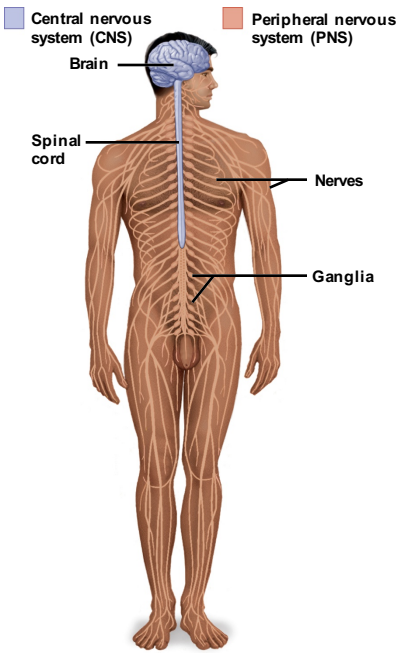
Fig. 12.1



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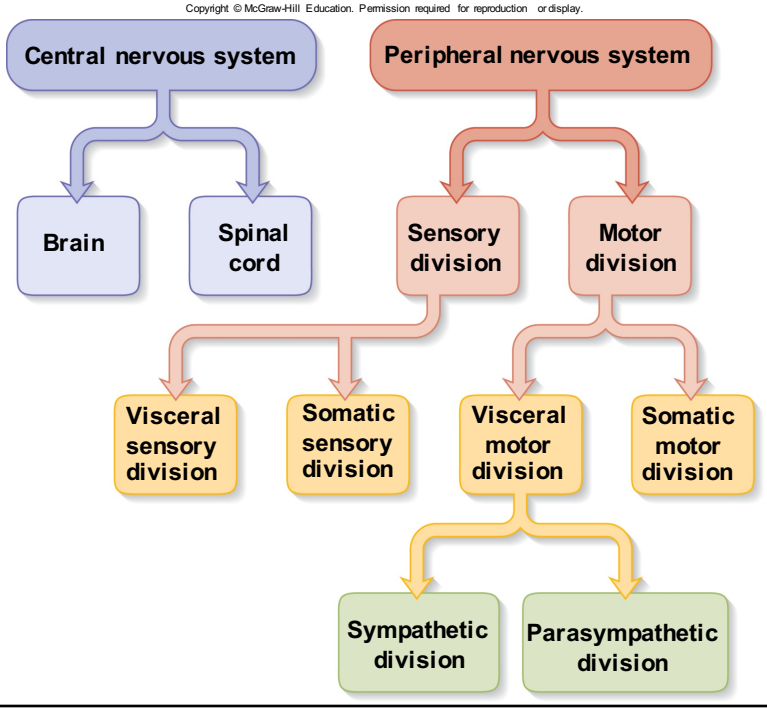

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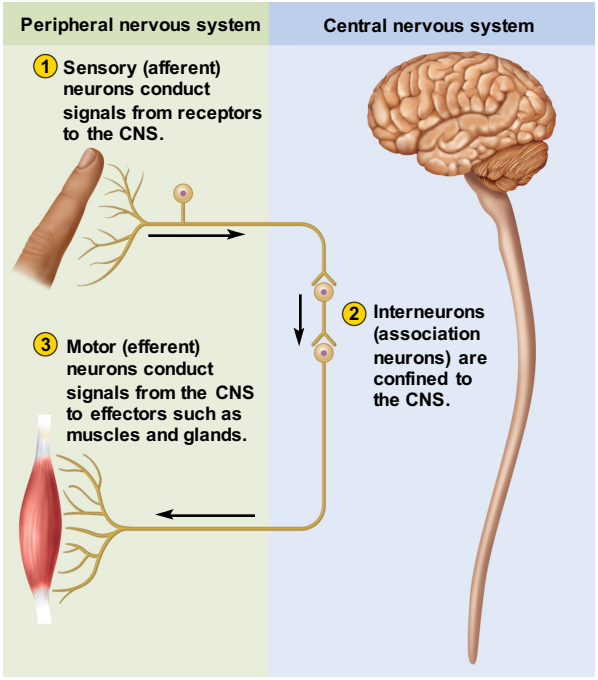

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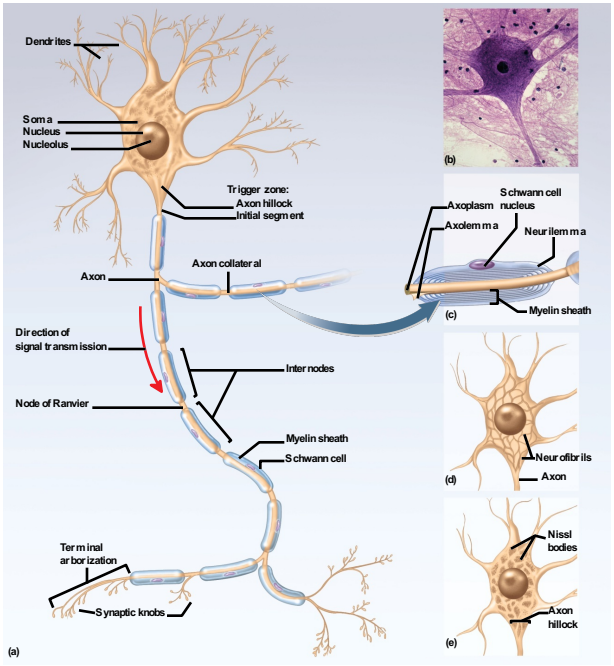

b: ©Ed Reschke

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Fig. 12.5

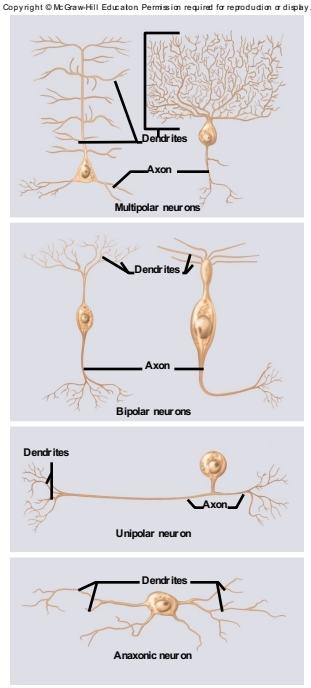

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Table 12.1

TABLE 12.1	Types of Glial Cells
Types	**Functions**
Neuroglia of CNS	
Oligodendrocytes	Form myelin in brain and spinal cord
Ependymal cells	Line cavities of brain and spinal cord; secrete and circulate cerebrospinal fluid
Microglia	Phagocytize and destroy microorganisms, foreign matter, and dead nervous tissue
Astrocytes	Cover brain surface and nonsynaptic regions of neurons; form supportive framework in CNS; induce formation of blood–brain barrier; nourish neurons; produce growth factors that stimulate neurons; communicate electrically with neurons and may influence synaptic signaling; remove K^+ and some neurotransmitters from ECF of brain and spinal cord; help to regulate composition of ECF; form scar tissue to replace damaged nervous tissue
Neuroglia of PNS	
Schwann cells	Form neurilemma around all PNS nerve fibers and myelin around most of them; aid in regeneration of damaged nerve fibers
Satellite cells	Surround somas of neurons in the ganglia; provide electrical insulation and regulate chemical environment of neurons

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Fig. 12.6

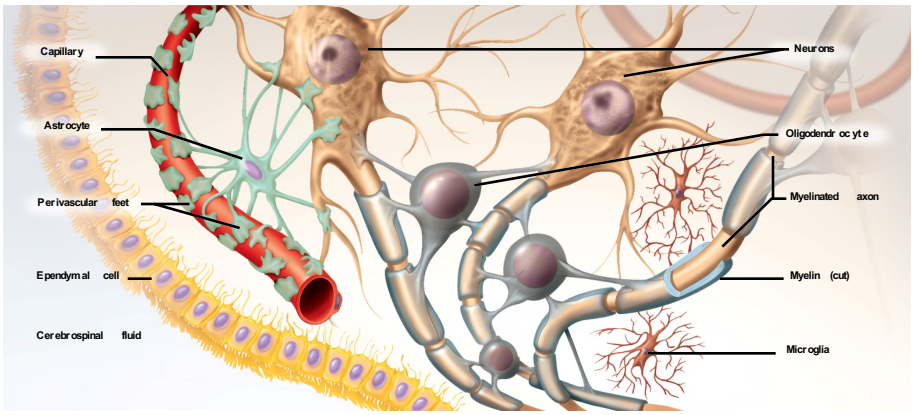

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Fig. 12.7

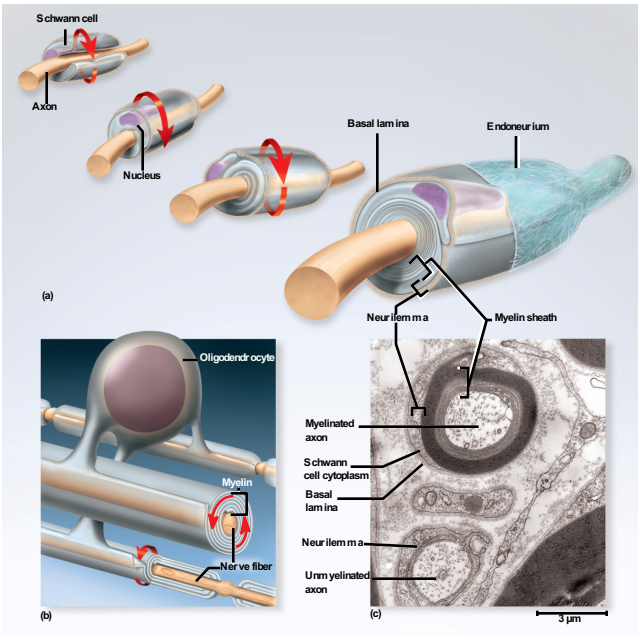

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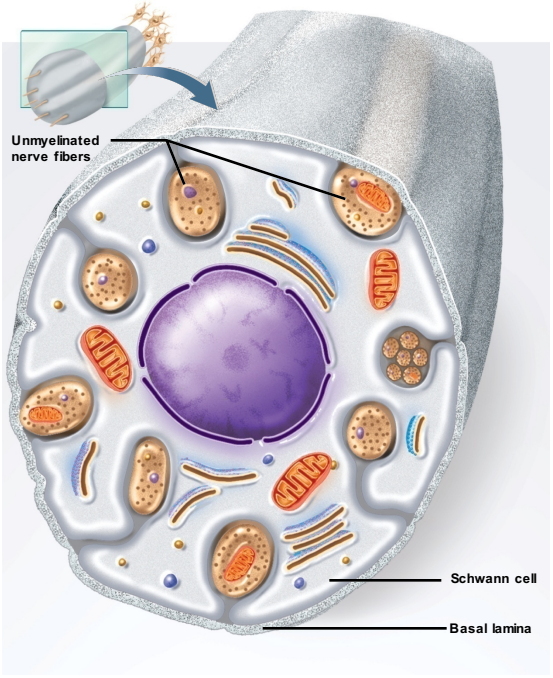
Fig. 12.8



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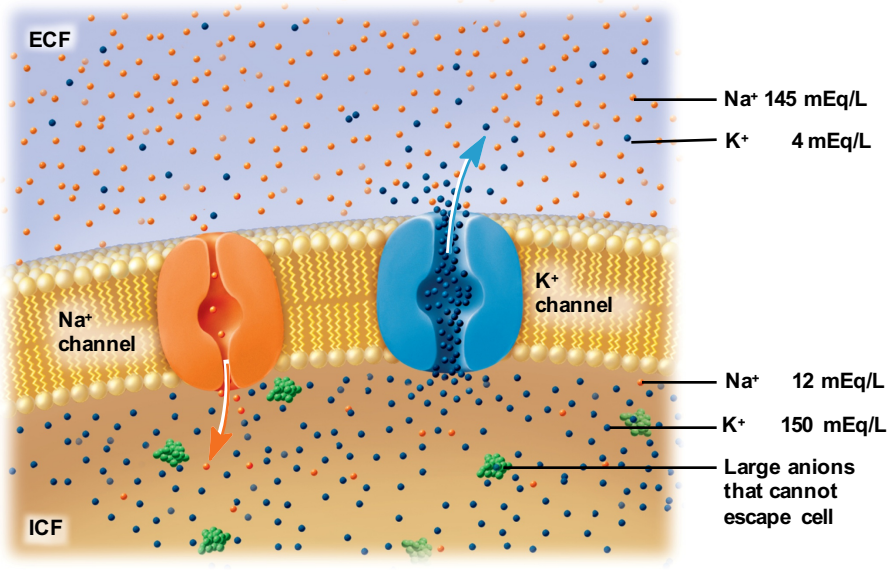

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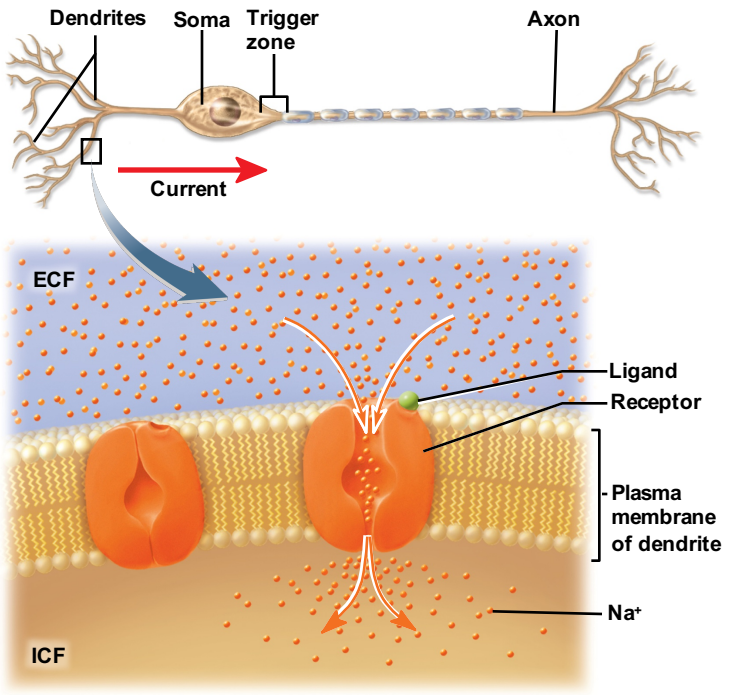

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Table 12.2

TABLE 12.2 Comparison of Local Potentials and Action Potentials

Local Potential	Action Potential
Produced by gated channels on the dendrites and soma	Produced by voltage-gated channels on the trigger zone and axon
May be a positive (depolarizing) or negative (hyperpolarizing) voltage change	Always begins with depolarization
Graded; proportional to stimulus strength	All or none; either does not occur at all or exhibits the same peak voltage regardless of stimulus strength
Reversible; returns to RMP if stimulation ceases before threshold is reached	Irreversible; goes to completion once it begins
Local; has effects for only a short distance from point of origin	Self-propagating; has effects a great distance from point of origin
Decremental; signal grows weaker with distance	Nondecremental; signal maintains same strength regardless of distance

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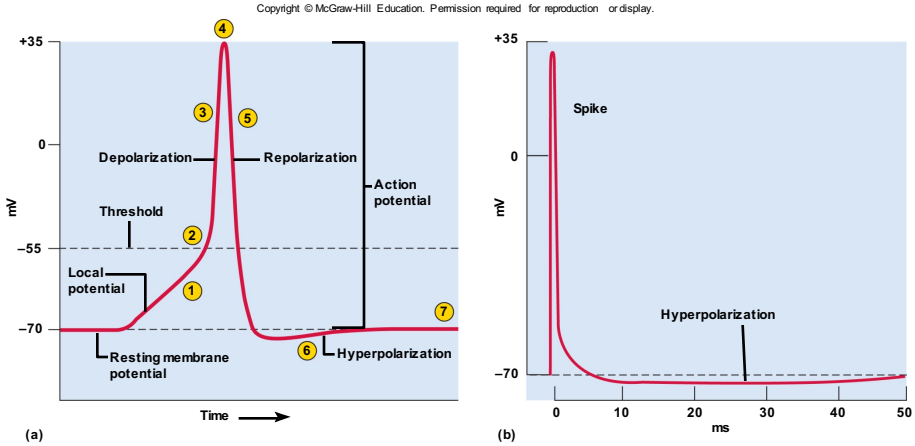
Fig. 12.13



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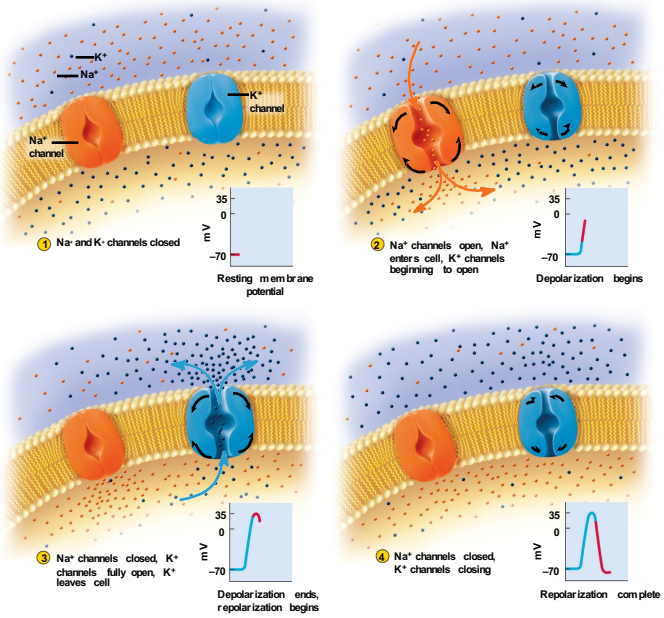

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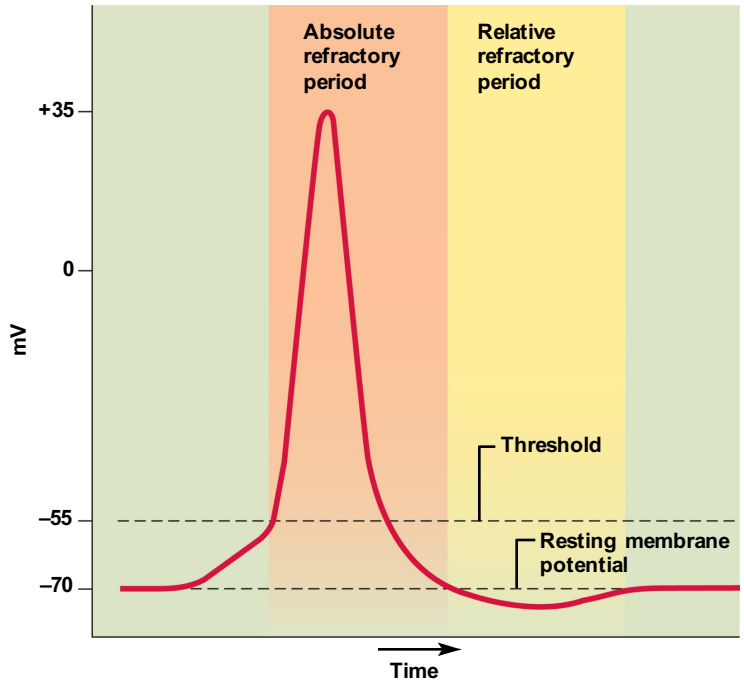

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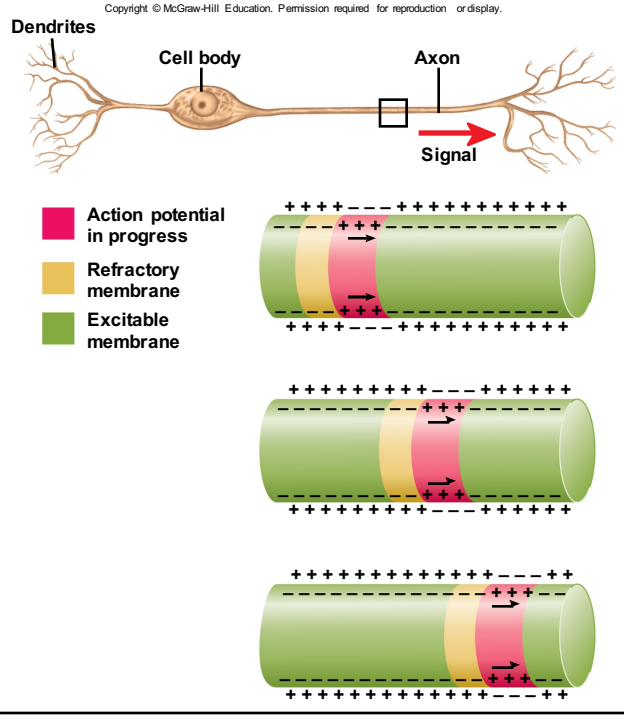
Fig. 12.16



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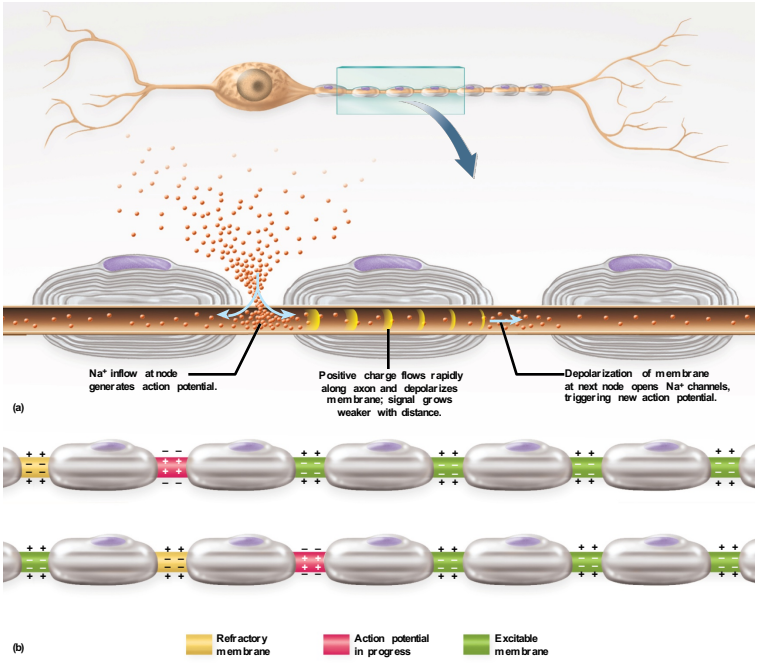

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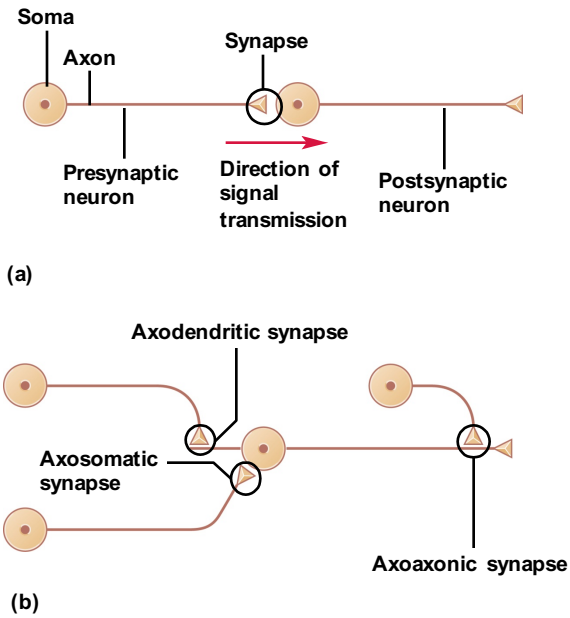

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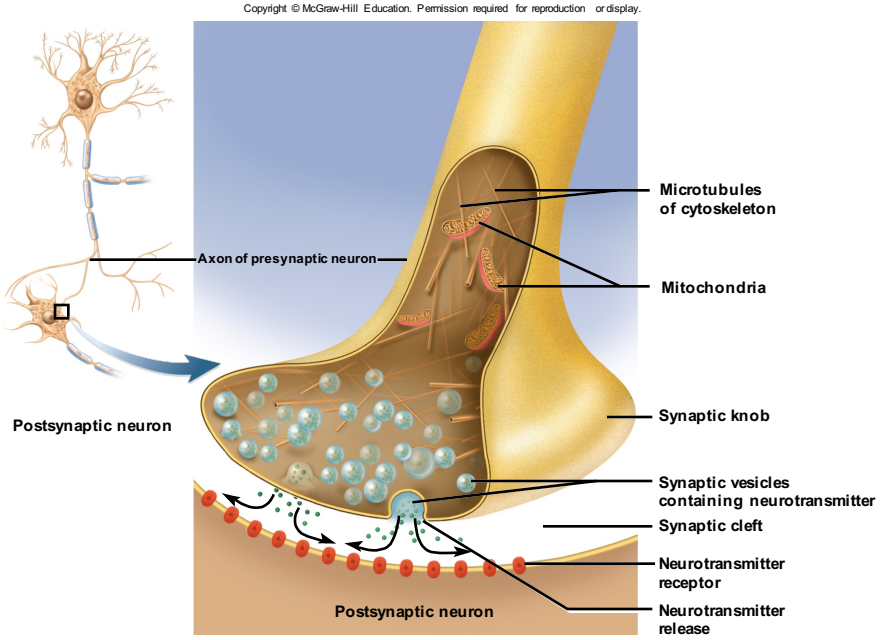

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Table 12.3

TABLE 12.3	Neurotransmitters (Selected Examples)
Name	**Locations and Actions**
Acetylcholine (ACh)	Neuromuscular junctions, most synapses of autonomic nervous system, retina, and many parts of the brain; excites skeletal muscle, inhibits cardiac muscle, and has excitatory or inhibitory effects on smooth muscle and glands depending on location
Amino acids	
Glutamate	Cerebral cortex and brainstem; accounts for about 75% of all excitatory synaptic transmission in the brain; involved in learning and memory
Aspartate	Spinal cord; effects similar to those of glutamate
Glycine	Inhibitory neurons of the brain, spinal cord, and retina; most common inhibitory neurotransmitter in the spinal cord
GABA	Thalamus, hypothalamus, cerebellum, occipital lobes of cerebrum, and retina; the most common inhibitory neurotransmitter in the brain
Monoamines	
Norepinephrine	Sympathetic nervous system, cerebral cortex, hypothalamus, brainstem, cerebellum, and spinal cord; involved in dreaming, waking, and mood; excites cardiac muscle; can excite or inhibit smooth muscle and glands depending on location
Epinephrine	Hypothalamus, thalamus, spinal cord, and adrenal medulla; effects similar to those of norepinephrine
Dopamine	Hypothalamus, limbic system, cerebral cortex, and retina; highly concentrated in substantia nigra of midbrain; involved in elevation of mood and control of skeletal muscles
Serotonin	Hypothalamus, limbic system, cerebellum, retina, and spinal cord; also secreted by blood platelets and intestinal cells; involved in sleepiness, alertness, thermoregulation, and mood
Histamine	Hypothalamus; also a potent vasodilator released by mast cells of connective tissue and basophils of the blood
Neuropeptides	
Substance P	Basal nuclei, midbrain, hypothalamus, cerebral cortex, small intestine, and pain-receptor neurons; mediates pain transmission
Enkephalins	Hypothalamus, limbic system, pituitary, pain pathways of spinal cord, and nerve endings of digestive tract; act as analgesics (pain relievers) by inhibiting substance P; inhibit intestinal motility; secretion increases sharply in women in labor
β-endorphin	Digestive tract, spinal cord, and many parts of the brain; also secreted as a hormone by the pituitary; suppresses pain; reduces perception of fatigue and may produce "runner's high" in athletes
Cholecystokinin	Cerebral cortex and small intestine; suppresses appetite

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Fig. 12.21

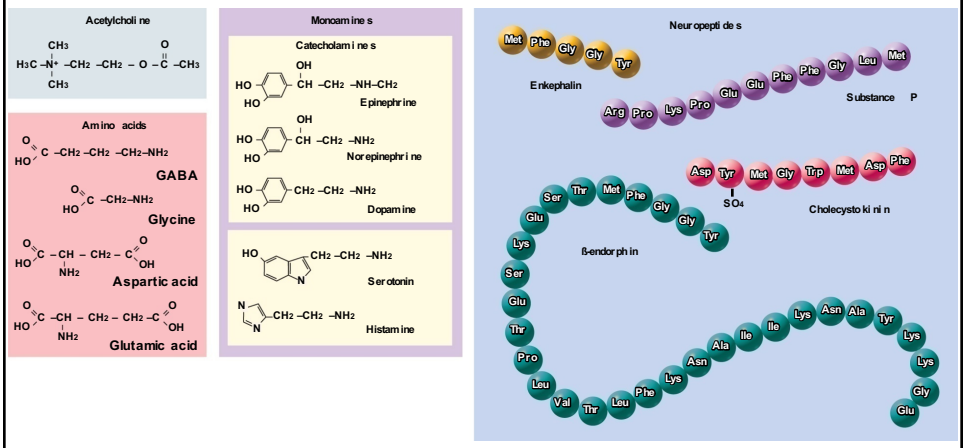

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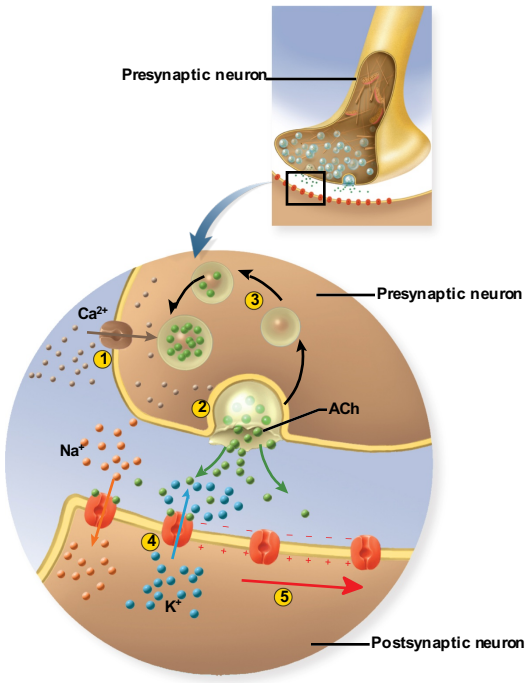
Fig. 12.22



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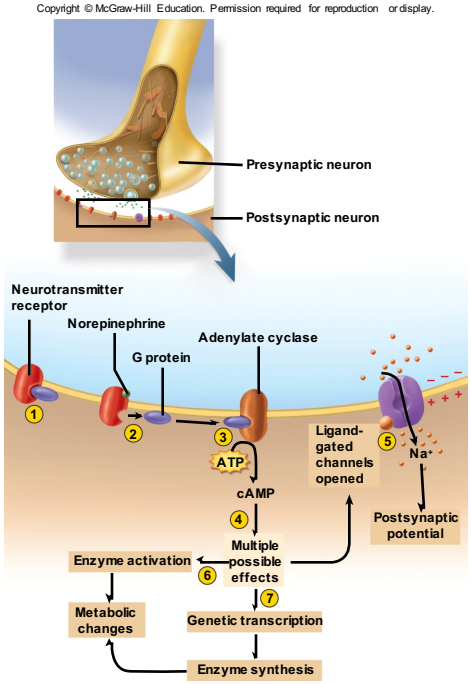

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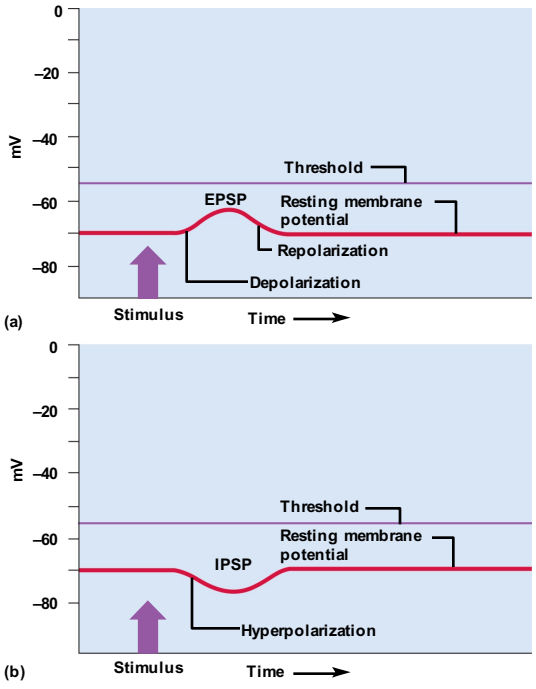
Fig. 12.24



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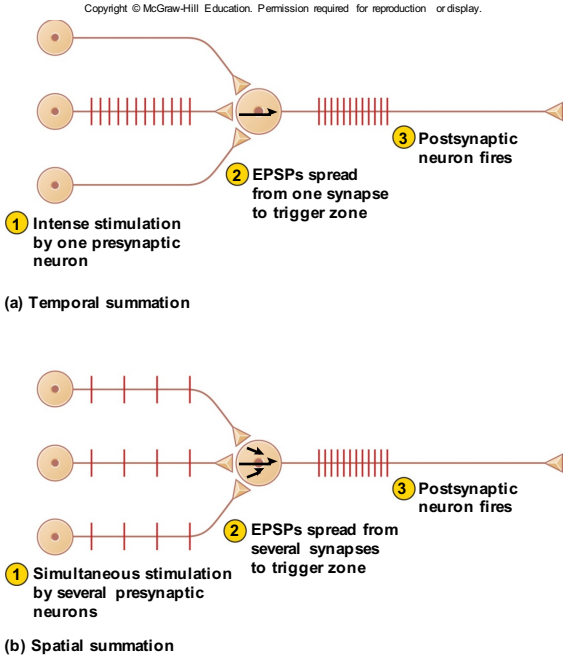

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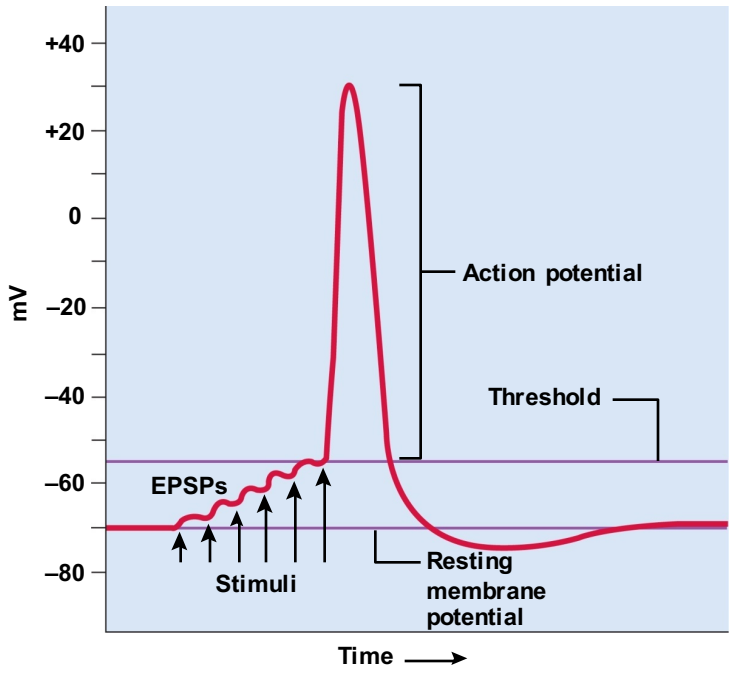
Fig. 12.26



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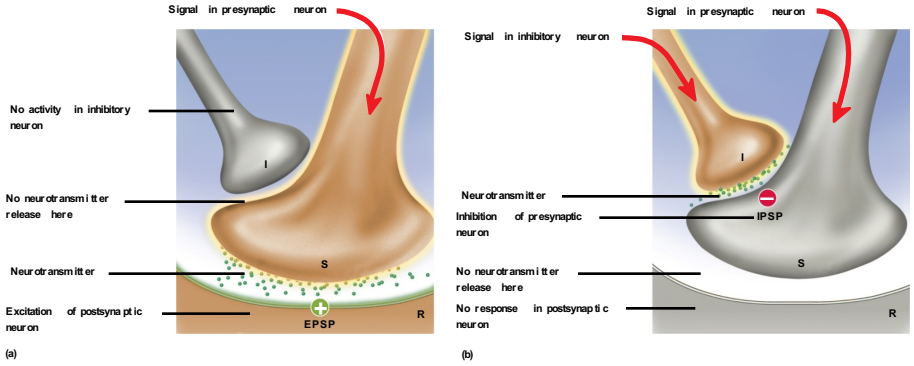

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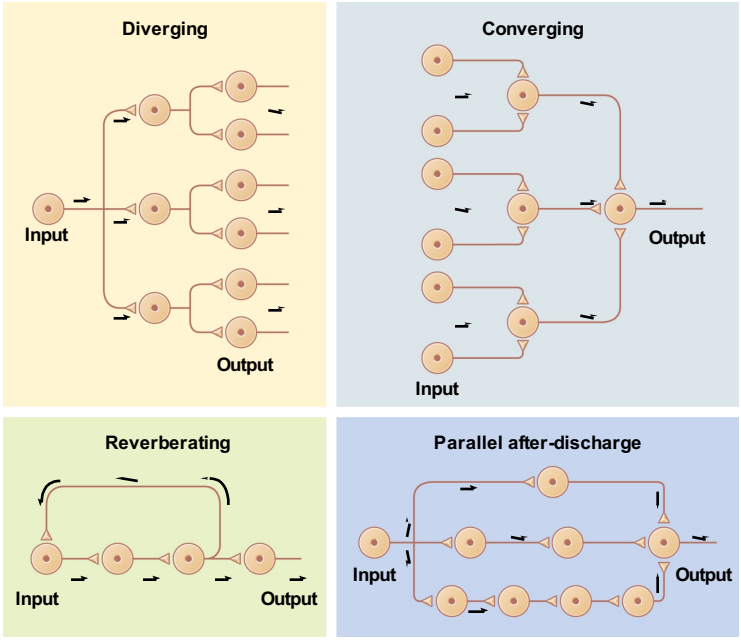

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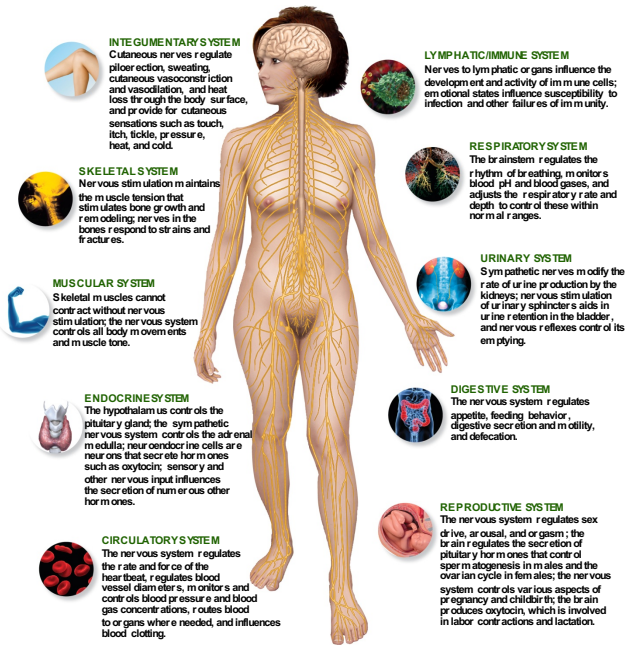

INTEGUMENTARY SYSTEM
Cutaneous nerves regulate piloerection, sweating, cutaneous vasoconstriction and vasodilation, and heat loss through the body surface, and provide for cutaneous sensations such as touch, itch, tickle, pressure, heat, and cold.

SKELETAL SYSTEM
Nervous stimulation maintains the muscle tension that stimulates bone growth and remodeling; nerves in the bones respond to strains and fractures.

MUSCULAR SYSTEM
Skeletal muscles cannot contract without nervous stimulation; the nervous system controls all body movements and muscle tone.

ENDOCRINE SYSTEM
The hypothalamus controls the pituitary gland; the sympathetic nervous system controls the adrenal medulla; neuroendocrine cells are neurons that secrete hormones such as oxytocin; sensory and other nervous input influences the secretion of numerous other hormones.

CIRCULATORY SYSTEM
The nervous system regulates the rate and force of the heartbeat, regulates blood vessel diameters, monitors and controls blood pressure and blood gas concentrations, routes blood to organs where needed, and influences blood clotting.

LYMPHATIC/IMMUNE SYSTEM
Nerves to lymphatic organs influence the development and activity of immune cells; emotional states influence susceptibility to infection and other failures of immunity.

RESPIRATORY SYSTEM
The brainstem regulates the rhythm of breathing, monitors blood pH and blood gases, and adjusts the respiratory rate and depth to control these within normal ranges.

URINARY SYSTEM
Sympathetic nerves modify the rate of urine production by the kidneys; nervous stimulation of urinary sphincters aids in urine retention in the bladder, and nervous reflexes control its emptying.

DIGESTIVE SYSTEM
The nervous system regulates appetite, feeding behavior, digestive secretion and motility, and defecation.

REPRODUCTIVE SYSTEM
The nervous system regulates sex drive, arousal, and orgasm; the brain regulates the secretion of pituitary hormones that control spermatogenesis in males and the ovarian cycle in females; the nervous system controls various aspects of pregnancy and childbirth; the brain produces oxytocin, which is involved in labor contractions and lactation.

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