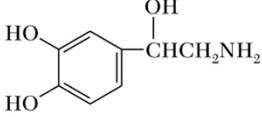
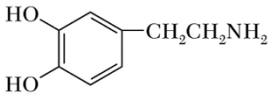
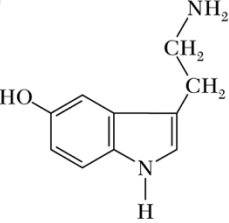


**Table 6-2** Typical small neurotransmitters, their structures, and functions

Neurotransmitter	Typical effects*	Structure
Acetylcholine (ACh)	Fast excitation; slow inhibition	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OCH}_2\text{CH}_2-\underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{N}^+}}-\text{CH}_3$
Glycine (Gly)	Fast inhibition	$^+\text{H}_3\text{N}-\underset{\text{COO}^-}{\overset{\text{H}}{\text{C}}}-\text{H}$
$\gamma$ -Aminobutyric acid (GABA)	Fast inhibition; slow inhibition	$^+\text{H}_3\text{N}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{COO}^-$
Glutamate (Glu)	Fast excitation; slow change in postsynaptic metabolism	$^+\text{H}_3\text{N}-\underset{\text{COO}^-}{\overset{\text{H}}{\text{C}}}-\text{CH}_2-\text{CH}_2-\text{COO}^-$

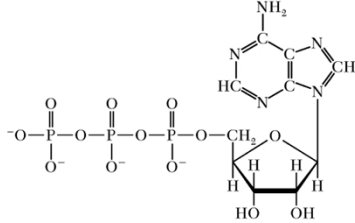
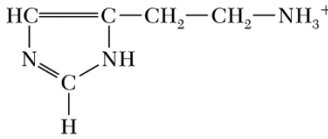
\*Notice that the effect of a neurotransmitter depends on the properties of the postsynaptic cell. For most neurotransmitters, however, it is possible to identify their most probable effect.

**Table 6-2** Typical small neurotransmitters, their structures, and functions

Neurotransmitter	Typical effects*	Structure
Norepinephrine (Nor-epi)	Slow excitation; slow inhibition	
Dopamine	Differs with location but causes slow postsynaptic effects	
Serotonin (5-HT = 5- hydroxytryptamine)	Slow excitation or slow inhibition	

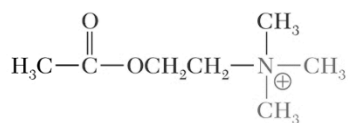
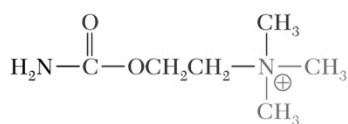
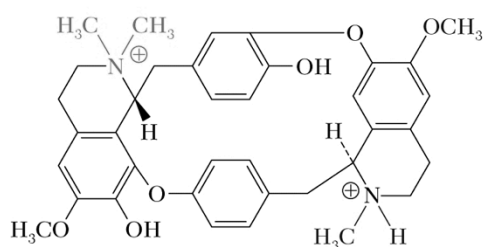
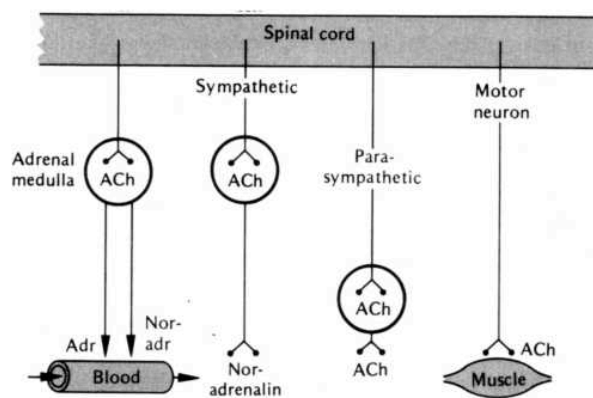
\*Notice that the effect of a neurotransmitter depends on the properties of the postsynaptic cell. For most neurotransmitters, however, it is possible to identify their most probable effect.

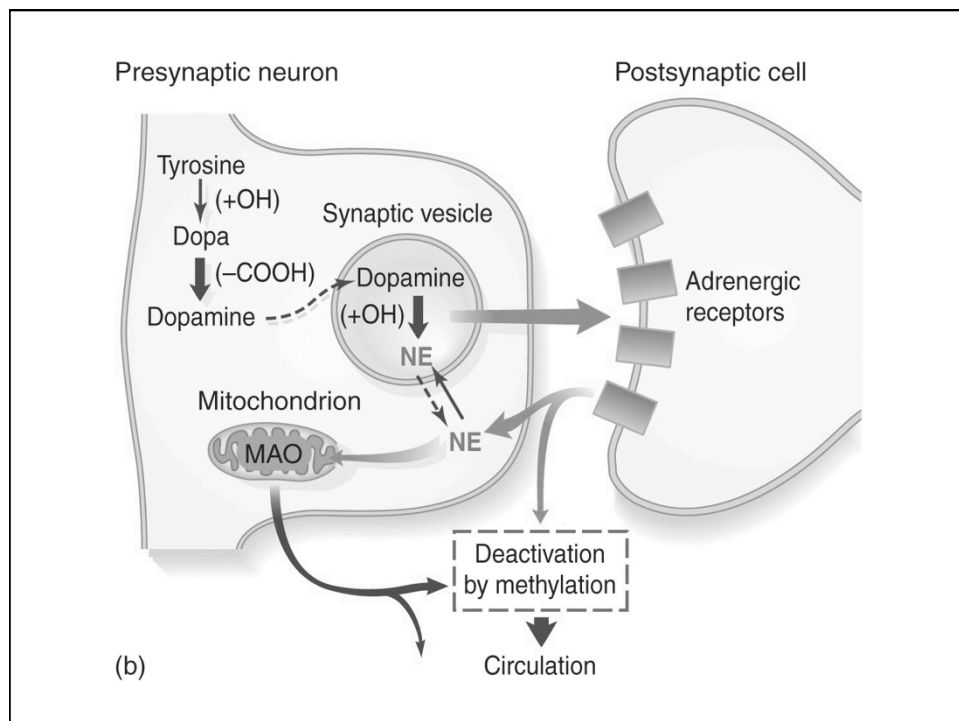
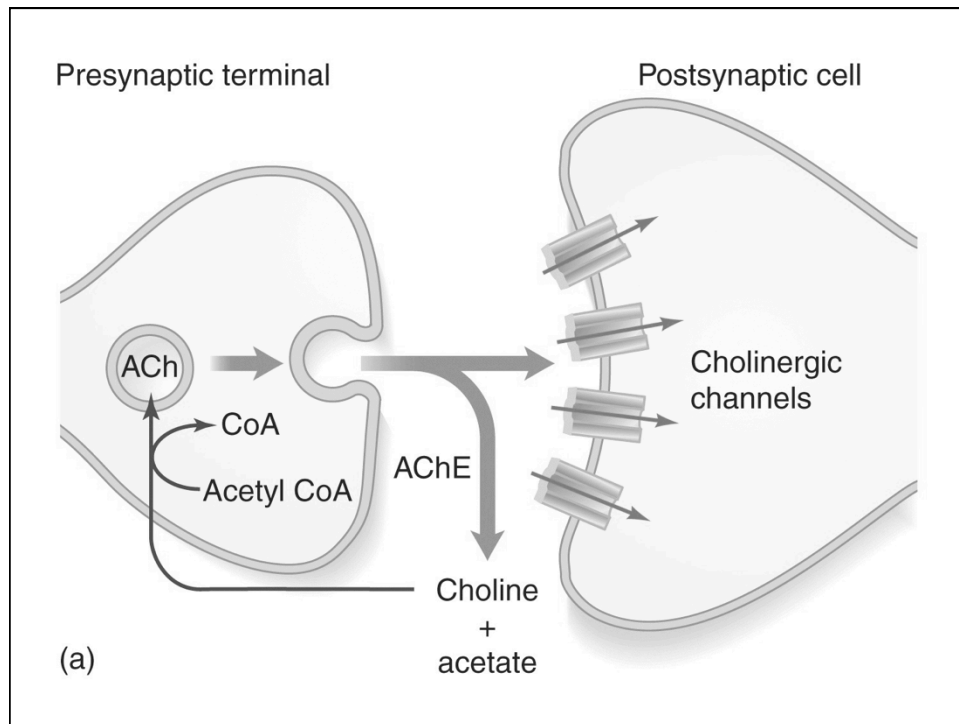
**Table 6-2** Typical small neurotransmitters, their structures, and functions

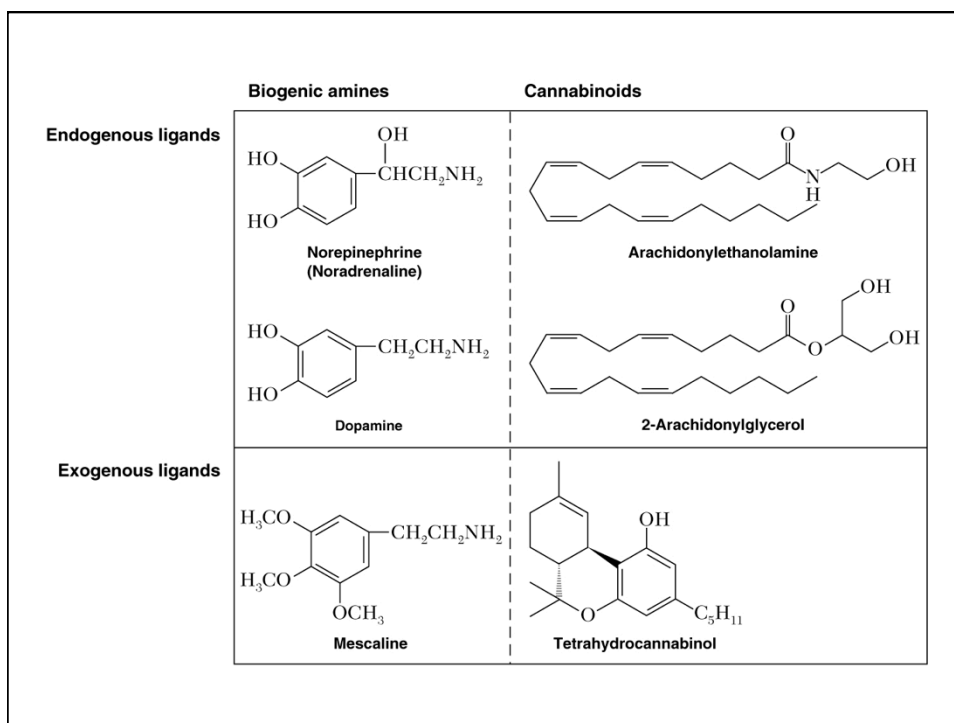
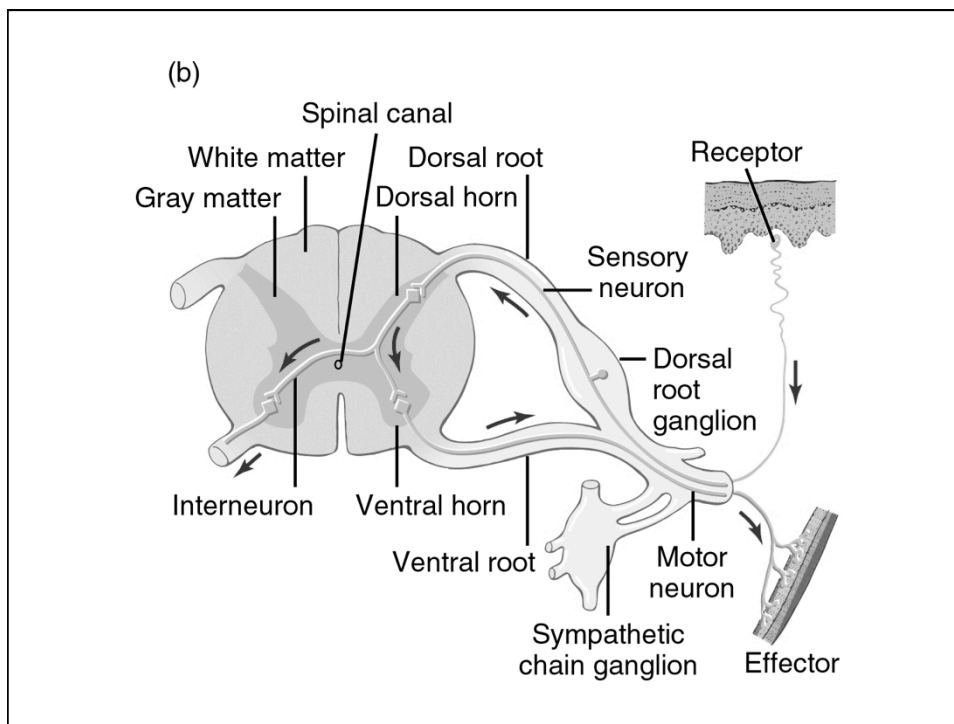
Neurotransmitter	Typical effects*	Structure
Nitrogen oxide (NO)	Synaptic modulation	$N = O$
Adenosine triphosphate (ATP)	Both fast and slow synaptic transmission	
Histamine	Slow modulation	

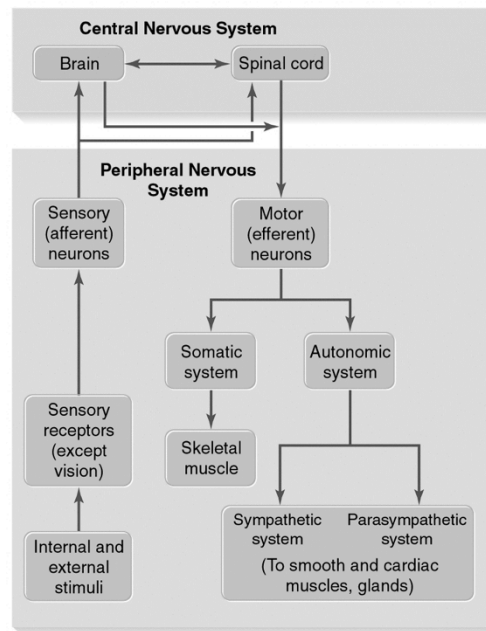
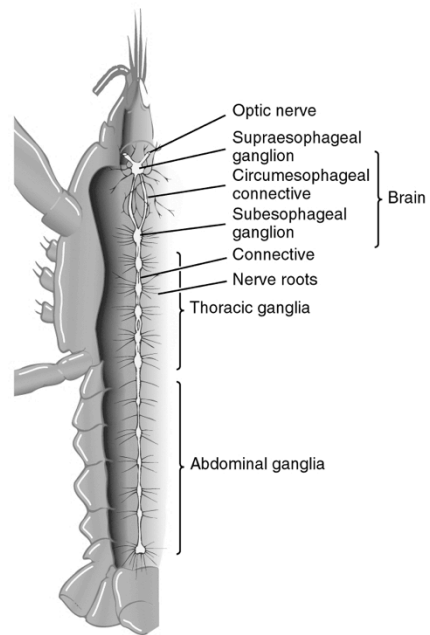
\*Notice that the effect of a neurotransmitter depends on the properties of the postsynaptic cell. For most neurotransmitters, however, it is possible to identify their most probable effect.



**Acetylcholine (ACh)****Carbachol, an ACh agonist****D-Tubocurarine, an ACh antagonist**







**Table 8-1** Opposing effects on target tissues of the sympathetic and parasympathetic divisions of the autonomic nervous system

Target tissue	Sympathetic division	Parasympathetic division
<b>Glands</b>		
Lacrimal (tear) glands	No effect	Stimulates production of tears
Salivary glands	Stimulates production of a small amount of viscous saliva ("dry mouth")	Stimulates production of a large amount of dilute saliva
Adrenal medulla	Stimulates secretion	No effect
<b>Eye</b>		
Radial muscles of iris	Pupillary dilation	No effect
Iris sphincter muscles	No effect	Pupillary constriction
Ciliary muscle (controls thickness of lens)	Relaxation (focuses on distant objects)	Contraction (focuses on close objects)
<b>Heart</b>		
Pacemaker cells	Increases rate of heartbeat	Decreases rate of heartbeat
Ventricular contractile fibers	Increases force of contraction	Little or no effect

**Table 8-1** Opposing effects on target tissues of the sympathetic and parasympathetic divisions of the autonomic nervous system

Target tissue	Sympathetic division	Parasympathetic division
<b>Lungs</b>		
Smooth muscles in walls of bronchioles	Dilates bronchioles	Constricts bronchioles
Mucous glands	No effect	Stimulates secretion of mucus
<b>Gastrointestinal tract</b>		
Sphincter muscles	Contraction	Relaxation
Smooth muscles in walls of tract	Reduces tone and motility	Increases tone and motility
Exocrine glands	Inhibits secretion	Stimulates secretion
Gallbladder	Inhibits contraction	Stimulates contraction
Liver	Increases glycogenolysis and therefore blood sugar	No effect
<b>Other tissues</b>		
Urinary bladder	No effect	Stimulates muscle contraction
Arterioles	Vasoconstriction in vessels supplying skin and gut; vasodilation in some vessels supplying skeletal muscle	No effect

**Table 8-2** Pharmacology of neurotransmission in the autonomic nervous system

	Transmitter of preganglionic neuron	Receptors on postganglionic neuron	Transmitter of postganglionic neuron	Receptors on target tissue
Sympathetic division	Acetylcholine (ACh)	Nicotinic ACh receptors	Norepinephrine	$\alpha$ - or $\beta$ -adrenergic receptors
Parasympathetic division	Acetylcholine	Nicotinic ACh receptors	Acetylcholine	Muscarinic ACh receptors