Orientation: Digestive System

The gastrointestinal (GI) or digestive system digests food and transports (absorbs) nutrients (including salts and water) into the blood.

Digestion involves breaking down foods both chemically and mechanically into smaller components that can be transported (absorbed) through the digestive tract wall (epithelium) and into the blood (most breakdown products) or lymph (for fat breakdown products).

Many secretions of the digestive system together with the muscular action of the GI tract are necessary to complete digestion.

Hunger and satiety are controlled via hormones and other chemicals that influence the hypothalamus control center for ingestion. Social factors and the availability of food also influence the amount of food that we eat.

Anatomy Review: Digestive System

Page 1: Introduction

The digestive system consists of two components: the alimentary canal (a.k.a. digestive tract) and accessory organs.
After food is ingested and then processed in the digestive tract, undigested food leaves the system as feces.

Page 2: Goals
- To identify the organs and circular muscles (sphincters) of the digestive tract.
- To list the structures found in a representative section of the wall of the digestive tract
- To recognize the accessory organs of the digestive system.
- To describe the general function for each organ of the digestive system.

Page 3: The Wall of the Digestive Tract
- A typical section of the digestive tract reveals four main layers. From inside (the lumen) to outside they are:
  - Mucosa
  - Submucosa
  - Muscularis (externa)
  - Serosa (a.k.a. visceral peritoneum)

Different regions of the digestive tract wall have unique structures that are related to the specialized functions of those regions.
- The mucosa is subdivided into three layers. From the lumen outward they are:
  - A simple columnar epithelium densely populated with goblet cells.
  - A lamina propria connective tissue layer containing blood and lymphatic vessels
  - A smooth muscle sheet called the muscularis mucosa
- The mucosal epithelium functions in both secretion of digestive substances and in absorption of nutrients.
- Goblet cells secrete mucus (a hydrated mucin protein), while other mucosal epithelial cells secrete digestive fluids and other substances such as water and salts.
- Enteroendocrine cells of the mucosa produce hormones that are released into the blood via the capillaries of the lamina propria.
- Nutrients are transported (absorbed) through the epithelial cells and into either the capillaries (most nutrients) or lacteal lymphatic vessels (fats).

![Image](image1.png)

- The mucosal epithelial cells are mitotically active, thus the epithelium is replaced approximately every three to six days.
- The function of the double-layered muscularis mucosa is to aid in digestion and absorption by moving the mucosal villi in the small intestine.
- Blood and lymph vessels as well as an intrinsic network of neurons (the submucosal plexus) are located in the submucosa.
- The muscularis externa contains two sheets of muscle (circular and longitudinal layers) throughout most of the alimentary canal wall (the stomach has three layers). The fibers in the two layers are arranged at right angles to each other.
- Peristalsis and segmentation are produced by the contractions of the circular and longitudinal layers of muscle in the muscularis externa.

![Image](image2.png)

- The myenteric plexus is a network of neurons in the muscularis externa; it is in close communication with the submucosal plexus, and together, the two plexuses comprise the enteric nervous system.
- The outermost layer of the digestive tract wall is the serous fluid-producing serosa, which both lubricates and reduces friction of the digestive tract within the ventral body cavity.
Page 4: The Upper Part of the GI Tract

- Ingestion occurs in the mouth.
- Chemical digestion (saliva w/amylase for starch digestion) and mechanical digestion (teeth & tongue) occur in the mouth.

- The lining of the oral cavity and pharynx is a stratified squamous epithelium mucosa.
- The partially digested bolus of food is moved from the mouth to the esophagus, and then the stomach.
- There is a transition in the esophagus wall from striated (skeletal) to smooth muscle, from the upper to lower portions, respectively.
- The muscular stomach is involved in chemical (mostly protein) and mechanical digestion, as well as storage of food.
- The cardia, fundus, body, and pyloric (w/antrum) regions are specialized areas of the stomach.
• The muscularis externa layer of the stomach wall is unique in that it has three sheets of muscle (circular, longitudinal, and oblique).

• The stomach can expand greatly because of internal folds called rugae.

• Once food is mixed with gastric juices in the stomach it is called chyme, which is then moved from the pylorus to the duodenum of the small intestine.

Page 5: The Lower Part of the GI Tract
• The majority of chemical digestion and virtually all-nutrient absorption occur in the small intestine.
• The three regions of the small intestine are the duodenum, jejunum, and ileum
The three modifications of the inner wall of the small intestine that function to increase surface area are (from macroscopic to microscopic) the plicae circularis (circular folds), villi, and microvilli.

The intestine aids the body in its defense against pathogens by secreting antibacterial enzymes and antibodies (immunoglobulins) and by providing specialized sites in the ileum (lymphoid nodules called Peyer’s patches) where leukocytes can fight pathogens.

The large intestine absorbs water, salt, and vitamin K.

The large intestine includes the cecum, appendix, colon, rectum, and anal canal.

LABEL THESE AREAS BELOW

Three bands of smooth muscle called taeniae coli cause the outer portion of the colon to be puckered into pockets called haustra.

Epiploic appendages are fat storage areas located on the outside of the colon.
- The final section of the digestive tract, the anus, is lined with stratified squamous epithelium
- Feces are composed of indigestible food, bacteria, inorganic substances, and sloughed off epithelial cells from the digestive tract wall

**Page 6: Sphincters**

- Sphincters regulate the passage of food from one region of the digestive tract to the next, and finally, out of the body as feces
- The sphincters of the digestive tract, from mouth to anus, are the:
  - Upper esophageal sphincter or UES (circular skeletal muscle – an anatomical sphincter)
  - Lower esophageal sphincter or LES (a physiological sphincter)
  - Pyloric sphincter (circular smooth muscle)
  - Ileocecal sphincter or valve (circular smooth muscle)
  - Internal anal sphincter or IAS (circular smooth muscle)
  - External anal sphincter or EAS (circular skeletal muscle)
- The UES prevents air from entering the esophagus
- The LES prevents acid reflux from the stomach into the esophagus
• The pyloric sphincter regulates passage of chyme from the stomach into the duodenum
• The ileocecal valve regulates passage of chyme from the ileum to the large intestine
• The IAS is under involuntary control; when relaxed, it produces the urge to defecate
• The EAS is under voluntary control; when relaxed, it allows for defecation.

Page 7: Accessory Glands
• The accessory glands that produce secretions to aid in digestion are the salivary glands (3 pair), liver, and pancreas.
• Salivary glands moisten food, cleanse and protect the mouth, and produce amylase to begin enzymatic digestion of starch

• The liver produces bile, which emulsifies fats to increase their surface area for subsequent chemical digestion by lipases; bile is stored in and released from the gall bladder into the duodenum

• The pancreas is the main digestive enzyme-producing exocrine organ in the body. It releases a host of digestive enzymes into the duodenum via the pancreatic duct; it also produces bicarbonate to neutralize the chyme from the stomach
Study Questions on Anatomy Review: Digestive System:

1. (Page 3.) Which histological layer of the digestive tract contains goblet cells for mucous secretion?
2. (Page 3). Which histological layer of the digestive tract is responsible for producing peristaltic contractions?
3. (Page 3). Which network of neurons would you find in the muscularis externa?
4. (Page 3). In which histological layer of the digestive tract would you find lacteals?
5. (Page 4). What is the name of the 3rd muscularis externa layer found only in the stomach?
6. (Page 5). List the three modifications of the small intestine that increase surface area for digestion and absorption.
7. (Page 5). List the regions of the large intestine.
8. (Page 6). Which sphincter allows for defecation and is under voluntary control?
9. (Page 7). Which accessory gland is located in the u-shaped fold of the duodenum and is connected via a duct to that organ?