Objectives:

Discuss the general functions and anatomy of the digestive tract, including accessory structures.

First, an overview of the tubular nature of the digestive system.

Describe the individual organs of the system, including a discussion of the gross and microscopic anatomy.
Digestive System Overview

AKA:
- Digestive Tract
- Alimentary Tract or Canal
- GI tract
- Gut

Muscular, hollow tube, from the lips to the anus + Various accessory organs

- Oral Cavity, Teeth, Tongue
  - Mechanical processing, moistening, mixing with salivary secretions
- Liver
  - Secretion of bile (important for lipid digestion), storage of nutrients, many other vital functions
- Gallbladder
  - Storage and concentration of bile
- Large Intestine
  - Dehydration and compaction of undigestible materials in preparation for elimination
- Small Intestine
  - Enzymatic digestion and absorption of water, organic substrates, vitamins, and ions
- Salivary Glands
  - Secretion of lubricating fluid containing enzymes that break down carbohydrates
- Pharynx
  - Pharyngeal muscles propel materials into the esophagus
- Esophagus
  - Transport of materials to the stomach
- Stomach
  - Chemical breakdown of materials via acid and enzymes; mechanical processing through muscular contractions
- Pancreas
  - Exocrine cells secrete buffers and digestive enzymes; endocrine cells secrete hormones
The function of the system as a whole is processing food in such a way that nutrients can be absorbed and residues eliminated.

Individual parts function in:

- Ingestion
- Propulsion
- Mechanical digestion and segmentation
- Chemical and enzymatic digestion
- Secretion
- Absorption
- Compaction
- Excretion and elimination (defecation)
Mesenteries (p 669)- double sheets of peritoneum, surrounding and suspending portions of the digestive organs

- **Greater omentum** - "fatty apron", hangs anteriorly from stomach; double layer encloses fat
- **Lesser omentum** - between stomach and liver
- **Mesentery proper** - suspends and wraps the small intestine
- **Mesocolon** - suspends and wraps the colon, parts are
  - transverse mesocolon
  - sigmoid mesocolon
General Organization
Structure of Small Intestinal Wall

**Plicae** circulares – circular pleats around the interior of the small intestine

**Villi** – minute finger-like projections, contain capillaries & lacteals

**Microvilli** – sub-microscopic size, projections on simple columnar cells

*Function of all three?*

**Crypts** at bottom of villi—Cell regeneration (mitosis)

**Glands**—mucus, enzymes
Smooth Muscle, a review

- One nucleus
- Nonstriated
  - Actin and myosin present
- Slow, sustained contraction
- Communication
  - Varicosities
  - Gap junctions
Histological Organization

Tube made up of four layers.
1. Mucosa
2. Submucosa
3. Muscularis externa
4. Serosa = Visceral Peritoneum

Modifications along its length as needed.
The 4 Layers of the Gut

1) **Mucosa**
   - Epithelium - usually simple columnar epithelium with goblet cells; may be stratified squamous if protection needed, e.g., esophagus
   - Lamina propria – areolar connective tissue deep to epithelium
   - Muscularis mucosae - produces folds - *plicae* (small intestine) or *rugae* (stomach)
The 4 Layers of the Gut

2) **Submucosa** – made up of loose connective tissue contains submucosal plexus and blood vessels.

*Fig 23.7*
3) **Muscularis externa** – smooth muscle, usually two layers (controlled by the myenteric plexus; source of peristalsis)
   - inner layer: circular
   - outer layer: longitudinal

![Fig 23.7 The 4 Layers of the Gut](image)
4) Serosa
visceral layer of mesentery (contiguous with the peritoneum) or adventitia depending on location

Fig 23.7
Repetitio est mater studiorum
- AKA **buccal cavity** or mouth - lined with oral mucosa (type of epithelium ?)
- Lips = labia
  - Labial frenulum
- Hard and soft palates - form roof of mouth
- Tongue - skeletal muscle
  - Lingual frenulum
- Salivary glands - three pairs
- Teeth
- Fauces = opening to pharynx
Types and Numbers of Teeth

Dental succession

**Deciduous** ($1^\circ$, baby, milk) teeth - 20, replaced by

Permanent teeth - 32 teeth
Crown - exposed surface of tooth
Neck - boundary between root and crown

Enamel - outer surface
Dentin – bone-like, but noncellular
Pulp cavity - hollow with blood vessels and nerves
Root canal - canal length of root
Gingival sulcus - where gum and tooth meet
Periodontal Ligament
Three pairs of Salivary Glands

1-1.5 L / day for digestion (?) lubrication (swallowing) moistening (tasting)

- **Parotid** – lateral side of face, anterior to ear, drain by parotid duct to vestibule near 2nd upper molar
- **Submandibular** – medial surface of mandible – drain near lingual frenulum drain posterior to lower molars
- **Sublingual** – in floor of mouth - drain near lingual frenulum
Swollen, painful parotid salivary glands (parotitis) on one or both sides of the face
Etiology: Mumps virus (Myxovirus)
Fever and sometimes orchitis, pancreatitis etc.
About 1/3 of infected people do not show symptoms

Effective vaccine (MMR) since 1967
Esophagus

- Lined with noncornified stratified squamous epithelium
- Food boluses propelled by peristalsis of both skeletal and smooth muscle (gravity too)
- Hiatus; lower esophageal sphincter
- GERD
Stomach

- Cardiac Sphincter (?)
- Cardia
- Fundus
- Body
- Pyloric antrum
- Pylorus
- Pyloric sphincter
- Greater and Lesser Curvatures
- Greater Omentum
Stomach

- Rugae or Rugal Folds
- Pylorus
- Pyloric sphincter
Circulation

Liver (cut)
Inferior vena cava
Celiac trunk
Hepatic artery proper
Common hepatic artery
Gastroduodenal artery
Right gastric artery
Gallbladder
Superior pancreaticoduodenal artery
Right gastroepiploic artery
Duodenum
Abdominal aorta
Diaphragm
Esophagus
Left gastric artery
Splenic artery
Left gastroepiploic artery
Spleen
Pancreas (major portion lies posterior to stomach)
Superior mesenteric artery
Histology of Stomach

Type of epithelium lining stomach?

Gastric pits – shallow pits, external half rapidly reproduces for replacement

Gastric glands – deep in lamina propria, 3 types of cells

1. Parietal cells (produce HCl and intrinsic factor $B_{12}$)
2. Chief cells (produce pepsinogen)
3. Enteroendocrine cells – G cells (several hormones including gastrin which stimulates both parietal and chief cells)
Ulcers

- Mucosal erosion of stomach or duodenum
- GERD
- NSAIDs
- *Helicobacter pylori*
- Stress??
- Dx by esophagogastroduodenoscopy

Endoscopy video
Review: