Chapter 21
Digestive System

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Introduction

- Digestive process is a “disassembly line”
- Digestive system provides processes in which proteins, carbohydrates, and fats are broken down and used as fuel
- Fuel carried to rest of body by circulatory system
- Parasympathetic nervous system initiates digestive functions during periods of low stress

Anatomy

- Alimentary canal (tube from mouth to anus)
- Gallbladder
- Liver
- Pancreas
- Salivary glands
- Teeth
- Tongue

Physiology

- Ingestion—orally taking materials into the body
- Digestion—processes that make food absorbable
  – Mechanical digestion—chewing, stomach churning, and movements in intestinal tube (peristalsis)
  – Chemical digestion—enzymes break food down further

Physiology

- Absorption—products of digestion move into bloodstream or lymph vessels and then body’s cells
- Defecation—eliminating indigestible or unabsorbed material from the body

Alimentary Canal

- Also called the GI tract
- Coiled, muscular passageway leading from mouth to anus; mostly smooth muscle
- Peristalsis—tonic and rhythmic contractions that help mix and propel food through GI tract
- Bolus—lump/ball of food that has been chewed, mixed with saliva, and swallowed
Alimentary Canal

- Peritoneum
  - Envelops abdominal wall
  - Largest serous membrane
  - Houses blood and lymph vessels, and nerves

Oral Cavity (Mouth)

- Port of entry for food and drink
- Includes tongue, teeth, gums, and openings from salivary ducts
- Mastication—chewing
- Deglutition—swallowing
- Salivary amylase, an enzyme, begins carbohydrate digestion
- Gustatory organs (taste buds)—chemoreceptors that detect sweet, sour, bitter, and salty tastes

Pharynx

- Also known as the throat
- Tube structure that transports food, liquid, and air to their respective destinations
- In digestion, pharynx takes food from oral cavity to esophagus during swallowing

Esophagus

- Muscular tube that connects pharynx to stomach
- Esophageal lining secretes mucus to aid in transport of food
- Esophagus bypasses thoracic organs and pierces the diaphragm to transport food to stomach

Stomach

- J-shaped organ that is an enlargement of the GI tract, bound at each end by sphincters
  - Cardioresophageal sphincter—junction between esophagus and stomach
  - Pyloric sphincter—junction between stomach and small intestine
- When empty, size of a large sausage
- When full, can hold up to 1 gallon of food

Stomach

- Rugae—longitudinal folds in lining of stomach that permit expansion
- Chyme—bolus reduced to thin, viscous fluid as food travels through stomach to small intestine
- Water, some minerals, alcohol, and some medications are the only substances absorbed by stomach lining
### Stomach
- Parietal cells secrete intrinsic (B12 absorption) and hydrochloric acid (breaks down proteins and activates enzymes)
- Chief cells secrete pepsinogen, a precursor to pepsin (protein digestion)

### Small Intestine
- Longest section of the alimentary canal
- Bound at both ends by sphincters:
  - Pyloric sphincter—between stomach and small intestine
  - Ileocecal sphincter—between small intestine and large intestine at the cecum
- Small intestine responsible for 90% of all absorption

### Small Intestine
- Divisions of small intestine in order: duodenum, jejunum, and ileum
- Villi: fingerlike projections housing blood and lymph capillaries
- Plicae circulares: circular folds within lumen
- Mesenteries: sections of the peritoneum that connect divisions of small intestines to abdominal wall
  - Greater and lesser omentums

### Absorption Sites in Digestive Tract

### Large Intestine (Colon)
- Lining produces a mucus that helps undigested matter move through
- Colon absorbs large amounts of water and some vitamins and minerals
- Characterized by two structures:
  - Taenia coli—resemble thread-gathering fabric
  - Haustra—pouches formed by tucks made by taenia coli along length of colon
Large Intestine (Colon)

- Divisions of large intestine:
  - Cecum—saclike structure in lower right abdomen and is first section
    - Vermiform appendix—lymph gland suspended from the cecum
  - Ascending, transverse, and descending (proper) colons—move clockwise
  - Rectum—main function is storage
  - Anal canal—also stores fecal matter
  - Anus—terminus of anal canal

Accessory Digestive Organs

- Liver—produces bile (fat emulsifier)
- Gallbladder—stores bile
- Pancreas—secretes enzymes that acts on proteins, carbs, and fats

Exocrine Cells of the Pancreas

Disassembly of Foods

- Proteins—organic compounds that contain large combinations of amino acids
  - 10 amino acids are non-essential (can be synthesized by body); 8 amino acids are essential (must be ingested)
- Carbohydrates—body’s preferred source of energy
  - Required for metabolism of other nutrients
  - Absorption mediated by insulin

- Fats—composed of lipids or fatty acids; can range in consistency from solid to liquid
  - Saturated fats—lard, processed oils; are solid at room temperature
  - Unsaturated fats—olive, peanut, flax seed, and sesame oils; are liquid at room temperature
Disassembly of Foods

- Vitamins—organic compounds essential for normal physiologic and metabolic functioning
  - Most vitamins cannot be made by the body and must be obtained from diet
  - Can be fat soluble or water soluble
    - fat-soluble are stored by the body; A, D, E, and K
    - water-soluble are not stored and must be ingested regularly; B and C

Pathological Conditions of the Gastrointestinal Tract

- Anorexia nervosa—prolonged avoidance of eating; both an eating disorder and an emotional disorder
- Appendicitis—inflammation of the vermiform appendix
- Bulimia—overeating (bingeing) and self-induced vomiting (purging)
- Colitis—inflammation of large intestine mucosa
- Cirrhosis of the liver—chronic degenerative disease in which hepatic cells are destroyed and are replaced with fibrous connective tissue
- Constipation—infrequent of difficult passing of stools
- Crohn’s disease—progressive inflammatory disease of the colon
- Diarrhea—frequent passing of unformed, loose, watery stools

Disassembly of Foods

- Minerals—essential nonorganic compounds found in nature that body uses
  - Only needed in trace amounts
  - Play a vital role in regulating many body functions
  - Referred to by name of a metal, nonmetal, radical, or phosphate, rather than by name of compound

Pathological Conditions of the Gastrointestinal Tract

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Disassembly of Foods

- Water—essential nutrient that every part of the body needs
  - Water-based fluids surround every cell in the body (except the outer layer in the skin)
  - All nutrients and wastes travel through water-based fluids
Pathological Conditions of the Gastrointestinal Tract

• Diverticulitis—inflammation of the pouchlike herniations of the colon wall where muscle has become weak
• Diverticulosis—small mucosal herniations through the muscular wall anywhere in the colon
• Gallstones—fusion of cholesterol crystals in bile; grow in size and number and obstruct flow of bile into duodenum

• Gastritis—inflammation of stomach’s lining; can be acute or chronic
• Gastroenteritis—inflammation of lining of stomach and intestines, characterized by nausea, vomiting, diarrhea, abdominal pain, lack of appetite, and weakness
• Gastroesophageal reflux disease—lower cardioesophageal sphincter fails to close normally after food enters stomach

• Obesity—abnormal increase in subcutaneous fat tissue
• Pancreatitis—inflammation of the pancreas; usually result of trauma, alcohol, abuse, or infection
• Peritonitis—inflammation of the peritoneum; caused by bacteria
• Pharyngitis (sore throat)—inflammation or infection of the pharynx

• Polyps—single or multiple growths on a mucous membrane, occurring most commonly in the colon; most are benign
• Thrush—fungi Candida albicans, affecting the oral mucosa; characterized by white plates of soft curd-like material
• Tonsillitis—inflammation of the tonsils, especially the palatine tonsils

• Hepatitis—general term for liver inflammation, which can be caused by alcohol, drugs, toxins, or viral infection
• Hernia—protrusion of an organ through its surrounding connective tissue membranes or cavity wall
• Irritable bowel syndrome—condition of large intestine with abnormal muscular contraction and excessive mucus in stools

• Ulcerative colitis—inflammation of the mucosa of large intestine and rectum; characterized by weight loss, intestinal ulcerations, diarrhea, and bleeding of the colon wall
• Ulcer—lesion in a membrane
Summary

• Digestive system consists of a series of structures designed to break down food and liquids into usable body fuel
• To carry out digestion, body makes use of a series of specialized structures known collectively as the alimentary canal
• Six types of nutrients are proteins, carbohydrates, fats, vitamins, minerals, and water