

Bonus

# 15 Nervous System

Name: \_\_\_\_\_

Due: \_\_\_\_\_

Block: \_\_\_\_\_

## I. Behavioral Objectives

Students should be able to

1. cite the various divisions of the nervous system and the particular functions for each division;
2. describe the structure and function of the three major types of neurons;
3. describe the nerve impulse as an electrochemical change that can be recorded by means of an oscilloscope;
4. describe the structure and function of a synapse, including transmission across a synapse;
5. classify and describe nerves and the path of a spinal reflex;
6. describe the autonomic nervous system and cite similarities as well as differences in the structure and function of the two divisions;
7. describe in general the anatomy of the brain, name five major parts, and give a function for each;
8. name the lobes of the cerebrum and give a function for each;
9. describe drug action in general and the specific action of various categories of drugs.

## II. Pretest

1. The peripheral nervous system may be divided into the somatic division and the autonomic division.
2. A motor neuron has a long axon and short dendrites.
3. In the first part of the nerve impulse, the ion sodium moves to the inside of the neuron.
4. The junction between one neuron and another is called a synapse.
5. The first element in a spinal reflex is a receptor.
6. Each division of the autonomic nervous system controls the same organs, but they generally have opposite effects.
7. The largest portion of the human brain is the cerebrum.
8. The parasympathetic nervous system causes the heartbeat to slow down.
9. The drug amphetamine has a chemical structure similar to the neurotransmitter Noradrenalin.
10. The cerebral cortex can be mapped: Sensory areas receive impulses from sense organs, and motor areas initiate impulses that eventually cause muscles to contract.

## III. Definitions

Define these terms:

1. neuron (p. 309) \_\_\_\_\_
2. CNS (p. 309) \_\_\_\_\_
3. PNS (p. 309) \_\_\_\_\_
4. dendrite (p. 310) \_\_\_\_\_
5. cell body (p. 310) \_\_\_\_\_
6. axon (p. 310) \_\_\_\_\_
7. sensory neuron (p. 310) \_\_\_\_\_
8. motor neuron (p. 310) \_\_\_\_\_
9. innervate (p. 310) \_\_\_\_\_
10. interneuron (p. 310) \_\_\_\_\_
11. fibers (p. 310) \_\_\_\_\_
12. myelin sheath (p. 310) \_\_\_\_\_
13. nerve impulse (p. 311) \_\_\_\_\_
14. resting potential (p. 312) \_\_\_\_\_
15. action potential (p. 313) \_\_\_\_\_
16. depolarization (p. 313) \_\_\_\_\_
17. repolarization (p. 313) \_\_\_\_\_
18. synapse (p. 314) \_\_\_\_\_
19. synaptic ending (p. 314) \_\_\_\_\_
20. presynaptic membrane (p. 314) \_\_\_\_\_
21. postsynaptic membrane (p. 314) \_\_\_\_\_
22. synaptic cleft (p. 314) \_\_\_\_\_
23. neurotransmitter substances (p. 314) \_\_\_\_\_
24. ACh (p. 314) \_\_\_\_\_
25. NA (p. 314) \_\_\_\_\_
26. AChE (p. 314) \_\_\_\_\_

Key unnecessary  
 for definitions.

27. local excitation (p. 314) \_\_\_\_\_
28. integration (p. 314) \_\_\_\_\_
29. ganglia (p. 316) \_\_\_\_\_
30. sensory nerves (p. 316) \_\_\_\_\_
31. motor nerves (p. 316) \_\_\_\_\_
32. mixed nerves (p. 316) \_\_\_\_\_
33. cranial nerves (p. 316) \_\_\_\_\_
34. spinal nerve (p. 316) \_\_\_\_\_
35. dorsal root ganglion (p. 318) \_\_\_\_\_
36. somatic nervous system (p. 318) \_\_\_\_\_
37. receptors (p. 318) \_\_\_\_\_
38. effectors (p. 318) \_\_\_\_\_
39. reflex (p. 318) \_\_\_\_\_
40. preganglionic axon (p. 319) \_\_\_\_\_
41. postganglionic axon (p. 319) \_\_\_\_\_
42. sympathetic nervous system (p. 319) \_\_\_\_\_
43. parasympathetic nervous system (p. 320) \_\_\_\_\_
44. meninges (p. 321) \_\_\_\_\_
45. cerebrospinal fluid (p. 321) \_\_\_\_\_
46. central canal (p. 322) \_\_\_\_\_
47. ventricles (p. 322) \_\_\_\_\_
48. tracts (p. 322) \_\_\_\_\_
49. medulla oblongata (p. 322) \_\_\_\_\_
50. hypothalamus (p. 322) \_\_\_\_\_
51. thalamus (p. 322) \_\_\_\_\_
52. ARAS (p. 323) \_\_\_\_\_
53. cerebellum (p. 323) \_\_\_\_\_
54. cerebrum (p. 324) \_\_\_\_\_
55. cerebral hemispheres (p. 324) \_\_\_\_\_
56. frontal lobe (p. 324) \_\_\_\_\_
57. parietal lobe (p. 324) \_\_\_\_\_
58. temporal lobe (p. 324) \_\_\_\_\_
59. occipital lobe (p. 324) \_\_\_\_\_
60. corpus callosum (p. 325) \_\_\_\_\_
61. EEG (p. 325) \_\_\_\_\_
62. Rem sleep (p. 325) \_\_\_\_\_
63. limbic system (p. 326) \_\_\_\_\_

**Key unnecessary  
for definitions.**

#### IV. Study Questions

1. 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

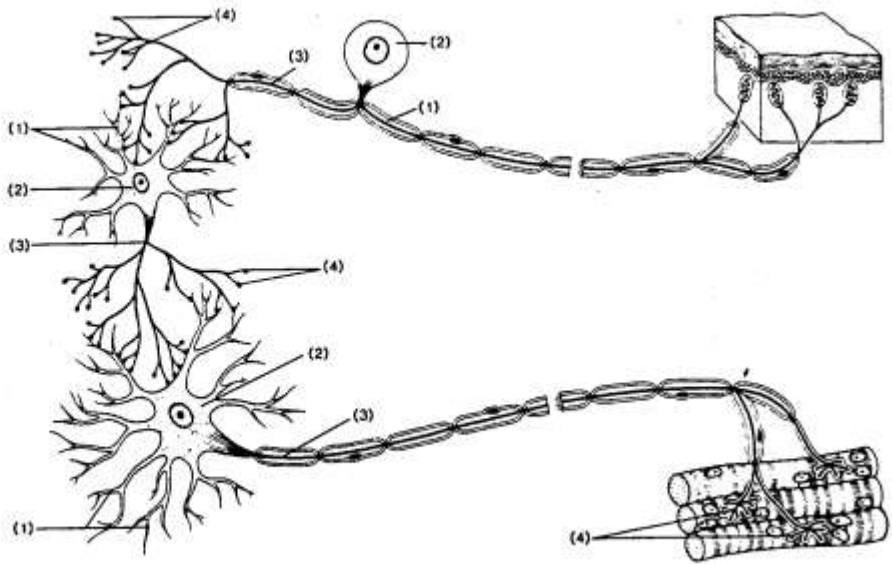
- 2 a. ganglia and nerves
- 4 b. functions without need for conscious control
- 1 c. brain and spinal cord
- 1 d. integration and control of other divisions
- 3 e. activation of skeletal muscles
- 4 f. regulates activity of internal organs
- 2 g. somatic and autonomic nervous systems
- 4 h. parasympathetic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

2. Every neuron has the three parts listed here. What is the function of each?

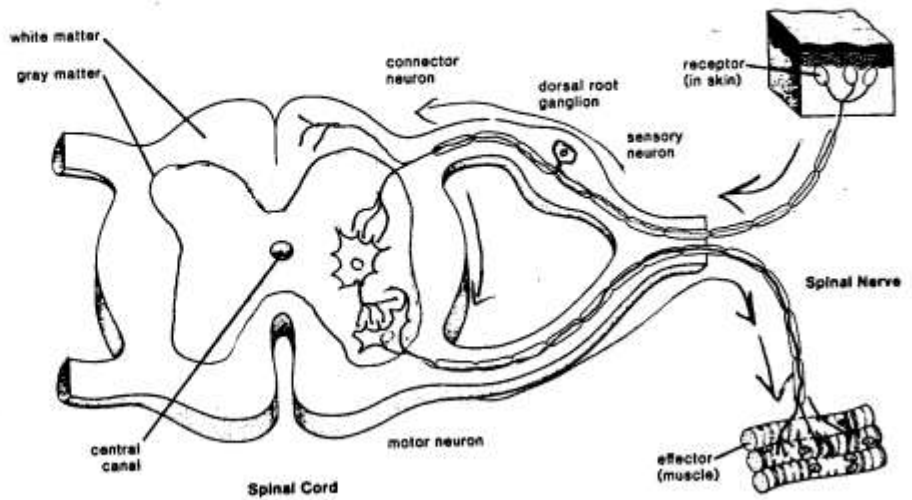
a. dendrite takes impulse to cell body  
 b. cell body control centre  
 c. axon take impulses away from cell body.

3. a. Label the parts of the sensory neuron in the diagram below. (next page)  
 b. State the function of the complete neuron. take nerve impulses to CNS
4. a. Label the parts of the interneuron.  
 b. State the function of the complete neuron. carry impulses between parts of CNS.
5. a. Label the parts of the motor neuron.  
 b. State the function of the complete neuron. take nerve impulses away from CNS.

1 = dendrite  
 2 = cell body  
 3 = axon  
 4 = synaptic endings



6. Add the sensory neuron, interneuron, and motor neuron to this diagram of the spinal cord and spinal nerve. Draw lines to connect the labels to your drawings.



a. Draw in arrows to indicate the path of the impulse.

b. Fill in these blanks to indicate what happens during a spinal reflex arc. A stimulus is received by a sense organ, which initiates an impulse in the sensory neuron. The sensory neuron takes the message to the cord and transmits it to the interneuron. This neuron passes the impulse to the motor neuron, which takes the message from the cord and innervates a muscle, causing a reaction to the stimulus.

c. Transmission across a synapse. Label the numbered parts in the drawings. (next page)

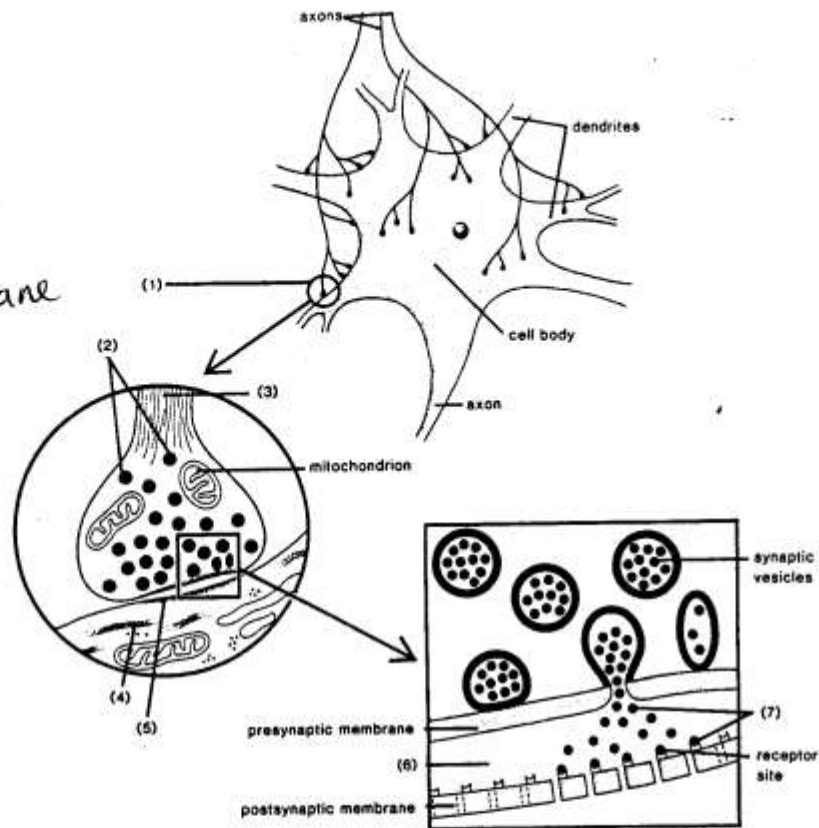
d. On the basis of the drawings, explain transmission of the nerve impulse across a synapse. impulse hits end of axon, Ca<sup>++</sup> rushes into axo, vesicles drawn to membrane

e. Explain how the brain becomes aware of the automatic reflex action. interneurons send message to brain

f. Explain why the left side of the brain controls the right side of the body. Tracts going to + from CNS cross over

and release neurotransmitters into clefts. Neurotransmitters bind to sites on next cell dendrite, causing it to fire (or, preventing).

- ① synapse
- ② synaptic vesicles
- ③ axon
- ④ dendrite
- ⑤ postsynaptic membrane
- ⑥ synaptic cleft
- ⑦ neurotransmitter



7. What structures would you expect to find in the
- a. cranial sensory nerves? long dendrites
  - b. cranial motor nerves? long axons
  - c. spinal mixed nerves? long dendrites + long axon
  - d. Why do nerves have a white appearance? long fibers are covered by a myelin sheath

8. a. Indicate three ways in which the sympathetic and parasympathetic system are similar.
- (1) control internal organs
  - (2) motor neurons only
  - (3) have ganglia
- b. Indicate ways in which the two systems differ by filling in the table below.

	Sympathetic	Parasympathetic
(1) Type of situation	emergencies	everyday activities
(2) Neurotransmitter	noradrenalin	acetylcholine
(3) Ganglia near cord or ganglia near organ?	near cord	near organ
(4) Spinal nerves only or spinal nerves + vagus?	spinal nerves only	spinal nerves + vagus nerve

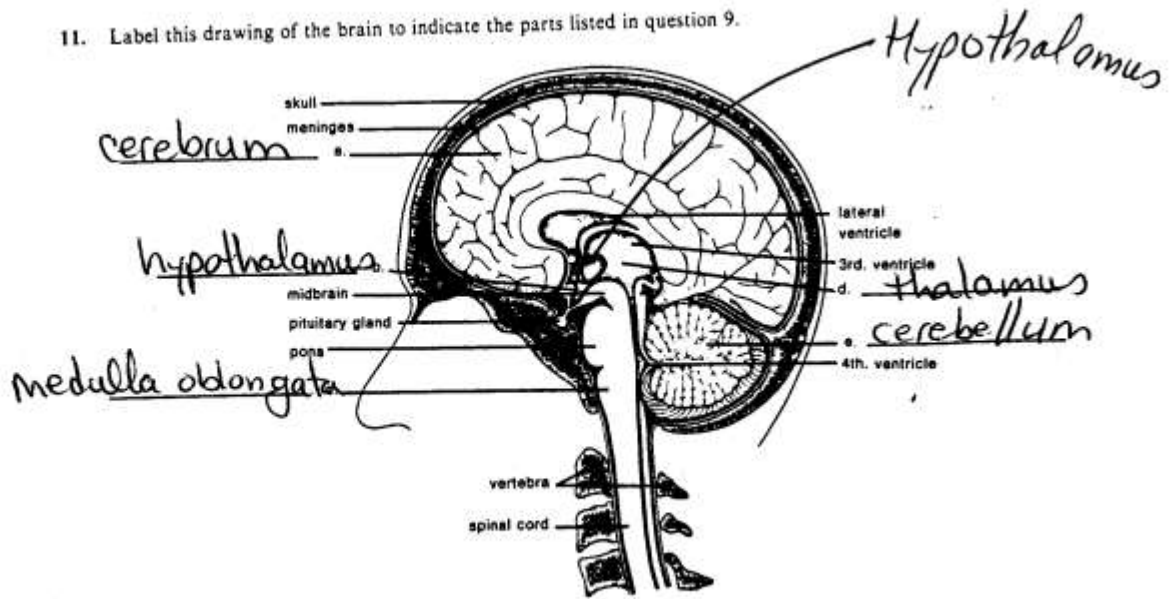
9. Fill in the table below to indicate the functions of the parts of the brain.

**Brain Functions**

a. Cerebrum	consciousness, will, memory, judgement etc.
b. Thalamus	gatekeeper to cerebrum, integrates sensory data
c. Hypothalamus	homeostasis
d. Cerebellum	motor coordination & balance
e. Medulla oblongata	control of internal organs

10. The outer part of the cerebrum is called the cerebral cortex, and the two halves of the cerebrum are called the cerebral hemispheres.

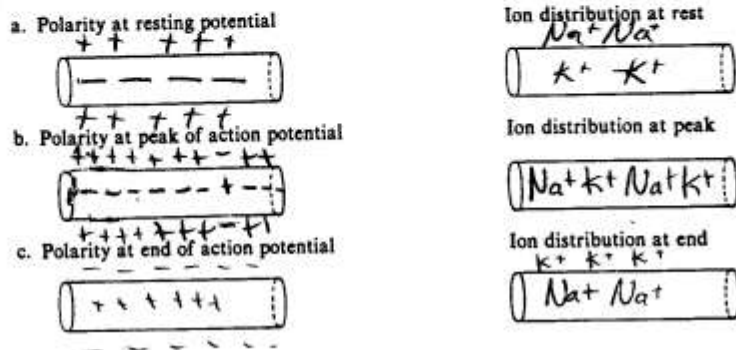
11. Label this drawing of the brain to indicate the parts listed in question 9.



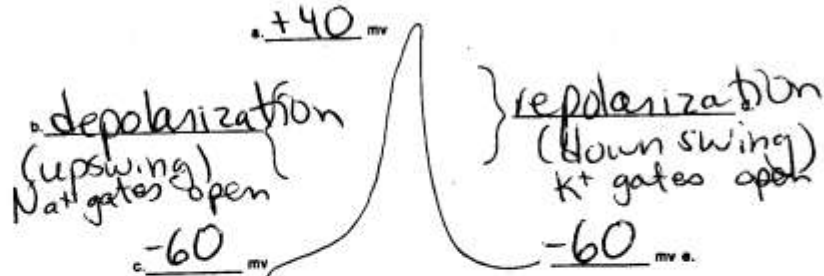
12. Place the correct name of the lobe beside the description of functions.

- frontal lobe a. control voluntary movements; higher mental functions such as problem solving  
parietal lobe b. senses associated with skin; expressing thoughts and feelings  
temporal lobe c. hearing and smelling; memory of music, visual scenes and other complex patterns  
occipital lobe d. vision; combining visual images with other sensory experiences

13. Below is a series drawings representing sections of axons. On the left, indicate the polarity asked for. On the right, indicate the distribution of ions that produce this polarity.



14. On this drawing of the trace that appears on the oscilloscope screen during the time of the action potential, label on one side  $\text{Na}^+$  (sodium) gates open, and on the other side  $\text{K}^+$  (potassium) gates open. Write in the appropriate values to indicate the resting potential and the peak potential.



15. During the time of rest the sodium, potassium pump restores the original distribution of ions across the membrane of a nerve fiber.

16. Drugs. Complete this table.

Name	Biological Action	Psychological Effect
a. Amphetamine	promotes release of NA	stimulation
b. Lithium	blocks release of NA	depression
c. LSD	affects serotonin	hallucinations
d. Heroin	replaces enkephalins	pleasure

- e. These drugs are believed to affect in particular what part of the brain? (1) limbic system  
 There are both inhibitory and excitatory neurotransmitters in the brain. If a drug blocks the action of an inhibitory neurotransmitter, what psychological effect will it have? (2) Stimulation If a drug blocks the action of an excitatory neurotransmitter, what psychological effect will it have? (3) depression
- f. According to enkephalin research, what causes heroin withdrawal symptoms?

Withdrawal symptoms

V. Nervous System Quiz

Fill in the blanks.

- The anatomical unit of the nervous system is the (a) Neuron, of which there are three types: (b) sensory, (c) motor, and (d) inter-. Each is made up of an (e) axon, (f) a dendrite, and (g) a cell body. Nerves are composed of a number of (b) neuron fibers. Cell bodies are found, first and foremost, in the central nervous system, but also in (h) ganglia, and the sensory neuron cell body is in the (j) dorsal root 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 lie (k) in ganglia near organs.
- The nerve impulse is the same in all neurons. It simply consists of an increase in (a) permeability of the membrane so that sodium moves to the (b) inside and potassium moves to the (c) outside. The significance of this is that an electrochemical change has occurred, which is propagated along the nerve until it reaches the synaptic (d) vesicles. Here a (e) neurotransmitter is released, and this enters the synaptic cleft. The nerve impulse is one-way because the synaptic vesicles are only at the ends of (f) axons. After passage across the synapse, acetylcholine is destroyed by (g) acetylcholinesterase.
- The central nervous system consists of the brain and spinal cord, and the cell bodies and connector neurons contained therein. The brain commands voluntary and involuntary activity of the individual and integrates all activity, so that we seem purposeful.
- The peripheral nervous system consists of nerves and ganglia. Ganglia contain cell bodies. Nerves contain axons and/or dendrites, the former being quite long in motor neurons and the latter being long in sensory neurons.
- The reflex is the action unit of the nervous system. Thus, messages are sent to the central nervous system via Sensory neurons, passed by interneurons to appropriate centers in the brain, and sent on to motor neurons. All translation of data takes place in the CNS or spinal cord.
- Some body actions seem to be involuntary. For example, there are quick responses called reflexes that need not involve the brain. Also the autonomic nervous system automatically controls internal organs. The sympathetic portion is for fight or flight, and the parasympathetic portion is for normal situations. The transmitter substance for fight or flight is noradrenalin.


In questions 7-16, indicate which choice does not belong with the others.

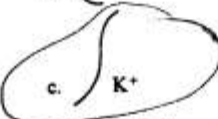
- Which of these would not be used when studying nerve conduction?
  - a voltmeter
  - an oscilloscope
  - an electron microscope
  - electrodes
  - an electric current

8. Which one is not *directly* needed for nerve conduction?
- dendrites
  - axons
  - a cell membrane
  - a nucleus
  - axoplasm
  - ions
9. Which one does *not* move during nerve conduction?
- sodium
  - potassium
  - plus charges
  - minus charges
10. Which one 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
11. Which one has nothing to do with an action potential?
- a resting potential
  - permeability
  - an Na/K pump
  - a cell membrane
  - acetylcholine
  - ions
  - glycogen

12. Which one does *not* conduct a nerve impulse?
- sensory neurons
  - osteocytes
  - motor neurons
  - sensory nerves
  - motor nerves
13. Which one is improperly matched?

a.  Na<sup>+</sup>

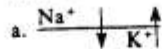
b.  K<sup>+</sup>


c.  K<sup>+</sup>

d.  $\frac{\text{Na}^+}{\text{K}^+} \frac{\text{Na}^+}{\text{K}^+}$

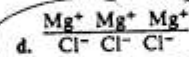
14. Which number could *not* be associated with an action potential?
- 60 millivolts
  - 0 millivolts
  - + 40 millivolts
  - 40 watts
15. Which one is improperly matched?
- e<sup>-</sup>—nerve impulse
  - Na/K pump—resting potential
  - + charge—Na<sup>+</sup>
  - charge—K<sup>+</sup>
  - cell membrane—selectively permeable

16. Which one is *not* true?



b. +40  
-60 

c. ++++++



## VI. Posttest

- The autonomic nervous system has two divisions called the
  - CNS and peripheral system
  - somatic and skeletal system
  - efferent and afferent
  - sympathetic and parasympathetic
- Synaptic vesicles
  - are at the ends of dendrites and axons
  - are at the ends of axons only
  - are along the length of all long fibers
  - all of these
- Sensory neurons (choose two)
  - are afferent neurons
  - take an impulse to the CNS
  - are efferent neurons
  - take an impulse away from the CNS
- Motor axons of the somatic nervous system release
  - acetylcholine
  - noradrenalin
  - dopamine
  - serotonin
- 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
- The resting potential is maintained by the sodium/potassium pump.
  - true
  - false
- The function of the cerebellum is
  - consciousness
  - motor coordination
  - homeostasis
  - sense reception
- A spinal nerve is a
  - motor nerve
  - sensory nerve
  - mixed nerve
  - all of these



9. Amphetamines have a chemical structure similar to that of
  - a. acetylcholine
  - b. dopamine
  - c. noradrenalin
  - d. serotonin
10. The neuron that is found wholly and completely within the CNS is the
  - a. motor neuron
  - b. sensory neuron
  - c. interneuron
  - d. all of these
11. Which of the following neurons would be found in the autonomic division of the peripheral nervous system?
  - a. motor neurons ending in skeletal muscle
  - b. motor neurons surrounding the esophagus
  - c. sensory neurons at the surface of the skin
  - d. interneurons in the spinal cord
12. Rapid conduction of a nerve impulse in vertebrates is due to
  - a. the large diameters of the axons
  - b. openings in the myelin sheath
  - c. an abundance of synapses
  - d. the high permeability of neuronal membranes to ions
  - e. all of these
13. Rapid automatic responses to specific external stimuli require
  - a. rapid impulse transmission along the spinal cord
  - b. the involvement of the brain
  - c. simplified pathways called reflex arcs
  - d. the involvement of the autonomic nervous system

Match the letter of the structure to the function.

- |  |                      |
|--|----------------------|
| 14. <u>c</u> contain neurotransmitters                 | a. dendrites         |
| 15. <u>e</u> are nerve cell bodies outside the CNS     | b. axons             |
| 16. <u>f</u> terminate at muscles                      | c. synaptic vesicles |
| 17. <u>d</u> are unmyelinated regions of a nerve fiber | d. nodes of Ranvier  |
|  | e. ganglia           |
|  | f. motor neurons     |

In questions 18–20, fill in each blank with the proper term.

18. meninges are protective membranous coverings about the central nervous system.
19. limbic system is an area of the forebrain implicated in visceral functioning and emotional responses.
20. spinal cord is the neural tube or nerve cord protected by vertebrae.

END