Chapter 1 Introduction to Physiology

- Introduction to Physiology
- Four themes of Physiology

What is Human Physiology?
- Physiology is the study of how normal body works to maintain life.
- Physiology is an integrative discipline that utilizes biology, chemistry and physics to explain:
  - Functions of the human body
  - Mechanisms (physical and chemical processes) of these functions (cells, tissues, organs and organ systems)
  - Regulation of body function

The Body’s External Environment (Figure 1.4)
- External environment = external side of epithelial body barrier such as
  - Surroundings external to skin
  - Connection to outside: air in lungs; food in GI tract; urine in renal tubules
- The Body’s Internal Environment (Figure 1.4)
  - Internal environment = Immediate environment of most cells such as tissue fluid and plasma

The Exchange of Materials between External and Internal Environment
- Lungs: Gas exchange through inspiration and expiration
- GI Tract
  - ________: Nutrients and water are transported from the lumen to the blood
  - ________: Materials are transported from the blood to the lumen
- Kidneys
  - ________ is the movement of fluid across the capillary wall from the plasma to the interstitium
  - __________ occurs when the materials are selectively transported back to the blood stream
  - The unwanted materials are transported from the bloodstream into the tubules during __________
  - Unwanted materials are eliminated from the human body through ________

Body Fluid Compartments of a 70 kg man (Figure 1.5)

<table>
<thead>
<tr>
<th>Body Fluid</th>
<th>Volume (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBW</td>
<td>42</td>
</tr>
<tr>
<td>ICF</td>
<td>28</td>
</tr>
<tr>
<td>ECF</td>
<td>14</td>
</tr>
<tr>
<td>Plasma</td>
<td>3</td>
</tr>
<tr>
<td>ISF</td>
<td>11</td>
</tr>
</tbody>
</table>
Four Themes in Physiology

- Homeostasis
- Structure-function relationships exist
- Communication
- Metabolism
- Homeostasis
  - Homeostasis is the ability to maintain a relatively constant internal environment around physiological set points
  - Set points (normal)
    - Expected value of regulated variable. Examples: Core body temperature = 37º C; glucose (sugar) = 100 mg/dL (Figure 1.6); pH = 7.4
  - How to achieve homeostasis?
    - Homeostatic regulatory mechanisms minimize the error signals
    - Error signals = actual value of a regulated variable - set point
  - Homeostasis Regulatory Components
    - Receptor
    - Integrating Center
    - Effector
  - How is homeostasis maintained?
    - Most by negative feedback loop (Figure 1.7)
    - The effectors act antagonistically to defend the set point against the deviations in any direction
  - Why is homeostasis important?
    - Disruption of homeostasis is the basis for disease and death

- Positive feedback loops are not homeostatic
  - In a positive feedback loop, the action of effectors amplifies the changes that stimulated the effectors
  - It reinforces the stimulus and its responses sends the regulated variable farther away from its set points
  - Examples: Luteinizing hormone (LH) stimulates the secretion of estrogen (Figure 1.8), child birth, blood clotting, urination

- Structure-function Relationships (Table 1.1)
  - The integration of structure and function
  - Molecule interactions: A molecule binds and reacts with other molecules
  - Compartmentalization at various levels of biological organization (cell, tissue, organ and organ system) allows each component has specialized function

- Communication permits coordination of events and homeostasis via endocrine system and nervous system
- Metabolism: Extract currency ATP from food for mechanical work, repair and growth of