The Digestive System

Chapter 15
Introduction

- Digestion refers to the mechanical and chemical breakdown of food so the nutrients can be absorbed by cells
  - Carried out by the digestive system
  - Consists of the alimentary canal, leading from the mouth to anus and several accessory organs whose secretions aid the processes of digestion.
Digestion

- **Chemical digestion** – complex molecules are broken down into smaller molecules

- **Mechanical digestion** – physical movement of food that breaks it down into smaller pieces.
  - Ex: chewing, grinding, mashing
  - Chewing is called “mastication”
Alimentary Canal

- A muscular tube about 9 meters long that passes through the body’s ventral cavity

- Movements of the alimentary canal
  - Mixing movements – occur when smooth muscles contract rhythmically in a small section of the tube
  - Propelling movements – a wavelike motion called peristalsis
    - Peristalsis – caused by contraction behind a mass of food as relaxation allows the mass to enter the next segment of the tube
Alimentary Canal
4 Layers of Alimentary Canal

1) Mucosa:
   - Protects the tissues beneath it and carries out secretion and absorption
   - Consists of epithelium, underlying CT, and a bit of muscle.

2) Submucosa:
   - Nourishes surrounding tissue and carries away absorbed materials
   - Consists of loose connective tissue, blood vessels, glands
4 Layers of Alimentary Canal

3) Muscular Layer:
- Layer which moves the tube
- Contains: two coats of smooth muscle tissue and nerves (plexus)
- Fibers of the inner coat surround the tube
  - When they contract the tube’s diameter decreases
- Fibers on the outer muscular coat run lengthwise
  - When they contract the tube shortens

4) Serosa:
- Protects underlying tissues and secretes serous fluid
Alimentary Canal

Figure 16-3

- Mesentery
- Serosa
- Submucosa
- Longitudinal muscle layer
- Circular muscle layer
- Mucosa
- Lumen
- Myenteric plexus
- Submucous plexus

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Movements of the Alimentary Canal

- **Mixing movements**
  - Occurs when smooth muscle in small units of the tube contract rhythmically
  - Mixes food with digestive juices secreted by the mucosa

- **Propelling movements**
  - Known as peristalsis
Mouth

- First portion of the alimentary canal
- Functions to receive food and begins mechanical digestion by mastication (chewing)

Cheeks and Lips
- Cheeks form the lateral walls of the mouth
- Lips are highly mobile structures that surround the mouth opening
  - Are highly sensitive and help to judge the temperature and texture of food
Mouth

- **Tongue**
  - A thick, muscular organ covered by mucous membrane and housing taste buds within papillae.
  - Attached to the floor of the mouth by the frenulum.

- **Palate**
  - The palate forms the roof of the oral cavity and has an anterior hard palate and posterior soft palate.
  - The soft palate and uvula function to close off the nasal cavity during swallowing.
  - Associated with the palate in the back of the mouth are palatine tonsils.
    - Help protect the body against infection.
Tongue/Palate

- Hard palate
- Soft palate
- Palatine tonsil
- Epiglottis
- Vocal fold
- Tongue
- Trachea
- Esophagus
Mouth

- **Teeth**
  - Two sets of teeth develop in sockets within the maxillary and mandibular bones
  - The 20 primary teeth are shed in the order they appeared and are replaced by 32 secondary teeth.
  - Through the actions of chewing, teeth break food into smaller pieces, beginning mechanical digestion
Teeth
Teeth

- Different teeth are adapted to handle food in different ways and include:
  - Incisors
  - Cuspids
  - Bicuspids
  - Molars
- Each tooth consists of a crown and a root
- Each tooth is made of enamel, dentin, pulp, cementum, nerves and blood vessels
Anatomy of a Tooth

- Enamel
- Dentin
- Pulp
- Cementum
- Periodontal membrane
- Nerve and blood supply
Mouth

- Salivary Glands
  - Secrete saliva, which moistens food particles, binds them together, allows tasting, helps to cleanse the mouth and teeth and begins carbohydrate digestion.
  - Receive parasympathetic stimulation that triggers the production of a large volume of saliva at the sight or smell of food.
  - Contain 2 cells
    - Serous cells: produce amylase (breaks down carbs)
    - Mucus cells: produce mucus to bind to food and lubricate during swallowing.
Salivary Glands
Pharynx and Esophagus

• Pharynx
  • A cavity lying behind the mouth
  • Connects the nasal and oral cavities with the larynx and esophagus
  • Is divided into a nasopharynx (top portion), oropharynx (middle portion) and laryngopharynx (bottom portion)

• Swallowing Mechanism:
  • Swallowing reflexes can be divided into 3 stages:
    • Food is mixed with saliva and voluntarily forced into the pharynx with the tongue
    • Sensory receptors in the pharynx sense food, which triggers swallowing reflexes.
    • Peristalsis transports the food in the esophagus to the stomach
Pharynx and Esophagus

- **Esophagus**
  - A muscular, straight, collapsible passageway leading to the stomach
  - Lined with mucous glands that moisten and lubricate the inner lining of the tube.
  - The lower esophageal sphincter helps to prevent regurgitation of the stomach contents into the esophagus.
Heartburn

- Regurgitation of stomach acid into the esophagus.
Stomach

- A J-Shaped muscular organ that receives and mixes food with digestive juices, and propels food to the small intestine.

- A pyloric sphincter controls release of food from the stomach into the small intestine.
Stomach

- Has about a 1 liter capacity
- Contains rugae which allows it to expand
- Divided into 4 regions
  - Cardiac
  - Fundic
  - Body
  - Pyloric
Stomach

- Mixing and Emptying Actions
  - Following a meal, mixing actions of the stomach turn the food into chyme and pass it toward the pyloric region using peristaltic waves
  - The rate at which the stomach empties depends on the fluidity of the chyme and the type of food.
Stomach Ulcers

- Breaking down of mucosal lining.
Pancreas

- Produces pancreatic juice that aids digestion
  - Pancreatic juice contains enzymes that digest carbohydrates, fats, proteins and nucleic acids.
  - Protein-digesting enzymes are released in an inactive form and are activated upon reaching the small intestine.
Liver

- Reddish-brown structure located in the upper-right quadrant of the abdominal cavity
- The body’s largest internal organ
- Divided into left and right lobes
- Has many functions:
  - Metabolism of carbohydrates, lipids and proteins
  - Stores glycogen, vitamins A,D, and B12, iron, and blood
  - Filters blood, removing damaged red blood cells and foreign substances, and removes toxins
  - Secretes bile during digestion
Liver

- Oesophagus
- Right lobe of liver
- Left lobe of liver
- Gall bladder
- Cystic duct
- Common bile duct
- Duodenum
- Pylorus
- Pancreas
- Common hepatic duct
- Small intestine
Bile

- A yellowish-green liquid that includes water, bile salts, bile pigments, cholesterol and electrolytes.
  - Bile pigments are breakdown products from red blood cells
  - Only bile salts have a digestive function
    - Bile salts emulsify fats and aid in the absorption of fatty acids, cholesterol and certain vitamins
Gallbladder

• Pear-shaped sac lying on the interior surface of the liver

• Contains the bile duct that leads to the duodenum

• A sphincter muscle controls the release of bile from the common bile duct

• Bile does not normally enter the duodenum until the gall bladder is stimulated to contract.
Gallbladder
Small Intestine

- Receives secretions from the pancreas and liver
- Completes digestion of the nutrients in chyme
- Absorbs the products of digestion
- Transports the remaining residues to the large intestine
- Consists of the duodenum, jejunum and ileum

Duodenum
- Shortest and most fixed portion of the small intestine (the rest is mobile and lies free in the peritoneal cavity)
- Small intestine is suspended from the posterior abdominal wall by a double-layered fold of peritoneum called mesentery.

- Inner wall of the small intestine is lined with intestinal villi, which greatly increase the surface area available for absorption and aid in mixing actions.
Small Intestine

- Duodenum
- Jejunum
- Ileum empties into cecum (large intestine)
Absorption in the small intestine:
- Major site of absorption in the alimentary canal

Movements of the small intestine:
- Small intestine moves chyme by peristalsis
Large Intestine

- Absorbs water and electrolytes and forms and stores feces

- Parts of the Large intestine
  - Cecum – pouch at the beginning of the large intestine
  - Colon – ascending, transverse, descending and sigmoid regions
  - Rectum
  - Anal Canal
    - Opens to the outside as the anus
    - Is guarded by an involuntary internal anal sphincter and a voluntary external anal sphincter muscle.
Large Intestine

- Functions of the Large Intestine
  - Does not digest or absorb nutrients
  - Secretes mucus
  - Absorbs water and electrolytes

- Movements of the Large Intestine
  - Similar to those of the small intestine
  - Peristaltic waves happen only two or three times during the day
  - Defecation is stimulated by a defecation reflex that forces feces into the rectum where they can be expelled.

- Feces
  - Composed of undigested material, water, electrolytes, mucus and bacteria.