

## 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? \_\_\_\_\_

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b. What role does neuron divergence play in this? \_\_\_\_\_

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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? \_\_\_\_\_

\_\_\_\_\_