Digestive System
= Gastrointestinal (GI) tract or _______________ plus Accessory organs

_MODULE 22.1: OVERVIEW OF THE DIGESTIVE SYSTEM_
Introduction

• Digestive system
  – breaks down food into nutrients that can be absorbed by bloodstream and delivered to body cells in useable form
  = GI tract or alimentary canal
  and __________

Introduction

• Alimentary canal
  – continuous tube consisting of ________ (mouth), pharynx, esophagus, stomach, small intestine, and __________

• Accessory organs
  – located around alimentary canal and assist in digestion in some way
    - include teeth, tongue, salivary glands, liver, ________________
Introduction

Figure 22.1 Overview of the digestive system.

Basic Digestive Functions and Processes

Functions:
1. ____________, break it down into its component nutrients to be used by body cells
2. ____________, and acid-base homeostasis
3. Ingest vitamins and minerals, produce hormones, excrete wastes
Basic Digestive Functions and Processes

• Main processes include:
  1. Ingestion – bring food and water into month
  2. Secretion – mucus, enzymes, acid, and hormones
  3. ____________ – via peristalsis
  4. Digestion – mechanical and chemical
  5. ____________ – through wall of alimentary canal into blood or lymph
  6. Defecation – eliminate waste products

Regulation of Motility by Nervous and Endocrine Systems

Motility - key process in every region of alimentary canal
• Oral cavity, pharynx, superior esophagus, and last portion of L.I. - ____________
• Remainder of alimentary canal - ____________

Types: mixing & churning, propulsion
Regulation:
  1. Nervous ANS: SNS inhibits PSN stimulates
  2. Endocrine hormones – stimulate or inhibit
Histology of Alimentary Canal

• _______ = concentric layers of tissue surround a space
• 4 main layers:
  1. ________ - epithelium
  2. Submucosa – CT
  3. Muscularis externa - smooth muscle
  4. Serosa (or _________) - CT

Histology of the Alimentary Canal

• Mucosa:
  a. epithelium – _______ or
     stratified squamous
     goblet cells → _______
  b. lamina propria - CT
  c. muscularis mucosae – SMC
Histology of Alimentary Canal

- dense irregular CT, with blood vessels and submucosal glands
- submucosal plexus (Meissner’s plexus) regulate secretions

Histology of Alimentary Canal

- **Muscularis externa**
  - inner circular SMC
  - outer longitudinal SMC
  - ______________(Auerbach’s plexus) regulate motility
Histology of Alimentary Canal

- **Serosa**
  - within peritoneal cavity
  - simple squam. epithelium & loose CT

  or

- **Adventitia**
  - outside peritoneal cavity
  - *dense irregular* CT

**Figure 22.2** The basic tissue organization of most of the alimentary canal.
Organization of Abdominopelvic Organs

- **Peritoneal membranes** *(Figure 22.3):*
  - Outer *parietal peritoneum*
    
    &lt; peritoneal cavity- serous fluid&gt;
  - Inner *visceral peritoneum (serosa)*

- **Mesenteries**
  - Folds of visceral peritoneum between loops of intestines
  - ______________ “fatty apron” : hangs from base of stomach
  - **Lesser Omentum** : lesser curvature of stomach to liver

---

*Figure 22.3a* The peritoneum, the largest serous membrane in the body.
Peritonitis (p. 850)

**Peritonitis** = *inflammation* of peritoneum

- Results when blood or contents of an abdominal organ leak into peritoneal cavity; usually due to *trauma*; often involves a bacterial infection

- Treatment for peritonitis may involve

---

**Organization of Abdominopelvic Organs**

*Figure 22.3b* The peritoneum, the largest serous membrane in the body.
Organization of Abdominopelvic Organs

(c) Anterior view of the abdominal organs and omenta, illustration (left), and cadaver photo (right)

Figure 22.3c The peritoneum, the largest serous membrane in the body.

MODULE 22.2 THE ORAL CAVITY, PHARYNX, AND ESOPHAGUS
Introduction

**Oral cavity** *(mouth)*

- posterior to teeth and bounded by cheeks
- lined with *stratified squamous nonkeratinized epith.*

- beginning of alimentary canal
- accessory organs: ____________
- forms _______ = saliva and chewed food

Structure of Oral Cavity

- **Cheeks:** ____________
- **Lips:**
  - *orbicularis oris* muscle and covered with ____________
  - *labial frenulum*
- **Vestibule** – *space between lips, cheeks and gums*
- **Gums** – ____________
- **Palate:**
  - *hard palate* (ant. 2/3) = ___________
  - *soft palate* (post. 1/3) = *skeletal muscle*
  - *uvula* – prevents food from entering nasal cavity
Structure of Oral Cavity

Figure 22.4 Oral cavity and pharynx.

Teeth and Mastication

**Teeth**
- organs of mechanical digestion (Figures 22.5, 22.6)
- Mastication – _________ to increase surface area of food
- Teeth located in bony sockets called **alveoli** maxilla and mandible
- **Dentition Formula:** 3 2 1 4 1 *
  3 – tricuspids (molars)
  2 – bicuspsids (premolars)
  1 - cuspids (canines)
  4 - incisors
The Teeth and Mastication

Figure 22.5a Types of teeth and the primary and secondary dentition.

Teeth and Mastication

• **Secondary dentition (____ permanent teeth)**
• **Tooth structure**
  • ________ – above gum line
    - Enamel – hard mineralized substances
    - Dentin
  • ________ – below gum line
    - Pulp – blood vessels, nerves
**Tongue**

**Tongue**
- skeletal muscle covered w/ stratified squamous epith.
  - lingual frenulum ______________________

- Papillae:
  1. __________
  2. fungiform
  3. circumvallate
  4. foliate papillae
- All papillae except filiform contain sensory receptors called **taste buds**

**Salivary Glands**

Salivary glands → **saliva** contains water, enz., mucus, and other solutes (Fig. 22.7)

1. __________ (25-30% of saliva)
   → parotid duct
   - located over masseter muscle
2. ____________ glands (65-70%)
   → submandibular ducts
   - located along mandible
3. ____________ (5%)
   → sublingual ducts
   – situated inferior to tongue
Salivary Glands

Figure 22.7 Anatomy of the salivary glands. The percentages indicate the portion of total salivary production for each type of gland.

Saliva
- ____________, initiates CHO digestion
  - Lysozyme enz. kills bacteria
  - IgA antibody that destroys pathogens
  - Bicarbonate to neutralize acid

- Parotid glands $\rightarrow$ water and enzymes
- Submandibular glands $\rightarrow$ secrete enzymes, mucus
- Sublingual glands $\rightarrow$ secrete mainly mucus, some enz.
Salivary Glands

• **Functions of Saliva:**
  
  *Moistening, lubricating, and cleansing oral mucosa*
  
  – Lysozyme and IgA **deter growth** of bacteria
  
  – ____________ digestion by moistening and mixing ingested food into a bolus so it can be swallowed
  
  – ____________ digestion by salivary amylase
  
  – ____________ in water of saliva to stimulate taste receptors on tongue

Pharynx

Common passageway for 2 systems:
  
  - extends from internal nares

  → ______________

• **Pharynx** (throat)
  
  – nasopharynx
  
  – oropharynx
  
  – laryngopharynx
Pharynx

Function of pharynx

• ________ - bolus passes into esophagus
  – Pharynx is surrounded by three pairs of skeletal muscles: upper, middle, and lower **pharyngeal constrictor muscles**

Tonsils

Tonsils – defend body from pathogens that have entered nasal or oral cavities

1. ________ **tonsils**
   - posterior oral cavity on either side of tongue

2. ________ **tonsils**
   - located under base of tongue

3. ________ **tonsils**
   - located on posterior wall of nasopharynx
Esophagus

- **Esophagus** (Figure 22.8)
  - muscular tube about 25 cm (10 in.) long
  - posterior to trachea
  - transports bolus from pharynx to stomach
  - **mucosa**: lined with

  - muscularis: superior 1/3 skeletal
    middle 1/3 skeletal & SMC
    inferior 1/3 SMC

Esophagus

**Upper esophageal sphincter**
- junction of pharynx and esophagus
- modified sphincter

**Gastroesophageal sphincter** (aka

_________________________ LES or cardiac sphincter)
- regulates passage of bolus into stomach;
  also prevents reflux

___________ - opening in diaphragm
Esophagus

• Primary functions of esophagus

• During swallowing, skeletal muscle and smooth muscle of muscularis undergo *peristalsis*
  – Thick esophageal epithelium protects esophagus from *abrasion* by food, also prevents *absorption*
Swallowing or Deglutition

Swallowing or __________
- specialized type of propulsion that pushes bolus of food from oral cavity through pharynx and esophagus to stomach

(Figure 22.9):

1. Voluntary phase – tongue pushes bolus posteriorly toward oropharynx
2. ______________ – bolus enters oropharynx
   - soft palate and epiglottis seal off nasopharynx and larynx
   - swallowing reflex initiated by medulla
   - all structures (uvula, larynx) move up and epiglottis depresses
3. ___________ – peristaltic waves move bolus down esophagus to stomach
Swallowing or Deglutition

Figure 22.9 The process of swallowing (deglutition).

MODULE 22.3 THE STOMACH
Gross Anatomy of Stomach

Anatomy

greater curvature – convex left side
lesser curvature - concave right side

5 regions:
Cardia – receives bolus when LES relaxes
Fundus – upper left domed-shaped
________ – largest section
Pyloric antrum – inferior portion
________ – connects with duodenum via pyloric sphincter

Rugae = ____________

(a) Regions and tissue layers of the stomach

Figure 22.10a  Gross anatomy of the stomach.
Gross Anatomy of Stomach

Figure 22.10b Gross anatomy of the stomach.

Histology of Stomach

- Stomach
  - same four tissue layers as rest of alimentary canal with modifications (Figure 22.11):
    - Muscularis externa: additional inner layer of ________________
  
  Chyme – ________________
Histology of Stomach

• Mucosa - indentations to form __________(Fig. 22.11):
  Goblet cells → __________
  **Gastric glands**, found at base of gastric pits
  • contain both endocrine cells that secrete **hormones**
    and **acidic, enzyme-containing fluid** called **gastric juice**

Histology of Stomach

• 4 main cells types (Figure 22.11b):
  1. ____________ cells → **hormones**
     **G cells** secrete hormone **gastrin** stimulates secretions
  2. ____________ → **pepsinogen**
     -precursor to enzyme **pepsin** which begins protein dig.
  3. ____________ → **hydrochloric acid** (HCl)
     → **intrinsic factor** (req. for absorption of **vitamin B12**)
  4. **Mucous neck cells** → secrete acidic mucus
Histology of Stomach

Figure 22.11b Structure and functions of the stomach mucosa and gastric glands.

Functions of Stomach

**Gastric secretions:**

- **HCl**
  - __________________________
  - nec. to convert pepsinogen to pepsin

- **Mucus**
  - from goblet cells & mucus glands

- **Intrinsic factor**
  - from parietal cells
  - req. for Vit. B\textsubscript{12} absorption

- **Pepsinogen**
  - ______________________
  - inactive form of pepsin

- **Pepsin**
Histology of the Stomach

Figure 22.11c  Structure and functions of the stomach mucosa and gastric glands.

Functions of Stomach

• Regulation of Gastric Secretions: (Figure 22.12):
  1. ____________ (30 - 40%)
     - triggered by sight, smell, taste, or thought of food
     - PSN (Vagus n.) triggers gastric juice secretion
  2. ____________ (50 - 60%)
     - triggered by food in stomach
     - gastrin released
     - gastric juice secreted
  3. ____________ (~5%)
     - triggered by food moving into S.I.
     - intestinal gastrin released → secretion of gastric juice
Functions of the Stomach

**Figure 22.12** The three phases of acid secretion from the stomach.

**Functions of the Stomach**

**Figure 22.12** The three phases of acid secretion from the stomach.
Gastroesophageal Reflux Disease (GERD)

• Gastroesophageal sphincter normally remains closed except during swallowing; when this mechanism *fails*, acid from stomach *regurgitates* into esophagus

• If this occurs on a chronic basis, it is called *gastroesophageal reflux disease*, or GERD, and may lead to pain, difficulty swallowing, vocal cord damage, respiratory problems, and even *esophageal cancer*

Gastroesophageal Reflux Disease (GERD) (p. 865)

• Causes
  – Acid

  – H. pylori

• Treatment
Functions of the Stomach

• **Enterogastric reflex**
  – as chyme enters duodenum, declining pH (more acidic) and presence of lipids trigger enterogastric reflex
  → decreases vagal activity and reduces acid secretion → ____________

Figure 22.12 The three phases of acid secretion from the stomach.
Functions of the Stomach

- **Emptying function**
- Liquids move rapidly
- Solids must be converted to a *nearly liquid* state before entering S.I.
- _________ → delays gastric emptying
- Duodenum needs to process incoming chyme

(Figure 22.13) The process of churning in the stomach.
Vomiting (p. 865)

- Vomiting (emesis)
- Complex motor response

- Due to:
  - Drugs (anti emetics)

MODULE 22.4: THE SMALL INTESTINE
Introduction

Small intestine (small bowel)
– 6 meters long (~20 feet)
- secretion, digestion, absorption, and propulsion

3 regions:

1. Duodenum
   • ~25 cm, retroperitoneal, “C” shaped
   • Major duodenal papilla –

   • Duodenal (Brunner’s) glands →

Divisions of Small Intestine

2. Jejunum
   – middle segment
   ~ 2.5 meters (7.5 feet) in length

3. Ileum
   – final segment, is also intraperitoneal
   ~ 3.6 meters (10.8 feet) in length
Divisions of Small Intestine

Figure 22.14 Gross anatomy of the small intestine.

Structure and Functions of Small Intestine

Increased surface area for absorption ~400 to 600x:

1. **Circular folds** or ____________ (Figure 22.15a)
   - mucosa and submucosa of S.I.
   - ____________ to give **enterocytes** (S.I. cells)
     more time to absorb nutrients
Structure and Functions of Small Intestine

2. Villi
   - layer of enterocytes surrounding blood capillaries and lymphatic vessel _________

(b) Intestinal villi, photomicrograph (left) and illustration (right)

Structure and Functions of Small Intestine

3. Microvilli _________
   - Modification of plasma membrane of enterocytes (Figure 22.15c)
Motility of Small Intestine

• Types of movement:
  - **Peristalsis**
  - **Segmentation**

---

**Table 22.1** Hormones and Paracrines Involved in Secretion and Motility of the Digestive Organs.

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Stimulus for Production</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach Hormones</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastrin</td>
<td>Partially digested proteins, stimulation from the vagus nerve</td>
<td>Increases acid secretion by parietal cells</td>
</tr>
<tr>
<td>Histamine</td>
<td>Stimulation from the vagus nerve</td>
<td>Increases acid secretion by parietal cells</td>
</tr>
<tr>
<td>Serotonin</td>
<td>Distention of the stomach</td>
<td>Stimulates gastric motility</td>
</tr>
<tr>
<td>Somatostatin</td>
<td>Decreasing stomach pH</td>
<td>Decreases acid secretion by parietal cells</td>
</tr>
<tr>
<td>Intestinal Hormones</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholecystokinin (CCK)</td>
<td>Partially digested proteins and lipids in chyme entering the duodenum</td>
<td>Causes gallbladder to contract and release bile; stimulates secretion of pancreatic enzymes from acinar cells, relaxes hepatopancreatic sphincter</td>
</tr>
<tr>
<td>Gastric Inhibitory peptide</td>
<td>Chyme entering the small intestine</td>
<td>Inhibits acid secretion from parietal cells</td>
</tr>
<tr>
<td>Intestinal gastrin</td>
<td>Chyme entering the small intestine</td>
<td>Stimulates acid secretion from parietal cells</td>
</tr>
<tr>
<td>Motile</td>
<td>Released regularly during fasting</td>
<td>Stimulates the migrating motor complex of the small intestine</td>
</tr>
<tr>
<td>Secretin</td>
<td>Partially digested proteins in the duodenum</td>
<td>Inhibits gastric motility and acid secretion; stimulates bicarbonate release from pancreatic duct cells; increases bile production by the liver</td>
</tr>
<tr>
<td>Inhibitory Intestinal Peptide</td>
<td>Partially digested proteins in the duodenum</td>
<td>Inhibits acid secretion by parietal cells; stimulates pancreatic secretion; increases intestinal blood flow</td>
</tr>
</tbody>
</table>

Table 22.1 Hormones and Paracrines Involved in Secretion and Motility of the Digestive Organs.
Appendicitis (p. 870)

MODULE 22.5: THE LARGE INTESTINE
Introduction

Large intestine (large bowel)

- ~1.5 meters (5 feet) long
- receives material from S. I. not digested or absorbed

- bacteria mfr. vitamins

Gross Anatomy of Large Intestine

L. I. = Cecum, Colon (ascending, transverse, descending, sigmoid), rectum, anus

• Cecum
  – vermiform appendix contains lymphatic nodules
  • ________ colon – right side
  • ________ colon
  • ________ colon – left side
  • Sigmoid colon
Gross Anatomy of Large Intestine

**Rectum**
Rectal valves - horizontal folds to hold feces in

**Anal canal**
Internal anal sphincter – ________
External anal sphincter – levator ani muscle
Histology of Large Intestine

Histological features:
- Mucosa _________ and its cells lack microvilli
- Many ___________
  \( \rightarrow \) protective and lubricating mucus
- Taeniae coli = __________________(Fig. 22.17a)
- Haustra = pockets or saccules
- Epiploic appendages
  = __________________

Bacteria in Large Intestine

Normal flora (gut flora)
- 500 different bacterial species that have symbiotic (_____________ ) relationship
  - Produce Vit. K (___________)
  - Metabolize undigested materials
  - Deter growth of pathogens
  - Stimulate immune system
Motility of Large Intestine and Defecation

- Two main types of motility:
  - Segmentation (churning)
  - Mass movement (mass peristalsis)
  
    - 3-4 times per day
  
Defecation reflex – ___________
  
  - __________ of internal & anal sphincters, contraction of SMC

Histology of Large Intestine

Figure 22.18  Defecation.
Motility of Large Intestine and Defecation

- **Diarrhea**
  - ____________, not have enough time to absorb water $\rightarrow$ produces *watery feces*

- **Constipation**
  - motility __________, too much water absorption and fecal material becomes *hard*
**Module 22.6: The Pancreas, Liver, and Gallbladder**

**Introduction**

- Pancreas, liver, and gallbladder
- Accessory organs
- ____________ secrete a product into a duct to outside of body
Pancreas

Pancreas – both endocrine and exocrine functions
(Figure 22.20)

- **Hormones** (pancreatic islets: beta & alpha cells)
  - insulin (__________)
  - glucagon (__________)

- Pancreatic juice (exocrine) *enzymes* secreted by
  ____________

---

Pancreas

- **Pancreas**
  - left upper quadrant of abdomen
  - **3 regions:** ________________
    - Pancreatic duct & accessory duct

---

(a) Gross anatomy of the pancreas

(b) Microscopic structure of the pancreas
The Pancreas

• ________________
  – Bicarbonate ions
  – *Pancreatic amylase*
  – *Pancreatic lipase*
  – *Trypsin, chymotrypsin, carboxypeptidase*
  – *Nucleases*

Pancreas

Hormonal stimulation of Pancreas

• *Cholecystokinin (CCK)* (duodenum)
  –

• *Secretin* (duodenum)
  –
The Pancreas

Figure 22.21  Secretion of pancreatic juice.

Liver and Gallbladder

Liver
- covered by thin CT capsule
- 4 lobes: right, left, ________, ________
- falciform ligament separates right and left lobes
- round ligament: remnant of umbilical vein
The Liver and Gallbladder

- **Liver lobule**
  - basic unit of liver
  - composed cords of **hepatocytes** arranged around a central vein \(\rightarrow\) hepatic v. \(\rightarrow\) IVC
  - hepatic sinusoids drain

*Figure 22.22b* Gross anatomy of the liver.
The Liver and Gallbladder

Figure 22.23 The structure of a liver lobule.

Liver and Gallbladder

- Functions of liver
  - Hepatocytes →
    - Nutrient metabolism
    - Detoxification – *detoxifies* substances produced by body, and substances that we eat or drink
    - _______ – directly *excretes* bilirubin in bile, antibiotics and other substances liver processes
Liver and Gallbladder

- **Gallbladder**
  - small sac on posterior liver
  - CCK triggers *contraction* of SMC causing release bile into _________
  - Cystic duct joins with common hepatic duct → ____________
  - → **hepatopancreatic ampulla** through **hepatopancreatic (h-p) sphincter**

---

*Figure 22.24* Structure of the gallbladder and its ducts.
The Liver and Gallbladder

- **CCK** causes ________ of G.B.
  - Relaxation of h-p sphincter

- **Secretin** stimulates bile *production*
Figure 22.26 Secretion of bile.

Figure 22.27 Structure and function of the accessory digestive organs.
**Module 22.7 Nutrient Digestion and Absorption**

Digestion and Absorption of Carbohydrates

**Salivary amylase** (salivary glands)
- - inactivated in stomach due to low pH

**Pancreatic amylase** (exocrine pancreas)
- picks up CHO digestion in duodenum ([Fig. 22.29](#))

**Lactase, maltase, sucrase** (brush border enz. S.I.)

- Lactose $\rightarrow$ G + galactose
- Maltose $\rightarrow$ G + G
- Sucrose $\rightarrow$ G + fructose
Lactose Intolerance, (p. 884)

Lactose intolerance -lack of enzyme lactase and as a result cannot digest milk sugar lactose (in adults)

Digestion and Absorption of Proteins

Proteins → __________

Pepsin (stomach)
- Chief cells of gastric glands
- Pepsinogen → pepsin (req. pH 2)
  _______ (activated by brush border enz.)
- from trypsinogen (pancreas)
  __________ (pancreas)
Carboxypeptidase (pancreas)
Digestion and Absorption of Lipids

*Triglycerides →__________*

*Bile salts* cause ________ of lipids

**Gastric lipase** *(stomach)*

**Pancreatic lipase** *(pancreas)*

___________ (protein-coated lipid pkg.) absorbed into lacteal → lymphatic circulation → thoracic duct → Lt. Subclavian vein (blood circulation)

---

**Figure 22.33** Lipid absorption in the small intestine.
Digestion and Absorption of Lipids

Figure 22.32 Summary of the digestion of carbohydrates, proteins, and lipids.

Digestion and Absorption of Nucleic Acids

Nucleic acids (DNA, RNA) $\rightarrow$ nucleotides

__________ (pancreas)
Digestion and Absorption of Nucleic Acids

### Table 22.2 Digestive Enzymes

<table>
<thead>
<tr>
<th>Enzyme(s)</th>
<th>Source</th>
<th>Reaction Catalyzed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salivary amylase</td>
<td>Salivary glands</td>
<td>Polysaccharides into smaller polysaccharides and oligosaccharides</td>
</tr>
<tr>
<td>Pancreatic amylase</td>
<td>Pancreatic juice</td>
<td>Polysaccharides into oligosaccharides</td>
</tr>
<tr>
<td>Maltrase, sucrase, lactase</td>
<td>Intestinal brush border</td>
<td>Oligosaccharides into monosaccharides</td>
</tr>
<tr>
<td>Proteins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pepsin</td>
<td>Chief cells of gastric glands (secreted as precursor pepsinogen)</td>
<td>Protein into polypeptides and oligopeptides</td>
</tr>
<tr>
<td>Trypsin</td>
<td>Pancreatic juice</td>
<td>Oligopeptides into small peptides, activates itself and other pancreatic enzymes</td>
</tr>
<tr>
<td>Chymotrypsin</td>
<td>Pancreatic juice</td>
<td>Oligopeptides into small peptides</td>
</tr>
<tr>
<td>Carboxypeptidase</td>
<td>Pancreatic juice</td>
<td>Oligopeptides into small peptides</td>
</tr>
<tr>
<td>Dipeptidase and tripeptidase</td>
<td>Intestinal brush border</td>
<td>Dipeptides and tripeptides into amino acids</td>
</tr>
<tr>
<td>Lipids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastric lipase</td>
<td>Gastric glands</td>
<td>Triacylglycerols into free fatty acids and diacylglycerols</td>
</tr>
<tr>
<td>Pancreatic lipase</td>
<td>Pancreatic juice</td>
<td>Triacylglycerols into free fatty acids and monoglycerides</td>
</tr>
</tbody>
</table>

### Absorption of Water, Electrolytes, and Vitamins

- > 9 L. H₂O __________
  - ~2 L. of water are *ingested*
  - ~ 7 L. *secreted* into alimentary canal

Of the 9 liters, about ______ are absorbed into enterocytes of S.I.

- Most of remaining water is absorbed into enterocytes of L.I., leaving only about 0.1 liter of water to be excreted in feces
The Big Picture of Digestion

Figure 22.34 The Big Picture of Digestion.