

CHAPTER SCOPE

The *brain* and *spinal cord* are structural and functional nervous tissue of the body that together make up the **central nervous system** (CNS). The action potentials (nerve impulses) that come into the brain via sensory (*afferent*) neurons and exit via motor (*efferent*) neurons are interconnected by numerous *association* neurons. Within the many specialized portions of the brain these action potentials are interpreted, giving us the ability to speak, express emotion, be motivated, move muscles, and remember things.

The deeper structures of the brain, such as the **thalamus**, **hypothalamus**, and **medulla oblongata**, are critical interpretive areas and are vital relay centers for information traveling into and out of the brain. In addition, these more primitive areas of the brain provide essential electrical links to the many hormones released by the complex endocrine system. Triggered by nerve impulses, endocrine glands secrete many hormones into the blood that ultimately control many of the body's homeostatic processes, especially those of the *viscera* (internal tissues).

The white matter of the spinal cord can be subdivided into ascending (sensory) and descending (motor) *tracts* (axon bundles). The spinal cord also houses the descending pathways for somatic motor neurons originating in the **motor cortex** (*precentral gyrus*) that controls voluntary muscle contractions. This route directs nerve impulses through important brain regions such as the **basal nuclei** (or *basal ganglia*) and the **cerebellum**. In the cerebellum rough, voluntary commands are modulated into smooth, coordinated contractions. Similarly, selected spinal cord tracts (and cranial nerves) carry sensory action potentials in the opposite direction. Many of these ascending pathways ultimately arrive at the **sensory cortex** (*postcentral gyrus*) for interpretation of the various senses. The sensory system will be described in more detail in the next chapter. Of further interest is the *simple reflex arc*, a pathway of both sensory and motor neurons joined at the spinal cord that is an integral part of all voluntary muscle movements.

I. STRUCTURAL ORGANIZATION OF THE BRAIN

The brain is composed of an enormous number of association neurons and accompanying neuroglia, arranged in regions and subdivisions. These neurons receive sensory information, direct the activity of motor neurons, and perform such higher brain functions as learning and memory.

A. Multiple Choice

- ___ 1. The embryonic tissue layer that eventually forms the epidermis of the skin and the nervous system is the
 - a. ectoderm.
 - b. mesoderm.
 - c. endoderm.
- ___ 2. The telencephalon and diencephalon are subdivisions of the larger
 - a. prosencephalon.
 - b. mesencephalon.
 - c. rhombencephalon.
- ___ 3. Neuron cell bodies and dendrites deep within the brain form gray aggregations or gray matter known as
 - a. the cortex.
 - b. ventricles.
 - c. the cerebrum.
 - d. nuclei.

B. True or False/Edit

- ___ 4. Eventually, the neural tube will become the central nervous system in the growing embryo.
- ___ 5. The embryonic hindbrain, or mesencephalon, eventually divides into the metencephalon and myelencephalon brain regions.
- ___ 6. The hollow center of the neural tube eventually forms the ventricle cavities of the brain and central canal of the spinal cord.
- ___ 7. The adult brain receives about 20% of the total blood flow from the heart each minute.

II. CEREBRUM

The cerebrum, consisting of five paired lobes within two convoluted hemispheres, contains gray matter in its cortex and in deeper cerebral nuclei. Most of what are considered to be the higher functions of the brain are performed by the cerebrum.

A. Multiple Choice

- ___ 8. The largest portion of the brain (80% of its mass) is the
 - a. cerebellum.
 - b. cerebrum.
 - c. hypothalamus.
 - d. basal ganglia.
 - e. None of these is the largest portion of the brain.
- ___ 9. Which of the following is *not* a lobe of the cerebral cortex?
 - a. occipital
 - b. parietal
 - c. insula
 - d. cerebellar
 - e. temporal
- ___ 10. Which of the following does *not* send somesthetic sensory information to the cerebral cortex sensory area (located in the *postcentral gyrus*)?
 - a. skin (cutaneous)
 - b. muscle fibers
 - c. tendons
 - d. joints
 - e. All of these regions are somesthetic sensory areas.
- ___ 11. Somesthetic sensory information is interpreted in the brain area known as the
 - a. cerebellum.
 - b. precentral gyrus.
 - c. basal ganglia.
 - d. postcentral gyrus.
 - e. occipital cortex.
- ___ 12. The size of the sensory and motor maps on the cerebral cortex are determined by the
 - a. size of the area represented in square meters.
 - b. precise location of the area represented in the body.
 - c. highest density of receptors or the greatest number of effectors in the area represented.
 - d. time of development during embryonic growth.
- ___ 13. The lobe most responsible for interpreting sensory information from the cochlea and for processing both auditory and visual information, is the
 - a. frontal.
 - b. parietal.
 - c. temporal.
 - d. occipital.
 - e. insula.
- ___ 14. Which of the following techniques for visualizing brain function used complex manipulation of x-ray absorption data obtained from active neurons that take up emitters of single photons, such as technetium?
 - a. single photon emission computer tomography (SPECT)
 - b. positron emission tomography (PET)
 - c. magnetic resonance imaging (MRI)
 - d. magnetoencephalogram (MEG)
- ___ 15. Which of the following newer techniques for visualizing the brain creates excellent images by detecting emitted radio wave signals released from stimulated protons aligned in the tissues?
 - a. single photon emission computer tomography (SPECT)
 - b. positron-emission tomography (PET)
 - c. magnetic resonance imaging (MRI)

- ___ 16. The EEG pattern recorded from the parietal and occipital regions that is characteristic in an awake, yet relaxed person whose eyes are closed, is
- alpha.
 - beta.
 - theta.
 - delta.
- ___ 17. The basal nuclei (or basal ganglia) are masses of gray matter that function primarily in the
- perception of auditory and visual stimuli.
 - control of voluntary muscle movements.
 - relay of sensory and motor information.
 - synthesis and release of important regulatory hormones.
- ___ 18. Which of the following statements is *not* characteristic of rapid eye movement (REM) sleep?
- EEG waves are desynchronized, similar to those of wakefulness.
 - The total brain metabolism increases with increased blood flow.
 - The breathing pattern and heart tend to be very regular.
 - The limbic system with its involvement in emotions such as fear and anxiety is activated.
- ___ 19. The study of speech and language disorders (aphasias) have contributed greatly to our understanding of the brain, particularly that region known as
- basal ganglia.
 - cerebellum.
 - Broca's and Wernicke's areas.
 - limbic system.
- ___ 20. That brain region formerly known as the "smell brain" but now known as a center for basic emotional drives is the
- hypothalamus.
 - pituitary.
 - limbic system.
 - basal ganglia.
 - Broca's and Wernicke's areas.
- ___ 21. Which of the following processes is thought to be the least regulated by the hypothalamus and limbic system?
- absolute fear
 - language interpretation
 - feeding and satiety
 - sexual drive and sexual behavior
 - aggression (rage)
- ___ 22. That portion of the brain thought to be involved primarily in the consolidation of short-term into long-term memory, is the
- cerebral cortex.
 - hypothalamus.
 - limbic system.
 - medial temporal lobe.
 - basal ganglia.
- ___ 23. That portion of the brain most involved in the memory of emotional responses and particularly in the memory of fear, is the
- hippocampus.
 - amygdala portion of the limbic system.
 - cerebellum.
 - basal nuclei.
 - cerebral cortex.

- ___ 24. *Long-term potentiation* (LTP) is a type of synaptic learning that is proposed to involve all of the following events, *except*
- Ca²⁺ activation of calcium/calmodulin-dependant protein kinase II (CaMKII) enzymes within dendrites of the postsynaptic neuron.
 - binding of excitatory glutamate neurotransmitter to NMDA receptors open channels, allowing Ca²⁺ to enter.
 - stimulation of embryonic stem cells to divide, forming new neurons.
 - structural changes occur in the postsynaptic neuron as a result of LTP.
 - “retrograde” messengers such as nitric oxide may be produced to stimulate neurotransmitter release.

B. True or False/Edit

- ___ 25. Contrary to early belief, the brains of adult mammals have neural stem cells located next to the ventricles (cavities) that are able to differentiate into new neurons and glial (supporting) cells.
- ___ 26. The elevated folds of the cerebral surface are sulci, and the depressed grooves are called gyri.
- ___ 27. The precentral gyrus is located in the frontal lobe and is involved in control of motor neuron activity.
- ___ 28. The fingers and face have a higher density of sensory receptors and more muscles for innervation, and so, have a correspondingly larger representation on the sensory and motor regions of the cerebral cortex, respectively.
- ___ 29. The parietal lobe is the primary area for vision and for the coordination of eye movements.
- ___ 30. That portion of the cerebrum most implicated in memory encoding and in pain sensation (visceral) and in coordinating the cardiovascular responses to stress, is the temporal lobe.
- ___ 31. The upper *caudate nucleus* and the lower *lentiform nucleus* make up the **corpus striatum**, a prominent portion of the basal nuclei (ganglia).
- ___ 32. In the voluntary control of muscle movement, areas of the cerebral cortex send excitatory glutamate neurotransmitters which stimulate the basal nuclei to release inhibitory GABA neurotransmitters acting on the thalamus which, in turn, relay excitatory messages to the motor areas of the cerebral *motor circuit*.
- ___ 33. Since sleep may help consolidate short-term memories, students who study earlier and plan to get adequate sleep may perform better than those who stay up all night studying before an exam.
- ___ 34. Each cerebral hemisphere ultimately receives information from both sides of the body as they intercommunicate via the corpus callosum tracts.
- ___ 35. *Cerebral lateralization* refers to the specialty of function delegated to one hemisphere or the other, while *cerebral dominance* is related to the concept of handedness (right or left).
- ___ 36. The left hemisphere is more adept than the right hemisphere at visuospatial tasks, such as reading maps or finding the way around an unfamiliar house.
- ___ 37. People with *Broca's aphasia* have damage to the superior temporal gyrus of the left hemisphere (usually) resulting in incomprehensible speech that has been described as a “word salad.”
- ___ 38. The *Papez circuit* refers to the closed pathways that interconnect the limbic system, the thalamus, and the hypothalamus for processing information regarding emotion.
- ___ 39. Long-term memory may involve relatively permanent changes in the neurons and synapses involved, such as the synthesis of new proteins.
- ___ 40. Certain areas of the mammalian brain have recently been shown to contain neural stem cells – cells that can renew themselves through mitosis and that can produce differentiated (specialized) neurons and neuroglia.
- ___ 41. The amygdala region of the human brain has been shown to contain mitotically active neural stem cells that have been surgically isolated and may be of future use in patients whose amygdala region has been damaged or has degenerated.

C. Label the Figure — Lobes and Important Regions of the Left Cerebral Cortex

Numerous folds and grooves called *convolutions* characterize the cerebral cortex. The elevated folds of the convolutions are called *gyri*, and the depressed grooves are the *sulci* (*fissures*). Deep sulci, or fissures subdivide each cerebral hemisphere into five lobes, yet only four of which are visible from the surface. Study figure 8.1 and label the four main lobes and the two sulci (the lateral sulcus and the central sulcus). Next, on the lines of the figure that point to the various cortical brain regions, write the important general function attributed to that area of the brain. Then, compare your answers with those in figure 8.6 in your text. Pay particular attention to the sensory and motor areas that located adjacent to the central sulcus. Study hard!

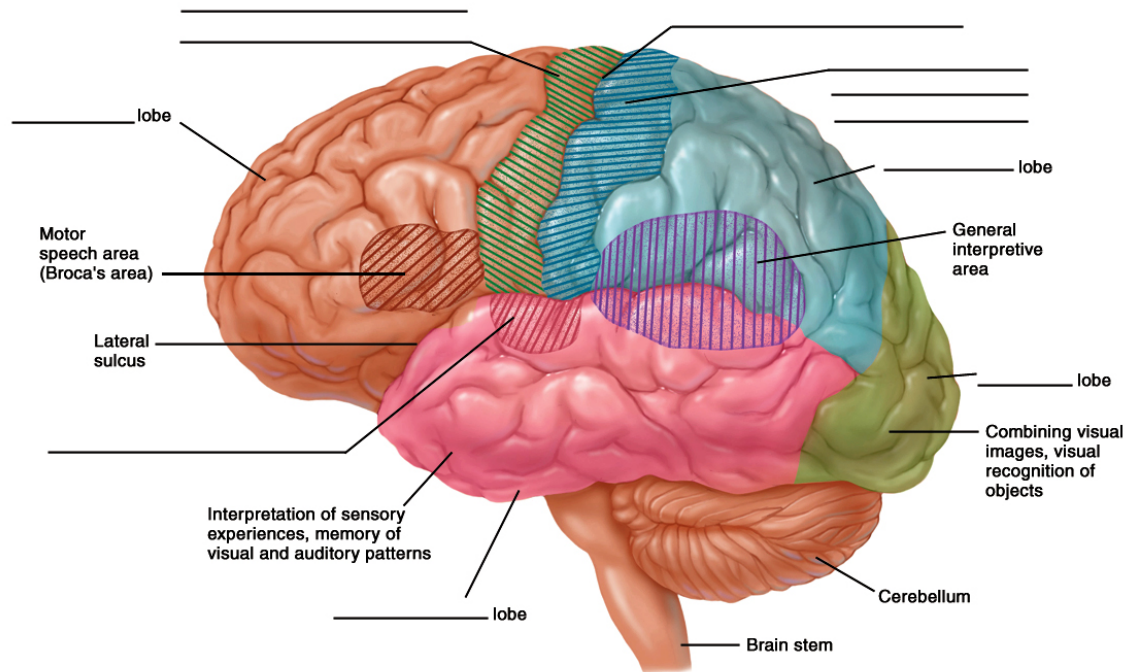


Figure 8.1 The lobes of the left cerebral hemisphere showing the principle motor and sensory areas of the cerebral cortex.

III. DIENCEPHALON

The diencephalon is the part of the forebrain that contains such important structures as the thalamus, hypothalamus, and part of the pituitary gland. The hypothalamus performs numerous vital functions, most of which relate directly or indirectly to the regulation of visceral activities by way of other brain regions and the autonomic nervous system.

A. Multiple Choice

- ___ 42. That portion of the brain acting primarily as a relay center through which all sensory information (except smell) passes on the way to the cerebrum, is the
- thalamus.
 - hypothalamus.
 - hippocampus.
 - limbic system.
 - basal nuclei (ganglia).
- ___ 43. *Melatonin* is a hormone secreted by the
- thalamus.
 - hypothalamus.
 - pituitary gland.
 - pineal gland.
 - None of these brain regions secrete melatonin.
- ___ 44. The *choroid plexus* located in each of the four cerebral ventricles is primarily responsible for
- relaying sensory information to the cortex.
 - altering motor control over voluntary muscle action.
 - synthesizing neurotransmitters for cranial nerves.
 - secreting cerebrospinal fluid (CSF).

- ___ 45. Which of the following vital physiologic functions is *not* centered in the **hypothalamus**?
- hunger
 - thirst
 - control over heart rate and blood pressure
 - control over body temperature (“thermostat”)
 - control over pituitary gland secretion of hormones
- ___ 46. A “somatic response” refers to a response by the
- whole body.
 - sensory system only.
 - skeletal (voluntary) muscles only (for example, shivering).
 - visceral glands of the autonomic (involuntary) nervous system only.
 - skin and connective tissues (muscle and bone).

B. True or False/Edit

- ___ 47. The only sensation that is *not* relayed through the thalamus en route to the cerebrum for interpretation is the sense of taste.
- ___ 48. The hormone melatonin may play a role in the hormonal control of reproduction.
- ___ 49. With regard to hunger, the hypothalamus has opposing “feeding” (eating) and “satiety” (fullness) centers that are located in the lateral and medial regions, respectively.
- ___ 50. The supraoptic and paraventricular nuclei are specialized neurons located in the hypothalamus where the important hormones *vasopressin (ADH)* and *oxytocin* are made and packaged for delivery to the posterior pituitary gland.
- ___ 51. The **anterior pituitary** is mostly nerve tissue and is known as the *neurohypophysis*, while the **posterior pituitary** is mostly glandular tissue and is known as the *adenohypophysis*.
- ___ 52. The *hypothalamo-hypophyseal tract* is a nerve fiber pathway that joins the hypothalamus to the posterior pituitary gland.
- ___ 53. The body’s “master clock” is the suprachiasmatic nuclei (SCN) region of the hypothalamus that synchronizes cycles of light and darkness from the retina of the eyes into circadian rhythms that control many body functions, such as hormone release.

IV. MIDBRAIN AND HINDBRAIN

The midbrain and hindbrain contain many important relay centers for sensory and motor pathways, and are particularly important in the control of skeletal movements by the brain. The medulla oblongata, a vital region of the hindbrain, contains centers for the control of breathing and cardiovascular function.

A. Multiple Choice

- ___ 54. That portion of the brain housing the “four bodies” known as the *corpora quadrigemina* is the
- midbrain.
 - hindbrain.
 - diencephalons.
 - prosencephalon.
 - cerebellum.
- ___ 55. The positive reinforcement that encourages drug abuse – including nicotine, heroin, morphine, cocaine, and amphetamines – involves the release of dopamine from the _____ of the midbrain region.
- mesolimbic system
 - nigrostriatal system
 - cerebral penduncles
 - corpora quadrigemina
 - red nucleus

- ___ 56. The *apneustic* center and *pneumotaxic* center that work together to influence respiratory movements, are located in the
 - a. hypothalamus.
 - b. cerebellum.
 - c. midbrain.
 - d. pons.
 - e. medulla oblongata.
- ___ 57. Damage to the **cerebellum**, the second largest structure in the brain, usually results in
 - a. long-term and short-term memory loss.
 - b. loss of visual and auditory reflexes.
 - c. loss of respiratory and cardiovascular control.
 - d. ataxia or lack of muscular coordination.
- ___ 58. Which of the following is *not* a vital center within the *medulla oblongata* portion of the myelencephalon?
 - a. vasomotor center (diameter of blood vessels)
 - b. center for rage and aggression (deep emotion)
 - c. parasympathetic inhibitory control of the heart rate
 - d. respiratory center (with the pons) for control of breathing
 - e. All of these are vital centers in the medulla oblongata.
- ___ 59. That portion of the brain most responsible for the general arousal of the cerebral cortex when a variety of sensory sources are activated, is the
 - a. cerebellum.
 - b. hypothalamus.
 - c. limbic system.
 - d. medulla oblongata.
 - e. reticular activating system (RAS).

B. True or False/Edit

- ___ 60. The *superior colliculi* portion of the corpora quadrigemina region of the midbrain is involved in visual reflexes while the *inferior colliculi* portion is involved in auditory reflexes.
- ___ 61. Cocaine and the amphetamines are drugs that are abused primarily because the euphoria produced is caused by increased amounts of dopamine and other excitatory neurotransmitters on the postsynaptic membrane of neurons.
- ___ 62. The reward pathway for alcohol involves the release of dopamine, serotonin, and the endogenous opioids from the mesolimbic region of the midbrain.
- ___ 63. The *mesencephalon* is also known as the hindbrain and contains the cerebral peduncles, red nucleus, and the substantia nigra.
- ___ 64. The *metencephalon* is composed of the pons and the cerebellum.
- ___ 65. The *pons* contains several nuclei (cell bodies of neurons) associated with the control and interpretation of specific cranial nerves.
- ___ 66. The *cerebellum* receives sensory information from proprioceptors and, through relays with other nuclei, coordinates muscle movements and may also be involved in processing sensory data, memory, emotion, and other higher functions.
- ___ 67. Skeletal muscle (motor) learning and coordination needed to touch your nose with your finger, bring a fork of food to your mouth, or find your keys in your pocket requires proper functioning of inhibitory *Purkinje cells* of the cerebellum.
- ___ 68. The *pyramids* of the medulla are characterized by crossing-over or decussation of nerve fiber tracts to the contralateral (opposite) side of the medulla.
- ___ 69. Falling asleep and loss of consciousness due to anesthesia perhaps both involve suppression of the *reticular activating system* (RAS).

V. SPINAL CORD TRACTS

Sensory information from receptors throughout most of the body is relayed to the brain by means of ascending tracts of fibers that conduct impulses up the spinal cord. When the brain directs motor activities, these directions are in the form of nerve impulses that travel down the spinal cord in descending tracts of fibers.

A. Multiple Choice

- ___ 70. The term “funiculi” refers to
 - a. specific clusters of motor and sensory nuclei (cell bodies) in the spinal cord.
 - b. spinal cord ascending and descending columns of axons (myelinated, white matter).
 - c. regions of gray matter crossovers (decussations) in the spinal cord.
 - d. autonomic vital centers located in the spinal cord.
- ___ 71. Which of the following descending tracts is *not* extrapyramidal?
 - a. reticulospinal
 - b. corticospinal
 - c. rubrospinal
 - d. vestibulospinal
 - e. All of these tracts are extrapyramidal.

B. True or False/Edit

- ___ 72. Unlike the brain, the spinal cord white matter is located in a central “H” pattern, with gray matter found on the outside.
- ___ 73. The spinothalamic and corticospinal tracts are both descending tracts in the spinal cord.
- ___ 74. All descending motor tracts from the brain eventually cross over and, thus, innervate muscles on the contralateral side of the body.
- ___ 75. The two major groups of descending tracts from the brain are the corticospinal (pyramidal) and extrapyramidal tracts.
- ___ 76. The positive Babinski sign, or reflex (upward movement of the toes) indicates damage to the extrapyramidal motor pathway.

VI. CRANIAL AND SPINAL NERVES

The central nervous system communicates with the body by means of nerves that exit the CNS from the brain (cranial nerves) and spinal cord (spinal nerves). These nerves, together with aggregations of cell bodies located outside the CNS, constitute the peripheral nervous system.

A. Multiple Choice

- ___ 77. How many pairs of **cranial** nerves exit the brain?
 - a. twelve
 - b. eighteen
 - c. twenty-four
 - d. thirty-eight
 - e. forty-six
- ___ 78. How many pairs of **spinal** nerves exit the spinal cord?
 - a. twelve
 - b. twenty-four
 - c. thirty-one
 - d. forty-six
 - e. fifty-two
- ___ 79. The dorsal root ganglion region of the spinal cord contains the
 - a. axons of motor (efferent) and sensory (afferent) spinal neurons.
 - b. cell bodies of motor and sensory spinal neurons.
 - c. cell bodies of sensory spinal neurons only.
 - d. axons of sensory spinal neurons only.
 - e. cell bodies of motor spinal neurons only.

- ___ 80. The ventral root portion of the spinal cord is composed of
- axons of sensory (afferent) spinal neurons.
 - nuclei (cell bodies) of sensory spinal neurons.
 - axons of motor (efferent) spinal neurons.
 - nuclei (cell bodies) of motor spinal neurons.

B. True or False/Edit

- ___ 81. Most cranial nerves are classified as mixed nerves because they contain both sensory and motor fibers.
- ___ 82. All spinal nerves are classified as mixed nerves.
- ___ 83. The cell bodies of all somatic motor neurons are located in the dorsal root ganglia.
- ___ 84. A reflex arc occurs when some sensory stimulus produces an unconscious (that is, the brain is not directly involved) motor response.

CHAPTER REVIEW

A. Completion

85. The embryonic brain develops into: a forebrain made up of the _____ and the _____; the midbrain which is the _____; and the hindbrain, which contains the _____ and the _____.
86. Cerebrospinal fluid (CSF) is secreted by specialized capillaries called _____, which are found in brain cavities called _____. The large neuron tract that connects the two hemispheres is the _____, which links the _____ (left/right) hemisphere, which is normally dominant in language and analytical ability, with the _____ (left/right) hemisphere, which is normally strong in pattern and face recognition, music, and song creativity.
87. The cerebral cortex and basal ganglia are _____ (gray/white) matter due to collections of cell bodies, whereas the _____ (gray/white) matter is primarily _____. Damage primarily to the _____ (left/right) cerebral cortex produces speech disabilities called _____, involving two specific areas that are joined by a fiber tract called the arcuate fasciculus. That brain area involved in the concept of written or spoken word comprehension is _____'s area, whereas _____'s area is required for the act of speaking intelligibly.
88. The two brain regions most associated with emotion are the _____ and the _____. The two forms of memory are _____ - _____ and _____ - _____, which appear to involve various brain areas in a very complex way.
89. In the diencephalon the important sensory relay center is the _____; the epithalamus contains a _____ for CSF production and the _____ gland synthesizing the hormone _____. The diencephalon includes the hypothalamus and pituitary gland.
90. The hypothalamus houses centers for control of _____, _____, _____, and emotions. It also has *direct* neuron contact with the _____ (anterior/posterior) pituitary and *indirect* contact via _____ with the _____ (anterior/posterior) pituitary gland.
91. Visual reflexes are coordinated in the _____ of the corpora _____, whereas auditory reflexes involve the _____.
92. The pons has two centers for breathing control called the _____ and _____ centers. A few _____ nerves have cell bodies originating in the pons. The medulla oblongata _____ also regulates _____ and controls cardiovascular functions as well.
93. Sensory information travels up _____ tracts, while the two motor tracts are _____. These motor tracts are the _____ or corticospinal tracts—which are nonstop neurons, crossing over or _____ in the medulla oblongata controlling fine muscle movement — and the _____ tracts — composed of many indirect connections among various brain regions and the muscles.
94. There are _____ (#) pairs of cranial nerves which are either _____ (sensory or motor) only or mixed. All _____ (#) pairs of spinal nerves are _____, with cell bodies of sensory neurons in the _____ ganglion, and motor neurons exiting the spinal cord along the _____ root. Sensory, association, and motor neurons may all interact in the subconscious pathway known as the _____.

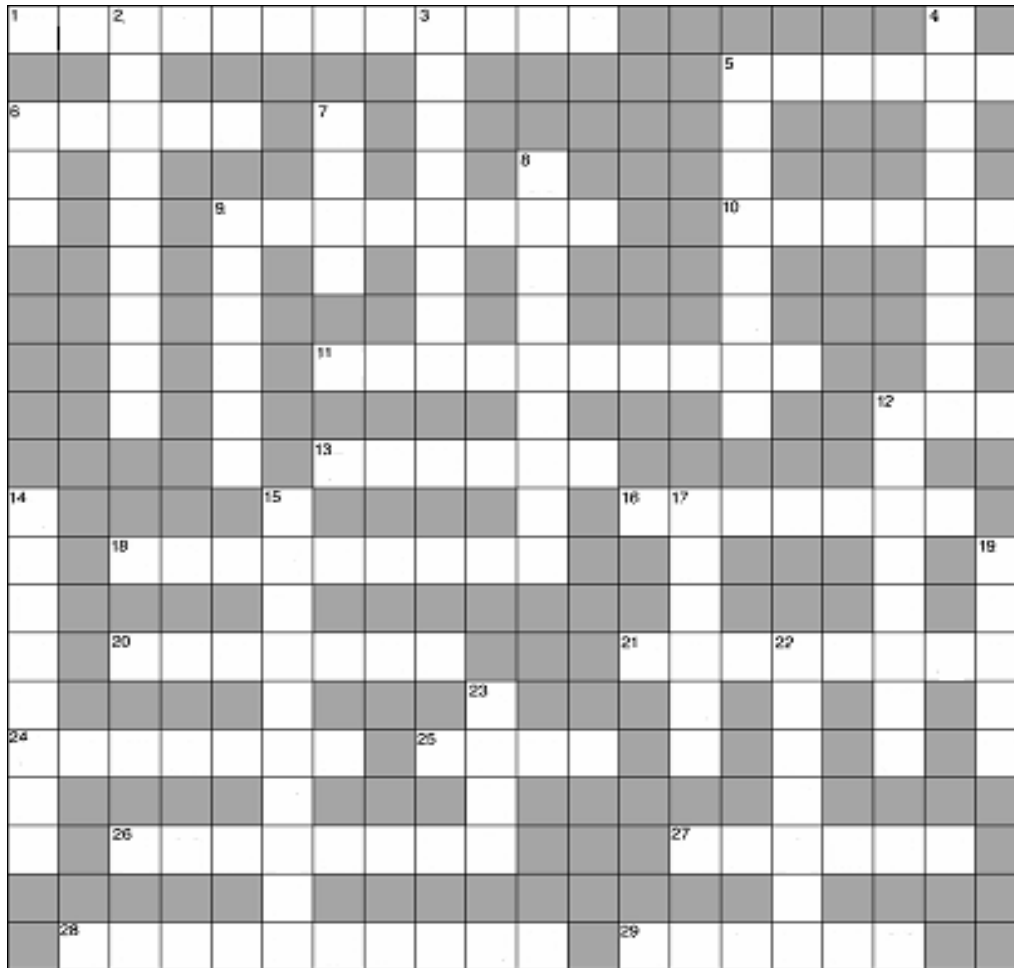
B. Crossword Puzzle — The Central Nervous System

Across

1. part of the diencephalon—control over the pituitary gland
5. cerebral gray matter
6. descending (motor) tracts may be _____ - pyramidal or pyramidal
9. mesencephalon region
10. this system may be a center for various emotions
11. metencephalon region for control and coordination of skeletal muscle movements
12. fluid produced by the choroid plexus of the ventricles
13. area required for mechanical performance of speech
16. afferent neurons of the reflex arc, for example
18. the telencephalon and diencephalon
20. function common to the limbic system and hypothalamus
21. a word for internal tissue functions—controlled by the hypothalamus
24. language disability
25. dorsal or ventral _____
26. important relay center for sensory information
27. a visceral function of the hypothalamus (seek water!)
28. in most people one or the other of these is dominant
29. sensory and motor neurons are part of the _____ arc

Down

2. gland controlled mainly by the hypothalamus
3. hormones from the hypothalamus control the _____ pituitary
4. area of the cortex involved in speech comprehension
5. cerebral hemispheres are joined by the corpus _____
6. test used to measure electrical activity in the brain
7. that part of the neuron that makes brain matter “gray” is the cell _____
8. the metencephalon and the myelencephalon combined
9. important function of the medial temporal lobes, especially the hippocampus
12. consists of two hemispheres
14. important function of the left cerebral cortex—Wernicke's and Broca's areas
15. fluid-filled brain cavities
17. a visceral function controlled by the hypothalamus
19. the thalamus is an important _____ center for sensory information
22. twelve pair of _____ nerves
23. metencephalon source of cranial nerves V through VIII



C. Essay

Essay Tutorial

This essay tutorial will answer the first essay question found in the “**Review Activities**” section of your *Human Physiology* textbook. Please read question 1 of the “**Test Your Understanding of Concepts and Principles**” section located at the end of chapter 8 and let me guide you through one possible answer. Watch for key terms in boldface type, helpful tips and general suggestions on writing the essay or short-answer questions. Enjoy!

95. Define the term **decussation** and explain its significance in terms of the **pyramidal** motor system.

Answer: First, define the term decussation as the crossover of neuron fibers from one side of the brain or spinal cord to the other. The pyramidal tracts are exclusively descending and originate primarily from the motor (precentral gyrus) cortex, traveling nonstop to the spinal cord. Along the way, however, these neurons decussate in the medulla oblongata, forming visible triangular patterns on the dorsal surface of the medulla—hence the name pyramids. The major significance of this crossing-over means that the right cerebral hemisphere controls the muscles of the left half of the body, while the left hemisphere controls muscles of the right side of the body.

[You see, some “essay” answers can be short and sweet. However, always reread the question to be sure that all parts of the question have been answered. Too many of my students have needlessly lost important points with incomplete answers. Have you? For extra practice, try a couple more, OK?]

96. What does *EEG* stand for? Explain the neuron events that are responsible for the erratic cycles recorded on the EEG.

97. Describe the location of the *cerebellum*, its size, and explain how it functions in the indirect control over the coordination of voluntary muscle movements.

98. Describe the location of *Wernicke’s* and *Broca’s areas* in the cerebral cortex, and explain the evidence from neurosurgery and from damage to these areas which led to our current understanding of how speech is formed and interpreted.

99. A pesky mosquito lands on your left arm! Trace the action potentials that originate in your motor cortex (precentral gyrus) along the pyramidal tracts to the muscles of the opposite arm to swat the insect. *Note:* Keep track of left and right.

Answers — Chapter 8

- I. Structural Organization of the Brain
- A. 1. a, 2. a, 3. d
- B. 4. T, 5. F—Replace “mesencephalon” with “rhombencephalon,” 6. T, 7. T
- II. Cerebrum
- A. 8. b, 9. d, 10. e, 11. d, 12. c, 13. c, 14. a, 15. c, 16. a, 17. b, 18. c, 19. c, 20. c, 21. b, 22. d, 23. b, 24. c
- B. 25. T, 26. F—Switch “sulci” and “gyri,” 27. T, 28. T, 29. F—Replace “parietal” with “occipital,” 30. F—Replace “temporal lobe” with “insula,” 31. T, 32. T, 33. T, 34. T, 35. T, 36. F—Switch “left” and “right,” 37. F—Replace “Broca’s” with “Wernicke’s,” 38. T, 39. T, 40. T, 41. F—Replace “amydala” with “hippocampus”
- C. Label the Figure — Lobes and Important Regions of the Left Cerebral Cortex. See figure 8.6 in the text.
- III. Diencephalon
- A. 42. a, 43. d, 44. d, 45. c, 46. c
- B. 47. F—Replace “taste” with “smell,” 48. T, 49. T, 50. T, 51. F—Switch “anterior” and “posterior,” 52. T, 53. T
- IV. Midbrain and Hindbrain
- A. 54. a, 55. a, 56. d, 57. d, 58. b, 59. e
- B. 60. T, 61. T, 62. T, 63. F—Replace “hindbrain” with “midbrain,” 64. F—Replace “cerebrum” with “cerebellum,” 65. T, 66. T, 67. T, 68. T, 69. T
- V. Spinal Cord Tracts
- A. 70. b, 71. b
- B. 72. F—Switch “white” and “gray,” 73. F—“Spinothalamic” tracts are ascending, 74. T, 75. T, 76. F—Replace “extrapyramidal” with “pyramidal”
- VI. Cranial and Spinal Nerves
- A. 77. a, 78. c, 79. c, 80. c
- B. 81. T, 82. T, 83. F—Cell bodies of somatic motor neurons are located in the spinal cord, 84. T
- Chapter Review
- A. 85. telencephalon, diencephalon, mesencephalon, metencephalon, myelencephalon, 86. choroid plexi, ventricles; corpus callosum, left, right, 87. gray, white, axons; left, aphasia; Wernicke, Broca, 88. limbic system, hypothalamus; short-term, long-term, 89. thalamus, choroid plexus, pineal, melatonin, 90. hunger, thirst, temperature; posterior, hormones, anterior, 91. superior colliculi, quadrigemina, inferior colliculi, 92. apneustic, pneumotaxic; cranial; oblongata, breathing, 93. ascending, descending; pyramidal, decussating; extrapyramidal, 94. twelve, sensory; thirty-one, mixed, dorsal root, ventral; reflex arc

B. Crossword Puzzle

| | | | | | | | | | | | | | | | | | | | | | | | | |
|----|----|----|----|---|---|----|---|---|---|----|---|---|---|---|----|----|----|---|----|----|---|---|----|---|
| 1 | H | Y | 2 | P | O | T | H | A | L | 3 | A | M | U | S | | | | | | | 4 | W | | |
| | | | I | | | | | | | N | | | | | | | 5 | C | O | R | T | E | X | |
| 6 | E | X | T | R | A | | 7 | B | T | | | | | | | | A | | | | | R | | |
| E | | U | | | | O | E | | 8 | H | | | | | | L | | | | | | N | | |
| G | | I | | 9 | M | I | D | B | R | A | I | N | | | | 10 | L | I | M | B | I | C | | |
| | | T | E | Y | | | | | | | | | | | | O | | | | | | C | | |
| | | A | M | | | | | O | D | | | | | | | S | | | | | | K | | |
| | | R | O | | | 11 | C | E | R | E | B | E | L | L | U | M | | | | | | E | | |
| | | Y | R | | | | | | | | R | | | | | M | | | | 12 | C | S | F | |
| | | | | Y | | 13 | B | R | O | C | A | S | | | | | | | | | | E | | |
| 14 | L | | | | | 15 | V | | | | | | | | 16 | S | 17 | E | N | S | O | R | Y | |
| | A | | 18 | F | O | R | E | B | R | A | I | N | | | | A | | | | | E | | 19 | R |
| N | | | | | | N | | | | | | | | | | T | | | | | B | | E | |
| G | | 20 | E | M | O | T | I | O | N | | | | | | 21 | V | I | S | 22 | C | E | R | A | L |
| U | | | | | | R | | | | 23 | P | | | | | N | | R | | | U | | A | |
| 24 | A | P | H | A | S | I | A | | | 25 | R | O | O | T | | G | | A | | | M | | Y | |
| G | | | | | | C | | | | | | | | | | | | | | | N | | | |
| E | | 26 | T | H | A | L | A | M | U | S | | | | | | 27 | T | H | I | R | S | T | | |
| | | | | | | E | | | | | | | | | | | | | | | A | | | |
| | 28 | H | E | M | I | S | P | H | E | R | E | | | | 29 | R | E | F | L | E | X | | | |