Chapter 2: Structure and Function of the Nervous System

LEARNING OBJECTIVES

2.1 Understand the structure of neurons and synapses.

2.2 Explain the role of ion channels in changing neuronal membrane potential.

2.3 Describe the impact of depolarization on the resting potential, and on the likelihood of subsequent action potentials.

2.4 Describe the influence of myelin and voltage-gated ion channels on action potentials.

2.5 Understand electrical and chemical transmission at the synapse, including the use and removal of neurotransmitters after binding.

2.6 Explain the roles of different types of glial cells, including astrocytes, oligodendrocytes, Schwann cells, and microglial cells.

2.7 Define and recognize differences between the central nervous system, peripheral nervous system, sympathetic system, parasympathetic system, cerebral cortex, gray and white matter, and corpus callosum.

2.8 Understand the functions of the spinal cord, brainstem, and cerebellum.

2.9 Understand the functions of the thalamus, hypothalamus, and pituitary gland.

2.10 Understand the functions of the limbic system and basal ganglia.

2.11 Define and describe anatomical structures and principles that include gyri, sulci, Brodmann areas, lobes, topography, and association cortices.

2.12 Explain the developmental process of the nervous system and the mechanisms behind neurogenesis.

MULTIPLE CHOICE

1. The two main classes of cells in the nervous system are
   a. dendrites and axons.
   b. axons and neurons.
   c. neurons and glial cells.
   d. glial cells and dendrites.

   ANS: C DIF: Easy REF: 2.1 The Cells of the Nervous System
   OBJ: 2.1 MSC: Remembering

2. In the nervous system, these cells provide structural support and insulation for neurons.
   a. glia
   b. dendrites
   c. mitochondria
   d. Purkinje cells

   ANS: A DIF: Easy REF: 2.1 The Cells of the Nervous System
   OBJ: 2.1 MSC: Remembering

3. Two main types of projections extend from the cell body of a neuron. _____ receive inputs from other neurons, while _____ send information to other neurons.
   a. Synapses; glia
   b. Axons; dendrites
   c. Glia; synapses
   d. Dendrites; axons

ANS: D DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.1 MSC: Remembering

4. Within a neuron, the transmission of information is usually _____. Between neurons, the transmission of information is usually _____.
   a. chemical; chemical
   b. electrical; electrical
   c. electrical; chemical
   d. chemical; electrical

   ANS: C DIF: Medium REF: 2.1 The Cells of the Nervous System
   OBJ: 2.1 MSC: Remembering

5. The term *concentration gradient* refers to a difference in the
   a. number of two different ion types within the neuron.
   b. number of ions found on opposite sides of the cell membrane.
   c. permeability of the membrane to one kind of ion compared to another.
   d. permeability of the membrane at rest compared to during an action potential.

   ANS: B DIF: Medium REF: 2.1 The Cells of the Nervous System
   OBJ: 2.1 | 2.2 MSC: Remembering

6. At the resting state, a higher concentration of _____ is found outside a neuron and a higher concentration of _____ is found inside a neuron.
   a. K^+; Na^+
   b. Na^+; K^+
   c. dopamine; serotonin
   d. serotonin; dopamine

   ANS: B DIF: Easy REF: 2.1 The Cells of the Nervous System
   OBJ: 2.1 | 2.2 MSC: Remembering

7. If you were to insert a microelectrode through the cell membrane of a neuron, you would be able to demonstrate that
   a. the region inside the cell membrane is more positively charged than the region outside the membrane.
   b. the region inside the cell membrane is more negatively charged than the region outside the membrane.
   c. there is a greater concentration of potassium ions outside the cell membrane than inside the membrane.
   d. there is a greater concentration of potassium ions inside the cell membrane than outside the membrane.

   ANS: B DIF: Medium REF: 2.1 The Cells of the Nervous System
   OBJ: 2.1 | 2.2 MSC: Applying

8. The ease with which a cell membrane will permit ions to cross is referred to as
   a. the concentration gradient.
   b. permeability.
   c. the action potential.
   d. conductivity.

   ANS: B DIF: Easy REF: 2.1 The Cells of the Nervous System
   OBJ: 2.2 MSC: Remembering

9. If you inserted a micropipette into a neuron without harming the cell and pumped in a small quantity of calcium ions, each of which carried two positive charges, how would this affect the membrane potential?
   a. The membrane potential would become depolarized relative to the resting potential.
   b. The membrane potential would become hyperpolarized relative to the resting potential.
   c. There would be no change because calcium does not contribute to the resting potential.

d. There would be no change because the sodium–potassium pump would remove excess calcium from the cell.

ANS: A DIF: Medium REF: 2.1 The Cells of the Nervous System
OBJ: 2.2 | 2.3 | 2.4 MSC: Applying

10. The Hodgkin–Huxley cycle describes how the depolarization of the membrane causes voltage-gated sodium channels to _____, allowing _____ sodium ions to enter the cell. This change in sodium concentration then causes _____ of the cell.
    a. close; fewer; further depolarization
    b. close; fewer; repolarization
    c. open; more; further depolarization
    d. open; more; repolarization

ANS: C DIF: Difficult REF: 2.1 The Cells of the Nervous System
OBJ: 2.2 | 2.3 | 2.4 MSC: Understanding

11. Ouabain is a toxin that works by permanently inhibiting the activity of sodium–potassium pumps embedded in neuronal membranes. How would ouabain administration affect the resting potential of a neuron?
    a. The magnitude of the resting potential would shift toward zero.
    b. The resting potential would hyperpolarize toward a more negative value.
    c. The resting potential would reverse to a positive, rather than a negative, value.
    d. Application of ouabain would not affect the resting potential.

ANS: A DIF: Difficult REF: 2.1 The Cells of the Nervous System
OBJ: 2.2 MSC: Applying

12. The value of the membrane potential to which an axon must be depolarized to initiate an action potential is called the _____ potential for that neuron.
    a. graded
    b. resting
    c. threshold
    d. refractory

ANS: C DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.3 MSC: Remembering

13. The poison tetraethylammonium (TEA) interferes with normal neural communication. The toxin binds to and blocks voltage-gated potassium channels in the neuron cell membrane. Which of the following best describes the effects of TEA on the action potential?
    a. The depolarization phase of the action potential fails to occur.
    b. The repolarization phase of the action potential is blocked.
    c. The refractory period of the action potential is shortened.
    d. The action potential fails to be regenerated at the nodes of Ranvier.

ANS: B DIF: Difficult REF: 2.1 The Cells of the Nervous System
OBJ: 2.4 MSC: Applying

14. Demyelinating diseases such as multiple sclerosis disrupt normal neural communication by
    a. destroying receptors on postsynaptic cells so that neurotransmitters cannot bind normally.
    b. creating lesions in the blood–brain barrier that allow toxic substances to enter the brain from the bloodstream.
    c. causing deterioration of the fatty substance that normally coats and insulates axons.
    d. diminishing the activity of the sodium–potassium pumps that usually maintain the resting potential of neurons.

ANS: C DIF: Medium REF: 2.1 The Cells of the Nervous System
OBJ: 2.4 MSC: Evaluating

15. The nodes of Ranvier are

a. vesicles of neurotransmitters, stored in presynaptic neurons.
b. little knobs attached by small necks to the surface of dendrites.
c. vesicles of calcium ions, stored in postsynaptic neurons.
d. points along axons that are not surrounded by myelin.

ANS: D DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.4 MSC: Remembering

16. The primary reason why neurons are refractory for a short period after firing action potentials, and the reason underlying the absolute refractory period, is that the
a. voltage-gated sodium channels are inactivated.
b. voltage-gated potassium channels are inactivated.
c. sodium–potassium pump has to remove sodium ions from inside the cell.
d. sodium–potassium pump has to retrieve potassium ions from outside the cell.

ANS: A DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.4 MSC: Evaluating

17. If electrical currents on multiple dendrites sum together at the axon hillock, and the current flows across the neuronal membrane to the spike-triggering zone, what is likely to happen?
a. An action potential will be initiated.
b. A sodium-potassium pump will activate.
c. Hyperpolarization.
d. Saltatory conduction.

ANS: A DIF: Medium REF: 2.1 The Cells of the Nervous System
OBJ: 2.4 MSC: Understanding

18. The term *saltatory conduction* refers to the fact that
a. action potentials travel faster when extracellular salt concentration is high.
b. action potentials evoked by strong stimuli travel faster than those evoked by weaker stimuli.
c. action potentials appear to jump from node to node in myelinated axons.
d. action potentials are generated only by myelinated portions of axons.

ANS: C DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.4 MSC: Remembering

19. In which of the following diseases is myelin damaged or lost?
a. Alzheimer’s
b. Parkinson’s
c. schizophrenia
d. multiple sclerosis

ANS: D DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.4 MSC: Evaluating

20. _____ enable(s) the rapid transmission of action potentials down an axon and increase(s) the distance over which transmission can occur.
a. Soma
b. Dendrites
c. Neurotransmitters
d. Myelin

ANS: D DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.4 MSC: Remembering

21. The _____, which is comprised of _____, restricts the diffusion of certain molecules and microbes from the circulatory system, protecting the brain from chemical compounds that might otherwise interfere with neuronal activity.
    a. sodium–potassium pump; astrocytes
    b. blood–brain barrier; astrocytes
    c. myelin sheath; oligodendrites
    d. lipid bilayer; oligodendrites

    ANS: B DIF: Medium REF: 2.1 The Cells of the Nervous System
    OBJ: 2.6 MSC: Remembering

22. Which of the following cells produce myelin in the peripheral nervous system?
    a. astrocytes
    b. microglia
    c. oligodendrocytes
    d. Schwann cells

    ANS: D DIF: Easy REF: 2.1 The Cells of the Nervous System
    OBJ: 2.6 MSC: Remembering

23. Which of the following cells devour and remove damaged brain cells?
    a. astrocytes
    b. microglia
    c. oligodendrocytes
    d. Schwann cells

    ANS: B DIF: Easy REF: 2.1 The Cells of the Nervous System
    OBJ: 2.6 MSC: Remembering

24. Which of the following statements best describes the immediate consequence of neurotransmitter molecules binding to ligand-gated ion channel receptors?
    a. Voltage-gated channels in the cell membrane open and permit ion flow through the membrane.
    b. The activity of the sodium–potassium pumps increases.
    c. Calcium absorption into the axon terminal cell is triggered.
    d. Neurotransmitter-containing vesicles bind to the inside of the axon terminal membrane.

    ANS: A DIF: Medium REF: 2.2 Synaptic Transmission
    OBJ: 2.2 | 2.5 MSC: Understanding

25. The role of calcium ions (Ca^{2+}) in synaptic transmission is to
    a. bind neurotransmitter molecules to the postsynaptic membrane.
    b. mediate the release of neurotransmitter molecules from the presynaptic neuron.
    c. repolarize the postsynaptic cell after transmission has been completed.
    d. increase the activity of the sodium–potassium pumps in the presynaptic cell.

    ANS: B DIF: Easy REF: 2.2 Synaptic Transmission
    OBJ: 2.5 MSC: Remembering

26. Which of the following sequences of steps best represents the order of events that occur during synaptic transmission?
    a. binding of neurotransmitter at the postsynaptic membrane → diffusion of neurotransmitter across the synapse → release of neurotransmitter from the presynaptic cell
    b. diffusion of neurotransmitter across the synapse → binding of neurotransmitter at the postsynaptic membrane → release of neurotransmitter from the presynaptic cell
    c. release of neurotransmitter from the presynaptic cell → binding of neurotransmitter at the postsynaptic membrane → diffusion of neurotransmitter across the synapse
    d. release of neurotransmitter from the presynaptic cell → diffusion of neurotransmitter across the synapse → binding of neurotransmitter at the postsynaptic membrane

    ANS: D DIF: Medium REF: 2.2 Synaptic Transmission
    OBJ: 2.5 MSC: Evaluating

27. Compare the following analogy to chemical synaptic transmission: Two postage companies use different methods for delivery. Company One's method is to send a delivery person out with packages that will be delivered directly to the address on the label. Company Two's method is to send a delivery person out to a transfer center, and a second driver will deliver the package to the address. Company One's method best compares to _____, while Company Two's method best compares to _____. Company ___ uses a faster method.
    a. G protein-coupled receptors (GPCRs); ligand-gated ion channels; One
    b. G protein-coupled receptors (GPCRs); ligand-gated ion channels; Two
    c. ligand-gated ion channels; G protein-coupled receptors (GPCRs); One
    d. ligand-gated ion channels; G protein-coupled receptors (GPCRs); Two

    ANS: C DIF: Difficult REF: 2.2 Synaptic Transmission
    OBJ: 2.5 MSC: Analyzing

28. Consider the synapse shown schematically here.

    If neuron A causes neuron B to become hyperpolarized relative to B's resting state,
    a. neuron B is more likely to fire its own action potential.
    b. neuron B is less likely to release neurotransmitter molecules from its own axon terminal.
    c. neuron B is more likely to absorb extracellular potassium through voltage-gated channels.
    d. neuron B is less likely to absorb extracellular sodium through the sodium–potassium pump.

    ANS: B DIF: Medium REF: 2.2 Synaptic Transmission
    OBJ: 2.5 MSC: Analyzing

29. A gap junction is
    a. the point where a neurotransmitter vesicle binds to the presynaptic membrane.
    b. a connection between two sections of a G protein that plays a role in second-messenger cascades.
    c. a transmembrane channel that connects the cytoplasm of two cells at an electrical synapse.
    d. more likely to be found on the amino acids than on the biogenic amines.

    ANS: C DIF: Easy REF: 2.2 Synaptic Transmission
    OBJ: 2.5 MSC: Remembering

30. Which of the following is a catecholamine?
    a. gamma-aminobutyric acid (GABA)
    b. glutamate
    c. serotonin
    d. norepinephrine

    ANS: D DIF: Medium REF: 2.2 Synaptic Transmission
    OBJ: 2.5 MSC: Remembering

31. The effect of a particular neurotransmitter on postsynaptic neurons
    a. is always either excitatory or inhibitory.
    b. depends on the properties of the postsynaptic neuron.
    c. may be modulated by the presence or absence of another neurotransmitter.
    d. depends on the properties of the postsynaptic neuron and may be modulated by the presence or absence of another neurotransmitter.

    ANS: D DIF: Medium REF: 2.2 Synaptic Transmission

OBJ: 2.5 MSC: Understanding

32. Which of the following is NOT a mechanism for removing a neurotransmitter from the synaptic cleft?
    a. diffusion of the neurotransmitter away from the synapse
    b. active reuptake of the neurotransmitter back into the presynaptic terminal
    c. enzymatic breakdown of the neurotransmitter in the synaptic cleft
    d. transport of the neurotransmitter by ion channels into neighboring glial cells

    ANS: D DIF: Medium REF: 2.2 Synaptic Transmission
    OBJ: 2.5 MSC: Evaluating

33. Many drugs produce their effects by facilitating or interfering with neurotransmitters at synapses. Which of the following drugs would most likely increase the effect of serotonin?
    a. a drug that binds to directly coupled serotonin receptors but does not change membrane permeability to ions
    b. a drug that prevents the activity of an enzyme that breaks down serotonin molecules in the synaptic cleft
    c. a drug that blocks the effect of Ca^{2+} ions
    d. a drug that blocks the effect of a conditional neurotransmitter that normally facilitates the effect of serotonin

    ANS: B DIF: Difficult REF: 2.2 Synaptic Transmission
    OBJ: 2.5 MSC: Applying

34. Cerebrospinal fluid (CSF) is produced in the lateral and third ventricles by the
    a. dura mater.
    b. substantia nigra.
    c. globus pallidus.
    d. choroid plexus.

    ANS: D DIF: Easy REF: 2.3 Overview of Nervous System Structure
    OBJ: 2.7 MSC: Remembering

35. The thick outer membrane that encloses the brain within the skull is the
    a. gray matter.
    b. white matter.
    c. myelin sheath.
    d. dura mater.

    ANS: D DIF: Easy REF: 2.3 Overview of Nervous System Structure
    OBJ: 2.7 MSC: Remembering

36. The two main divisions of the central nervous system are the
    a. forebrain and brainstem.
    b. white matter and gray matter.
    c. brain and spinal cord.
    d. cerebral hemispheres and cerebellum.

    ANS: C DIF: Easy REF: 2.3 Overview of Nervous System Structure
    OBJ: 2.7 MSC: Remembering

37. The difference between gray matter and white matter is that *gray matter* refers to _____, whereas *white matter* refers to _____.
    a. protruding rounded surfaces; fissures and invaginations
    b. fissures and invaginations; protruding rounded surfaces
    c. cell bodies; axon tracts
    d. axons; cell bodies

    ANS: C DIF: Easy REF: 2.3 Overview of Nervous System Structure
    OBJ: 2.7 MSC: Remembering

38. Gray matter is to white matter as _____ are to _____.
    a. gyri; sulci
    c. cell bodies; axon tracts

b. glial cells; neurons
d. oligodendrocytes; Schwann cells

ANS: C DIF: Medium REF: 2.3 Overview of Nervous System Structure
OBJ: 2.7 MSC: Analyzing

39. The brainstem includes all of the following components EXCEPT the
a. medulla.
b. midbrain.
c. hypothalamus.
d. pons.

ANS: C DIF: Easy REF: 2.4 A Guided Tour of the Brain
OBJ: 2.8 MSC: Evaluating

40. The specialized structures that comprise the midbrain control functions such as
a. hormone regulation.
b. visual reflexes.
c. memory.
d. emotional processing.

ANS: B DIF: Easy REF: 2.4 A Guided Tour of the Brain
OBJ: 2.8 MSC: Understanding

41. The dorsal portions of the gray matter in the spinal cord carry
a. motor information.
b. sensory information.
c. motor and sensory information from the dorsal surface of the body.
d. sensory and motor information to the cerebellum.

ANS: B DIF: Medium REF: 2.4 A Guided Tour of the Brain
OBJ: 2.8 MSC: Understanding

42. A patient has great difficulty in maintaining his posture, walking, and coordinating his movements. His brain injuries probably involve the
a. cerebellum.
b. corpus callosum.
c. superior colliculus.
d. third ventricle.

ANS: A DIF: Medium REF: 2.4 A Guided Tour of the Brain
OBJ: 2.8 MSC: Applying

43. A patient reports that she is functionally blind after a focal brain injury, even though her eyes and optic nerves are completely intact. Of the structures listed here, the most probable location for the brain injury is the
a. inferior colliculus.
b. lateral geniculate nucleus.
c. superior temporal lobe.
d. postcentral gyrus.

ANS: B DIF: Difficult REF: 2.4 A Guided Tour of the Brain
OBJ: 2.9 MSC: Applying

44. The part of the thalamus that is most important in relaying information to the primary visual cortex is the
a. lateral geniculate nucleus.
b. superior colliculus.
c. medial geniculate nucleus.
d. inferior colliculus.

ANS: A DIF: Easy REF: 2.4 A Guided Tour of the Brain
OBJ: 2.9 MSC: Remembering

45. This brain structure is often called the gateway to the cortex because almost all sensory inputs synapse here before continuing to their primary cortical sensory areas.
a. hypothalamus
b. hippocampus
c. thalamus
d. amygdala

ANS: C DIF: Easy REF: 2.4 A Guided Tour of the Brain
OBJ: 2.9 MSC: Remembering

46. Which of the following functions is NOT mediated primarily by the hypothalamus?
    a. endocrine system regulation
    b. maintenance of homeostatic states in the body
    c. relay of sensory information from the body to the cortex
    d. hormone control

    ANS: C DIF: Medium REF: 2.4 A Guided Tour of the Brain
    OBJ: 2.9 MSC: Evaluating

47. As a result of a brain injury to this diencephalic structure, a patient is experiencing disruptions in maintaining homeostasis of bodily states and endocrine control.
    a. thalamus
    b. hypothalamus
    c. hippocampus
    d. cingulate gyrus

    ANS: B DIF: Medium REF: 2.4 A Guided Tour of the Brain
    OBJ: 2.9 MSC: Applying

48. Injury to the hypothalamus would most likely interfere with
    a. hormone regulation.
    b. motor control.
    c. memory.
    d. olfactory sensation.

    ANS: A DIF: Medium REF: 2.4 A Guided Tour of the Brain
    OBJ: 2.9 MSC: Understanding

49. All of the structures listed here are major components of the basal ganglia EXCEPT the
    a. globus pallidus.
    b. amygdala.
    c. caudate nucleus.
    d. putamen.

    ANS: B DIF: Easy REF: 2.4 A Guided Tour of the Brain
    OBJ: 2.10 MSC: Evaluating

50. As a result of a brain injury to the medial temporal lobes and neighboring subcortical structures, a patient exhibits a number of cognitive and behavioral changes. Of the following options, which is the LEAST likely to be affected?
    a. memory
    b. emotional processing
    c. learning
    d. somatosensation

    ANS: D DIF: Medium REF: 2.4 A Guided Tour of the Brain
    OBJ: 2.10 MSC: Applying

51. The _____ is a system of structures that includes the _____. This system has been implicated in _____.
    a. limbic system; amygdala; emotion behavior
    b. limbic system; putamen; motor preparation
    c. basal ganglia; amygdala; emotion behavior
    d. basal ganglia; hippocampus; motor preparation

    ANS: A DIF: Difficult REF: 2.4 A Guided Tour of the Brain
    OBJ: 2.10 MSC: Evaluating

52. All of the following are advantages of a folded cerebral cortex EXCEPT:
    a. The need for blood vasculature in the cortex is eliminated.
    b. Neural conduction time between areas is reduced.
    c. Neurons are brought into closer three-dimensional relationships.

d. More cortical surface can be packed into the skull.

ANS: A DIF: Medium REF: 2.5 The Cerebral Cortex
OBJ: 2.7 MSC: Evaluating

53. Communication between the two hemispheres of the brain occurs mainly through the
a. basal ganglia.
b. cingulate gyrus.
c. corpus callosum.
d. limbic system.

ANS: C DIF: Easy REF: 2.5 The Cerebral Cortex
OBJ: 2.7 MSC: Remembering

54. The corpus callosum
a. permits communication between the two cerebral hemispheres.
b. is the area of the cortex in which information about touch, pain, temperature, and limb position is processed.
c. separates the temporal lobe from the frontal and parietal lobes.
d. is a fluid-filled chamber that cushions and supports the brain.

ANS: A DIF: Easy REF: 2.5 The Cerebral Cortex
OBJ: 2.7 MSC: Understanding

55. The most caudal lobe of the cerebral cortex is the _____ lobe.
a. frontal
b. temporal
c. occipital
d. parietal

ANS: C DIF: Medium REF: 2.5 The Cerebral Cortex
OBJ: 2.7 | 2.11 MSC: Understanding

56. Neurons in two different regions of Brodmann's cytoarchitectonic map always
a. use different types of neurotransmitters to communicate.
b. differ in cell morphology and organization.
c. lie inside different lobes of the cerebral cortex.
d. are separated by fissures in the cortex.

ANS: B DIF: Easy REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Understanding

57. The temporal lobe is to the occipital lobe as _____ is to _____.
a. touch; vision
b. touch; audition
c. audition; vision
d. audition; touch

ANS: C DIF: Medium REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Analyzing

58. The morphology of the brain of Albert Einstein revealed an unusual Sylvian fissure, the division that separates the _____ lobe from the _____ lobes.
a. occipital; frontal and parietal
b. temporal; frontal and parietal
c. frontal; temporal and occipital
d. parietal; temporal and occipital

ANS: B DIF: Easy REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Evaluating

59. The central sulcus is an anatomical landmark that separates the _____ lobe from the _____ lobe.

a. temporal; frontal
b. frontal; parietal
c. parietal; occipital
d. occipital; temporal

ANS: B DIF: Easy REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Remembering

60. The term *cytoarchitectonics* refers to
a. how cells in one brain region appear morphologically and how they are arranged with respect to each other.
b. how assemblies of neurons function together and how they communicate with neighboring ganglia.
c. how different brain regions differ in volume and how they interact to produce complex cognitive phenomena.
d. how the brains of different animals differ from each other in gross anatomy and the evolutionary bases of these differences.

ANS: A DIF: Medium REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Understanding

61. Of the following choices, the most anterior portion of the frontal lobes—the prefrontal cortex—is most critical to
a. processing information about pain, touch, and temperature.
b. executive functions.
c. the "what" visual pathway.
d. the "where" visual pathway.

ANS: B DIF: Easy REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Evaluating

62. The primary visual cortex, or V1, is located in
a. the striate cortex.
b. Brodmann area 41.
c. Heschl's gyrus.
d. the Sylvian fissure.

ANS: A DIF: Easy REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Remembering

63. The neocortex contains _____ cortical layers, with _____ typically being the input layer.
a. 10; layer IV
b. 10; layer I
c. six; layer IV
d. six; layer I

ANS: C DIF: Easy REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Remembering

64. The frontal lobe is _____ to the occipital lobe, whereas the temporal lobe is _____ to the parietal lobe.
a. posterior; superior
b. anterior; inferior
c. superior; caudal
d. inferior; rostral

ANS: B DIF: Easy REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Understanding

65. All of the following terms refer to the same cortical region that processes visual input EXCEPT
a. striate cortex.
b. area V1.
c. Heschl's gyrus.
d. Brodmann area 17.

ANS: C DIF: Medium REF: 2.5 The Cerebral Cortex
OBJ: 2.11 MSC: Evaluating

66. The primary auditory cortex is organized using a tonotopic map, which means that there is an orderly representation of
    a. loudness.
    b. frequency.
    c. duration.
    d. spatial location.

    ANS: B DIF: Easy REF: 2.5 The Cerebral Cortex
    OBJ: 2.11 MSC: Understanding

67. A patient recently suffered a traumatic blow to the head. She reports that she is having social difficulties, such as adding inappropriate comments to conversations. She cannot seem to control these outbursts. Which area of her cortex is most likely affected?
    a. the posterior frontal lobe
    b. the anterior parietal lobe
    c. the anterior frontal lobe
    d. the posterior parietal lobe

    ANS: C DIF: Medium REF: 2.5 The Cerebral Cortex
    OBJ: 2.11 MSC: Applying

68. The volume of cortex that is not sensory or motor has traditionally been termed _____ cortex.
    a. extrastriate
    b. cognitive
    c. association
    d. equipotential

    ANS: C DIF: Easy REF: 2.5 The Cerebral Cortex
    OBJ: 2.11 MSC: Remembering

69. Parts of the brain where metabolic activity is relatively high are characterized by
    a. elevated regional blood flow.
    b. increased cerebrospinal fluid production.
    c. a high degree of myelination.
    d. greater concentrations of calcium ions.

    ANS: A DIF: Medium REF: 2.5 The Cerebral Cortex
    OBJ: 2.11 MSC: Understanding

70. This type of early cell line is the precursor to the cells that will compose the nervous system.
    a. blastula
    b. gastrula
    c. endoderm
    d. ectoderm

    ANS: D DIF: Medium REF: 2.7 Development of the Nervous System
    OBJ: 2.12 MSC: Remembering

71. Which of the following statements regarding the prenatal development of the human nervous system is correct?
    a. The brain develops from ectoderm cells, whereas the spinal cord develops from mesoderm cells.
    b. Ectoderm cells are the precursors of the entire nervous system.
    c. Glial cells are derived from endoderm cells, whereas neurons are derived from ectoderm cells.
    d. Mesoderm cells are the precursors for all parts of the human nervous system.

    ANS: B DIF: Difficult REF: 2.7 Development of the Nervous System
    OBJ: 2.12 MSC: Evaluating

72. A team of scientists from California and Sweden (Eriksson et al., 1998) administered BrdU, a synthetic form of thymidine, to patients. Which of the following best summarizes the findings from these procedures?
    a. Very few neurons are generated after birth.

b. Synaptogenesis and synapse elimination peak earlier in sensory cortex than in association cortex.
c. Brains of humans and rats are anatomically similar.
d. New neurons are produced in the adult human brain.

ANS: D DIF: Medium REF: 2.7 Development of the Nervous System
OBJ: 2.12 MSC: Analyzing

73. _____ refers to the process of rapid cell division that occurs early in development of the nervous system.
a. Neurulation
b. Neuronal proliferation
c. Neuronal migration
d. Neural determination

ANS: B DIF: Easy REF: 2.7 Development of the Nervous System
OBJ: 2.12 MSC: Remembering

74. The cells in the brain that guide migrating neurons to their final locations are called
a. microglia.
b. radial glia.
c. oligodendrocytes.
d. ventricular cells.

ANS: B DIF: Easy REF: 2.7 Development of the Nervous System
OBJ: 2.12 MSC: Remembering

75. Which of the following best describes the reason for substantial growth of the human brain from birth to adulthood?
a. The birth of neurons and expansion of axons.
b. The absorption of cerebral fluid into the brain.
c. The formation of synapses and growth of dendritic trees.
d. The formation of new neurons.

ANS: C DIF: Medium REF: 2.7 Development of the Nervous System
OBJ: 2.12 MSC: Evaluating

TRUE/FALSE

1. The cell body of a neuron contains the same machinery found in most cells, including a nucleus, ribosomes, and mitochondria.

ANS: T DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.1 MSC: Remembering

2. Dendrites, which are large treelike processes extending from a neuron, are said to be presynaptic.

ANS: F DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.1 MSC: Remembering

3. Action potentials are electrical signals that are conducted down the axon of a neuron.

ANS: T DIF: Easy REF: 2.1 The Cells of the Nervous System
OBJ: 2.1 | 2.3 MSC: Remembering

4. The term *selective permeability* refers to the fact that a cell membrane will allow some ions to pass through more readily than others.

ANS: T DIF: Easy REF: 2.1 The Cells of the Nervous System

OBJ: 2.1 | 2.2 MSC: Remembering

5. The resting potential of a neuron is typically +40 to +90 millivolts (mV).

   ANS: F DIF: Easy REF: 2.1 The Cells of the Nervous System
   OBJ: 2.1 | 2.3 MSC: Remembering

6. The *equilibrium potential* is the membrane voltage at which there is no net flow of ions in or out.

   ANS: T DIF: Easy REF: 2.1 The Cells of the Nervous System
   OBJ: 2.1 | 2.2 | 2.3 MSC: Remembering

7. Hyperpolarization makes the inside of a cell more positive and more likely to generate an action potential.

   ANS: F DIF: Easy REF: 2.1 The Cells of the Nervous System
   OBJ: 2.2 | 2.3 | 2.4 MSC: Remembering

8. The amplitude of an action potential is directly proportional to the size of the initial depolarization that produced it.

   ANS: F DIF: Easy REF: 2.1 The Cells of the Nervous System
   OBJ: 2.2 | 2.3 MSC: Remembering

9. If the sum of the excitatory postsynaptic potentials (EPSPs) causes a postsynaptic neuron to reach its threshold, then the postsynaptic neuron will generate an action potential.

   ANS: T DIF: Easy REF: 2.1 The Cells of the Nervous System
   OBJ: 2.3 MSC: Understanding

10. Communication between two neurons is always achieved through chemical, and not electrical, mechanisms.

    ANS: F DIF: Easy REF: 2.2 Synaptic Transmission
    OBJ: 2.5 MSC: Remembering

11. The term *commissure* refers to the white matter tracts that connect the brain and spinal cord.

    ANS: F DIF: Easy REF: 2.3 Overview of Nervous System Structure
    OBJ: 2.7 MSC: Remembering

12. Neural inputs that target the cortex and originate in the thalamus are referred to as *corticothalamic*.

    ANS: F DIF: Easy REF: 2.3 Overview of Nervous System Structure
    OBJ: 2.11 MSC: Remembering

13. The hippocampus is considered part of the neocortex.

    ANS: F DIF: Easy REF: 2.4 A Guided Tour of the Brain
    OBJ: 2.10 MSC: Remembering

14. Sulci are the protruding rounded surfaces of the cortex, and gyri are the fissures and invaginations between the sulci.

    ANS: F DIF: Easy REF: 2.5 The Cerebral Cortex

OBJ: 2.11 MSC: Remembering

15. During development, a structure called the *blastula* begins to form when the neural plate invaginates via neural folds being pushed up at its border.

ANS: F DIF: Easy REF: 2.7 Development of the Nervous System
OBJ: 2.12 MSC: Remembering

SHORT ANSWER

1. Describe the structure of a prototypical neuron. In your answer, provide definitions for the following terms: *soma*, *axon*, *dendrite*, *myelin*, and *synapse.*

ANS:
Answers will vary.

DIF: Medium REF: 2.1 The Cells of the Nervous System
OBJ: 2.1 MSC: Analyzing

2. Describe the chemical and electrical properties of an action potential. In your answer, describe the movement of Na^+ ions and K^+ ions across the cell membrane and the resulting changes in electrical potential.

ANS:
Answers will vary.

DIF: Difficult REF: 2.1 The Cells of the Nervous System
OBJ: 2.2 | 2.3 | 2.4 MSC: Analyzing

3. Explain the concept of electrochemical equilibrium. How does this concept allow us to understand the transmembrane potentials in neurons?

ANS:
Answers will vary.

DIF: Medium REF: 2.1 The Cells of the Nervous System
OBJ: 2.2 | 2.3 MSC: Analyzing

4. What are the major differences between electrotonic conduction and the action potential? Describe how these two processes play out in neural transmission.

ANS:
Answers will vary.

DIF: Medium REF: 2.1 The Cells of the Nervous System
OBJ: 2.2 | 2.3 MSC: Analyzing

5. Describe the structure, and explain the function, of three types of glial cells.

ANS:
Answers will vary.

DIF: Medium REF: 2.1 The Cells of the Nervous System
OBJ: 2.6 MSC: Analyzing

6. How do two neurons communicate with each other? Describe the process of synaptic transmission, including both chemical and electrical synapses.

   ANS:
   Answers will vary.

   DIF: Medium REF: 2.2 Synaptic Transmission OBJ: 2.5
   MSC: Analyzing

7. Choose six of the following eight brain regions. For each region, briefly describe its location in the brain and one of its functions. Draw a picture to accompany your answer.
   - frontal lobe
   - parietal lobe
   - temporal lobe
   - occipital lobe
   - basal ganglia
   - hypothalamus
   - thalamus
   - cerebellum

   ANS:
   Answers will vary.

   DIF: Medium REF: 2.4 A Guided Tour of the Brain OBJ: 2.8 | 2.9 | 2.10 | 2.11
   MSC: Analyzing

8. What are the advantages of a cerebral cortex with gyri and sulci? Why might the human cerebral cortex be more heavily folded than those of other mammals?

   ANS:
   Answers will vary.

   DIF: Difficult REF: 2.4 A Guided Tour of the Brain OBJ: 2.11
   MSC: Evaluating

9. Histological methods have been used to classify the cerebral cortex into different cytoarchitectonic divisions, such as the Brodmann areas. Can we predict the function of a brain region based on cytoarchitectonics? Why or why not?

   ANS:
   Answers will vary.

   DIF: Difficult REF: 2.5 The Cerebral Cortex OBJ: 2.11
   MSC: Evaluating

10. Describe the events following the fertilization of an egg that pertain to the development of the nervous system. In your answer, name the three main types of cell lines found in the blastula and describe what parts of the organism these cells become.

    ANS:
    Answers will vary.

    DIF: Medium REF: 2.7 Development of the Nervous System

OBJ: 2.12 MSC: Analyzing