the number of synapses? Vivid memories and the limbic system?
42. Name 2 neurotransmitters that are associated with behavioral states of mood, sleep, and learning.
43. What is the function of endorphins and how do they affect substance P?
44. Describe the cause of Parkinson disease. Of Huntington disease. Of Alzheimer disease.
- 296 45. What are the 2 general effects that drugs have on the nervous system? Define drug abuse.
- 297 46. Why do women show a greater sensitivity to alcohol? What happens to the liver in an alcoholic?
- 298 47. The effects of marijuana depend upon what factors? What are the characteristics of chronic intoxication? Why is it called a *gateway* drug? Does it produce a physical or psychological dependence?
48. How is cocaine taken into the body? What is its mode of action? Describe the experience of a person addicted to it.
- 299 49. What is heroin derived from? Describe its mode of action. List several withdrawal symptoms.
- 300 50. What is "ice"? What are designer drugs?

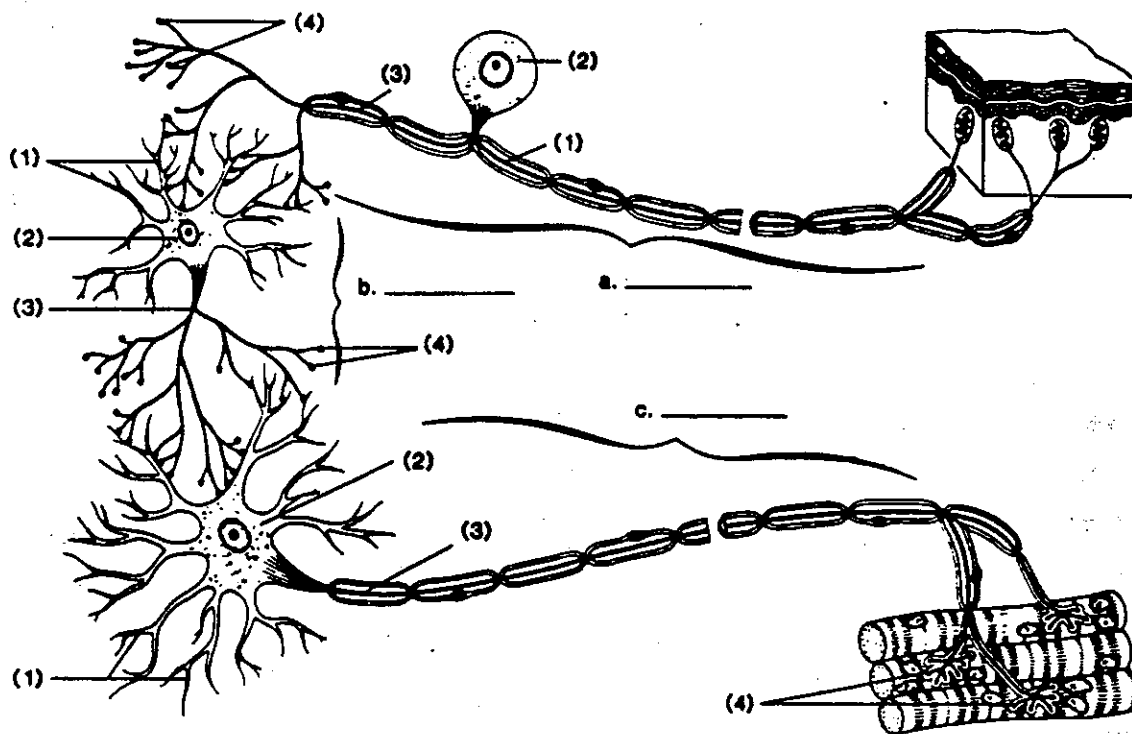
III. Objective Chapter Test

Completion and Short Answer Questions

- The peripheral nervous system may be divided into the _____ and _____ divisions.
- A motor neuron has a _____ (*long / short*) axon and _____ (*long / short*) dendrites.
- During depolarization of the nerve impulse, the _____ ion moves to the inside of the neuron.
- The junction between one neuron and another is called a _____.

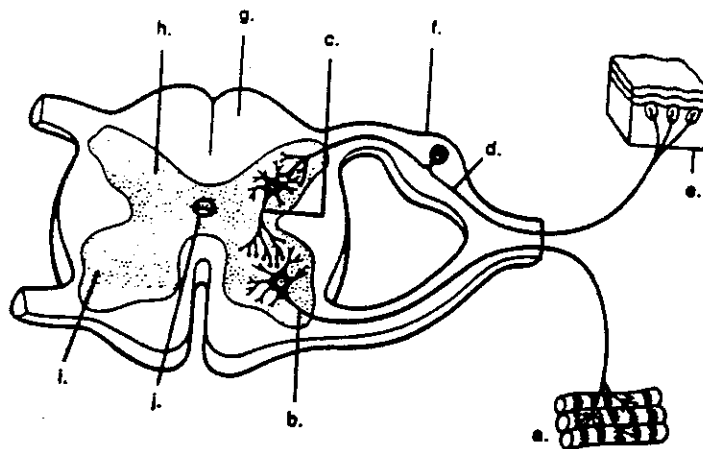
5. _____ are automatic, involuntary responses to changes occurring inside or outside the body.
6. Each division of the autonomic nervous system controls the same organs, but they generally have _____ effects.
7. The largest portion of the human brain is the _____.
8. The parasympathetic nervous system causes the heartbeat to _____ (*increase : decrease*).
9. The _____ are protective membranes covering the central nervous system.
10. The _____ lies just beneath the cortex of the cerebrum that when stimulated will cause the individual to experience rage, pain, pleasure, or sorrow.
11. In the diagram below, label *a*, *b*, and *c* as either the motor neuron, interneuron, or sensory neuron.

1. All the parts labeled #1 in the diagram below are called _____. Their function is to _____.
2. All the parts labeled #2 in the diagram below are called _____. Their function is to _____.
3. All the parts labeled #3 in the diagram below are called _____. Their function is to _____.
4. All the parts labeled #4 in the diagram below are called _____. Their function is to _____.



12. The nerve cell of the nervous system is called the (a) _____, of which there are three types: (b) _____, (c) _____, and (d) _____. Each is made up of a(n) (e) _____, (f) _____, and (g) a _____.
- Nerves are composed of a number of (h) _____. Cell bodies are found in the central nervous

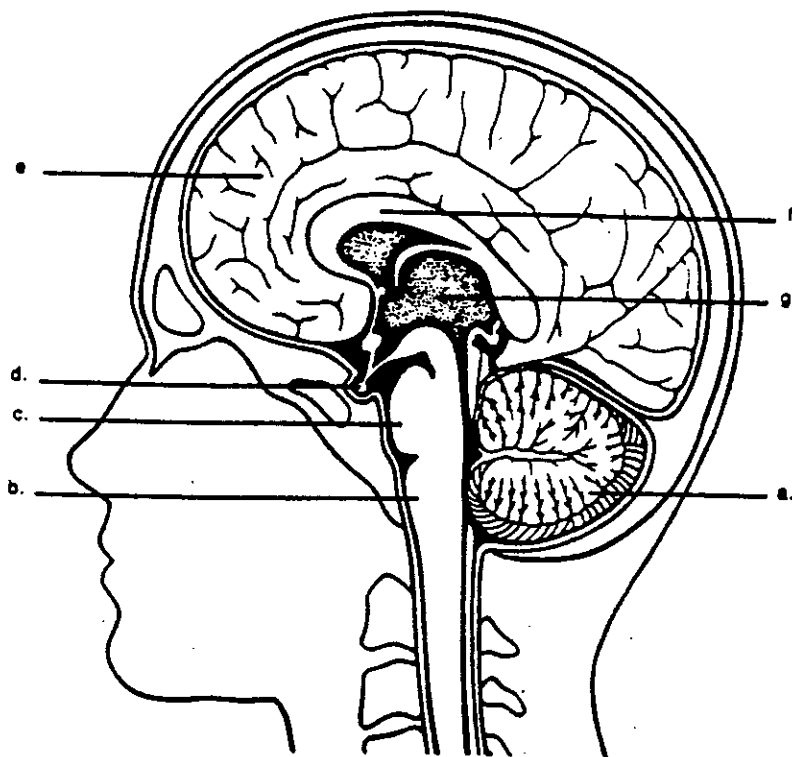
- system and in (i) _____ of the peripheral nervous system. The sensory neuron cell body is found in the (j) _____ ganglion. The postganglionic cell body of the sympathetic system is found in ganglia that lie alongside the spinal cord, and the postganglionic cell body of the parasympathetic neurons lies in ganglia located near (k) _____.
13. (a) _____ cells may encircle an axon and lay down several layers of cellular membrane that contains (b) _____, which gives nerve fibers their white, glistening appearance. The outermost sheath about a nerve fiber is called the (c) _____ and the inner one is called the (d) _____ sheath. The gaps between Schwann cells on myelinated nerve fibers are called (e) _____, which causes the speed of nerve impulse conduction to be much (f) _____ (slower / faster).
14. The outer part of the cerebrum is called the _____, and the two halves of the cerebrum are called the _____.
15. Label the following diagram of the reflex arc. Draw arrows to indicate the pathway of the nerve impulse.



16. In the above diagram of a spinal reflex arc, a stimulus is received by a(n) (a) _____ organ, which initiates an impulse in the (b) _____ neuron. The sensory neuron takes the message to the spinal cord and transmits it to the (c) _____. This neuron passes the impulse to the (d) _____ neuron, which takes the message from the spinal cord and innervates a muscle.
17. Fill in the table below to indicate the functions of the following parts of the brain.

Brain Part	Function
a. Cerebrum	
b. Thalamus	
c. Hypothalamus	
d. Cerebellum	
e. Medulla oblongata	

18. Label this drawing of the brain.



19. Place the correct name of the cerebral lobe beside the description of functions.

- _____ a. controls voluntary skeletal muscles, elaboration of conscious thought
- _____ b. sensory areas responsible for sensations of temperature, touch, pressure, pain from skin
- _____ c. hearing and smelling
- _____ d. responsible for vision

20. Describe the relative length of the nerve fiber and whether it would be an axon or dendrite in the

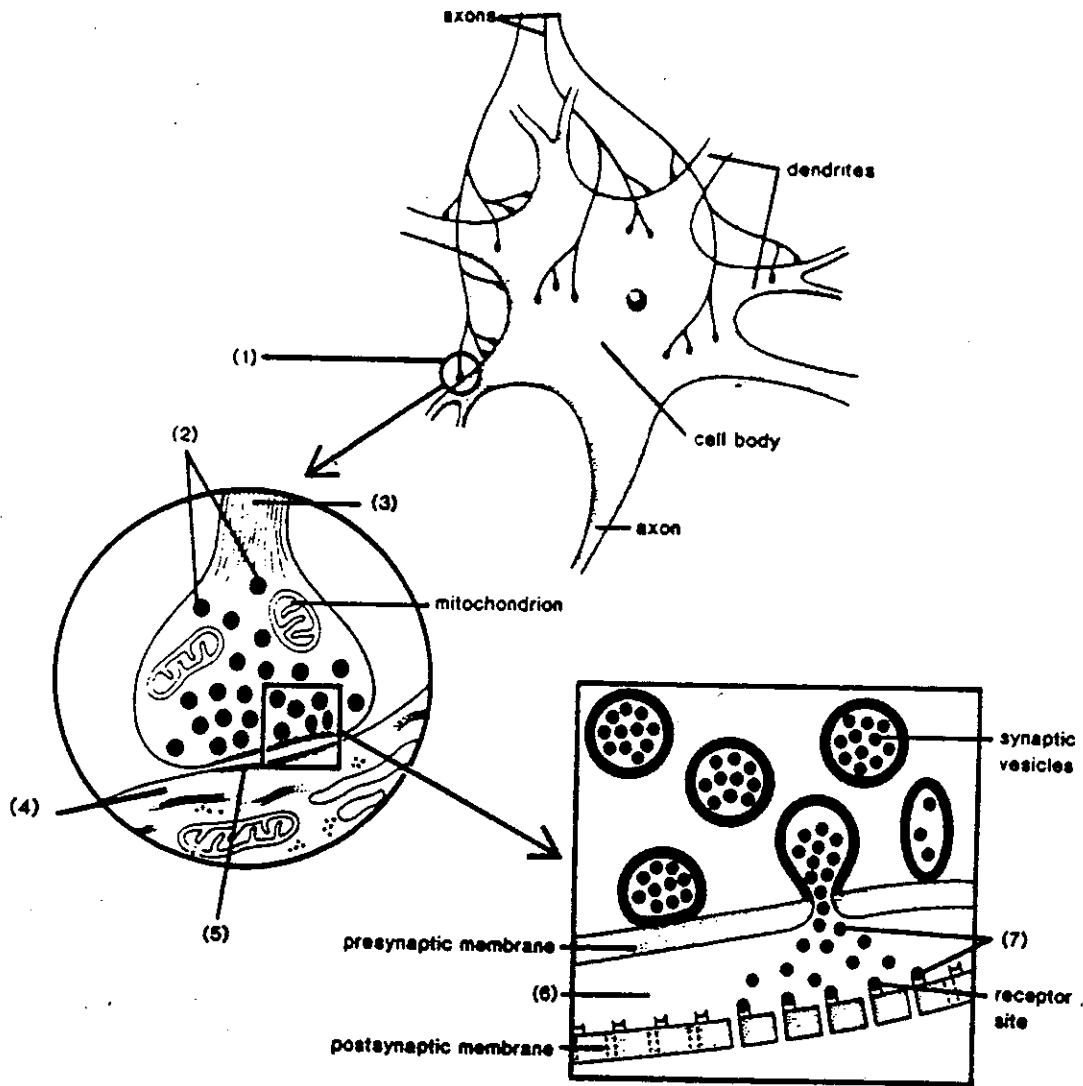
- a. cranial sensory nerves. _____
- b. cranial motor nerve. _____
- c. spinal mixed nerves. _____

21. Which type of brain wave is found on an electroencephalogram when a subject is awake with the eyes open? (a)

_____ When subjects are awakened during (b) _____ sleep, they always report that they were dreaming.

22. On the basis of the diagram below, explain the transmission of the nerve impulse across a synapse. _____

23. Transmission across a synapse. Label the numbered parts in the diagram below.



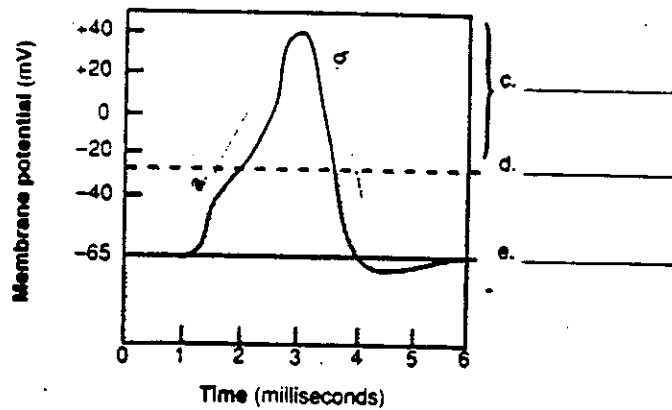
24. Indicate three ways in which the sympathetic and parasympathetic systems are similar.

- a. _____
- b. _____
- c. _____

25. Indicate ways in which the sympathetic and parasympathetic systems differ in the following table.

	Sympathetic	Parasympathetic
a. Type of situation used		
b. Neurotransmitter released		
c. Ganglia near cord or near organ?		
d. Spinal nerves only or spinal nerves plus vagus cranial nerve		

26. The drawing below shows a trace that appears on the oscilloscope screen when a nerve is stimulated. At each letter, label the diagram using the following terms: *action potential*, *resting potential*, *threshold*, *sodium gates open*, *potassium gates open*, *depolarization*, and *repolarization*. Some letters may have more than one term used.



27. During the time of rest, the _____ pump restores the original distribution of ions across the membrane of a nerve fiber.
28. The nerve impulse is the same in all neurons. It consists of an increase in membrane (a) _____ so that sodium moves to the (b) _____ of the axon and potassium moves to the (c) _____. The significance of this is that an electrochemical change has occurred, which is propagated along the nerve until it reaches the axon (d) _____. Here a(n) (e) _____ is released, and this enters the synaptic cleft. The nerve impulse is one-way because the synaptic vesicles are found only at the ends of (f) _____. After passage across the synapse, acetylcholine is destroyed by (g) _____.
29. Drugs. Complete the following table.

Name	Mode of Action	Psychological Effect
a. Alcohol		
b. Marijuana		
c. Cocaine		
d. Heroin		

30. There are both inhibitory and excitatory neurotransmitters in the brain. If a drug blocks the action of an inhibitory neurotransmitter, will the psychological effect be stimulated or depressed? (a) _____. If the drug blocks the action of an excitatory neurotransmitter, what will the psychological effect be? (b) _____
31. According to endorphin research, what causes heroin withdrawal symptoms? _____
32. Ganglia contain (a) _____. Nerves contain (b) _____ and/or (c) _____, the former being quite long in motor neurons and the latter being long in sensory neurons.

33. Divisions of the nervous system. Match the items in the key to the phrases below.

- Key: (1) CNS
(2) PNS
(3) somatic nervous system
(4) autonomic nervous system

- _____ a. ganglia and nerves
_____ b. functions without need for conscious control
_____ c. brain and spinal cord
_____ d. integration and control of other divisions
_____ e. activation of skeletal muscles
_____ f. regulates activity of internal organs
_____ g. somatic and autonomic nervous systems
_____ h. parasympathetic and sympathetic nervous systems

Match the functions below with the following answers: a. synaptic vesicles b. nodes of Ranvier c. ganglia

d. motor neurons

- _____ 34. contain neurotransmitters
_____ 35. are nerve cell bodies outside the CNS
_____ 36. terminate at muscles
_____ 37. are unmyelinated regions of a nerve fiber

Multiple Choice Questions

38. Which of the following would *not* be used when studying nerve conduction?
- a voltmeter
 - an oscilloscope
 - an electron microscope
 - electrodes
 - an electric current
39. Which of the following is *not directly* needed for nerve conduction?
- dendrites
 - axons
 - a cell membrane
 - a nucleus
 - axoplasm
 - ions
40. Which one does *not* move during nerve conduction?
- sodium
 - potassium
 - positive ions
 - negative ions
41. Which of the following is the opposite to the true situation for a resting neuron?
- positive on both sides of the membrane
 - positive on the outside of the membrane and negative on the inside
 - negative on both sides of the membrane
 - negative on the outside and positive on the inside
42. Which of the following has nothing to do with an action potential?
- a resting potential
 - permeability
 - a sodium/potassium pump
 - a cell membrane
 - acetylcholine
 - ions
 - glycogen
43. Which of the following does *not* conduct a nerve impulse?
- sensory neurons
 - osteocytes
 - motor neurons
 - sensory nerves
 - motor nerves

44. Which of the following numbers could *not* be associated with an action potential?
- 65 millivolts
 - 0 millivolts
 - + 40 millivolts
 - 40 watts
45. Which of the following is improperly matched?
- electrons — nerve impulse
 - Na/K pump — resting potential
 - positive charge — Na⁺
 - negative charge — K⁺
 - cell membrane — selectively permeable
46. ____ contain only long dendrites and/or long axons.
- Motor neurons
 - Sensory neurons
 - Interneurons
 - Somatic neurons
 - Nerves
47. The autonomic nervous system has two divisions called the
- CNS and the peripheral system.
 - somatic and skeletal system.
 - efferent and afferent system.
 - sympathetic and parasympathetic.
48. Synaptic vesicles are
- at the ends of dendrites and axons.
 - at the ends of axons only.
 - at the ends of dendrites only.
 - along the length of all long fibers.
 - All of the above are true.
49. Sensory neurons (choose two answers)
- are afferent neurons.
 - take an impulse to the CNS.
 - are efferent neurons.
 - take an impulse away from the CNS.
50. Postganglionic axons of the sympathetic autonomic nervous system release
- acetylcholine.
 - norepinephrine.
 - dopamine.
 - serotonin.
51. The downswing of the nerve impulse is caused by the movement of
- sodium ions to the inside of a neuron.
 - sodium ions to the outside of a neuron.
 - potassium ions to the inside of a neuron.
 - potassium ions to the outside of a neuron.
52. The function of the cerebellum is
- consciousness.
 - motor coordination.
 - homeostasis.
 - sense reception.
53. A spinal nerve is
- a motor nerve.
 - a sensory nerve.
 - a mixed nerve.
 - composed of a single nerve fiber.
54. The neuron that is found completely within the CNS is the
- motor neuron.
 - sensory neuron.
 - interneuron.
 - All of the above are true.
55. Which of the following neurons would be found in the autonomic division of the peripheral nervous system?
- motor neurons ending in skeletal muscle
 - motor neurons surrounding the esophagus
 - sensory neurons at the surface of the skin
 - interneurons in the spinal cord
56. Rapid conduction of a nerve impulse in vertebrates is due to
- the small diameters of the axons.
 - nodes of Ranvier.
 - an abundance of synapses.
 - the high permeability of neuronal membranes to ions.
57. Rapid automatic responses to specific external stimuli require
- rapid impulse transmission along the spinal cord.
 - the involvement of the brain.
 - simplified pathways called reflex arcs.
 - the involvement of the autonomic nervous system.