

About this Chapter

- Digestion function and processes
- Anatomy of the digestive system
- Motility
- Secretion
- Regulation of GI function
- Digestion and absorption

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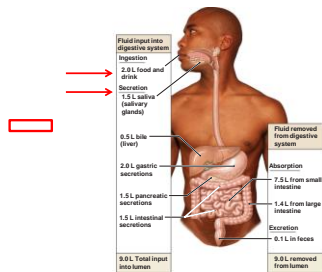
About this Chapter

- The cephalic phase
- The gastric phase
- The intestinal phase
- Immune functions of the GI tract

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Digestive Function and Processes

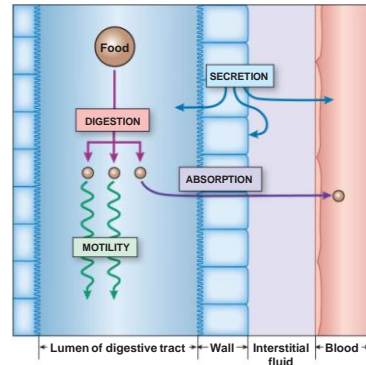
- The volume of fluid entering the GI tract must equal the volume leaving



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Figure 21-1

Four Basic Processes of the Digestive System

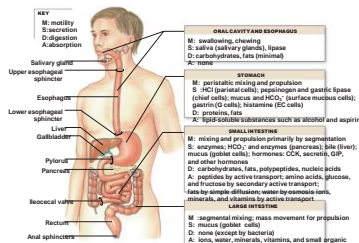


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Figure 21-2

Digestion and Absorption

- Summary of motility, secretion, digestion, and absorption in different regions of the digestive system

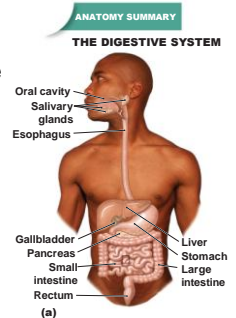


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Figure 21-22

Digestive System Anatomy

- Oral cavity → esophagus → stomach → small intestine → large intestine → rectum



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Figure 21-3a

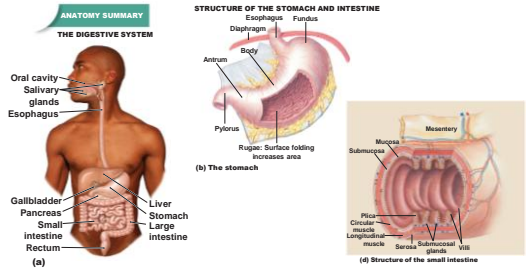
Digestive System Anatomy

- Stomach
 - Fundus → body → antrum
- Pyloric valve
- Small intestine
 - Duodenum → jejunum → ileum
- Accessory organs: pancreas and liver
- Large intestine: colon and rectum
- Anus

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Digestive System Anatomy

- A closer look at the structure of the stomach and small intestine



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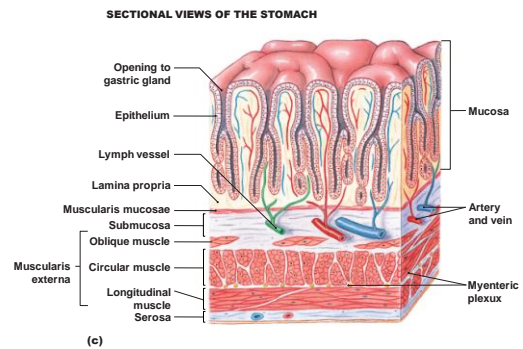
Figure 21-3a-b, d

Digestive System Anatomy

- Mucosa
 - Created from
 - Epithelial cells
 - Lamina propria
 - Muscularis mucosae
 - Modifications increase surface area
- Submucosa
- Muscularis externa
 - Circular muscle
 - Longitudinal muscle
- Serosa

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Digestive System Anatomy

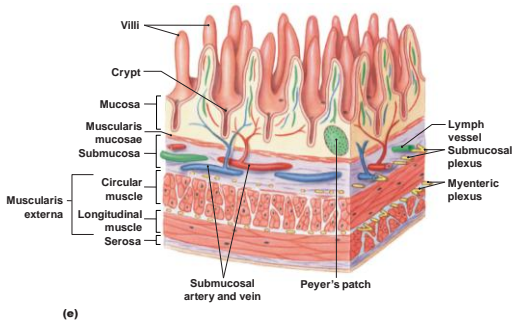


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Figure 21-3c

Digestive System Anatomy

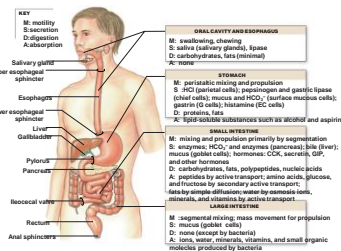
SECTIONAL VIEWS OF THE INTESTINE



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Figure 21-3e

Motility



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Figure 21-22

Motility

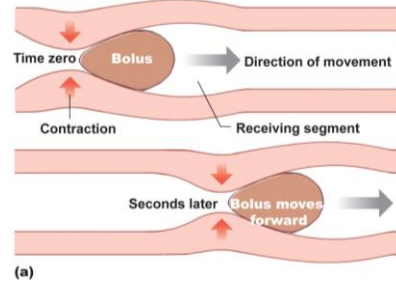
Different regions display different types of contraction

- Tonic contractions
 - Sustained (minutes to hours)
 - Occur in sphincters and anterior stomach
 - Keep bolus from moving backwards
- Phasic contractions
 - Last a few seconds
 - Peristalsis moves bolus forward
 - Segmentation mixes
 - Posterior stomach and small intestine

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Contractions in the GI Tract

- Peristalsis promotes forward movement
 - Contraction of circular muscles (relaxation of longitudinal muscles)

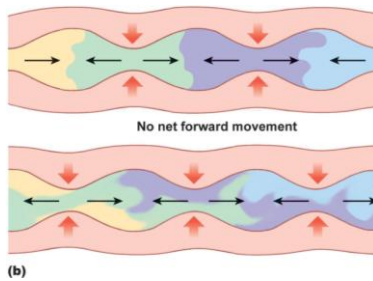


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Figure 21-5a

Motility

- Segemental contractions promote mixing

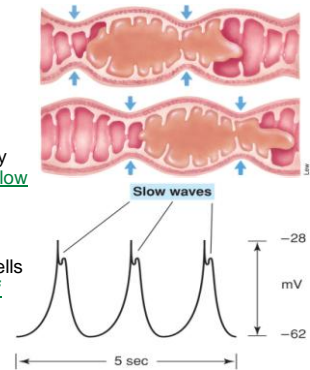


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Figure 21-5b

Intestinal Contractions and Motility

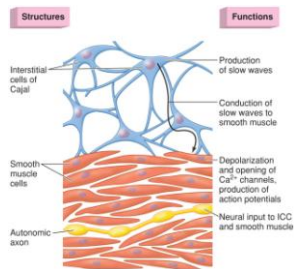
- **Slow wave potentials**
 - Occur automatically via endogenous pacemaker activity
 - Contractions are driven by graded depolarizations (**slow waves**)
 - Produced by non-neural/non-muscular cells called **Interstitial cells of Cajal (ICC)**



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Intestinal Contractions and Motility

Frequency of slow waves influence duration of contraction

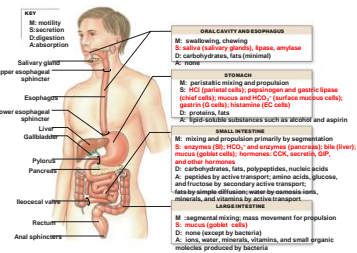


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Secretion: Ions, water, hormones, mucus, others

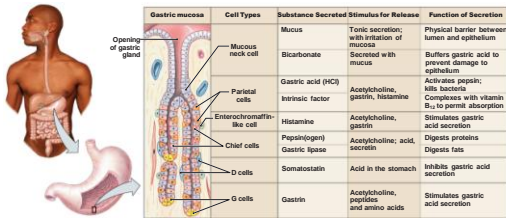
- 7 liters of secretions/ day!
- Digestive enzymes secreted into mouth, stomach and intestine
- Mucous cells in stomach and goblet cells in intestine
- Saliva is an exocrine secretion
- Liver secretes bile



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Figure 21-22

Secretion: Stomach

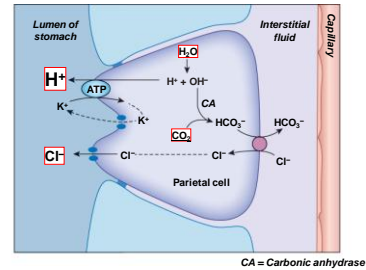


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Figure 21-25

Acid Secretion (Stomach)

- Parietal cells secrete hydrochloric acid (HCl) into the lumen of the stomach
- HCL breaks apart proteins, kills some bacteria
- Lumen can reach a pH of 1!!!!

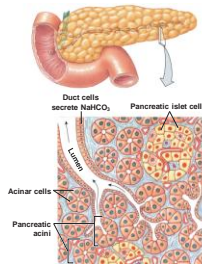


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Figure 21-6

Bicarbonate Secretion Pancreas

- Anatomy of the exocrine and endocrine pancreas
 - Endocrine gland: Pancreatic Islets (Insulin, Glucagon)
 - Exocrine gland: Pancreatic acini (Enzymes & Sodium Bicarbonate NaHCO₃)
 - Into pancreatic duct and duodenum

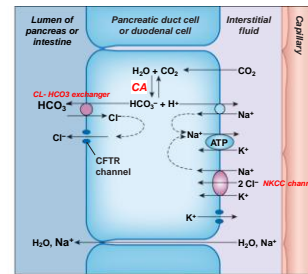


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Figure 21-7

Secretion

- Bicarbonate secretion in pancreas (Similar in some small intestine and colonic cells)
- Bicarbonate neutralizes acidic chyme

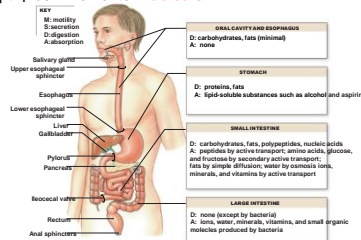


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Figure 21-8

Digestion and Absorption

- Mechanical and chemical digestion occurs along entire system
- GI secretions facilitate digestion
- Most absorption occurs in small intestine
 - Villi and microvilli enhance surface area
- Nutrients absorbed entire capillaries within villi
 - Except lipids which enter **Lacteals**

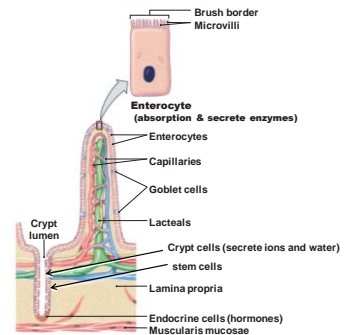


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Figure 21-22

Digestion and Absorption

- A villus and a crypt in the small intestine
- Increase surface area



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Figure 21-13

Digestion and Absorption

- 1/2 of what we eat is Carbs (starch and sugar)
- break down into monosaccharides for transport

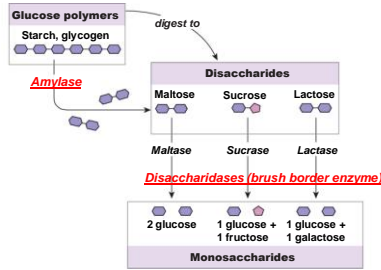


Figure 21-14

Digestion and Absorption (Proteins)

- Not all proteins equally digestible
- 2 groups of protein enzymes
- 1) Endopeptidase (protease)
- 2) Exopeptidase
- Digestion produces AAs, dipeptides, and tripeptides
- Some larger proteins can be absorbed

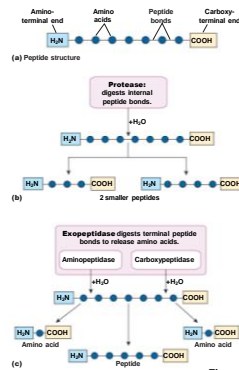
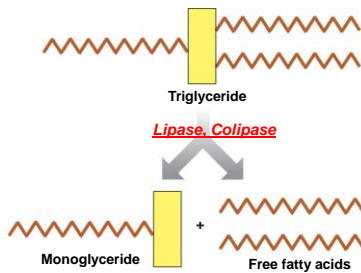


Figure 21-16

Digestion and Absorption (Fats)

- Triglycerides digest into monoglycerides and free fatty acids



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Digestion and Absorption

- Carbohydrate absorption in the small intestine

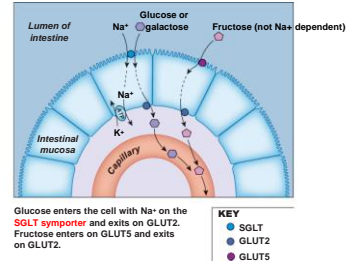


Figure 21-15

Digestion and Absorption (Proteins)

- Note: Na/K+ pump helps maintain Na+ gradient for apical diffusion of Na+

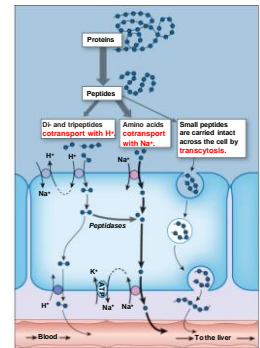


Figure 21-17

Digestion and Absorption (Fats)

- Bile salts facilitate fat digestion
 - From liver
 - Coat lipid
- Lipases also used to digest fat

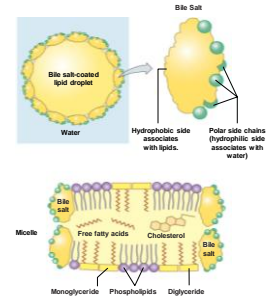
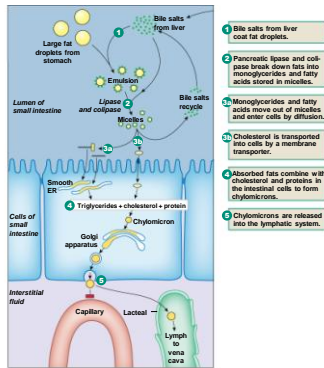


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Digestion and Absorption of Fats



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Figure 21-20

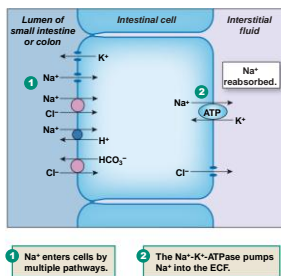
Digestion and Absorption

- Nucleic acids are digested into nitrogenous bases and monosaccharides
- Bases active transport
- Monosaccharides
- Intestine absorbs vitamins and minerals
- Fat-soluble vitamins (A,D,E,K) absorbed with fats
- Water-soluble vitamins (C & Most B) by mediated transport
 - Except: Vitamin B₁₂ attaches to intrinsic factor and absorbed in ileum (Needed for RBC production)
- Minerals by active transport
- Iron: Heme by apical transporter Fe⁺ then removed and absorbed via transporter
 - Or Free Fe⁺ Co-transport with H⁺

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Digestion and Absorption

- NaCl reabsorption in the small intestine and colon

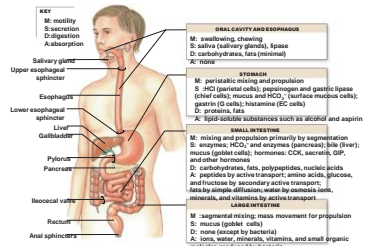


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Figure 21-21

Digestion and Absorption

- Summary of motility, secretion, digestion, and absorption in different regions of the digestive system



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Figure 21-22