

Table 11-5

TABLE 11-5 Comparison of Somatic and Autonomic Divisions		
	SOMATIC	AUTONOMIC
Number of neurons in efferent path	1	2
Neurotransmitter/receptor at neuron-target synapse	ACh/nicotinic	ACh/muscarinic or NE/ $\alpha$ - or $\beta$ -adrenergic
Target tissue	Skeletal muscle	Smooth and cardiac muscle; some endocrine and exocrine glands; some adipose tissue
Neurotransmitter released from	Axon terminals	Varicosities and axon terminals
Effects on target tissue	Excitatory only: muscle contracts	Excitatory or inhibitory
Peripheral components found outside the CNS	Axons only	Preganglionic axons, ganglia, postganglionic neurons
Summary of function	Posture and movement	Visceral function, including movement in internal organs and secretion; control of metabolism

Figure 11-1

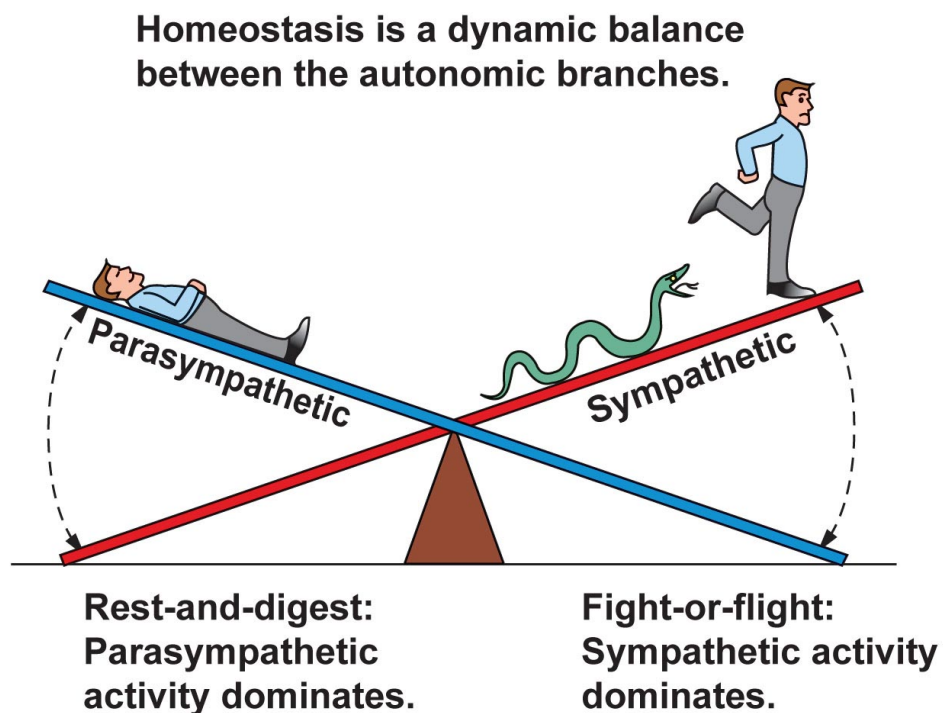


Table 11-4

TABLE 11-4 Comparison of Sympathetic and Parasympathetic Branches		
	SYMPATHETIC	PARASYMPATHETIC
Point of CNS origin	1st thoracic to 2nd lumbar segments	Midbrain, medulla, and 2nd–4th sacral segments
Location of peripheral ganglia	Primarily in paravertebral sympathetic chain; 3 outlying ganglia located alongside descending aorta	On or near target organs
Structure of region from which neurotransmitter is released	Varicosities	Varicosities
Neurotransmitter at target synapse	Norepinephrine (adrenergic neurons)	ACh (cholinergic neurons)
Inactivation of neurotransmitter at synapse	Uptake into varicosity, diffusion	Enzymatic breakdown, diffusion
Neurotransmitter receptors on target cells	Adrenergic	Muscarinic
Ganglionic synapse	ACh on nicotinic receptor	ACh on nicotinic receptor
Neuron-target synapse	NE on $\alpha$ - or $\beta$ -adrenergic receptor	ACh on muscarinic receptor

Figure 11-2

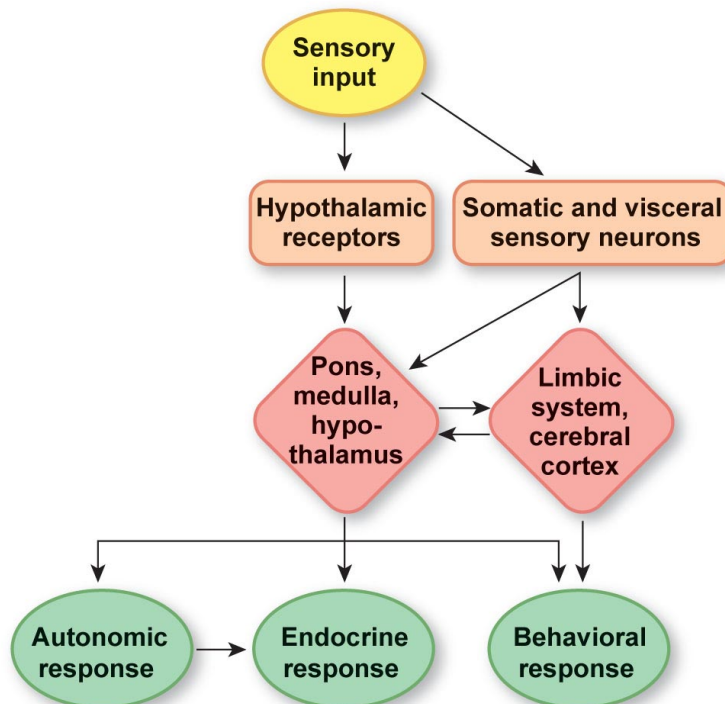


Figure 11-3

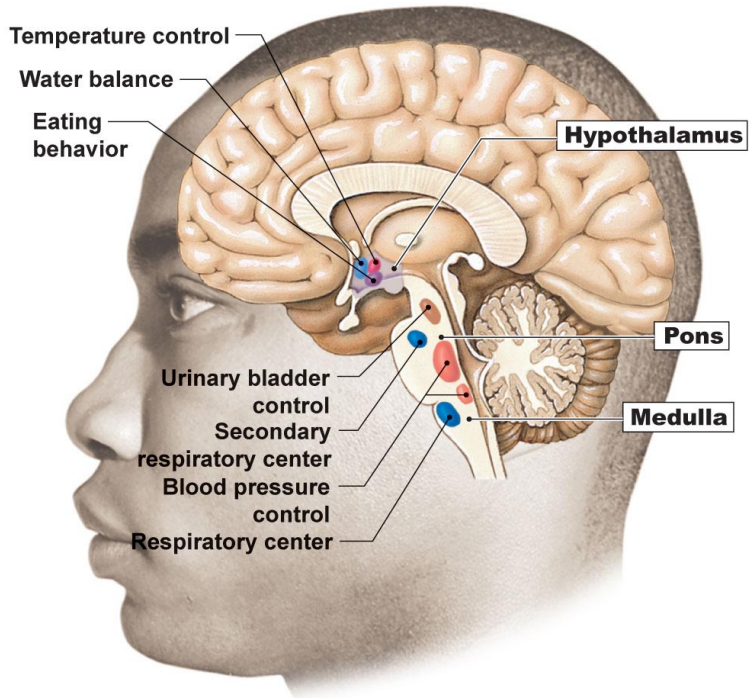


Figure 11-4

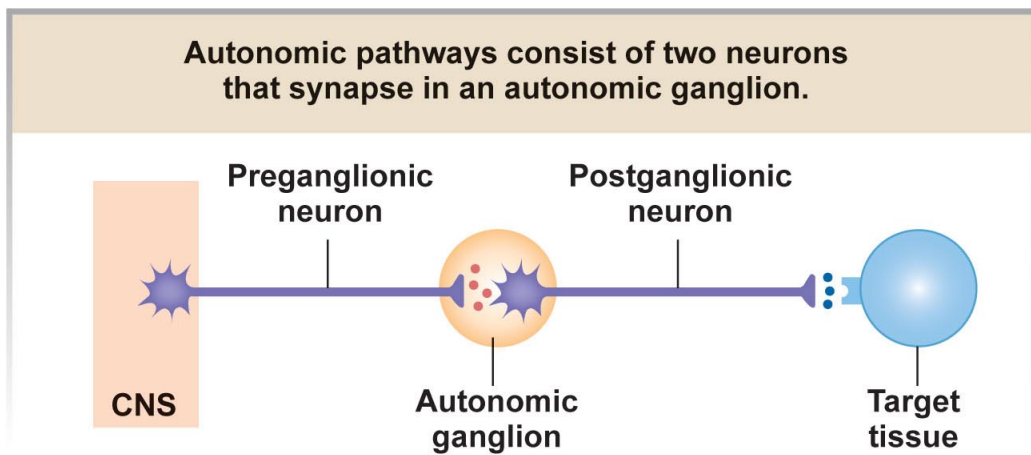
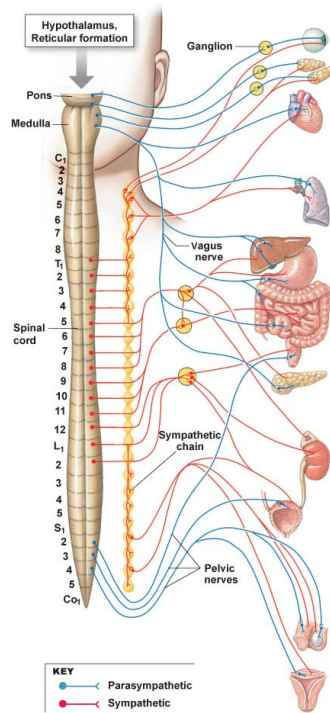


Figure 11-5, overview



Effector Organ	Parasympathetic Response **	Sympathetic Response	Adrenergic Receptor
Pupil of eye	Constricts	Dilates	$\alpha$
Salivary glands	Watery secretion	Mucus, enzymes	$\alpha$ and $\beta_2$
Heart	Slows rate	Increases rate and force of contraction	$\beta_1$
Arterioles and veins	—	Constricts Dilates	$\alpha$ $\beta_2$
Lungs	Bronchioles constrict	Bronchioles dilate	$\beta_2^*$
Digestive tract	Increases motility and secretion	Decreases motility and secretion	$\alpha, \beta_2$
Exocrine pancreas	Increases enzyme secretion	Decreases enzyme secretion	$\alpha$
Endocrine pancreas	Stimulates insulin secretion	Inhibits insulin secretion	$\alpha$
Adrenal medulla	—	Secretes catecholamines	—
Kidney	—	Increases renin secretion	$\beta_1$
Urinary bladder	Release of urine	Urinary retention	$\alpha, \beta_2$
Adipose tissue	—	Fat breakdown	$\beta$
Sweat glands	—	Localized sweating	$\alpha$
Male and female sex organs	Erection	Ejaculation (male)	$\alpha$
Uterus	Depends on stage of cycle	Depends on stage of cycle	$\alpha, \beta_2$
Lymphoid tissue (not illustrated)	—	Generally inhibitory	$\alpha, \beta_2$

\*\*All parasympathetic responses are mediated by muscarinic receptors. \*Hormonal epinephrine only

Figure 11-6

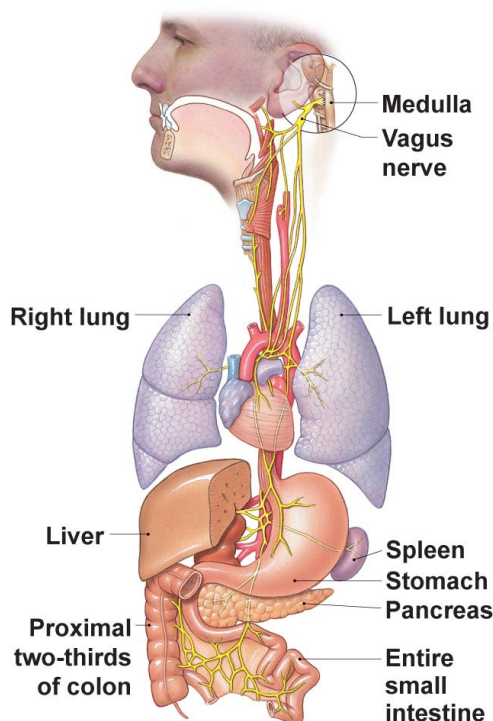
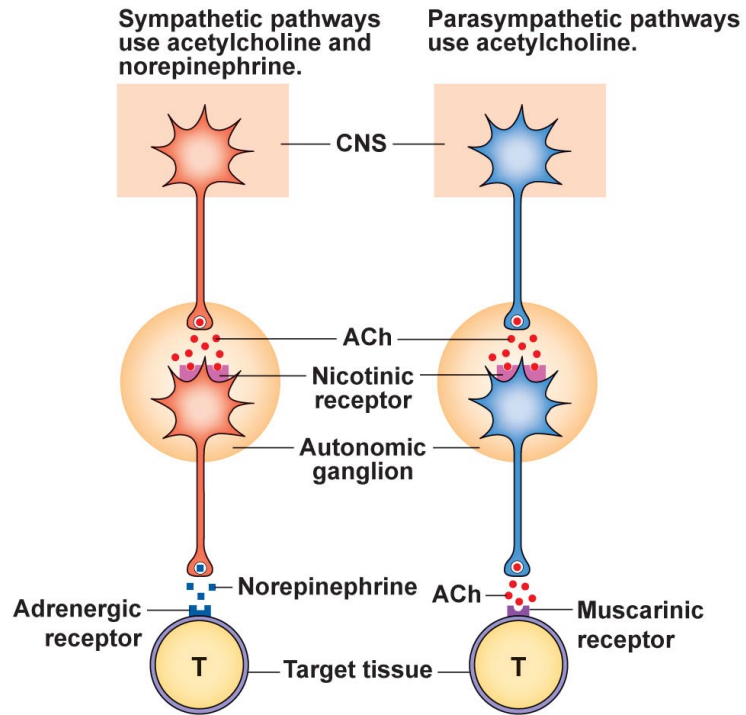
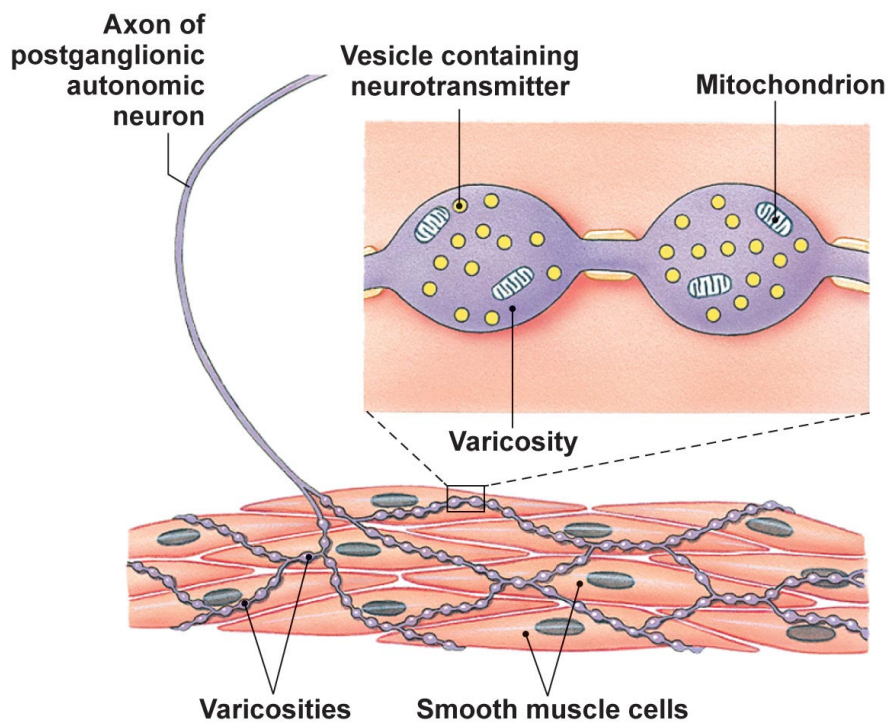


Figure 11-7



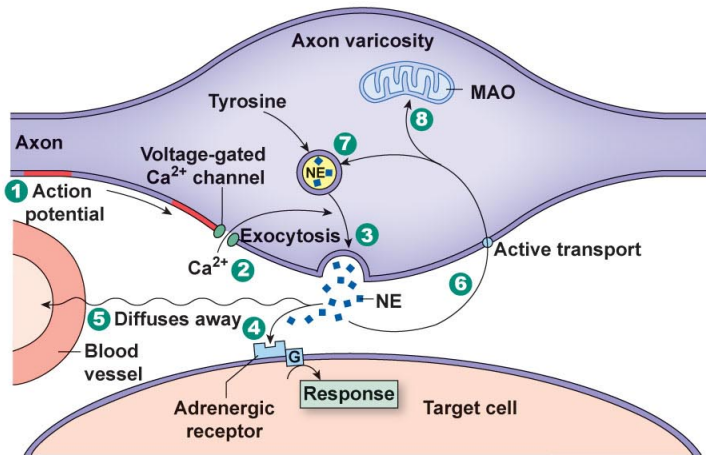
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Figure 11-8



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Figure 11-9, overview



- 1 Action potential arrives at the varicosity.
- 2 Depolarization opens voltage-gated Ca<sup>2+</sup> channels.
- 3 Ca<sup>2+</sup> entry triggers exocytosis of synaptic vesicles.
- 4 NE binds to adrenergic receptor on target.
- 5 Receptor activation ceases when NE diffuses away from the synapse.
- 6 NE is removed from the synapse.
- 7 NE can be taken back into synaptic vesicles for re-release.
- 8 NE is metabolized by monoamine oxidase (MAO).

Figure 11-10

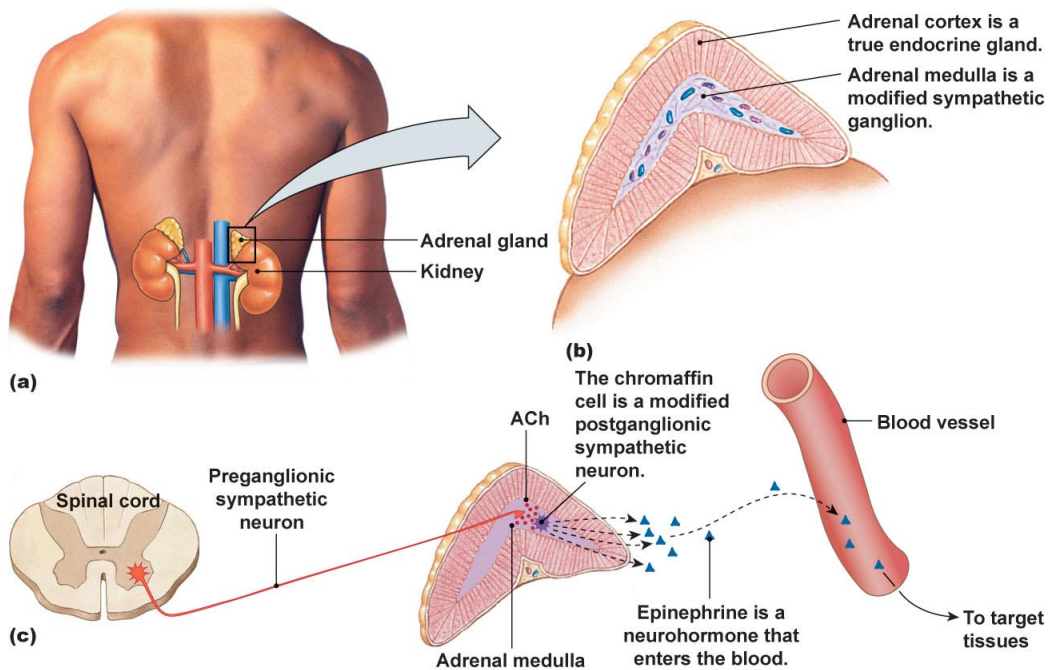
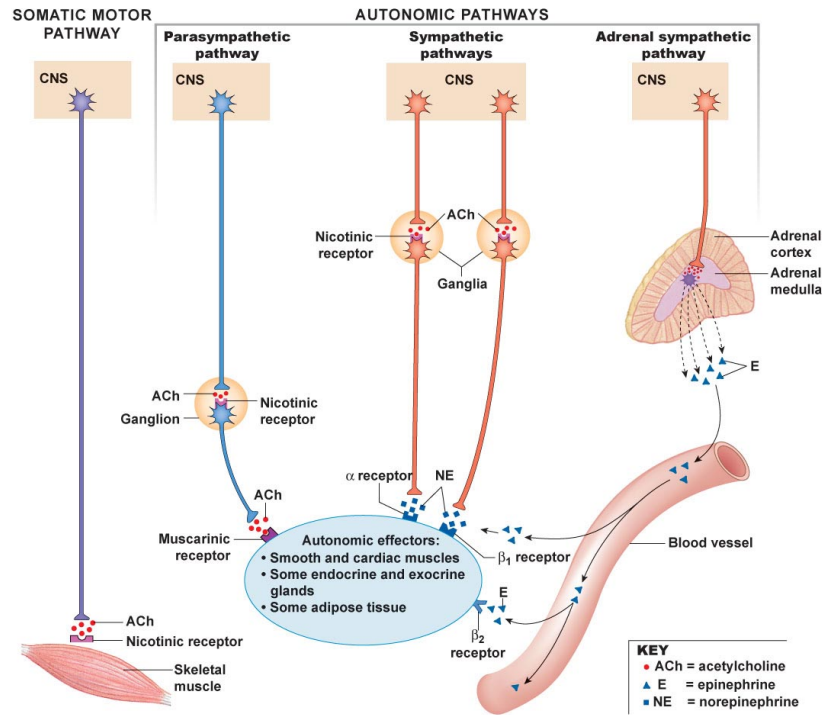


Figure 11-11, overview



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Table 11-1

TABLE 11-1	Postganglionic Autonomic Neurotransmitters	
	SYMPATHETIC DIVISION	PARASYMPATHETIC DIVISION
Neurotransmitter	Norepinephrine (NE)	Acetylcholine (ACh)
Receptor types	α- and β-adrenergic	Nicotinic and muscarinic cholinergic
Synthesized from	Tyrosine	Acetyl CoA + choline
Inactivation enzyme	Monoamine oxidase (MAO) in mitochondria of varicosity	Acetylcholinesterase (AChE) in synaptic cleft
Varicosity membrane transporters for	Norepinephrine	Choline

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