

CHAPTER 16

AUTONOMIC NERVOUS SYSTEM

CHAPTER OVERVIEW: This chapter introduces the autonomic nervous system. The structures and functions of each of the divisions of the ANS are reviewed. Comparisons and contrasts are drawn between the somatomotor and autonomic portions of the peripheral nervous system, especially in terms of the pharmacology of the synapses, the number and organization of neurons, and the effector organs innervated.

OUTLINE (two fifty-min. lectures):
Seeley, A&P, 5/e

Chapt. Object.	Topic Outline, Chapter 16	Figures & Tables	Transparency Acetates
1	I. Contrasting Somatic Motor and Autonomic Nervous Systems, p. 509 A. Somatic Motor System 1. Single Cells Extending From CNS 2. Innervate Skeletal Muscles 3. All Conscious and Unconscious Movements of Skeletal Muscles B. Autonomic Nervous System	Table 16.1, p.510	
2	1. Series of Two Neurons from CNS to Effector a. Preganglionic Neuron - Cell Body in CNS b. Postganglionic Neuron - Cell Body in Autonomic Ganglion 2. Innervate Smooth Muscle, Cardiac Muscle and Glands 3. Unconscious or Subconscious Control of Visceral Organs	Fig. 16.1, p.510	TA-325
3	II. Divisions of the Autonomic Nervous System, p. 509 A. Sympathetic Division 1. Preganglionic Cell Bodies in CNS - Thoracolumbar Division a. Gray Matter of Lateral Horns of Spinal Cord b. Level of T1 to L2 - Thoracolumbar Division 2. Preganglionic Axons (Myelinated) a. Ventral Spinal Root to White Rami Communicantes b. Through White Rami to Sympathetic Chain Ganglia	Table 16.2, p.511 Fig. 16.2, p.511	TA-326
4	c. Exit is by One of Four Routes 1). Synapse with Postganglionic Fiber in Chain Ganglion a). Unmyelinated	Fig. 16.3, p.512 Fig. 16.3a,b, p.512	TA-327

Postganglionic Fiber
Through Gray Ramus
Back to Spinal Nerve
b). Postganglionic Fiber
Forms Sympathetic
Nerve

2). Pass Through Chain Ganglion Without Synapsing Fig. 16.3c,d, p.512 TA-328

a). Form Splanchnic
Nerves; Synapse at
Collateral (Prevertebral)
Ganglia

b). Preganglionic
Neurons End at
Synapse with Secretory
Cells of Adrenal
Medulla; 80% Release
Epinephrine, 20%
Release Norepi-
nephrine

3 B. Parasympathetic Division Fig. 16.4, p. 513 TA-329

1. Preganglionic Cell Bodies in CNS -
Craniosacral Division

a. Brainstem Nuclei for Cranial Nerves

b. Lateral Horns of Spinal Gray
Matter, Level S2 to S4

2. Preganglionic Axons Travel

a. From Brain to Terminal Ganglia via
Cranial Nerves

1). Oculomotor (III)

2). Facial (VII)

3). Glossopharyngeal (IX)

4). Vagus (X) - 75% of All
Parasympathetic Axons

b. From Sacral Region to Terminal
Ganglia via Ventral Roots of Pelvic
Nerves

3. Terminal Ganglia Located at or Near Organ
Innervated Clinical Note,
p.514

III. Physiology of the Autonomic Nervous System, p. 514

5 A. Neurotransmitters Fig. 16.5, p.515 TA-330

1. Acetylcholine

a. Released by Cholinergic Neurons

b. All Preganglionic Neurons of ANS

c. All Parasympathetic Postganglionic
Neurons

d. Some Sympathetic Postganglionic
Neurons to Sweat Glands

2. Norepinephrine

a. Released by Adrenergic Neurons

		b. Most Sympathetic Postganglionic Neurons		
6, 10	B. Receptors		Clinical Focus, p.517	
7	1. Cholinergic Receptors		Predict Quest. 1	
	a. Nicotinic Receptors			
	1). Cell Bodies of All Postganglionic Neurons (Both Parasymp. and Symp.)			
	2). Membranes of Skeletal Muscle Cells			
	3). Effect Always Excitatory			
	b. Muscarinic Receptors			
	1). All Parasympathetic Effector Cells			
	2). At Sympathetic Effector Cells Receiving Cholinergic Innervation			
	3). Effect Excitatory at Some Cells, Inhibitory at Others			
	2. Adrenergic Receptors		Fig. 16.5, p.515	TA-330
			Table 16.3, p.516	
			Clinical Note, .515	
	a. Types			
	1). Alpha () - Binds Epinephrine and Norepinephrine			
	2). Beta () - Binds Epinephrine but Less Well to Norepinephrine			
	b. Distribution on Sympathetic Effector Cells			
	1). Some Alpha Only			
	2). Some Beta Only			
	3). Some Have Both Types			
	c. Effect Excitatory at Some Cells and Inhibitory at Others			
	IV. Regulation of the Autonomic Nervous System, p. 518			
8	A. Autonomic Reflexes Regulate Activity of Visceral Organs, Glands, and Blood Vessels		Fig. 16.6, p.518	TA-331
			Predict Quest. 2 & 3	
	B. Same Parts as Somatic Reflexes			
	C. Influenced by Activity in Hypothalamus and Higher Brain Centers		Fig. 16.7, p. 519	TA-332
9, 10	V. Functional Generalizations About the Autonomic Nervous System		Clinical Focus, p.520	
	A. Stimulatory vs. Inhibitory Effects			
	B. Dual Innervation		Table 16.3, p.516	

- C. Opposite Effects
- D. Cooperative Effects
 - 1. Coordinated Activity Within a Division
 - 2. Coordinated Activity Between Divisions (i.e., Reproductive Function)
- E. General Versus Localized Effects
 - 1. Sympathetic Division Has More Generalized Effect
 - a. Systemic Release of Epinephrine from Adrenal Gland
 - b. More Divergence of Neural Connections - One Preganglionic Sympathetic Neuron Synapses with Many Postganglionic Neurons
 - 2. Parasympathetic Division Has More Localized Effect
 - a. Neurotransmitter only Released at Synapses
 - b. Little Divergence - One Preganglionic Parasympathetic Neuron Synapses with One or Two Postganglionic Neurons
- F. Functions at Rest Versus Activity

<ul style="list-style-type: none"> 1. Parasympathetic Effects Greatest Under Resting Conditions 2. Sympathetic Effects Greatest Under Conditions of Physical Exertion or Stress 	<p>Predict Quest.4</p> <p>Clinical Focus, p.522</p>
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IMPORTANT CONSIDERATIONS: The logical break falls so that the structure of the system is in one session and the pharmacology of receptors and regulation of the ANS falls in the second session. Many students will find their first introduction to the neurotransmitters, receptors and target cells of the autonomic nervous system to be confusing. The concept of dual innervation is also difficult for many students to grasp initially.

SEE INSTRUCTOR'S MANUAL AND COURSE SOLUTIONS MANUAL FOR ADDITIONAL RESOURCES.