Some concepts you must know for the next test:

- Difference between somatic impulse origin and pathways and autonomic impulse origin and pathways; effectors innervated; number of neurons in pathway; neurotransmitters and receptor types
- Spinal nerves constituting the sympathetic division; organization of the sympathetic division: preganglionic, postganglionic, chain ganglia, collateral ganglia
- Routes of sympathetic axons from origin in lateral horns to effectors: spinal route, sympathetic nerve route, splanchnic nerve route, adrenal medulla route. Why does each route exist?
- Cranial and sacral nerves constituting the parasympathetic division; organization, preganglionic, postganglionic, terminal ganglia
- Basics of enteric nervous system
- The distribution of nicotinic, muscarinic, and adrenergic receptors in the autonomic nervous system and its effectors: what is the impact of having a particular receptor on your membrane? Which neurons and effectors possess specific receptors
- Consider the diagram of Innervation of Organs by ANS; reconcile this diagram with information below:
  - Sympathetic (thoracolumbar) Division:
    - 3 E’s – emergency, exercise, and excitement – give considerable thought to the numerous activities that occur during this time
    - Preganglionic axons have many collateral branches
    - autonomic ganglia close to spinal cord; in consideration of divergence, activation activates many organs, smooth muscles, or glands – mass activation or local activation
  - Parasympathetic (craniosacral) Division:
    - rest and digest – give considerable thought to the individual activities that occur during this time
    - Preganglionic axons have few collateral branches
    - autonomic ganglia are close to or in the effector organ, smooth muscle or gland; activation activates particular organs, muscles, or glands – local activation

Concepts you may have to learn on your own:
- The effect of drugs on the ANS
- Individual organ responses to ANS stimulation

Concepts not appearing on this test:
- Sympathetic and parasympathetic nerve plexuses
- Visceral reflexes
- Table 14.2 Cholinergic and Adrenergic receptor types
- Homeostatic imbalances of the ANS
- Developmental aspects of the ANS

Lecture Outline:

I. Divisions of the ANS
   a. sympathetic
      i. innervates many internal organs including glands/blood vessels of skin and adrenal glands
   b. parasympathetic
      i. innervates the same organs as sympathetic except skin glands/vessels and adrenals
   c. work together though to maintain homeostasis but generally thought to oppose one another
   d. uses both cranial and spinal nerves to connect brain ANS centers with muscles and glands

II. Features
   a. optimal support for daily activities
   b. unconscious regulation
   c. target tissues stimulated or inhibited
   d. uses two neurons, PNS ganglia, and two neurotransmitters

III. Neurotransmitters Used:
   a. cholinergic neurons release ACH
      i. all preganglionic axons
      ii. all postganglionic parasympathetic axons
iii. postganglionic sympathetic axons innervating sweat glands
b. adrenergic neurons release norepinephrine
   i. most postganglionic sympathetic axons

IV. Receptor types:
   a. nicotinic receptors present on membranes at
      i. neuromuscular junctions
      ii. receptive zones of all postganglionic neurons
      iii. hormone producing cells of adrenal medulla
      iv. nicotinic receptors respond by opening ion channels to depolarize postsynaptic cell
   b. muscarinic receptors present on membranes at
      i. all effectors stimulated by postganglionic cholinergic fibers
      ii. excitatory or inhibitory depending on receptor type – often a receptor linked to G protein mechanism
   c. adrenergic receptors present on membranes at
      i. most effectors stimulated by postganglionic adrenergic (sympathetic) fibers

V. Details of the sympathetic or thoracolumbar division
   a. Pathway
      i. preganglionic neurons exit SC using spinal nerves T_1-L_2
      ii. exit spinal nerve via white rami communicantes and enter sympathetic trunk where synapse with postganglionic neuron occurs
      iii. may reenter spinal nerve via gray rami communicantes
      iv. may form sympathetic nerves or splanchnic nerves
      v. terminate at effect
   b. General function
      i. fight or flight, 3 E’s, 4 E’s or E division
         1. increased HR, dry mouth, sweat, dilated pupils, increased respiration and lung involvement, slowing of digestion, urine production, liberation of glucose into blood
      ii. sympathetic tone
         1. blood pressure control even at rest
         2. adrenergic receptors may be manipulated pharmacologically
      iii. Unique roles
      iv. routes of sympathetic axons
         1. spinal
         2. cranial

VI. Details of the Parasympathetic or craniosacral division
   a. Pathway
      i. long preganglionic neurons exit SC via cranial (III, VII, IX, X) or sacral spinal (S_2-S_4) nerves
      ii. extend to terminal ganglia at effector where synapse with short postganglionic neuron
   b. general function
      i. rest and digest, D division
         1. maintenance and conservation
      ii. parasympathetic tone

VII. Interactions between the two systems
   a. dynamic antagonism
   b. cooperation
   c. localized versus diffuse effects

VIII. ANS Control
   a. hypothalamus is the boss
      i. limbic effects
      ii. cerebral cortex effects