Chapter 16: Autonomic Nervous System

I. Contrasting the Somatic and Autonomic Nervous Systems

A. Neurons

1. Somatic motor neurons innervate ______________________________
2. Autonomic motor neurons innervate:
   a. ______________________________
   b. ______________________________
   c. ______________________________

B. Pathways

1. Somatic neurons:
   a. Have cell bodies in ____________________
   b. Axons extend from __________ to ______________________________
   c. The effect of somatic neurons on skeletal muscle is always ____________
2. The ANS pathway has __________ in a series from _______ to __________
   a. The first neuron is called ______________________________________
      1. Their cell bodies are located in ______________________________
      2. Their axons extend to ________________ located ____________
   b. The second neuron is called ____________________________________
      1. Their cell bodies are located in ______________________________
      2. Their axons extend to ________________ where ______________
   c. The effect of autonomic neurons on target tissues can be:
      1. ______________________________ or
      2. ______________________________

II. Anatomy of the Autonomic Nervous System

A. Sympathetic Division

1. Cell bodies of preganglionic neurons are in __________________________
   between ____________________ and the __________________
   a. Therefore this division is sometimes also called ____________________
2. The axons exit through the ventral root and pass to the
   ______________________________ ganglia
3. What is the “white ramus communicans”? ____________________________
   a. Axons of which neurons are found here? __________________________

4. Sympathetic axons exit the sympathetic chain by four routes:
   a. Axons of postganglionic neurons pass through __________________
      and reenter a __________________
      1. The axons project through the spinal nerve to __________________
   b. The axons of postganglionic neurons form _________________________
   c. Preganglionic neurons pass through the sympathetic chain without
      synapsing and exit as ______________________________
      1. These nerves extend to ______________________________
      2. The preganglionic neurons synapse here with __________________
      3. The postganglionic neurons form small nerves that _____________
   d. Preganglionic neurons go to adrenal medulla without ______________
      1. The cells of the adrenal medulla came from the same cells in the
         embryo that formed ______________________________
         a. About 80% of these cells secrete ______________________
         b. About 20% of these cells secrete ______________________
      2. Stimulation of the adrenal medulla by preganglionic neurons results in
         ______________________________
      3. Functionally these substances prepare the body for _____________

B. Parasympathetic Division
   1. Cell bodies of preganglionic neurons are located:
      a. Within ______________________________ in the brainstem
      b. Within ______________________________ from ________ to ________
      c. Therefore this division is sometimes called ______________________
   2. Which cranial nerves contain parasympathetic preganglionic axons?
      ______________________________
   3. Where are the terminal ganglia located? __________________________
   4. Postganglionic neurons extend from terminal ganglia to ______________

C. Enteric Nervous System
   1. The enteric nervous system consists of ____________________________
2. The plexuses have contributions from:
   a. ________________________________________
   b. ________________________________________
   c. ________________________________________

3. Enteric sensory neurons ________________________________________

4. Enteric motor neurons __________________________________________

5. Enteric interneurons ____________________________________________

D. The Distribution of Autonomic Nerve Fibers

1. Sympathetic Division
   a. What is an autonomic nerve plexus? _____________________________
   b. Typically an autonomic nerve plexus is named for:
      1. ______________________________ or
      2. ______________________________
   c. Spinal nerves from all levels of the sympathetic chain:
      1. Postganglionic axons project through _________________________
      2. Axons extend to ________________________________ by spinal nerves
      3. Supply:
         a. ______________________ in the skin
         b. ______________________ in skeletal and skin blood vessels
         c. ______________________ of the arrector pili
   d. Head and neck nerve plexuses:
      1. Derived from the ________________________________
      2. Supply:
         a. ______________________ in the skin
         b. ______________________ in skeletal and skin blood vessels
         c. ______________________ of the arrector pili
      3. Axons from the plexuses also join the trigeminal nerve to supply:
         a. ______________________ of the face
         b. ______________________ glands
         c. ______________________ &
         d. ______________________ of the eye
e. Thoracic nerve plexuses:
   1. Derived from ________ & _____________________________
   2. Postganglionic axons contribute to:
      a. __________________ supplying the __________________
      b. __________________ supplying the __________________
      c. and other thoracic plexuses

f. Abdominopelvic nerve plexuses:
   1. Derived from sympathetic chain ganglia from __________________
   2. Postganglionic axons from the collateral ganglia innervate ________ & ___________ in the abdominopelvic organs

2. Parasympathetic Division
   a. Cranial nerves supplying the head and neck:
      1. Oculomotor nerve supplies ________ & _________ of the eye
      2. Facial nerve supplies:
         a. __________________ gland
         b. __________________ of the nasal cavity and palate
         c. __________________ & __________________ gland
      3. Glossopharyngeal nerve supplies __________________ gland

   b. The vagus nerve and thoracic nerve plexuses:
      1. Contribute to the __________________ which supplies _________
      2. Contribute to the __________________ which supplies _________
      3. Also forms the __________________ plexus

   c. Abdominal nerve plexuses:
      1. What structures in the abdominopelvic cavity are supplied?
         _______________________________________________________

   d. Pelvic nerves and pelvic nerve plexuses:
      1. The cell bodies are in the __________________ of the spinal cord
      2. What structures are supplied by the pelvic plexus? ____________
         _______________________________________________________
      3. What structures are supplied by the hypogastric plexus? __________
         _______________________________________________________
III. Physiology of the Autonomic Nervous System

A. Neurotransmitters

1. What neurotransmitter is secreted by a “cholinergic neuron”? ____________

2. What neurotransmitter is secreted by an “adrenergic neuron”? ____________

3. Which three autonomic neurons are cholinergic?
   a. ______________________________
   b. ______________________________
   c. ______________________________

4. Which autonomic neuron is adrenergic? _____________________________
   a. An exception to this is neurons innervating _________________________

B. Cholinergic Receptors

1. List the two structural types of cholinergic receptors:
   a. ______________________________
   b. ______________________________

2. Which type of receptor is found on the membranes of all postganglionic neurons? ______________________________

3. Which type of receptor is found on the membranes of effector cells that respond to acetylcholine? ______________________________

4. When acetylcholine binds to nicotinic receptors it has an ________________ because it results in ____________________ & _______________________

5. When acetylcholine binds to muscarinic receptors the cell's response is __________________ through ______________________________
   a. Depending on the target tissue the response will be __________________

C. Adrenergic Receptors

1. What chemicals bind to adrenergic receptors? __________________________

2. Adrenergic postganglionic neurons of the sympathetic division release _________________ as a neurotransmitter which diffuses across the synapse

3. What chemicals are released by the adrenal glands? _____________________
   a. These reach adrenergic receptors through ______________________________

4. The response of adrenergic receptors is mediated through __________________
5. List the four types of adrenergic receptors:
   a. ______________________________
   b. ______________________________
   c. ______________________________
   d. ______________________________

6. Which receptors normally create a stimulatory response? ________________

7. Which receptors are generally found in the vicinity of sympathetic nerve terminals? ________________________________

8. Which receptors generally are not near nerve terminals and therefore respond to secretions from the adrenal glands? ________________________________

IV. Regulation of the Autonomic Nervous System

A. Autonomic Reflexes
   1. List the structural components of an autonomic reflex:
      a. ______________________________
      b. ______________________________
      c. ______________________________
      d. ______________________________
      e. ______________________________

   2. Baroreceptors in the walls of large arteries detect __________________
      a. What part of the brain integrates this information? ___________________

   3. A sudden increase in blood pressure initiates a ________________ reflex
      that ______________________________ & __________________________

   4. A sudden decrease in blood pressure initiates a ________________ reflex
      which _____________________________ & _________________________

B. Control Centers for Autonomic Reflexes
   1. What part of the brain is in overall control of the ANS? ________________
      a. Which part produces sympathetic responses? ________________
      b. Which part produces parasympathetic responses? ________________

   2. Which system plays an important role in emotions? ________________
      a. Pleasant thoughts generally stimulate ______________________ neurons
b. Emotions like anger generally stimulate ____________________ neurons

C. Enteric Nervous System

1. What supplies information to the CNS about intestinal contents? __________
   __________________________________________________________________________

2. ANS neurons to the enteric plexuses effect _____________________________
   __________________________________________________________________________

3. Neurons of the enteric nervous system can operate independently of the CNS through ______________________________

V. Functional Generalizations About the Autonomic Nervous System

A. Stimulatory Versus Inhibitory Effects

1. Does one division of the ANS produce only stimulatory effects? __________

2. Does one division of the ANS produce only inhibitory effects? __________

B. Dual Innervation

1. The term dual innervation refers to the fact that most organs are innervated by both the ________________ & ________________ division

2. Do all viscera have dual innervation from the ANS? __________

3. Does dual innervation mean equal control by both divisions? __________

C. Opposite Effects

1. Explain what "opposite effects" refers to if a single structure is innervated by both divisions of the ANS:
   __________________________________________________________________________

D. Cooperative Effects

1. Explain "cooperative effects" when one division of the ANS is involved?
   __________________________________________________________________________

2. Explain "cooperative effects" when two divisions of the ANS are involved?
   __________________________________________________________________________

E. General Versus Localized Effects

1. Which division of the ANS has a more general effect on the entire body?
   ______________________

   a. What role does the adrenal medulla play in this? __________________________

Page 7 of 8
b. What role does neuron divergence play in this? ____________________

______________________________

c. Sympathetic stimulation often activates __________________________
at the same time

F. Functions at Rest Versus Activity

1. Which ANS division has a greater influence during physical activity?
   ________________________________

2. Which ANS division has a greater influence during resting conditions?
   ________________________________

3. What does "fight-or-flight response" refer to? __________________________
   ________________________________

4. What does "SLUDD" stand for? ________________________________
   ________________________________