Now that students have a good handle on the structural organization of the digestive system, the processes and functions of this system will seem fairly straightforward. Key functions of the digestive system all serve one purpose—to bring essential nutrients into the internal environment so that they are available to each cell of the body. These functions include ingestion (the taking in of food materials); digestion (breaking complex nutrients down into simpler nutrients); motility (movement of food along the GI tract through movement of the GI wall); absorption (movement through the GI mucosa into the internal environment); and finally, elimination (excretion to make room for more material). An understanding of this process will prepare students for Chapter 27, which discusses the fate of nutrients once they have been absorbed.

Objectives
After students have completed this chapter, they should be able to:
1. Describe the primary mechanisms of the digestive system.
2. Define and compare mechanical and chemical digestion.
3. Discuss the function of mastication.
4. List and explain the three main steps or stages of deglutition.
5. Differentiate between peristalsis and segmentation.
6. Explain the process of emptying the stomach.
7. Define the different processes involved in mechanical digestion and identify the organs that accomplish each process.
8. Define chemical digestion.
9. Define the term enzyme and classify enzymes according to the type of chemical reaction catalyzed.
10. List and discuss important properties of digestive enzymes.
11. List the most important digestive juices and enzymes, the food product each digests, and the resulting products.
12. Compare and contrast protein, fat, and carbohydrate digestion.
13. Discuss the control of salivary, gastric, pancreatic, biliary, and intestinal exocrine secretions.
14. Identify and discuss the absorption of nutrients resulting from the digestive process and the structures into which they are absorbed.
15. Define the terms micelles, chylomicrons, vasoactive intestinal peptide, gastric inhibitory peptide, and hydrolysis.
16. Discuss elimination and defecation.

Lecture Outline
I. Overview of Digestive Function (Table 26-1)
   A. Primary function: bring nutrients from external environment to internal environment
   B. Specific functions
      1. Ingestion
2. Digestion
3. Motility
4. Secretion
5. Absorption
6. Elimination

II. Digestion of Two Types (p. 772)

A. Mechanical digestion—functions to increase surface area; mix and propel food (Table 26-2)

1. Mastication
2. Deglutition (Fig. 26-1)
   a. Oral stage
   b. Pharyngeal stage
   c. Esophageal stage
3. Peristalsis and segmentation
   a. Peristalsis—wave of contraction that moves chyme (Fig. 26-2)
   b. Segmentation—mixing movement (Fig. 26-3)

4. Regulation of motility (p. 774)
   a. Gastric motility
      1) Mixing of chyme
      2) Control mechanisms
         a) Gastric inhibitory peptide (GIP)
            (1) Stimulus for release: fat in the duodenum
         b) Enterogastric reflex
            (1) Stimulus: acid in the duodenum
            (2) Inhibits peristalsis
   b. Intestinal motility
      1) Peristalsis and segmentation
      2) Control mechanisms
         a) Intrinsic stretch reflexes
            (1) Initiated by stretching of intestinal wall
         b) Cholecystokinin-pancreozymin (CCK)
            (1) Stimulates peristalsis

B. Chemical digestion (Table 26-3)

1. Digestive enzymes (p. 774)
   a. Definitions
      1) Enzyme = organic catalyst
2) Digestion = hydrolysis (process of breaking large molecules down into smaller ones)

b. Naming: substrate acted upon plus -ase suffix
c. Classified as extracellular
d. Classified chemically as hydrolases

2. Properties of digestive enzymes
   a. Specific action—"key-in-a-lock" kind of action (Fig. 26-4)
   b. Function optimally at specific pH (Fig. 26-5)
   c. Most catalyze a reaction in both directions
   d. Continually being destroyed or eliminated
   e. Most synthesized as proenzymes

3. Carbohydrate digestion (Fig. 26-6)
   a. Amylase (found in saliva and pancreatic juice)
   b. Sucrase, lactase, maltase (located in intestinal brush border)

4. Protein digestion (Fig. 26-7)
   a. Pepsin (in gastric juice)
   b. Trypsin and chymotrypsin (in pancreatic juice)
   c. Proteases (from intestinal brush border)

5. Fat digestion (p. 777)
   a. Emulsification essential since fats are insoluble in water (large droplets of fat and little surface area resulting in slow digestion)
      1) Lecithin and bile salts serving as emulsifiers
      2) Micelles (Fig. 26-8)
         a) Formed when lecithin surrounds a lipid
         b) Results in making fat water-soluble
   b. Lipases (Fig. 26-9)
      1) Digest fats into fatty acids, monoglycerides, and glycerol
      2) Breakdown enhanced by colipase (a coenzyme)

6. Residues of digestion (p. 777)
   a. Feces
      1) Cellulose
      2) Connective tissue
      3) Undigested fats
      4) Bacteria, pigments, and water

III. Secretion (Table 26-4)
Chapter 26: Physiology of the Digestive System

A. Saliva

1. Water
2. Mucus
3. Amylase
4. Lipase
5. Sodium bicarbonate

B. Gastric juice (p. 779)

1. Chief cells (zymogenic cells)
   a. Secrete pepsinogen
   b. Pepsinogen converted to pepsin by HC1
2. Parietal cells (Fig. 26-10)
   a. Secrete hydrochloric acid
   b. Secrete intrinsic factor (binds to vitamin B12)

C. Pancreatic juice (secreted by acinar cells in inactive form as zymogens)

1. Trypsin
   a. Released as trypsinogen
   b. Trypsinogen converted to trypsin by enterokinase
2. Chymotrypsin
   a. Activated by trypsin
3. Lipases
   a. Activated by trypsin
4. Nucleases
   a. Activated by trypsin
5. Amylase
   a. Activated by trypsin
6. Sodium bicarbonate

D. Bile (p. 781)

1. Lecithin and bile salts
2. Sodium bicarbonate
3. Bilirubin —hemolysis

E. Intestinal juice

1. Mucus
2. Sodium bicarbonate
3. Water

IV. Control of Digestive Gland Secretion (p. 781)

A. Control of salivary secretion

1. Controlled by chemical, mechanical, olfactory, and visual stimuli
B. Control of gastric secretion (Fig. 26-12)
   1. Cephalic phase
      a. Parasympathetic stimulation
      b. Gastrin secretion (Table 26-5)
   2. Gastric phase
      a. Gastrin secretion stimulated by proteins
      b. Secretion of gastric glands stimulated by gastrin
   3. Intestinal phase—inhbition of gastric juice secretion by gastric inhibitory peptide (GIP)
      a. Secretin (Table 26-5)
      b. CCK (Table 26-5)
      c. Enterogastric reflex

C. Control of pancreatic secretion (p. 784)
   1. Secretin stimulates production of alkaline-rich pancreatic fluid
   2. Cholecystokinin-pancreozymin (CCK) effects
      a. Causes increased pancreatic secretion, high in enzymes
      b. Inhibits gastric secretion of HCl
      c. Stimulates contraction of gallbladder, releasing bile into duodenum

D. Control of bile secretion
   1. Secreted continually by the liver
   2. Controlled release of bile from the gallbladder
      a. Gallbladder contraction stimulated by secretin and CCK

E. Control of intestinal secretion
   1. Vasoactive intestinal peptide (VIP)
      a. Increases intestinal juice secretion
   2. Neural reflexes

V. Absorption (Table 26-6)
A. Process of absorption (Fig. 26-13, Fig. 26-14, Fig. 26-15, Fig. 26-16)
   1. Into blood or lymph
   2. Mostly in small intestine
   3. Capillaries and lacteals in villi
B. Mechanisms of absorption (Fig. 26-16)
   1. Osmosis (water)
   2. Secondary active transport (sodium, glucose, amino acids) (Fig. 26-14)
   3. Diffusion (lipid micelles) (Fig. 26-15)
      a. Lipid micelles are formed from lecithin and bile salts in intestine
b. Fatty acids and simple lipids enter the absorptive cells
c. Inside the cell, fatty acids and monoglycerides unite to form triglycerides
d. Chylomicrons (water-soluble coats around the lipid) are formed inside the cell
e. Chylomicrons are into lymph lacteal diffused

VI. Elimination (p. 787)
A. Defecation
   1. Expelling of feces
   2. Reflex
      a. Rectum is normally empty
      b. Colonic peristalsis moves feces to rectum
      c. Distention of the rectum causes defecation desire and relaxation of internal anal sphincter
      d. Conscious relaxation of the external anal sphincter and colonic peristalsis results in defecation
B. Constipation
   1. Slow movement of colon contents, resulting in too much reabsorption of water from feces
C. Diarrhea
   1. Increased motility of small intestine, resulting in less water reabsorption
   2. Bacterial toxins

VII. The Big Picture: Digestion and the Whole Body (p. 788) (Fig. 26-17)
A. Maintains constancy of nutrient concentration in internal environment
B. Nervous and endocrine systems involved in control
C. Oxygen provided by respiratory and circulatory systems
D. Digestive organs protected by integumentary and skeletal systems
E. Skeletal muscles: ingestion, mastication, deglutition, and defecation

VIII. Mechanisms of Disease: Disorders of the Digestive System (p. 789)
A. Disorders of the GI tract (Fig. 26-18)
   1. Signs and symptoms
      a. Gastroenteritis
      b. Anorexia
      c. Nausea
      d. Emesis (vomiting)
      e. Diarrhea
      f. Constipation
      g. Ulcer
Chapter 26: Physiology of the Digestive System

2. Ulcer
3. Stomach cancer
4. Malabsorption syndrome
5. Diverticulosis and diverticulitis
6. Colitis
7. Irritable bowel syndrome
8. Colorectal cancer

B. Disorders of the liver and pancreas
1. Hepatitis
2. Cirrhosis
3. Pancreatitis
4. Pancreatic cancer