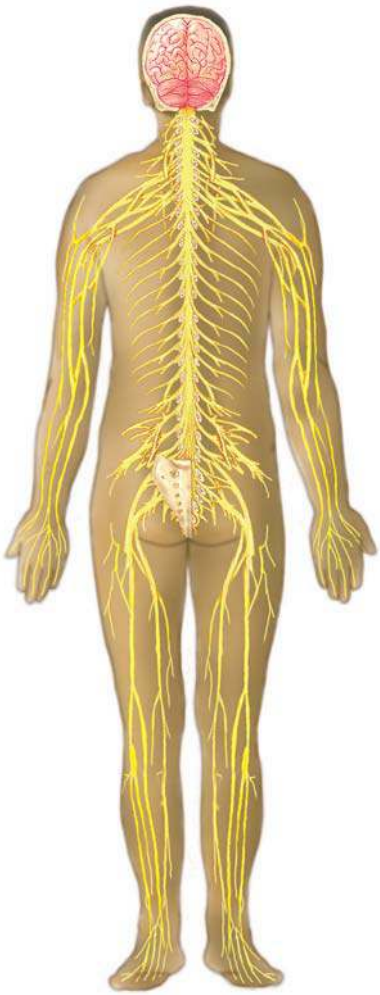
CHAPTER 8

The Nervous System

▶ NEUROLOGY
▶ ANESTHESIOLOGY

After studying this chapter, you will be able to:

- 8.1 Name the parts of the nervous system and discuss the function of each part
- 8.2 Define the combining forms used in building words that relate to the nervous system
- 8.3 Identify the meaning of related abbreviations
- 8.4 Name the common diagnoses, laboratory tests, and clinical procedures used in testing and treating disorders of the nervous system
- 8.5 List and define the major pathological conditions of the nervous system
- 8.6 Define surgical terms related to the nervous system
- 8.7 Recognize common pharmacological agents used in treating disorders of the nervous system



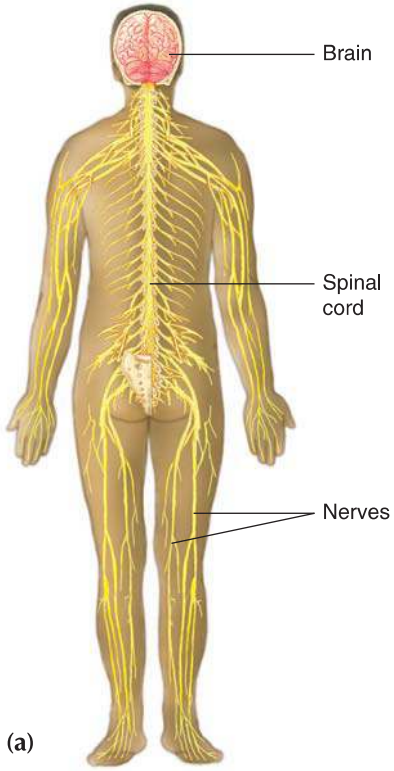
Structure and Function

The nervous system directs the function of all the human body systems (Figure 8-1). Every activity, whether voluntary or involuntary, is controlled by some of the more than 100 billion nerve cells throughout the body. The nervous system is divided into two subsystems: the central nervous system (CNS) and the peripheral nervous system (PNS).

A **nerve cell** or **neuron** (Figure 8-2) is the basic element of the nervous system. Neurons are highly specialized conducting cells and vary greatly in function, shape, and size. All neurons have three parts:

1. The **cell body,** which has branches or fibers that reach out to send or receive impulses. The cell body contains all the biological structures that are common to all human cells.
2. **Dendrites,** which are thin branching extensions of the cell body. They conduct nerve impulses *toward* the cell body.
3. The **axon,** which conducts nerve impulses *away* from the cell body. It is generally a single branch covered by fatty tissue called the **myelin sheath.** This protective sheath prevents the nerve impulse from transmitting in the wrong direction.

Outside the myelin sheath is a membranous covering called the **neurilemma.** At the end of the axon, there are **terminal end fibers** through which pass the impulses leaving the neuron. The nerve impulse then jumps from one neuron to the next over a space called a **synapse.** The nerve impulse is



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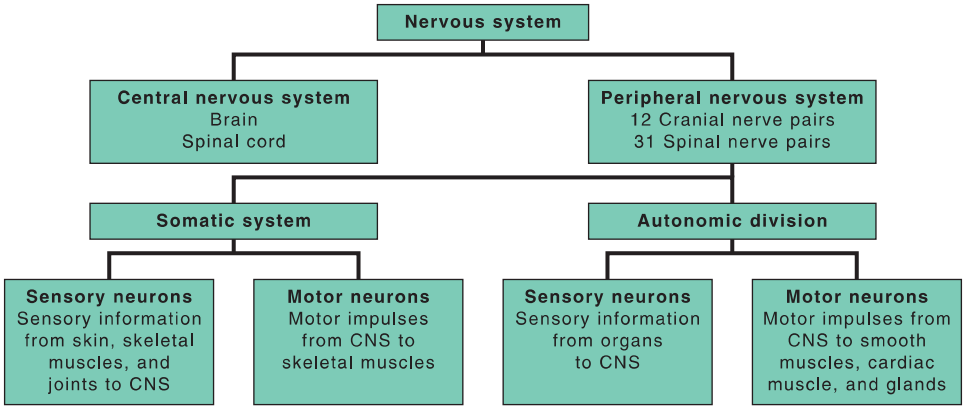

(b)

FIGURE 8-1 **(a)** The nervous system directs the function of all the human body systems. **(b)** The chart illustrates the functions controlled by the various parts of the nervous system.

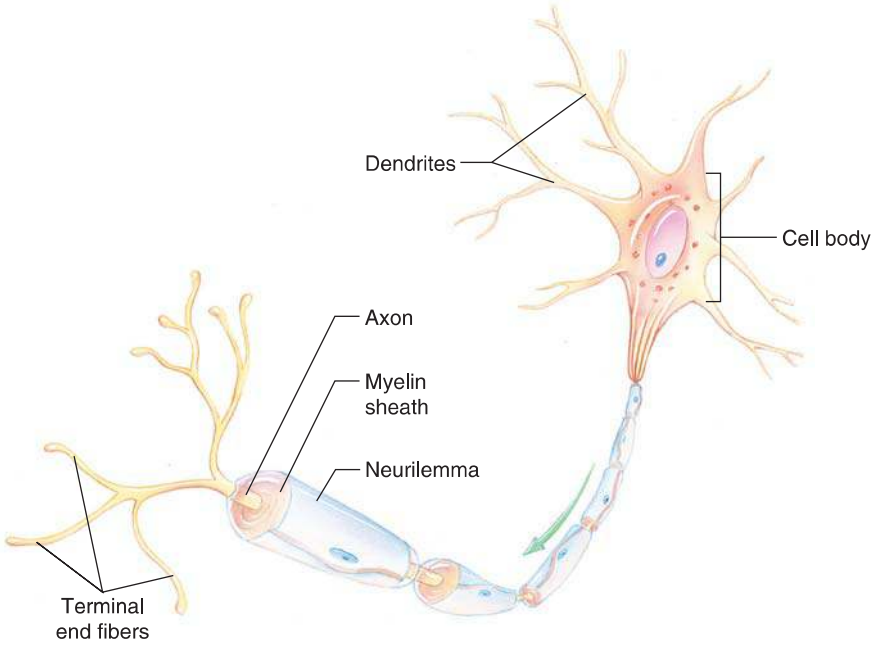

FIGURE 8-2 Parts of a neuron.

stimulated to jump over the synapse by a **neurotransmitter,** any of various substances produced by and located in tiny sacs at the end of the terminal end fibers. Table 8-1 lists some common neurotransmitters.

All neurons also have two basic properties—**excitability,** the ability to respond to a **stimulus** (anything that arouses a response), and **conductivity,**

TABLE 8-1 Some Common Neurotransmitters

Neurotransmitter Group	Compounds in Neurotransmitter	Probable Nervous System Functions
acetylcholine	acetylcholine (ACH)	excites and inhibits muscular and glandular activity; affects memory
amino acids	gamma-aminobutyric acid (GABA) glutamic acid aspartic acid glycine	inhibits certain brain activity excites certain brain activity excites certain brain activity inhibits certain spinal cord activity
monoamines	dopamine histamine norepinephrine (NE) serotonin	involved in brain and motor activity involved in brain activity involved in heat regulation, arousal, motor activity, reproduction; acts as hormone in bloodstream involved in sleep, mood, appetite, and pain
neuropeptides	somatostatin endorphins	involved in secretion of growth hormone have pain-relieving properties

the ability to transmit a signal. The three types of neurons are classified by the direction in which they transmit impulses:

1. **Efferent (motor) neurons,** which convey information to the muscles and glands from the central nervous system
2. **Afferent (sensory) neurons,** which carry information from sensory receptors to the central nervous system
3. **Interneurons,** which carry and process sensory information and make possible more complex types of reflexes.

Some nerves contain combinations of at least two types of neurons.

Neurons are microscopic entities that form bundles called **nerves,** the bearers of electrical messages to the organs and muscles of the body. The body's cells contain stored electrical energy that is released when the cells receive outside stimuli or when internal chemicals (for example, **acetylcholine**) stimulate the cells. The released energy passes through the nerve cell, causing a **nerve impulse.** Nerve impulses are received or transmitted by tissue or organs called **receptors.** These impulses are then transmitted to other receptors throughout the body.

In addition to nerve cells, other cells in the nervous system support, connect, protect, and remove debris from the system. These cells, **neuroglia** or **neuroglial cells,** do not transmit impulses. Each of the three types of neuroglia serves different purposes.

1. Star-shaped **astroglia** (or **astrocytes**) maintain nutrient and chemical levels in neurons and form a supporting network in the brain and spinal cord.
2. **Oligodendroglia** produce myelin and help in supporting neurons by forming rows between neurons in the brain and spinal cord.
3. **Microglia** are phagocytes—small cells that remove debris.

Certain neuroglia, along with the almost solid walls of the brain's capillaries, form what is known as the *blood-brain barrier,* the barrier that permits some chemical substances to reach the brain's neurons, but blocks most others, thereby protecting vital brain tissue. Figure 8-3 shows neuroglia.

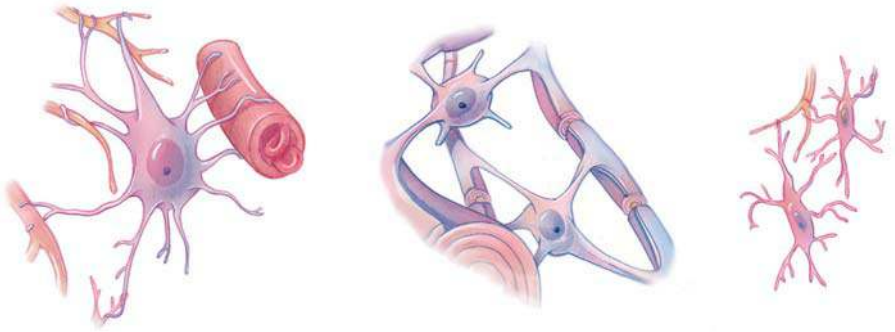

FIGURE 8-3 The three types of neuroglia shown here perform different functions in the nervous system.

Central Nervous System

The **central nervous system (CNS)** consists of the brain and spinal cord. The word *central* is the key to understanding the purpose of this subsystem. It is located centrally along the midsagittal plane of the body and is the center of control, receiving and interpreting all stimuli and sending nerve impulses to instruct muscles and glands to take or respond to certain actions. Designated actions throughout the body include both voluntary and involuntary movement, sight, hearing, thinking, secretion of hormones, memory, and responses to outside stimuli. The *meninges* (described later) are a covering crucial to the protection of the brain and spinal cord.

Brain

The human adult **brain** weighs about three pounds, is 75 percent water, has the consistency of gelatin, contains over 100 billion neurons, and is responsible for controlling the body's many functions and interactions with the outside world. The brain has four major divisions:

1. the brainstem
2. the cerebrum
3. the cerebellum
4. the diencephalon

The brainstem The **brainstem** is made up of the **midbrain** (involved with visual reflexes), the **pons** (controls certain respiratory functions), and the **medulla oblongata** (contains centers that regulate heart and lung functions, swallowing, vomiting, coughing, and sneezing). The brainstem connects the brain to the spinal cord and even small areas of damage can be devastating, even fatal. The midbrain connects the pons beneath it with the cerebellum and cerebrum above. The pons lies between the midbrain and the medulla oblongata, which connects the pons to the spinal cord (see Figure 8-4).

The cerebellum The **cerebellum** is the area that coordinates musculoskeletal movement to maintain posture, balance, and muscle tone.

The cerebrum Above the cerebellum lies the **cerebrum,** the third major brain structure. The cerebrum is the largest area of the brain, taking up about 85 percent of its mass. The cerebrum has two hemispheres, with an outer portion called the **cerebral cortex.** The inner portion is divided into two hemispheres—one on the left and one on the right.

The cerebral cortex (area of conscious decision making) has many **fissures** (also called **sulci**) and **convolutions** (also called **gyri**) and is composed

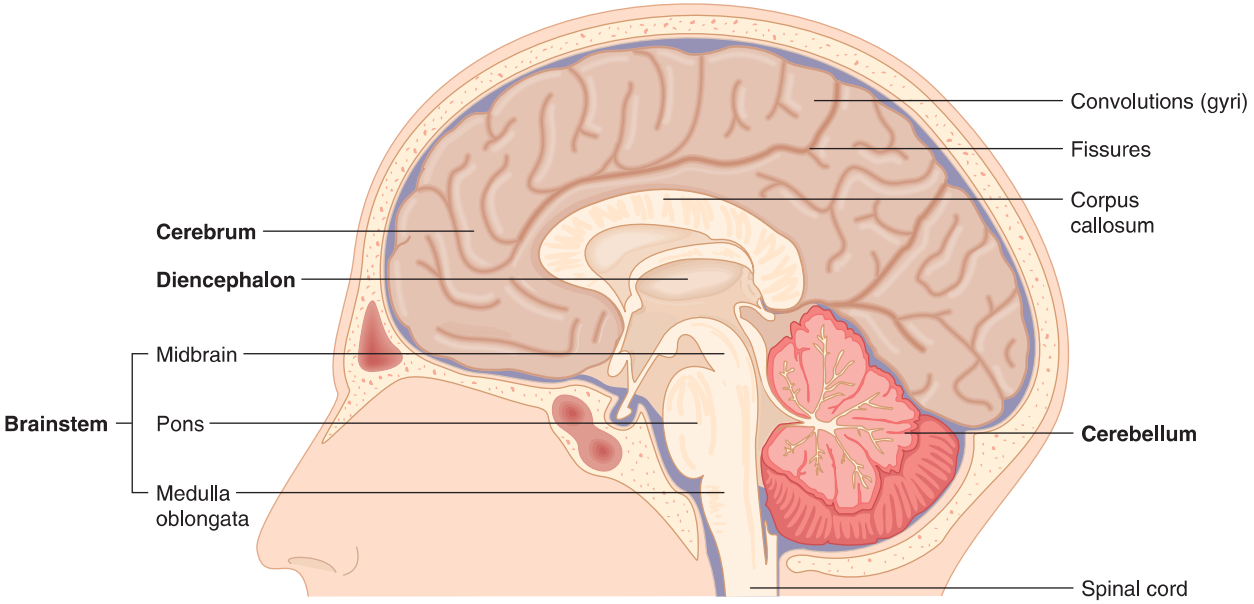

FIGURE 8-4 The parts of the brain.

of gray matter, the substance in the brain composed mainly of nerve cells and dendrites.

Below the cerebral cortex are white matter, substance in the brain composed mainly of nerve fibers, and masses of gray matter called the **basal ganglia** (involved with musculoskeletal movement). The left and right hemispheres of the cerebrum are each divided into four parts or lobes.

1. The **frontal lobe** controls voluntary motor movements, emotional expression, and moral behavior.
2. The **parietal lobe** controls and interprets the senses and taste.
3. The **temporal lobe** controls memory, equilibrium, emotion, and hearing.
4. The **occipital lobe** controls vision and various forms of expression.

The two hemispheres of the cerebrum are connected by the **corpus callosum,** a bridge of nerve fibers that relays information between the two hemispheres.

The diencephalon The **diencephalon** is the deep portion of the brain containing the **thalamus, hypothalamus, epithalamus,** and the **ventral thalamus.** These parts of the diencephalon serve as relay centers for sensations. They also integrate with the autonomic nervous system in the control of heart rate, blood pressure, temperature regulation, water and electrolyte balance, digestive functions, behavioral responses, and glandular activities.

The brain sits inside the **cranium,** a strong bony structure that protects it. The area between the brain and the cranium is filled with **cerebrospinal fluid (CSF),** a watery fluid that contains various compounds and flows throughout the brain and around the spinal cord delivering essential nutrients. This watery fluid cradles and cushions the brain. The fluid acts as a shock absorber in the event of head trauma. **Ventricles** or cavities in the brain also contain this fluid. The cranial meninges have the same structure as the spinal meninges (described next) and also protect the brain. Figure 8-4 illustrates the brain.

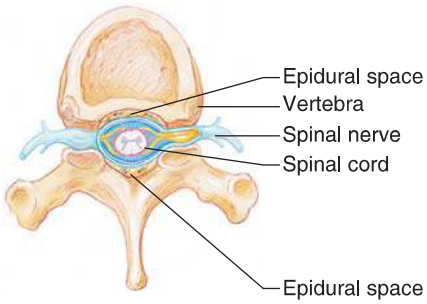

FIGURE 8-5 A section of the spinal column showing a vertebra.

Severe spinal cord injuries usually result in some type of paralysis. Research is under way to grow replacement cells for injured nerves. It is expected that some types of paralysis will be cured by 2010.

Spinal Cord

The **spinal cord** extends from the medulla oblongata of the brain to the area around the second lumbar vertebra in the lower back. The spinal cord is contained within the vertebral column. The space that contains the spinal column is called the vertebral canal. The spinal cord is protected by the bony structure of the vertebral column, by the cerebrospinal fluid that surrounds it, and by the spinal meninges. Figure 8-5 illustrates a section of the spinal cord. Extending out from the spinal cord are the nerves of the peripheral nervous system.

Meninges

The **meninges** (Figure 8-6) are three layers of connective tissue membranes that cover the brain and spinal cord. The outer layer, the **dura mater** (from Latin, "hard mother"), is a tough, fibrous membrane that covers the entire length of the spinal cord and contains channels for blood to enter brain tissue. The middle layer, the **arachnoid,** is a weblike structure that runs across the space (called the **subdural space**) containing cerebrospinal fluid. The **pia mater** (Latin, "tender mother"), the innermost layer of meninges, is a thin membrane containing many blood vessels that nourish the spinal cord. The space between the pia mater and the bones of the spinal cord is called the **epidural space.** It contains blood vessels and some fat. It is the space into which anesthetics may be injected to dull pain (as during childbirth and some pelvic operations) or contrast material for certain diagnostic procedures.

Peripheral Nervous System

The peripheral nervous system includes the 12 pairs of **cranial nerves** that carry impulses to and from the brain and the 31 pairs of **spinal nerves** that carry messages to and from the spinal cord and the torso and extremities of the body. Table 8-2 lists the cranial nerves and their functions.

For an easy way to remember and even test your cranial nerves, go to http://faculty.washington.edu/chudler/cranial.html.

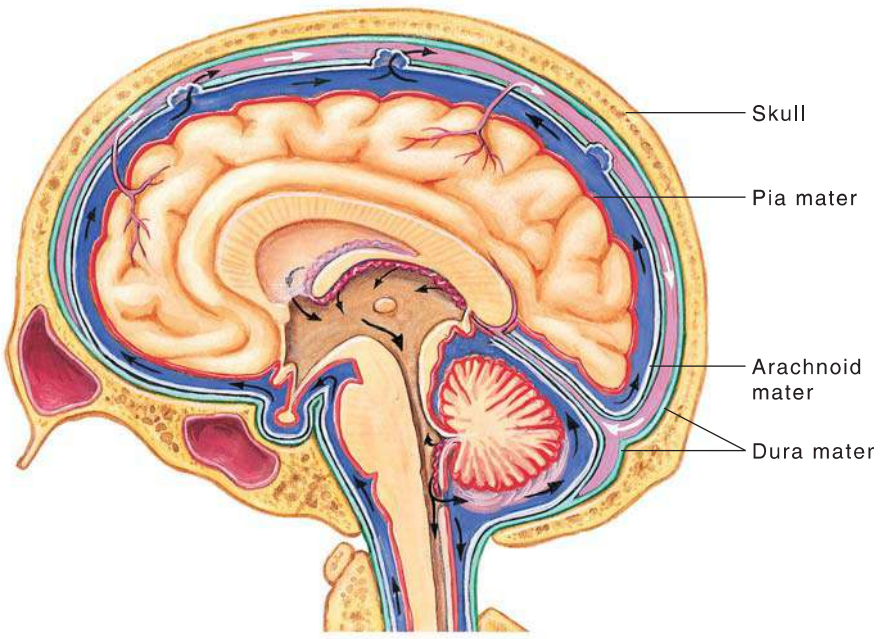

FIGURE 8-6 The brain and spinal cord are protected by the meninges.

TABLE 8-2 The Twelve Pairs of Cranial Nerves and Their Function

Pair of Cranial Nerves	Primary Type of Nerve	Function
I olfactory	sensory	involved in sense of smell
II optic	sensory	involved in sense of vision
III oculomotor	motor	involved in movement of eyes, controlling both the exterior and interior parts
IV trochlear	motor	involved in muscles that move the eyes
V trigeminal	sensory and motor	involved in eyes, tear glands, scalp, forehead, teeth, gums, lips, and muscles of the mouth
VI abducens	motor	involved with muscle conditioning
VII facial	sensory and motor	involved with taste, facial expressions, tear glands, and salivary glands
VIII vestibulocochlear	sensory	involved in equilibrium and hearing
IX glossopharyngeal	sensory and motor	involved in pharynx, tonsils, tongue, and carotid arteries; stimulates salivary glands
X vagus	sensory and motor	involved in speech, swallowing, heart muscles, smooth muscles, and certain glands
XI accessory (cranial and spinal)	motor	involved in muscles of the soft palate, pharynx, larynx, neck, and back
XII hypoglossal	motor	involved in muscles that move the tongue

TABLE 8-3 Major Spinal Nerve Divisions and Their Functions

Region of Spinal Cord	Location	Functions of Nerves
cervical	neck	involved in muscles of the back of the head and neck and in the diaphragm
brachial	lower neck, axilla	involved in the muscles and skin of the neck, shoulder, arm, and hand
lumbar	posterior abdominal wall	involved in abdominal skin and muscles
sacral	posterior pelvic wall	involved in the muscles of the buttocks, thighs, feet, legs, and voluntary sphincters
coccygeal	coccyx and surrounding area	skin in coccyx region

The 31 pairs of spinal nerves are grouped according to the segments of the spinal cord out of which they extend. Table 8-3 lists those groups and the regions served by the nerves of each group. The peripheral nerves are further divided into two subsystems—the somatic and autonomic nervous systems—according to their function.

Somatic Nervous System

Nerves of the **somatic nervous system** receive and process sensory input from the skin, muscles, tendons, joints, eyes, tongue, nose, and ears. They also excite the voluntary contraction of skeletal muscles.

Autonomic Nervous System

Nerves of the **autonomic nervous system** carry impulses from the central nervous system to glands, various smooth (involuntary) muscles, cardiac muscle, and various membranes. The autonomic nervous system stimulates organs, glands, and senses by stimulating secretions of various substances.

The autonomic nerves are further divided into the **sympathetic nervous system** and the **parasympathetic nervous system.** In general, the two systems play opposite roles. The sympathetic system operates when the body is awakening, increasing activity, or under stress. It helps to activate responses necessary to react to sudden changes in activity level or to dangerous or abnormal situations. These nerves control the "fight or flight" reaction to stress—that means it tells the body when to fight back or to flee in dangerous situations. The parasympathetic system, on the other hand, operates to keep the body in homeostasis or balance under normal conditions, as in the "rest and digest" activity of the body.

Vocabulary Review

In the previous section, you learned terms relating to the nervous system. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Term	Definition
acetylcholine [ăs-ē-tĭl-KŌ-lēn]	Chemical that stimulates cells.
afferent [ĂF-ĕr-ĕnt] **(sensory) neuron**	Neuron that carries information from the sensory receptors to the central nervous system.
arachnoid [ă-RĂK-nŏyd] Greek *arachne*, spider + -oid, resembling	Middle layer of meninges.
astrocyte, astroglia [ĂS-trō-sīt], [ăs-TRŎG-lē-ă] Greek *astron*, star + -cyte, cell	A type of neuroglia that maintains nutrient and chemical levels in neurons.
autonomic [ăw-tō-NŎM-ĭk] **nervous system** auto-, self + Greek *nomos*, law	Part of the peripheral nervous system that carries impulses from the central nervous system to glands, smooth muscles, cardiac muscle, and various membranes.
axon [ĂK-sŏn] Greek, axis	Part of a nerve cell that conducts nerve impulses away from the cell body.
basal ganglia [BĀ-săl GĂNG-glē-ă]	Large masses of gray matter within the cerebrum.
brain [brān] Old English *braegen*	Body organ responsible for controlling the body's functions and interactions with outside stimuli.
brainstem	One of the four major divisions of the brain; division that controls certain heart, lung, and visual functions.
cell body	Part of a nerve cell that has branches or fibers that reach out to send or receive impulses.

Term	Definition
central nervous system	The brain and spinal cord.
cerebellum [sĕr-ĕ-BĔL-ūm] Latin, little brain	One of the four major divisions of the brain; division that coordinates musculoskeletal movement.
cerebral cortex [SĔR-ē-brăl KŌR-tĕks]	Outer portion of the cerebrum.
cerebrospinal [SĔR-ĕ-brō-spī-năl] **fluid (CSF)** cerebro-, cerebrum + spinal	Watery fluid that flows throughout the brain and around the spinal cord.
cerebrum [SĔR-ĕ-brŭm, sĕ-RĒ-brŭm] Latin, brain	One of the four major divisions of the brain; division involved with emotions, memory, conscious thought, moral behavior, sensory interpretations, and certain bodily movement.
conductivity [kŏn-dŭk-TĬV-ĭ-tē]	Ability to transmit a signal.
convolutions [kŏn-vō-LŪ-shŭnz]	Folds in the cerebral cortex; gyri.
corpus callosum [KŌR-pŭs kă-LŌ-sŭm] Latin, body with a thick skin	Bridge of nerve fibers that connects the two hemispheres of the cerebrum.
cranial [KRĀ-nē-ăL] **nerves**	Any of 12 pairs of nerves that carry impulses to and from the brain.
cranium [KRĀ-nē-ŭm]	Bony structure that the brain sits in.
dendrite [DĔN-drīt]	A thin branching extension of a nerve cell that conducts nerve impulses toward the cell body.
diencephalon [dī-ĕn-SĔF-ă-lŏn] di-, separated + Greek *enkephalos*, brain	One of the four major structures of the brain; it is the deep portion of the brain and contains the thalamus.
dura mater [DŪ-ră MĀ-tĕr] Latin, hard mother	Outermost layer of meninges.
efferent [ĔF-ĕr-ĕnt] **(motor) neuron**	Neuron that carries information to the muscles and glands from the central nervous system.
epidural [ĕp-ĭ-DŪ-răl] **space** epi-, upon + dur(a mater)	Area between the pia mater and the bones of the spinal cord.
epithalamus [ĔP-ĭ-THĂL-ă-mŭs] epi- + thalamus	One of the parts of the diencephalon; serves as a sensory relay station.
excitability [ĕk-SĪ-tă-BĬL-ĭ-tē]	Ability to respond to stimuli.
fissure [FĬSH-ŭr]	One of many indentations of the cerebrum; sulcus.
frontal lobe	One of the four parts of each hemisphere of the cerebrum.
gyrus (*pl.*, gyri) [JĪ-rŭs (JĪ-rī)]	*See* convolution.
hypothalamus [HĪ-pō-THĂL-ă-mŭs] hypo-, below + thalamus	One of the parts of the diencephalon; serves as a sensory relay station.
interneuron [ĬN-tĕr-NŪ-rŏn] inter-, between + neuron	Neuron that carries and processes sensory information.

Term	Definition
medulla oblongata [mĕ-DŪL-ă ŏb-lŏng-GĂ-tă] Latin, long marrow	Part of the brain stem that regulates heart and lung functions, swallowing, vomiting, coughing, and sneezing.
meninges (*sing.*, meninx) [mĕ-NĬN-jēz (MĔ-nĭngks)] Greek, plural of *meninx*, membrane	Three layers of membranes that cover and protect the brain and spinal cord.
microglia [mī-KRŎG-lē-ă] micro-, small + Greek *glia*, glue	A type of neuroglia that removes debris.
midbrain mid-, middle + brain	Part of the brainstem involved with visual reflexes.
myelin sheath [MĪ-ĕ-lĭn shēth]	Fatty tissue that covers axons.
nerve [nĕrv]	Bundle of neurons that bear electrical messages to the organs and muscles of the body.
nerve cell	Basic cell of the nervous system having three parts: cell body, dendrite, and axon; also called a neuron.
nerve impulse	Released energy that is received or transmitted by tissue or organs and that usually provokes a response.
neurilemma [nūr-ĭ-LĔM-ă] neuri-, nerve + Greek *lemma*, husk	Membranous covering that protects the myelin sheath.
neuroglia [nū-RŎG-lē-ă], **neuroglial** [nū-RŎG-lē-ăl] **cell** neuro-, nerve + Greek *glia*, glue	Cell of the nervous system that does not transmit impulses.
neuron [NŪR-ŏn] Greek, nerve	Basic cell of the nervous system having three parts; also called a nerve cell.
neurotransmitters [NŪR-ō-trănz-MĬT-ĕrz] neuro- + transmitter	Various substances located in tiny sacs at the end of the axon.
occipital lobe [ŏk-SĬP-ĭ-tăl lōb]	One of the four parts of each hemisphere of the cerebrum.
oligodendroglia [ŌL-ĭ-gō-dĕn-DRŎG-lē-ă] oligo-, few + Greek *dendron*, tree + *glia*, glue	A type of neuroglia that produces myelin and helps to support neurons.
parasympathetic [păr-ă-sĭm-pă-THĔT-ĭk] **nervous system** para-, beside + sympathetic	Part of the autonomic nervous system that operates when the body is in a normal state.
parietal lobe [pă-RĪ-ĕ-tăl lōb]	One of the four parts of each hemisphere of the cerebrum.
pia mater [PĪ-ă, PĒ-ă MĀ-tĕr, MĂ-tĕr] Latin, tender mother	Innermost layer of meninges.
pons [pŏnz] Latin, bridge	Part of the brainstem that controls certain respiratory functions.
receptor [rē-SĔP-tĕr]	Tissue or organ that receives nerve impulses.

Term	Definition
somatic [sō-MĂT-ĭk] **nervous system**	Part of the peripheral nervous system that receives and processes sensory input from various parts of the body.
spinal cord	Ropelike tissue that sits inside the vertebral column and from which spinal nerves extend.
spinal nerves	Any of 31 pairs of nerves that carry messages to and from the spinal cord and the torso and extremities.
stimulus (*pl.*, stimuli) [STĬM-yū-lŭs (STĬM-yū-lī)]	Anything that arouses a response.
subdural [sŭb-DŪR-ăl] **space** sub-, under + dur(a mater)	Area between the dura mater and the pia mater across which the arachnoid runs.
sulcus (*pl.*, sulci) [SŬL-kŭs (SŬL-sī)]	*See* fissure.
sympathetic [sĭm-pă-THĔT-ĭk] **nervous system**	Part of the autonomic nervous system that operates when the body is under stress.
synapse [SĬN-ăps]	Space over which nerve impulses jump from one neuron to another.
temporal lobe [TĔM-pŏ-răl lōb]	One of the four parts of each hemisphere of the cerebrum.
terminal end fibers	Group of fibers at the end of an axon that passes the impulses leaving the neuron to the next neuron.
thalamus [THĂL-ă-mŭs]	One of the four parts of the diencephalon; serves as a sensory relay station.
ventral thalamus	One of the four parts of the diencephalon; serves as a sensory relay station.
ventricle [VĔN-trĭ-kl]	Cavity in the brain for cerebrospinal fluid.

CASE STUDY

Neurological Problem

Jose Gutierrez is a patient of Dr. Marla Chin, an internist. He is scheduled for his six-month checkup and medication review. Mr. Gutierrez has a history of heart disease and skin carcinoma. In the past few months he has been having trouble buttoning his shirts and remembering things. He has also developed a limp. Dr. Chin orders some tests.

Critical Thinking

1. Mr. Gutierrez has some new problems. According to his symptoms, what areas of the brain might have been affected by some disorder?
2. Dr. Chin does a thorough checkup and asks both Mr. Gutierrez and his wife many questions about such things as respiratory function, sleep habits, and so on. How will the answers to the questions help Dr. Chin determine the next steps to take?

Structure and Function Exercises

Know the Position

3. The brain and spinal cord are protected by three layers of meninges. Name the three layers in order from inside the skull to the brain and describe the structure of each.

   a. _____

   b. _____

   c. _____

Find a Match

Match the definition in the right-hand column to the word in the left-hand column.

4. _____ neuroglia	a. gray matter
5. _____ meninges	b. weblike meningeal layer
6. _____ neuron	c. internal chemical
7. _____ acetylcholine	d. cell that does not transmit impulses
8. _____ excitability	e. fissures
9. _____ ventricle	f. area between pia mater and spinal bones
10. _____ basal ganglia	g. responsiveness to stimuli
11. _____ sulci	h. protective membranes
12. _____ arachnoid	i. cell that transmits impulses
13. _____ epidural space	j. cavity for fluid

Complete the Thought

Fill in the blanks.

14. Organs that receive [or transmit] nerve impulses are called _____.
15. Each axon is covered by a _____ _____.
16. Neuron structures that conduct nerve impulses toward the cell body are called _____.
17. Neuron structures that conduct nerve impulses away from the cell body are called _____.
18. The spinal cord connects to the brain at the _____ _____.
19. The part of the brain with two hemispheres is called the _____.
20. The part of the brainstem that controls certain respiratory functions is called the _____.
21. The bony structure protecting the brain is the _____.
22. Ventricles hold _____ _____.
23. The deep portion of the brain is called the _____.

Spell It Correctly

Write the correct spelling in the blank to the right of each word. If the word is already correctly spelled, write C.

24. meninxes _____	26. ganoglia _____
25. thalomus _____	27. gyri _____

28. synapse _____
29. axen _____
30. neurilemma _____
31. acetycholine _____
32. neurglia _____
33. cerebrellum _____

Combining Forms and Abbreviations

The lists below include combining forms and abbreviations that relate specifically to the nervous system. Pronunciations are provided for the examples.

Combining Form	Meaning	Example
cerebell(o)	cerebellum	*cerebellitis* [sĕr-ĕ-bĕl-Ī-tĭs], inflammation of the cerebellum
cerebr(o), cerebri	cerebrum	*cerebralgia* [sĕr-ĕ-BRĂL-jē-ă], pain in the head
crani(o)	cranium	*craniofacial* [KRĀ-nē-ō-FĀ-shăl], relating to the face and the cranium
encephal(o)	brain	*encephalitis* [ĕn-sĕf-ă-LĪ-tĭs], inflammation of the brain
gangli(o)	ganglion	*gangliform* [GĂNG-glē-fŏrm], having the shape of a ganglion
gli(o)	neuroglia	*gliomatosis* [glī-ō-mă-TŌ-sĭs], abnormal growth of neuroglia in the brain or spinal cord
mening(o), meningi(o)	meninges	*meningocele* [mĕ-NĬNG-gō-sēl], protrusion of the spinal meninges above the surface of the skin; *meningitis* [mĕn-ĭn-JĪ-tĭs], inflammation of the meninges
myel(o)	bone marrow, spinal cord	*myelomalacia* [MĪ-ĕ-lō-mă-LĀ-shē-ă], softening of the spinal cord
neur(o), neuri	nerve	*neuritis* [nū-RĪ-tĭs], inflammation of a nerve
spin(o)	spine	*spinoneural* [spī-nō-NŪ-răl], relating to the spine and the nerves that extend from it
thalam(o)	thalamus	*thalamotomy* [thăl-ă-MŎT-ō-mē], incision into the thalamus to destroy a portion causing or transmitting sensations of pain
vag(o)	vagus nerve	*vagectomy* [vā-JĔK-tō-mē], surgical removal of a portion of the vagus nerve; *vagotomy* [vā-GŎT-ō-mē], surgical severing of the vagus nerve
ventricul(o)	ventricle	*ventriculitis* [vĕn-trĭk-yū-LĪ-tĭs], inflammation of the ventricles of the brain

Abbreviation	Meaning	Abbreviation	Meaning
Ach	acetylcholine	CSF	cerebrospinal fluid
ALS	amyotrophic lateral sclerosis	CT or CAT scan	computerized (axial) tomography
BBB	blood-brain barrier	CVA	cerebrovascular accident
CNS	central nervous system	CVD	cerebrovascular disease
CP	cerebral palsy	PNS	peripheral nervous system

CASE STUDY

Referral to a Neurologist

Dr. Chin takes some blood tests and decides to send Mr. Gutierrez to a neurologist, Dr. Martin Stanley, for an evaluation. Dr. Stanley reviews Dr. Chin's notes and finds that Mr. Gutierrez has no history of CVA, but is experiencing numbness in his fingers and has some difficulty walking. Dr. Stanley will test for CVA, but since Mr. Gutierrez has a history of normal blood pressure, he suspects another disorder.

Critical Thinking

34. Why is Mr. Gutierrez referred to a neurologist?

35. What nerves might affect Mr. Gutierrez's walking?

Combining Forms and Abbreviations Exercises

Root Out the Meaning

Find at least two nervous system combining forms in each word. Write the combining forms and their definitions in the space provided.

36. encephalomyelitis: _____

37. craniomeningocele: _____

38. glioneuroma: _____

39. cerebromeningitis: _____

40. spinoneural: _____

41. neuroencephalomyelopathy: _____

Trace the Root

Add the combining form that completes the word.

42. Acting upon the vagus nerve: _____tropic.

43. Tumor consisting of ganglionic neurons: ganglio _____oma.

44. Myxoma containing glial cells: _____myxoma.

45. Relating to nerves and meninges: neuro _____eal.

In each word, find the combining form that relates to the nervous system and give its definition.

46. parencephalia _____

47. angioneurectomy _____

48. cephalomegaly _____

49. myelitis _____

50. meningocyte _____

51. neurocyte _____

52. craniomalacia _____

53. vagotropic _____

54. glioblast _____

55. cerebrosclerosis _____

Reviewing Combining Forms

Match the following word parts with the correct meanings. Some answers may be used more than once or not at all.

56. _____ encephal(o)
57. _____ gli(o)
58. _____ myel(o)
59. _____ spin(o)
60. _____ cerebell(o)
61. _____ mening(o), meningi(o)
62. _____ neur(o), neuri
63. _____ gangli(o)
64. _____ crani(o)
65. _____ cerebr(o), cerebri
66. _____ myel(o)
67. _____ ventricul(o)
68. _____ radic(o), radicul(o), rhiz(o)
69. _____ thalam(o)
70. _____ dur(o)
71. _____ esthesi(o)
72. _____ mon(o)
73. _____ hemi-
74. _____ ment(o), psych(o)
75. _____ quadra, quadri
76. _____ -plegia

a. sensation, sensitivity, feeling
b. cerebrum
c. one, single
d. paralysis
e. ganglion
f. neuroglia
g. meninges
h. bone marrow, spinal cord
i. nerve
j. spine
k. four
l. vagus nerve
m. half, on one side
n. hard, dura mater
o. mind
p. cerebellum
q. cranium
r. ventricle
s. nerve root
t. thalamus
u. brain

Knowing Nervous System Abbreviations

Match the following abbreviations with their correct meaning.

77. _____ CVA
78. _____ ALS
79. _____ CSF
80. _____ BBB
81. _____ CVD
82. _____ CNS
83. _____ PNS
84. _____ CP
85. _____ CT scan, CAT scan
86. _____ Ach
87. _____ AD
88. _____ MS
89. _____ EP

a. electroencephalography
b. central nervous system
c. attention deficit hyperactivity disorder
d. Alzheimer disease
e. amyotrophic lateral sclerosis, Lou Gehrig's disease
f. polysomnography
g. acetylocholine
h. evoked potential (studies)
i. computerized (axial) tomography
j. obsessive-compulsive disorder
k. positron emission tomography
l. multiple sclerosis
m. Parkinson's disease

90. _____ MRI
91. _____ PET
92. _____ EEG
93. _____ LP
94. _____ EMG
95. _____ PSG
96. _____ ADHD
97. _____ OCD
98. _____ PD
99. _____ PTSD
100. _____ TIA

n. blood-brain barrier
o. peripheral nervous system
p. transient ischemic attack
q. cerebrovascular disease
r. lumbar puncture
s. posttraumatic stress disorder
t. cerebrovascular accident, stroke
u. cerebrospinal fluid
v. magnetic resonance imaging
w. cerebral palsy
x. electromyogram

Remembering Suffixes

Match the following suffixes commonly used with nervous system terms with their correct meaning.

101. _____ -iatry
102. _____ -iatrist
103. _____ -paresis
104. _____ -logy
105. _____ -algia
106. _____ -cele
107. _____ -itis
108. _____ -osis
109. _____ -phasia
110. _____ -plegia

a. physician, specialist
b. inflammation
c. pain
d. paralysis
e. slight paralysis
f. abnormal condition
g. speech
h. treatment
i. study of
j. hernia

FIGURE 8-7 An electroencephalogram (EEG) records the brain's impulses. The impulses are collected from electrodes placed around the patient's head.

Diagnostic, Procedural, and Laboratory Terms

Neurologic assessment is a step-by-step process of evaluating function, reviewing specific problems, and eliminating some causes while building a case for others. Many of the diagnostic tests used to examine the nervous system include electrodiagnostic procedures. An **electroencephalogram (EEG)** is a record of the electrical impulses of the brain (Figure 8-7). This record can detect abnormalities that signal certain neurological conditions. **Evoked potentials** are electrical waves observed in an electroencephalogram. Abnormal wave patterns can help in the diagnosis of auditory, visual, and sensory disorders. Peripheral nervous system diseases can sometimes be detected by shocking the peripheral nerves and timing the conductivity of the shock. This procedure is called **nerve conduction velocity** or *electromyogram*. **Polysomnography (PSG)** is a recording of electrical and movement patterns during sleep to diagnose sleep disorders, such as *sleep apnea*, a dangerous breathing disorder.

Various types of imaging are used to visualize the structures of the brain and spinal cord. *Magnetic resonance imaging* (*MRI*) is the use of magnetic fields and radio waves to visualize structures. *Magnetic resonance angiography* (*MRA*) is the imaging of blood vessels to detect various abnormalities. *Intracranial MRA* is the visualizing of the head to check for aneurysms and other abnormalities. *Extracranial MRA* is the imaging of the neck to check the carotid artery for abnormalities. **SPECT (single photon emission computed tomography) brain scan** is a procedure that produces brain images in various colors using radioactive isotopes. **PET (positron emission tomography)** is a procedure that produces brain images using radioactive isotopes and tomography. It gives highly accurate images in various colors of the brain structures and physiology and can provide diagnoses of various brain disorders. **Computerized (axial) tomography (CT or CAT) scans** use tomography to show cross-sectional radiographic images.

X-rays are used to diagnose specific malformations or structural disorders. A **myelogram** is an x-ray of the spinal cord after a contrast medium is injected. A **cerebral angiogram** is an x-ray of the brain's blood vessels after a contrast medium is injected. *Encephalography* is the radiographic study of the ventricles of the brain. The record made by this study is called an **encephalogram.** Sound waves are used to create brain images in a **transcranial sonogram** for diagnosing and managing head and stroke trauma. Ultrasound is also used in *echoencephalography*, encephalography using ultrasound waves.

Reflexes are involuntary muscular contractions in response to a stimulus. Reflex testing can aid in the diagnosis of certain nervous system disorders. **Babinski's reflex** is a reflex on the plantar surface of the foot used to evaluate weakness on one side of the body. In most physical examinations, the reflex of each knee is tested for responsiveness (Figure 8-8).

Cerebrospinal fluid that has been withdrawn from between two lumbar vertebrae during a **lumbar (spinal) puncture** can be studied for the presence of various substances, which may indicate certain diseases. Blood tests are also used to diagnose nervous system disorders.

FIGURE 8-8 Tapping just below the knee usually causes a reflex reaction similar to the one shown here.

VOCABULARY REVIEW

In the previous section, you learned terms relating to diagnosis, clinical procedures, and laboratory tests. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Term	Definition
Babinski's [bă-BĬN-skēz] **reflex** After Joseph F. Babinski, French neurologist (1857–1932)	Reflex on the plantar surface of the foot.
cerebral angiogram	X-ray of the brain's blood vessels after a dye is injected.
computerized (axial) tomography [(ĂKS-ē-ăl) tō-MŎG-ră-fē] **(CT or CAT) scan**	Radiographic imaging that produces cross-sectional images.

Term	Definition
electroencephalogram [ē-LĔK-trō-ĕn-SĔF-ă-lō-grăm] **(EEG)** electro-, electrical + encephalo-, brain + -gram, a recording	Record of the electrical impulses of the brain.
encephalogram [ĕn-SĔF-ă-lō-grăm] encephalo- + -gram	Record of the radiographic study of the ventricles of the brain.
evoked potentials [ē-VŌKT pō-TĔN- shălz]	Record of the electrical wave patterns observed in an EEG.
lumbar [LŬM-băr] **(spinal) puncture**	Withdrawal of cerebrospinal fluid from between two lumbar vertebrae.
myelogram [MĪ-ĕ-lō-grăm] myelo-, spinal cord + -gram	X-ray of the spinal cord after a contrast medium has been injected.
nerve conduction velocity	Timing of the conductivity of an electrical shock administered to peripheral nerves.
PET (positron emission tomography) [pet (PŎZ-Ĭ-trŏn ē-MĬ-shŭn tō-MŎG-ră-fē)]	Imaging of the brain using radioactive isotopes and tomography.
polysomnography [PŎL-ē-sŏm-NŎG-ră-fē] **(PSG)** poly-, many + somno-, sleep + -graphy, recording	Recording of electrical and movement patterns during sleep.
reflex [RĒ-flĕks]	Involuntary muscular contraction in response to a stimulus.
SPECT (single photon emission computed tomography) brain scan	Brain image produced by the use of radioactive isotopes.
transcranial sonogram [trănz-KRĀ-nē-ăl SŌN-ō-grăm] trans-, across + cranial	Brain images produced by the use of sound waves.

CASE STUDY

Ordering Treatment

Dr. Stanley orders an electroencephalogram of Mr. Gutierrez's brain. He also orders some additional blood tests. Dr. Stanley performs a number of reflex tests. The abnormalities present confirm Dr. Stanley's initial suspicion of Parkinson's disease. He prescribes several medications and schedules a visit for Mr. Gutierrez in three weeks to discuss his progress. He asks Mr. Gutierrez to keep a daily log of his walking ability, any vision changes, his speech, and tremors for the three weeks until his appointment.

Critical Thinking

111. Why does Dr. Stanley want Mr. Gutierrez to keep a log?

112. What might Mr. Gutierrez's abnormal reflex tests indicate?

Diagnostic, Procedural, and Laboratory Terms Exercises

Check Your Knowledge

Circle T for true and F for false.

113. Extracranial MRA is imaging of the spinal cord. T F
114. Reflexes are voluntary muscular contractions. T F
115. An encephalogram is a record of a study of the ventricles of the brain. T F
116. A lumbar puncture removes blood. T F
117. PET is an extremely accurate imaging system. T F
118. Evoked potentials are electrical waves. T F
119. A myelogram and an angiogram are both taken after injection of a contrast medium. T F
120. PSG is taken during waking hours. T F
121. Encephalography uses sound waves to produce brain images. T F

Understanding Terms

Match the following diagnostic, procedural, and laboratory terms with their correct definitions.

122. _____ reflex
123. _____ lumbar puncture
124. _____ Babinski's reflex
125. _____ SPECT
126. _____ cerebral angiogram
127. _____ myelogram
128. _____ encephalogram
129. _____ evoked potentials
130. _____ PET
131. _____ nerve conduction velocity
132. _____ CT scan, CAT scan
133. _____ polysomnography
134. _____ transcranial sonogram
135. _____ electroencephalogram
136. _____ extracranial MRA

a. brain images produced by using sound waves
b. record of the electrical wave patterns observed in an EEG
c. timing of the conductivity of an electrical shock to the peripheral nerves
d. record of the electrical impulses of the brain
e. imaging of the brain using radioactive isotopes and tomography
f. involuntary muscular contraction in response to a stimulus
g. x-ray of the brain's blood vessels using contrast dye
h. recording of electrical and movement patterns during sleep
i. record of the radiographic study of the brain's ventricles
j. reflex to stimulus on the plantar surface of the foot
k. collection of cerebrospinal fluid from between two lumbar vertebrae
l. imaging of the neck to check the carotid artery for abnormalities
m. radiographic imaging that produces cross-sectional images
n. brain image produced by the use of radioactive isotopes
o. x-ray of the spinal cord using contrast dye

Pathological Terms

Neurologial disorders can be caused by trauma, congenital abnormalities, infectious disorders, degenerative diseases, or vascular conditions. Bones, cerebrospinal fluid, and the meninges protect the nervous system from most types of external trauma, but not all, and the blood-brain barrier protects the brain from most infectious diseases.

Trauma Disorders

A **concussion** is an injury to the brain from an impact with an object. Cerebral concussions usually clear within 24 hours. Concussions may be followed by nausea, disorientation, dizziness, double vision (diplopia), sensitivity to light (photophobia), and/or vomiting. A severe concussion can lead to **coma,** abnormally deep sleep with little or no response to stimuli. Coma can also result from other causes, such as stroke. A more serious trauma than concussion is a **brain contusion,** a bruising of the surface of the brain without penetration into the brain. Brain contusions can result in extreme disorientation, listlessness, and even death. Traumatic injury, as during a car accident, may also cause the brain to hit the skull and then to rebound to the other side of the skull. This is called a *closed head trauma*, because there is no penetration of the skull. *Shaken baby syndrome* is a severe form of closed head trauma in which a young child experiences head trauma (as a result of falling, being shaken, or other trauma), causing the brain to hit the sides of the skull and causing potentially fatal damage.

Trauma to the brain can occur by breaking down of the blood-brain barrier. Go to http://faculty.washington.edu/chudler/bbb.html for some of the ways this can happen.

A *subdural hematoma* (between the dura mater and the arachnoid or at the base of the dura mater) is a tumorlike collection of blood often caused by trauma. Other types of cranial hematomas are *epidural hematomas* (located on the dura mater) and *intracerebral hematomas* (within the cerebrum).

Injuries that result in penetration of the brain through the skull are usually extremely serious and often fatal. Depending on the degree of penetration and the place penetrated, brain damage may result. Bleeding in the brain from an injury can also cause brain damage resulting in inability to function normally.

Congenital Disorders

Congenital diseases of the brain or spinal cord can be devastating and have an impact on the activities of daily living. **Spina bifida** is a defect in the spinal column. *Spina bifida occulta* is a covered lesion of the vertebra that is generally visible only by x-ray. This is the least severe form of spina bifida. *Spina bifida cystica* is a more severe form of the condition, usually with a **meningocele** (protrusion of the spinal meninges above the surface of the skin) or a **meningomyelocele** (protrusion of the meninges and spinal cord).

Tay-Sachs disease is a hereditary disease found primarily in the descendants of Eastern European Jews. It is a genetic disease characterized by an enzyme deficiency that causes deterioration in the central nervous system's cells. **Hydrocephalus** is an overproduction of fluid in the brain. It usually occurs at birth (although it can occur in adults with infections or tumors) and is treated with a shunt placed from the ventricle of the brain to the peritoneal space to relieve pressure by draining fluid. Figure 8-9 illustrates an infant with a shunt for relief of the pressure of hydrocephalus. See the

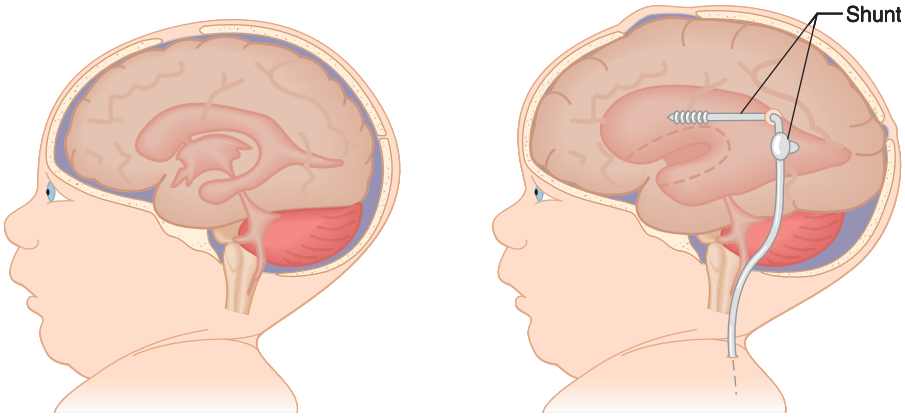

FIGURE 8-9 A shunt relieves the brain pressure of newborns with hydro-cephalus.

section on nondegenerative disorders, which discusses *cerebral palsy*, a disease caused by damage during gestation.

Degenerative Diseases

Degenerative diseases of the central nervous system can affect almost any part of the body. Deterioration in mental capacity is found in **dementia** and **Alzheimer's disease,** a progressive degeneration of neurons in the brain, eventually leading to death. Some symptoms that worsen as Alzheimer's disease progresses are **amnesia** (loss of memory), **apraxia** (inability to properly use familiar objects), and **agnosia** (inability to receive and understand outside stimuli).

Amyotrophic lateral sclerosis (ALS) is a degenerative disease of the motor neurons leading to loss of muscular control and death. It is also known as **Lou Gehrig's disease.** Several other degenerative diseases are not necessarily fatal. **Huntington's chorea** is a hereditary disease with uncontrollable, jerking movements and progressive loss of neural control. **Multiple sclerosis (MS)** is the destruction of the myelin sheath, called **demyelination,** leading to muscle weakness, unsteady **gait** (walking), **paresthesias** (odd sensations, of tingling, stinging, etc.), extreme fatigue, and some paralysis. In certain cases, it can lead to death. **Myasthenia gravis,** a disease with muscle weakness, can be treated to avoid the overproduction of antibodies that block neurotransmitters from sending proper nerve impulses to skeletal muscles. **Parkinson's disease,** a degeneration of nerves in the brain, causes tremors, weakness of muscles, and difficulty in walking. It is treated with drugs that increase the levels of **dopamine** in the brain. Treatment helps relieve symptoms but does not cure the disease. Parkinson's can become severe and lead to death.

FIGURE 8-10 Cerebral palsy often leads to significant disabilities.

Nondegenerative Disorders

Severe neurological disorders cause paralysis, convulsions, and other symptoms, but are not necessarily degenerative or congenital. **Palsy** is partial or complete paralysis. **Cerebral palsy** includes lack of motor coordination from cerebral damage during gestation or birth (Figure 8-10). **Bell's palsy** is paralysis of one side of the face. It usually disappears after treatment. **Ataxia** is lack of voluntary muscle coordination resulting from disorders of the cerebellum, pons, or spinal cord.

Most neurological disorders and diseases are helped by national organizations that maintain Web sites. See www.alz.org for information on Alzheimer's disease and www.nmss.org for information on multiple sclerosis. For other diseases, use a search engine and type in the name of the disease to find the Web site for the organization.

Stem Cells—One of the most emotionally charged issues to come up in the United States over past years has been the debate of federal funding for embryonic stem cell research. This area of research is a newly developing field that involves the derivation of stem cells from human embryos and other newly identified sources. These cells are undifferentiated, which means that they have the ability to grow into nearly any type of tissue in the human body. While scientists believe that such cells hold great promise for the treatment of diseases such as Parkinson's and diabetes, critics object to the research because it involves the destruction of human embryos.

Epilepsy is chronic, recurrent seizure activity. Epilepsy has been known since ancient times, when victims were thought to be under the influence of outside forces. Now it is understood that this disease occurs because of abnormal conditions in the brain that cause sudden excessive electrical activity. The seizures caused by this activity can be preceded by an **aura,** a collection of symptoms felt just before the actual seizure. Seizures may be mild or intense. **Absence seizures (petit mal seizures)** are mild and usually include only a momentary disorientation with the environment. **Tonic-clonic seizures (grand mal seizures)** are much more severe and include loss of consciousness, convulsions, and twitching of limbs. The most serious form of seizure is called *status epilepticus* and occurs when one seizure follows another with no recovery period or ability to regain consciousness between attacks. This is considered a medical emergency that requires immediate advanced medical care. In any form of seizure, it is not uncommon for the individual to experience ***amnesia*** (loss of memory) of the attack.

Tourette syndrome is a neurological disorder that causes uncontrollable sounds and twitching (**tics**). Some drugs are helpful in controlling symptoms and allowing sufferers to lead normal lives.

Infectious Diseases

Infectious diseases of the nervous system include **shingles** and **meningitis.** Shingles is a viral disease caused by the herpes zoster virus. Its symptoms include pain in the peripheral nerves and blisters on the skin.

Several types of meningitis, inflammation of the meninges, can be infectious. **Pyrogenic meningitis** (also called **bacterial meningitis**) is caused by bacteria and includes such symptoms as fever, headache, and stiff neck. It is usually treated with antibiotics. In some severe cases, it can be fatal. **Viral meningitis** is caused by viruses and, although it has the same symptoms as pyrogenic meningitis, it is usually allowed to run its course. Medication can be given for some of the more uncomfortable symptoms (fever, headache). Inflammation can also occur in the nerves (**neuritis**), the spinal cord (**myelitis**), the brain (**encephalitis**), the cerebellum (**cerebellitis**), the dura mater (**duritis**), the ganglion (**gangliitis**), or the spinal nerve roots (**radiculitis**). Some specific nerve inflammations, such as **sciatica,** cause pain in the area served by the nerve. This is a common cause of lower back and leg pain.

Abnormal Growths

Abnormal growths in the nervous system usually occur in the brain or the meninges. About one-third of all brain tumors are growths that spread from cancers in other parts of the body (lungs, breasts, skin, and so on). The remaining growths can be benign or malignant. In either case, the pressure and distortion of the brain caused by a tumor may result in many other neurological symptoms. **Gliomas** (tumors that arise from neuroglia) and **meningiomas** (tumors that arise from the meninges) can be either benign or malignant. Both may be removed surgically. **Astrocytoma, oligodendroglioma,** and **glioblastoma multiforme** are all types of gliomas, with the latter being the most malignant. Tumors can be treated surgically if they have

not infiltrated or affected certain essential areas of the brain. Radiation and medication may be used to try to reduce tumor growth. Some nontumorous growths can cause pain from pressure on nerves. A **ganglion** is any group of nerve cells bunched together to form a growth or a cyst, usually arising from a wrist tendon.

Vascular Disorders

Vascular problems, such as *arteriosclerosis*, may cause a **cerebrovascular accident** or **CVA,** a disruption in the normal blood supply to the brain. Various types of **strokes (cerebral infarctions)** result from this disruption. A **thrombus** (stationary blood clot) may cause **occlusion** (blocking of a blood vessel), which in turn may cause a **thrombotic stroke.** As the blockage grows, the person may experience milder symptoms before a major stroke. These short incidents are known as **transient ischemic attacks (TIAs).** TIAs may be symptomless or may cause brief disorientation and speech and motor difficulty. An **embolic stroke** is caused by an **embolus,** a clot that travels from somewhere in the body to the cerebral arteries and blocks a small vessel, causing a sudden stroke. A **hemorrhagic stroke** is caused by blood escaping from a damaged cerebral artery. It may be caused by sudden trauma or an **aneurysm,** an abnormal bulge in the wall of a blood vessel resulting from weaking of the blood vessel wall.

Strokes can be mild and result in complete recovery, or they can range from mild to severe, with symptoms that remain permanently. Common symptoms are thought disorders, **dysphasia** (speech difficulty), **aphasia,** (loss of speech), loss of muscular control, some paralysis, and disorientation. Note that dysphasia is different from *dysphagia*, difficulty in swallowing, discussed in Chapter 14.

Some states of consciousness are changed by lack of oxygen or brain abnormalities that affect the flow of blood and oxygen to the brain. **Fainting** or **syncope** is caused by lack of oxygen to the brain. **Somnolence** (extreme sleepiness), **somnambulism** (sleepwalking), and **narcolepsy** (uncontrollable, sudden lapses into deep sleep) are all altered states of consciousness.

MORE ABOUT . . .

Tourette Syndrome

Medications for Tourette syndrome do not always work. People who have Tourette syndrome may not be able to function in social and work environments because of their inability to control sounds, often inappropriate in nature, and twitching, often extreme and repetitive. The National Tourette Syndrome Association publicizes information about the syndrome, holds conventions for people with the syndrome, and provides information and support to its members. This large support group holds social events where members feel comfortable with their fellow sufferers. More information is available from the Association's Web site (www.tsa-usa.org) or from conducting a search for the word *tourette.*

Vocabulary Review

In the previous section, you learned terms relating to pathology. Before going on to the exercises, review the terms below and refer to the previous section if you have questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Term	Definition
absence seizure [SĒ-zhŭr]	Mild epileptic seizure consisting of brief disorientation with the environment.
agnosia [ăg-NŌ-zhē-ă] Greek, ignorance	Inability to receive and understand outside stimuli.
Alzheimer's [ĂLTS-hī-mĕrz] **disease** After Alois Alzheimer (1864–1915), German neurologist	A type of degenerative brain disease causing thought disorders, gradual loss of muscle control, and, eventually, death.
amnesia [ăm-NĒ-zhē-ă] Greek, forgetfulness	Loss of memory.
amyotrophic lateral sclerosis [ă-mī-ō-TRŌ-fĭk LĂT-ĕr-ăl sklĕ-RŌ-sĭs] **(ALS)**	Degenerative disease of the motor neurons leading to loss of muscular control and death.
aneurysm [ĂN-yū-rĭzm] Greek *aneurysma*, dilation	Abnormal widening of an artery wall that bursts and releases blood.
aphasia [ă-FĀ-zhē-ă] a-, without + -phasia, speech	Loss of speech.
apraxia [ă-PRĂK-sē-ă] a- + Greek *pratto*, to do	Inability to properly use familiar objects.
astrocytoma [ĂS-trō-sī-TŌ-mă] Greek *astron*, star + cyt-, cell + -oma, tumor	Type of glioma formed from astrocytes.
ataxia [ă-TĂK-sē-ă] a- + Greek *taxis*, order	Condition with uncoordinated voluntary muscular movement, usually resulting from disorders of the cerebellum or spinal cord.
aura [ĂW-ră] Latin, breeze	Group of symptoms that precede a seizure.
bacterial meningitis [mĕn-ĭn-JĪ-tĭs]	Meningitis caused by a bacteria; pyrogenic meningitis.
Bell's palsy [PĂWL-zē] After Sir Charles Bell, Scottish surgeon (1774–1842)	Paralysis of one side of the face; usually temporary.
brain contusion [kŏn-TŪ-zhŭn]	Bruising of the surface of the brain without penetration.
cerebellitis [sĕr-ĕ-bĕl-Ī-tĭs] cerebell-, cerebellum + -itis, inflammation	Inflammation of the cerebellum.
cerebral infarction [SĔR-ē-brăl ĭn-FĂRK- shŭn]	*See* cerebrovascular accident.

Term	Definition
cerebral palsy [PĂWL-zē]	Congenital disease caused by damage to the cerebrum during gestation or birth and resulting in lack of motor coordination.
cerebrovascular [SĔR-ē-brō-VĂS-kyū-lăr] **accident (CVA)** cerebro-, brain + vascular	Neurological incident caused by disruption in the normal blood supply to the brain; stroke.
coma [KŌ-mă] Greek *koma*, trance	Abnormally deep sleep with little or no response to stimuli.
concussion [kŏn-KŬSH-ŭn]	Brain injury due to trauma.
dementia [dē-MĔN-shē-ă]	Deterioration in mental capacity, usually in the elderly.
demyelination [dē-MĪ-ĕ-lĭ-NĀ-shŭn]	Destruction of myelin sheath, particularly in MS.
dopamine [DŌ-pă-mēn]	Substance in the brain or manufactured substance that helps relieve symptoms of Parkinson's disease.
duritis [dū-RĪ-tĭs] dur(a mater) + -itis	Inflammation of the dura mater.
dysphasia [dĭs-FĀ-zhē-ă] dys-, difficult + -phasia	Speech difficulty.
embolic [ĕm-BŎL-ĭk] **stroke**	Sudden stroke caused by an embolus.
embolus [ĔM-bō-lŭs]	Clot from somewhere in the body that blocks a small blood vessel in the brain.
encephalitis [ĕn-sĕf-ă-LĪ-tĭs] encephal-, brain + -itis	Inflammation of the brain.
epilepsy [ĔP-ĭ-LĔP-sē]	Chronic recurrent seizure activity.
fainting	*See* syncope.
gait [gāt]	Manner of walking.
gangliitis [găng-glē-Ī-tĭs] gangli(on) + -itis	Inflammation of a ganglion.
ganglion (*pl.*, ganglia, ganglions) [GĂNG-glē-ŏn (-a, -ons)]	Any group of nerve cell bodies forming a mass or a cyst in the peripheral nervous system; usually forms in the wrist.
glioblastoma multiforme [GLĪ-ō-blăs-TŌ-mă MŬL-tĭ-fŏrm]	Most malignant type of glioma.
glioma [glī-Ō-mă] Greek *glia*, glue + -oma	Tumor that arises from neuroglia.
grand mal [măhl] **seizure**	*See* tonic-clonic seizure.
hemorrhagic [hĕm-ō-RĂJ-ĭk] **stroke**	Stroke caused by blood escaping from a damaged cerebral artery.

Term	Definition
Huntington's chorea [kōr-Ē-ă] After George Huntington (1850–1916), U.S. physician	Hereditary disorder with uncontrollable, jerking movements.
hydrocephalus [hī-drō-SĔF-ă-lŭs] hydro-, water + Greek *kephale*, head	Overproduction of fluid in the brain.
Lou Gehrig's [GĔR-ĭgz] **disease**	*See* amyotrophic lateral sclerosis.
meningioma [mĕ-NĬN-jē-Ō-mă] meningi-, meninges + -oma, tumor	Tumor that arises from the meninges.
meningitis [mĕ-nĭn-JĪ-tĭs] mening-, meninges + -itis	Inflammation of the meninges.
meningocele [mĕ-NĬNG-gō-sēl] meningo-, meninges + -cele, hernia	In spina bifida cystica, protrusion of the spinal meninges above the surface of the skin.
meningomyelocele [mĕ-nĭng-gō-MĪ-ĕ-lō-sēl] meningo- + myelo-, spinal cord + -cele	In spina bifida cystica, protrusion of the meninges and spinal cord above the surface of the skin.
multiple sclerosis [MŬL-tĭ-pŭl sklĕ-RŌ-sĭs] **(MS)**	Degenerative disease with loss of myelin, resulting in muscle weakness, extreme fatigue, and some paralysis.
myasthenia gravis [mī-ăs-THĒ-nē-ă GRĂV-ĭs]	Disease involving overproduction of antibodies that block certain neurotransmitters; causes muscle weakness.
myelitis [mī-ĕ-LĪ-tĭs] myel-, spinal cord + -itis	Inflammation of the spinal cord.
narcolepsy [NĂR-kō-lĕp-sē] narco, sleep + -lepsy, condition with seizures	Nervous system disorder that causes uncontrollable, sudden lapses into deep sleep.
neuritis [nū-RĪ-tĭs] neur-, nerve + -itis	Inflammation of the nerves.
occlusion [ō-KLŪ-zhŭn]	Blocking of a blood vessel.
oligodendroglioma [ŎL-ĭ-gō-DĔN-drŏ-glī-Ō-mă] oligodendrogli(a) + -oma	Type of glioma formed from oligodendroglia.
palsy [PĂWL-zē]	Partial or complete paralysis.
paresthesia [pār-ĕs-THĒ-zhē-ă] para-, beside + Greek *aisthesia*, sensation	Abnormal sensation, such as tingling.
Parkinson's disease After James Parkinson (1755–1824), British physician	Degeneration of nerves in the brain caused by lack of sufficient dopamine.
petit mal [PĔ-tē măhl] **seizure**	*See* absence seizure.
pyrogenic [pī-rō-JĔN-ĭk] **meningitis** pyro-, fever + -genic, producing	Meningitis caused by bacteria; can be fatal; bacterial meningitis.
radiculitis [ră-dĭk-yū-LĪ-tĭs] radicul-, root + -itis	Inflammation of the spinal nerve roots.

Term	Definition
sciatica [sī-ĂT-ĭ-kă]	Inflammation of the sciatic nerve.
shingles [SHĬNG-glz]	Viral disease affecting the peripheral nerves.
somnambulism [sŏm-NĂM-byū-lĭzm] somno-, sleep + Latin *ambulo*, to walk	Sleepwalking.
somnolence [SŎM-nō-lĕns] Latin, sleepiness	Extreme sleepiness caused by a neurological disorder.
spina bifida [SPĪ-nă BĬF-ĭ-dă] Latin, cleft spine	Congenital defect of the spinal column.
stroke [strōk]	*See* cerebrovascular accident (CVA).
syncope [SĬN-kŏ-pē]	Loss of consciousness due to a sudden lack of oxygen in the brain.
Tay-Sachs [TĀ-săks] **disease**	Hereditary disease that causes deterioration in the central nervous system and, eventually, death.
thrombotic [thrŏm-BŎT-ĭk] **stroke**	Stroke caused by a thrombus.
thrombus [THRŎM-bŭs]	Blood clot.
tics [tĭks]	Twitching movements that accompany some neurological disorders.
tonic-clonic [TŎN-ĭk KLŎN-nĭk] **seizure**	Severe epileptic seizure accompanied by convulsions, twitching, and loss of consciousness.
Tourette [tū-RĔT] **syndrome** After Gilles de la Tourette (1857–1904), French physician	Neurological disorder that causes uncontrollable speech sounds and tics.
transient ischemic [ĭs-KĒ-mĭk] **attack (TIA)**	Short neurological incident usually not resulting in permanent injury, but usually signaling that a larger stroke may occur.
viral meningitis	Meningitis caused by a virus and not as severe as pyrogenic meningitis.

Pathological Terms Exercises

Check Your Knowledge

Fill in the blanks.

137. Palsy is partial or complete _____.

138. Dopamine sometimes helps the symptoms of _____ disease.

139. Inflammation of the spinal nerve roots is called _____.

140. A stationary blood clot is called a(n) _____.

141. A blood clot that moves is called a(n) _____.

142. Abnormally deep sleep with lack of responsiveness is a(n) _____.

143. A mild stroke that may be a signal that a larger stroke will occur is called a(n) _____ _____ _____.

144. _____ seizures are milder than _____ seizures.

145. Multiple sclerosis is usually associated with loss of _____, a covering for nerves.

146. ALS is a disease of the _____ neurons.

Make a Match

Match the definition in the right-hand column with the correct word in the left-hand column.

147. _____ coma
148. _____ shaken baby syndrome
149. _____ glioma
150. _____ duritis
151. _____ aphasia
152. _____ CVA
153. _____ spina bifida
154. _____ TIA
155. _____ syncope
156. _____ dysphasia

a. speech difficulty
b. fainting
c. disruption in brain's blood supply
d. loss of speech
e. short, mild stroke
f. congenital spinal cord disorder
g. abnormally deep sleep
h. brain damage caused by rough handling
i. neurological tumor
j. meningeal inflammation

CASE STUDY

Adjusting the Dosage

When Mr. Gutierrez returns to Dr. Stanley's office after three weeks, he reports that he can button his shirt again and that his walking has improved. He complains, however, that some of his cognitive symptoms have not improved. Dr. Stanley is encouraged that some of the physical symptoms have begun to improve. He will increase the dosage of the anti-Parkinson's medication he has prescribed. He is confident that Mr. Gutierrez will stabilize and possibly even gain strength.

Critical Thinking

157. Many medications cure the symptoms, but not the disease. How might exercise help Mr. Gutierrez regain mobility?
158. What compound does Mr. Gutierrez's medication contain?

Surgical Terms

Neurosurgeons are the specialists who perform surgery on the nervous system, especially on the brain and spinal cord. Neurosurgery is considered high risk because the potential for permanent injury is great. When some brain diseases, such as epilepsy, do not respond well to drugs, they may, in extreme cases, require surgery. A **lobectomy** is removal of a portion of the brain to treat epilepsy and other disorders, such as brain cancer. A **lobotomy,** severing of nerves in the frontal lobe of the brain, was once considered a primary method for treating mental illness. Now it is rarely used. Laser surgery

to destroy damaged parts of the brain is also used to treat some neurological disorders. Often, treatment is a combined approach, using surgery, radiation therapy, chemotherapy, and other medications.

When it is necessary to operate directly on the brain (as in the case of a tumor), a **craniectomy,** removal of part of the skull, or a **craniotomy,** incision into the skull, may be performed. **Trephination** (or **trepanation)** is a circular opening into the skull to operate on the brain or to relieve pressure when there is fluid buildup. **Stereotaxy** or **stereotactic surgery** is the destruction of deep-seated brain structures using three-dimensional coordinates to locate the structures.

Neuroplasty is the surgical repair of a nerve. **Neurectomy** is the surgical removal of a nerve. A **neurotomy** is the dissection of a nerve. A **neurorrhaphy** is the suturing of a severed nerve. A **vagotomy** is the severing of the vagus nerve to relieve pain. **Cordotomy** is an operation to resect (remove part of) the spinal cord.

Brain surgery is often performed using computers and minimal incisions. For up-to-date information, go to www.brain-surgery.com.

Vocabulary Review

In the previous section, you learned terms relating to surgery. Before going on to the exercises, review the terms below and refer to the previous section if you have questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Term	Definition
cordotomy [kŏr-DŎT-ō-mē] Greek *chorde*, cord + -tomy, a cutting	Removing part of the spinal cord.
craniectomy [krā-nē-ĔK-tō-mē] crani-, cranium + -ectomy, removal	Removal of a part of the skull.
craniotomy [krā-nē-ŎT-ō-mē] cranio-, cranium + -tomy	Incision into the skull.
lobectomy [lō-BĔK-tō-mē] lob-, lobe + -ectomy	Removal of a portion of the brain to treat certain disorders.
lobotomy [lō-BŎT-ō-mē] lobo-, lobe + -tomy	Incision into the frontal lobe of the brain.
neurectomy [nū-RĔK-tō-mē] neur-, nerve + -ectomy	Surgical removal of a nerve.
neuroplasty [NŪR-ō-PLĂS-tē] neuro-, nerve + -plasty, repair	Surgical repair of a nerve.
neurorrhaphy [nūr-ŎR-ă-fē] neuro- + -rrhaphy, a suturing	Suturing of a severed nerve.
neurosurgeon [nūr-ō-SĔR-jŭn] neuro- + surgeon	Medical specialist who performs surgery on the brain and spinal cord.
neurotomy [nū-RŎT-ō-mē] neuro- + -tomy	Dissection of a nerve.
stereotaxy, stereotactic [stĕr-ē-ō-TĂK-sē, stĕr-ē-ō-TĂK-tĭk] **surgery** Greek *stereos*, solid + *taxis*, orderly arrangement	Destruction of deep-seated brain structures using three-dimensional coordinates to locate the structures.

Term	Definition
trephination, trepanation [trĕf-ĭ-NĀ-shŭn, trĕp-ă-NĀ-shŭn]	Circular incision into the skull.
vagotomy [vā-GŎT-ō-mē] vag-, vagus nerve + -tomy	Surgical severing of the vagus nerve.

CASE STUDY

Repairing a Neurological Injury

Later in the year, Mr. Gutierrez was seriously injured in a car accident. He experienced some nerve damage in his leg. A neurosurgeon was called in to see if she could repair enough of the leg nerves to allow Mr. Gutierrez to walk. She operated, and the results were mixed. The trauma of the accident seemed to worsen some of the symptoms of Parkinson's disease, but Mr. Gutierrez experienced improvement with his walking after undergoing physical therapy. The neurologist decided not to increase Mr. Gutierrez's medication and to give him time to overcome the trauma.

Critical Thinking

159. The damaged leg nerves could actually be a result of an injury elsewhere in the body. What particular nerves or areas might the neurosurgeon examine before determining exactly where to operate?

160. Traumas can temporarily change body chemistry. The body produces dopamine naturally. Why did the doctor not increase the dosage?

SURGICAL TERMS EXERCISES

Check Your Knowledge

Fill in the blanks.

161. An incision into the skull is a(n) _____.

162. Removal of a portion of the skull is a(n) _____.

163. A circular skull incision is _____.

164. The incision into the frontal lobe is called a(n) _____.

165. The removal of a portion of the brain is called a(n) _____.

166. Suturing of a severed nerve is _____.

167. Removal of a nerve is _____.

168. Repair of a nerve is _____.

169. Vagotomy is severing the _____ nerve.

170. Removing a part of the spinal cord is a _____.

Pharmacological Terms

The nervous system can be the site of severe pain. **Analgesics** relieve pain. Other problems of the nervous system may be associated with diseases such as epilepsy. **Anticonvulsants** are often used to treat epilepsy and other disorders to lessen or prevent convulsions. **Narcotics** relieve pain by inducing a stuporous or euphoric state. **Sedatives** and **hypnotics** relax the nerves and sometimes induce sleep. **Anesthetics** block feelings or sensation and are used in surgery. Anesthetics can be given *locally* (to numb sensation to one section of the body) or *generally* (to numb sensation to the entire body).

TABLE 8-4 Medications for the Nervous System

Drug Class	Purpose	Generic	Trade Name
analgesic	relieves or eliminates pain	salicylates (aspirin) acetaminophen acetaminophen and codeine ibuprofen	various Tylenol, various Tylenol #3 Advil, Motrin, Nuprin
local anesthetic	causes loss of sensation in a localized area of the body	lidocaine procaine	Lidoderm Novocain
general anesthetic	causes loss of senstion over the whole body	enflurane propofol ketamine midazolam	Ethrane Diprivan Ketalar Versed
anticonvulsant	lessens or prevents convulsions	phenobarbital carbamazeprine clonazepam phenytoin	Luminal, Solfoton Tegretol Klonopin Dilantin
sedative/hypnotic	relieves feeling of agitation; induces sleepiness	diazepam zolpidem methaqualone meprobamate	Valium Ambien Quaalude Miltown

Table 8-4 lists some of the common pharmacological agents prescribed for the nervous system.

Vocabulary Review

In the previous section, you learned terms relating to pharmacology. Before going on to the exercises, review the terms below and refer to the previous section if you have questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Term	Definition
analgesic [ăn-ăl-JĒ-zĭk] Greek *analgesia*, insensibility	Agent that relieves or eliminates pain.
anesthetic [ăn-ĕs-THĔT-ĭk] Greek *anaisthesia*, without sensation	Agent that causes loss of feeling or sensation.
anticonvulsant [ĂN-tē-kŏn-VŬL-sănt] anti-, against + convulsant	Agent that lessens or prevents convulsions.
hypnotic [hĭp-NŎT-ĭk] Greek *hypnotikos*, inducing sleep	Agent that induces sleep.
narcotic [năr-KŎT-ĭk] Greek *narkotikos*, numbing	Agent that relieves pain by inducing a stuporous or euphoric state.
sedative [SĔD-ă-tĭv] Latin *sedativus*	Agent that relieves feelings of agitation.

CASE STUDY

Easing Pain with Medication

Mr. Gutierrez's internist, Dr. Chin, visited him in the hospital daily. She reconsidered all his medications in light of his trauma. She checked all the medications for any side effects that might be harmful and for any possible interactions among the medications. She ordered a sedative and a mild painkiller, to be taken as needed. Dr. Chin also made notes for the nutritionist, now that Mr. Gutierrez will have to stay in the hospital for at least three more weeks.

Critical Thinking

171. Pain management is a delicate art. Physicians have to consider the addictive nature and strong side effects of many painkillers while at the same time making the patient comfortable enough to recover. Many physicians and medical ethicists have endorsed the unlimited use of pain medication for those with terminal diseases. What might explain the reluctance of some practitioners to allow unlimited painkillers?

172. What might Dr. Chin ask the nutritionist to consider for Mr. Gutierrez in the next three weeks?

PHARMACOLOGICAL TERMS EXERCISES

Check Your Knowledge

Fill in the blanks.

173. An agent that induces sleep is called a(n) _____.

174. An agent that causes loss of feeling is called a(n) _____.

175. An agent that relieves nervousness is called a(n) _____.

176. A drug prescribed for epilepsy is probably a(n) _____.

177. Pain is relieved with a(n) _____.

178. A pain reliever that induces a euphoric state is a(n) _____.

CHALLENGE SECTION

Dr. Stanley has a 72-year-old patient whose diagnosis of a sleep disorder does not fit with some of the symptoms she is now experiencing. Dr. Stanley gives the patient, Mary Carpenter, a full physical exam and records notes on her chart.

The patient has had sleep difficulties since her CABG (coronary artery bypass graft) in 2004. She falls asleep easily but awakens 1 to 2 hours later and then sleeps little through the night. In the last two years she has noted increased difficulty in remembering names, numbers, and how to do things. She lost her way while driving, and her family wishes her to surrender her license. She has had intermittent numbness in her fingers and legs and seems more unsteady on her feet.

Objective:

General: very slow and wobbly gait.

Vitals: Wt. 160 P 56 BP 112/72 R 16 Temp. 97.3

Chest: Clear to percussion and auscultation

Neurologic: Cereb: F-F H-K doing well.; Motor: Symmetric strength and tone; Reflex: Symmetric; Sense: Normal vibratory sense; Gave date; Cannot spell easy words backwards.

Critical Thinking

Dr. Stanley tested physical and cognitive functions. He noted that Mary's family wanted her license surrendered and seemed to be legitimately worried about her ability to concentrate. What disease might Dr. Stanley be considering as a diagnosis? Does a sleep disorder affect cognitive functioning?

Terminology in Action

The following chart is for a 30-year-old. Write a brief paragraph discussing his current health and what steps he should be taking in light of his genetic profile.

Patient: Elijah Cannon December 24, 2XXX

SUBJECTIVE: Patient has had daily headaches for 5 days. He has intermittent nausea and vomiting with the headaches. He also complains of flashing lights in the right eye for a few minutes before the onset of a headache. The headaches are not associated with any time of the day or activity. He is in general good health. Anti-inflammatory medications do not offer improvement. Cafergot has been prescribed in the past. Mother died after complications following a CVA at age 55.

OBJECTIVE:

EARS: TMs are clear.

EYES: Normal discs and venous pulsations.

MOUTH AND THROAT: Clear.

FACE: Sinus percussion reveals no tenderness.

NECK: Supple without tenderness or rigidity.

NEUROLOGIC: Cranial nerves II-XII are intact. Muscle strength and coordination normal.

ASSESSMENT: Vascular, cluster, or migraine variant.

PLAN: Midrin capsules two q.4h. p.r.n. at first sign of headache. Recheck p.r.n. or immediately if symptoms worsen. Discuss long-term issues relating to mother's early death following a CVA.

Using the Internet

Go to the Alzheimer's Association Web site (http://www.alz.org) and write a paragraph on recent developments in Alzheimer's research. Also, list the stages of Alzheimer's disease.

CHAPTER REVIEW

The material that follows is to help you review all the material in this chapter.

Understanding Nervous Systems Terms

For the following definitions, write the correct term in the space provided.

179. star-shaped neuroglia; maintain nutrient and chemical levels in the neurons _____
180. conveys information to the muscles and glands from CNS _____
181. thin branching extensions of the cell body _____
182. portion of the brain that controls voluntary movements, emotional expression, and moral behavior _____
183. consists of the brain and spinal cord _____
184. made up of the midbrain, pons, and medulla oblongata _____
185. the largest portion of the brain, with two hemispheres _____
186. strong bony structure that protects the brain _____
187. the three layers of connective tissue membranes that cover the brain and spinal cord _____
188. carries impulses to and from the brain and includes 12 pairs of cranial nerves and 31 pairs of spinal nerves _____
189. receives and process sensory input from the skin, muscles, tendons, joints, eyes, tongue, nose, and ears _____
190. chemical that stimulates cells _____
191. considered the "basic element" of the nervous system _____
192. conducts nerve impulses away from the cell body _____
193. neurons that carry information from sensory receptors to the central nervous system _____
194. produce myelin and help support neurons _____
195. permits some chemical substances to reach the brain's neurons but blocks others _____
196. portion of the brain that controls and interprets the senses and taste _____
197. area of the brain that coordinates musculoskeletal movement to maintain posture, balance, and muscle tone _____
198. congenital disease causing a defect in the spinal column _____
199. overproduction of fluid in the brain _____
200. hereditary disease with uncontrollable, jerking movements and progressive loss of neural control _____
201. a degeneration of nerves in the brain, causing tremors, weakness of muscles, and difficulty in walking _____

202. viral disease caused by the herpes zoster virus _____
203. mild epileptic seizure consisting of brief disorientation _____
204. abnormally deep sleep with little or no response to stimuli _____
205. deterioration in mental capacity, usually in the elderly _____
206. brain injury due to trauma _____
207. sleepwalking _____
208. twitching movements that accompany some neurological conditions _____

True or False

Circle T for true or F for false.

209. Spina bifida may cause paralysis. T F
210. A transient ischemic attack (TIA) causes death of affected brain cells. T F
211. CT stands for carinothoracic. T F
212. Epilepsy is a brain disorder characterized by recurrent seizures. T F
213. Sciatica causes nerve pain in the legs.T F
214. A CVA causes death of the affected brain cells. T F
215. A form of facial paralysis affecting one or both sides of the face and usually temporary is called Bell's palsy. T F
216. Medications prescribed to relieve pain are called analgesics. T F
217. A surgical procedure to sever nerves in the frontal lobe of the brain is called a lobectomy. T F

Remembering Prefixes

Match the following prefixes commonly used with nervous system terms with their correct meaning.

218. _____ hemi-
219. _____ poly-
220. _____ dys-
221. _____ eu-
222. _____ iso-
223. _____ bi-
224. _____ infra-
225. _____ para-
226. _____ a-, an-
227. _____ quadri-, quadra-

a. positioned beneath
b. half
c. four
d. equal
e. without
f. difficult, abnormal
g. beside, involving two parts
h. normal
i. many
j. two

Word Building

Using word parts you have learned in this chapter, build the correct medical terms for the following definitions.

228. any disease of the mind _____
229. condition of difficulty speaking _____
230. pertaining to below the dura mater _____
231. paralysis of four limbs _____

232. record of the electrical impulses of the brain _____
233. excision of a nerve _____
234. tumor of the meninges _____
235. nerve weakness _____
236. softening of the brain _____
237. protrusion of the meninges _____
238. disease of nerves and joints _____
239. recording of impulses of the brain _____
240. inflammation of a nerve _____
241. pertaining to within the cerebrum _____
242. physician who treats and studies diseases of the nervous system _____
243. paralysis of one limb _____
244. inflammation of many nerves _____
245. disease of the nerves _____
246. incision into a nerve root _____
247. slight paralysis of one limb _____
248. originating in the mind _____
249. specialist of the mind _____
250. pain in a nerve _____
251. process of recording the electrical impulses of the brain _____
252. pertaining to the mind and the body _____
253. protrusion of the meninges and spinal cord _____
254. the study of nerves _____
255. paralysis of half of the body _____
256. loss of feeling or sensation _____
257. pertaining to the cerebrum _____

Definitions

Define the following terms and combining forms. Review the chapter before starting. Make sure you know how to pronounce each term as you define it. The blue words in curly brackets are references to the Spanish glossary is available online at www.mhhe.com/medterm3e.

Word

258. absence seizure [SĒ-zhŭr]
259. acetylcholine [ăs-ē-tĭl-KŌ-lēn] {acetilcolina}
260. afferent [ĂF-ĕr-ĕnt] (sensory) neuron
261. agnosia [ăg-NŌ-zhē-ă] {agnosia}
262. Alzheimer's [ĂLTS-hī-mĕrz] disease
263. amnesia [ăm-NĒ-zhē-ă] {amnesia}
264. amyotrophic lateral sclerosis [ă-mī-ō-TRŌ-fĭk LĂT-ĕr-ăl sklĕ-RŌ-sĭs] (ALS)
265. analgesic [ăn-ăl-JĒ-zĭk]
266. anesthetic [ăn-ĕs-THĔT-ĭk]

Word

267. aneurysm [ĂN-yū-rĭzm] {aneurisma}
268. anticonvulsant [ĂN-tē-kŏn-VŬL-sănt]
269. aphasia [ă-FĀ-zhē-ă] {afasia}
270. apraxia [ă-PRĂK-sē-ă] {apraxia}
271. arachnoid [ă-RĂK-nŏyd] {aracnoideo}
272. astrocyte [ĂS-trō-sīt], astroglia [ăs-TRŎG-lē-ă] {astrocito, astroglia}
273. astrocytoma [ĂS-trō-sī-TŌ-mă] {astrocitoma}
274. ataxia [ă-TĂK-sē-ă] {ataxia}
275. aura [ĂW-ră] {aura}
276. autonomic [ăw-tō-NŎM-ĭk] nervous system
277. axon [ĂK-sŏn] {axón}
278. bacterial meningitis [mĕn-ĭn-JĪ-tĭs]
279. Babinski's [bă-BĬN-skēz] reflex
280. basal ganglia [BĀ-săl GĂNG-glē-ă]
281. Bell's palsy [PĂWL-zĕ]
282. brain [brān] {cerebro}
283. brain contusion [kŏn-TŪ-zhŭn]
284. brainstem {tronco encefálico}
285. cell body
286. central nervous system
287. cerebell(o)
288. cerebellitis [sĕr-ĕ-bĕl-Ī-tĭs] {cerebelitis}
289. cerebellum [sĕr-ĕ-BĔL-ŭm]
290. cerebr(o), cerebri
291. cerebral [SĔR-ē-brăl] angiogram
292. cerebral cortex [KŌR-tĕks]
293. cerebral infarction [ĭn-FĂRK-shŭn]
294. cerebral palsy [PĂWL-zē]
295. cerebrospinal [SĔR-ĕ-brō-spī-năl] fluid (CSF)
296. cerebrovascular [SĔR-ĕ-brō-VĂS-kyū-lăr] accident (CVA)
297. cerebrum [SĔR-ĕ-brŭm, sĕ-RĒ-brŭm] {cerebrum}
298. coma [KŌ-mă] {coma}
299. computerized (axial) tomography [(ĂKS-ē-ăl) tō-MŎG-ră-fē] (CT or CAT) scan
300. concussion [kŏn-KŬSH-ŭn] {concusión}
301. conductivity [kŏn-dŭk-TĬV-ĭ-tē] {conductividad}
302. convolution [kŏn-vō-LŪ-shŭn] {circunvolución}
303. cordotomy [kōr-DŎT-ō-mē] {cordotomía}
304. corpus callosum [KŌR-pŭs kă-LŌ-sŭm]
305. crani(o)
306. cranial [KRĀ-nē-ăl] nerves
307. craniectomy [krā-nē-ĔK-tō-mē] {craniectomía}
308. craniotomy [krā-nē-ŎT-ō-mē] {craneotomía}
309. cranium [KRĀ-nē-ŭm] {cráneo}
310. dementia [dē-MĔN-shē-ă] {demencia}
311. demyelination [dē-MĪ-ĕ-lĭ-NĀ-shŭn] {desmielinación}
312. dendrite [DĔN-drīt] {dendrita}
313. diencephalon [dī-ĕn-SĔF-ă-lŏn] {diencéfalo}
314. dopamine [DŌ-pă-mēn] {dopamina}
315. dura mater [DŪ-ră MĀ-tĕr]
316. duritis [dū-RĪ-tĭs]
317. dysphasia [dĭs-FĀ-zhē-ă] {disfasia}
318. efferent [ĔF-ĕr-ĕnt] (motor) neuron
319. electroencephalogram [ē-LĔK-trō-ĕn-SĔF-ă-lō-grăm] (EEG) {electroencefalógrafo}
320. embolic [ĕm-BŎL-ĭk] {émbolo} stroke
321. embolus [ĔM-bō-lŭs]
322. encephal(o)
323. encephalitis [ĕn-sĕf-ă-LĪ-tĭs] {encefalitis}
324. encephalogram [ĕn-SĔF-ă-lō-grăm] {encefalograma}
325. epidural [ĕp-ĭ-DŪ-răl space
326. epilepsy [ĔP-ĭ-LĔP-sē] {epilepsia}
327. epithalamus [ĔP-ĭ-THĂL-ă-mŭs] {epitálamo}
328. evoked potentials [ē-VŌKT pō-TĔN-shălz]
329. excitability [ĕk-SĪ-tă-BĬL-ĭ-tē] {excitabilidad}
330. fainting
331. fissure [FĬSH-ŭr] {fisura}
332. frontal lobe
333. gait [gāt] {marcha}
334. gangli(o)
335. gangliitis [găng-glē-Ī-tĭs] {ganglitis}
336. ganglion (*pl.* ganglia, ganglions) [GĂNG-glē-ŏn (-a, -ons)] {ganglio}
337. gli(o)
338. glioblastoma multiforme [GLĪ-ō-blăs-TŌ-mă MŬL-tĭ-fŏrm]
339. glioma [glī-Ō-mă] {glioma}
340. grand mal [măhl] seizure

Word

341. gyrus (*pl.*, gyri) [JĪ-rŭs (JĪ-rī)] {circunvolución}
342. hemorrhagic [hĕm-ō-RĂJ-ĭk] stroke
343. Huntington's chorea [kōr-Ē-ă]
344. hydrocephalus [hī-drō-SĔF-ă-lŭs] {hidrocefalia}
345. hypnotic [hĭp-NŎT-ĭk]
346. hypothalamus [HĪ-pō-THĂL-ă-mŭs] {hipotálamo}
347. interneuron [ĬN-tĕr-NŪ-rŏn] {interneurona}
348. lobectomy [lō-BĔK-tō-mē] {lobotomía}
349. lobotomy [lō-BŎT-ō-mē]
350. Lou Gehrig's [GĔR-ĭgz] disease
351. lumbar [LŬM-băr] (spinal) puncture
352. medulla oblongata [mĕ-DŪL-ă ŏb-lŏng-GĂ-tă]
353. mening(o), meningi(o)
354. meninges (*sing.*, meninx) [mĕ-NĬN-jēz (MĒ-nĭngks)] {meninges}
355. meningioma [mĕ-NĬN-jē-Ō-mă] {meningioma}
356. meningitis [mĕn-ĭn-JĪ-tĭs] {meningitis}
357. meningocele [mĕ-NĬNG-gō-sēl] {meningocele}
358. meningomyelocele [mĕ-nĭng-gō-MĪ-ĕ-lō-sēl] {meningomielocele}
359. microglia [mī-KRŎG-lē-ă] {microglia}
360. midbrain {cerebro medio}
361. multiple sclerosis [MŬL-tĭ-pŭl sklĕ-RŌ-sĭs] (MS)
362. myasthenia gravis [mī-ăs-THĒ-nē-ă GRĂV-ĭs]
363. myel(o)
364. myelin sheath [MĪ-ĕ-lĭn shēth]
365. myelitis [mī-ĕ-LĪ-tĭs]
366. myelogram [MĪ-ĕ-lō-grăm] {mielograma}
367. narcolepsy [NĂR-kō-lĕp-sē] {narcolepsia}
368. narcotic [năr-KŎT-ĭk]
369. nerve [nĕrv] {nervio}
370. nerve cell
371. nerve conduction velocity
372. nerve impulse
373. neur(o), neuri
374. neurectomy [nū-RĔK-tō-mē] {neurectomía}
375. neurilemma [nūr-ĭ-LĔM-ă] {neurilema}
376. neuritis [nū-RĪ-tĭs] {neuritis}
377. neuroglia [nū-RŎG-lē-ă], neuroglial [nū-RŎG-lē-ăl] cell
378. neuron [NŪR-ŏn] {neurona}
379. neuroplasty [NŪR-ō-PLĂS-tē]
380. neurorrhaphy [nūr-ŌR-ă-fē]
381. neurosurgeon [nūr-ō-SĔR-jŭn] {neurocirujano}
382. neurotomy [nū-RŎT-ō-mē]
383. neurotransmitter [NŪR-ō-trănz-MĬT-ĕr] {neurotramisor}
384. occipital lobe [ŏk-SĬP-ĭ-tăl lōb]
385. occlusion [ō-KLŪ-zhŭn] {oclusión}
386. oligodendroglia [ŌL-ĭ-gō-dĕn-DRŎG-lē-ă] {oligodendroglia}
387. oligodendroglioma [ŌL-ĭ-gō-DĔN-drŏ-glī-Ō-mă] {oligodendroglioma}
388. palsy [PĂWL-zē] {parálisis}
389. parasympathetic [păr-ă-sĭm-pă-THĔT-ĭk] nervous system
390. paresthesia [păr-ĕs-THĒ-zhē-ă]
391. parietal lobe [pă-RĪ-ĕ-tăl lōb]
392. Parkinson's disease
393. PET (positron emission tomography) {TEP}
394. petit mal [PĔ-tē măhl] seizure
395. pia mater [PĪ-ă, PĒ-ă MĀ-tĕr, MĂ-tĕr)] {piamadre}
396. polysomnography [PŎL-ē-sŏm-NŎG-ră-fē] (PSG)
397. pons [pŏnz] {pons}
398. pyrogenic [pī-rō-JĔN-ĭk] meningitis
399. radiculitis [ră-dĭk-yū-LĪ-tĭs] {radiculitis}
400. receptor [rē-SĔP-tĕr] {receptor}
401. reflex [RĒ-flĕks] {reflejo}
402. sciatica [sī-ĂT-ĭ-kă] {ciática}
403. sedative [SĔD-ă-tĭv]
404. shingles [SHĬNG-glz] {culebrilla}
405. somatic [sō-MĂT-ĭk] nervous system
406. somnambulism [sŏm-NĂM-byū-lĭzm] {sonambulismo}
407. somnolence [SŎM-nō-lĕns] {somnolencia}
408. SPECT (single photon emission computed tomography) brain scan

WORD

409. spin(o)
410. spina bifida [SPĪ-nă BĬF-ĭ-dă]
411. spinal cord
412. spinal nerves
413. stereotaxy [stĕr-ē-ō-TĂK-sē], stereotactic [stĕr-ē-ō-TĂK-tĭk] surgery
414. stimulus (*pl.*, stimuli) [STĬM-yū-lŭs (STĬM-yū-lī)] {estimulo}
415. stroke [strōk] {accidente cerebrovascular}
416. subdural [sŭb-DŪR-ăl] space
417. sulcus (*pl.*, sulci) [SŬL-kŭs (SŬL-sī)] {surco}
418. sympathetic [sĭm-pă-THĔT-ĭk] nervous system
419. synapse [SĬN-ăps] {sinapsis}
420. syncope [SĬN-kŏ-pē] {síncope}
421. Tay-Sachs [TĀ-săks] disease
422. temporal lobe [TĔM-pō-răl lōb]
423. terminal end fibers
424. thalam(o)
425. thalamus [THĂL-ă-mŭs] {tálamo}
426. thrombotic [thrŏm-BŎT-ĭk] stroke
427. thrombus [THRŎM-bŭs] {trombo}
428. tic [tĭk] {tic}
429. tonic-clonic [TŎN-ĭk KLŎN-nĭk] seizure
430. transcranial sonogram [trănz-KRĀ-nē-ăl SŌN-ō-grăm]
431. trephination [trĕf-ĭ-NĀ-shŭn], trepanation [trĕp-ă-NĀ-shŭn]
432. Tourette [tū-RĔT] syndrome
433. transient ischemic [ĭs-KĒ-mĭk] attack (TIA)
434. vag(o)
435. vagotomy [vā-GŎT-ō-mē]
436. ventral thalamus
437. ventricle [VĔN-trĭ-kl] {ventrículo}
438. ventricul(o)
439. viral meningitis

Abbreviation

Write out the full meaning of each abbreviation.

ABBREVIATION

440. ACH
441. ALS
442. BBB
443. CNS
444. CP
445. CSF
446. CT OR CAT SCAN
447. CVA
448. CVD
449. PNS

Name _____ Date _____

Chapter 8: Word- Building (20 questions—1 pts. each)

Using the following combining forms, complete the word that best fits the definition of each word relating to the nervous system listed below. Combining forms may be used more than once.

cerebell(o)	gli(o)	thalam(o)
cerebr(o)	mening(o)	vag(o)
crani(o)	myel(o)	ventricul(o)
encephal(o)	neur(o)	
gangli(o)	spin(o)	

1. Of the blood supply in the brain: _____ vascular
2. Early neural cell: _____ blast
3. Repair of the skull: _____ plasty
4. Hardening of the brain: _____ sclerosis
5. Inflammation of the meninges, brain, and spinal cord: _____ encephalomyelitis
6. Inflammation of the cerebellum: _____ itis
7. Of the thalamus and cerebral cortex: _____ cortical
8. Nerve pain: _____ algia
9. Dissolving of a ganglion: _____ lysis
10. Inflammation of the brain and spinal cord: _____ myelitis
11. Opening in a ventricle: _____ stomy
12. Of the cerebrum and spinal cord: _____ spinal
13. Attracted to the vagus nerve: _____ tropic
14. Study of drugs that affect nerves: _____ pharmacology
15. Instrument for measuring the skull: _____ meter
16. Mimicking the vagus nerve: _____ mimetic
17. Hemorrhage from the meninges: _____ rrhagia
18. Incision into the cerebrum: _____ tomy
19. Nervous system surgery: _____ surgery
20. Shaped like a ganglion: _____ form