Physiology
Unit 2

AUTONOMIC NERVOUS SYSTEM
Peripheral Nervous System Organization

**Somatic Division**
- Single neuron between CNS and skeletal muscle cells
- Innervates skeletal muscle
- Can only lead to muscle excitation

**Autonomic Division**
- Two neuron system between CNS and effector organs
- Innervates smooth muscle, cardiac muscle, glands
- Can be either excitatory or inhibitory
Autonomic Nervous System

- 2 neurons in series synapsing at a ganglia
  - *Preganglionic neuron*
    - CNS to ganglion
  - *Postganglionic neuron*
    - Ganglion to effector
Sympathetic Division

• Fight or Flight response
• Increases activity under conditions of physical or physiological stress
• All resources for physical exertion are activated
  – HR increases
  – BP increases
  – Blood flow to skeletal muscles, heart and brain increases
  – Liver releases glucose
  – Pupils dilate
  – GI tract activity is dampened
  – Blood flow to the skin is reduced
Sympathetic Division
Thoracolumbar Division

- Sympathetic neurons exit the CNS from the thoracic and lumbar regions of the spinal cord
- Ganglia arranged as the **sympathetic trunks**
  - Close to the spinal cord
  - 2 chains on either side of the spinal cord
Parasympathetic Division

• Rest and digest response
• Homeostatic functions are predominant
Parasympathetic Division
Craniosacral Division

- Preganglionic neurons exit the CNS from the brain stem and sacral regions of the spinal cord
- Parasympathetic ganglia lie within or very close to the effector organs that the postganglionic neurons innervate
Activation Patterns of the Divisions

• Sympathetic Division
  – More divergence of preganglionic neurons
  – Tends to respond as a single unit
  – Increased sympathetic activity tends to occur body wide

• Parasympathetic Division
  – Less divergence of preganglionic neurons
  – Specific organs are activated in a pattern that is dependent on each physiological response
Neurotransmitters of the ANS

- Preganglionic neurons release ACh
- Postganglionic neurons
  - Sympathetic division release NE
  - Parasympathetic division release ACh
- Cotransmitters released by preganglionic neurons with the primary neurotransmitter at many autonomic ganglia
  - ATP, dopamine, neuropeptides
- Postganglionic neurons
  - Nitrous oxide for smooth muscle dilation
Adrenal Medulla

• Postganglionic neurons that innervate the adrenal medulla do not develop axons

• The form the endocrine gland, the adrenal medulla

• Once activated by the sympathetic preganglionic neuron, the cells of the adrenal medulla release 80% Epi, 20% NE into the blood
Transmitters of the Peripheral Nervous System
Dual Innervation

• The heart, many glands and smooth muscle are innervated by both divisions of the ANS
• Opposing effects
• Divisions are usually activated reciprocally
  – Sympathetic activity increases
  – Parasympathetic activity decreases
  – Vis versa
• Provides precise control of the effector
Cooperative Control

• Both divisions of the ANS operate together
• Autonomic responses result from the regulated interactions of both the parasymapathetic and sympathetic divisions
• Autonomic responses usually occur without awareness or conscious control (autonomous)