A. Overview

Gastrointestinal (GI) tract organs
- mouth
- pharynx
- esophagus
- stomach
- small intestine (SI)
- large intestine (LI)

Accessory organs
- teeth
- tongue
- salivary glands
- liver
- gallbladder
- pancreas

Digestive processes - regional specialization:
1. ingestion - mouth
2. mechanical digestion - mouth (teeth and tongue: mastication), stomach
3. chemical digestion - mouth (salivary glands), stomach, SI, pancreas
4. absorption - SI (nutrients and fluid), LI (fluid)
5. waste packaging and elimination - LI

System-wide processes:
- secretion - exocrine glands: mucus, digestive enzymes, acid, base (bicarbonate)
- motility - muscular movement of the GI tract
- peristalsis - wavelike contractions of circular/longitudinal smooth muscle

B. Histology of the GI Tract (4 layers)
1. mucosa - mucous membrane, lines the GI tract
   a. epithelium - stratified squamous or simple columnar ET + glands
   b. lamina propria - areolar CT with blood and lymphatic vessels, contains MALT
   c. muscularis mucosa - thin layer of smooth muscle, supports mucosa
2. submucosa - supporting layer of areolar or dense irregular CT
   submucous plexus - enteric nerve net, innervates mucosa and submucosa
   submucosal glands in the esophagus and duodenum
3. muscularis - muscular wall of the GI tract
   skeletal muscle in mouth, pharynx, upper esophagus
   smooth muscle in the rest of the GI tract (inner circular layer, outer longitudinal layer)
   myenteric plexus - innervates smooth muscle, regulates motility of GI tract
4. serosa - serous membrane (visceral peritoneum)
   (serosa for intraperitoneal organs; adventitia for organs outside the peritoneal cavity)

C. Mouth
1. Oral cavity
   regions: vestibule, oral cavity proper
   other features: hard palate, soft palate, fauces, uvula
2. Teeth
   incisors, cuspids (canines), premolars (bicuspids), molars
   20 deciduous (baby) teeth, 32 permanent teeth (2:1:2:3 each side, upper and lower)
3. Tongue
   extrinsic and intrinsic muscles (skeletal muscle)
   papillae: filiform (for friction), fungiform and vallate (contain taste buds)

D. Salivary Glands
- secrete saliva: water, electrolytes, mucus, amylase and other enzymes
- major salivary glands (3 pairs):
  parotid glands → parotid ducts → upper oral vestibule
  submandibular glands → submandibular ducts → oral cavity under tongue
  sublingual glands → lesser sublingual ducts → oral cavity under tongue
- acini = secretory units:
  - serous acini (dark staining) - secrete watery saliva with enzymes
  - mucous acini (light staining) - secrete mucus
E. Pharynx
- oropharynx and laryngopharynx are both digestive and respiratory; nasopharynx is respiratory only

F. Esophagus
- mucosa: stratified squamous epithelium
- submucosa: contains mucous glands (esophageal glands)
- muscularis: skeletal muscle in upper half → swallowing
  smooth muscle in lower half → peristalsis
- adventitia
- upper esophageal sphincter - entry from laryngopharynx
- lower esophageal sphincter - exit to stomach
- gastroesophageal reflux disease (GERD)

G. Stomach
- regions: cardia, fundus, body, pylorus
- other features: greater curvature, lesser curvature, pyloric sphincter
- mucosa: simple columnar epithelium
  rugae: large folds of mucosa, enable stretching
  gastric pits: deep invaginations in mucosa
  gastric glands: mucous cells - secrete mucus to protect stomach lining
  parietal cells: secrete hydrochloric acid
  chief cells: secrete pepsinogen (precursor of pepsin for protein digestion)
  G cells: secrete gastrin (hormone)
- muscularis: 3 layers:
  inner circular
  outer longitudinal
- serosa: covers stomach, merges with lesser omentum and greater omentum

H. Small Intestine
- regions: duodenum, jejunum, ileum
- mucosa: simple columnar epithelium
  villi: fingerlike projections of mucosa into lumen
  absorptive cells: have microvilli on apical surface (“brush border”)
  goblet cells: secrete mucus
  intestinal glands (crypts): deep invaginations in mucosa, secrete intestinal juice
  lamina propria: contains MALT (Peyer’s patches)
- submucosa: contains duodenal (Brunner’s) glands in duodenum only
- muscularis: 2 layers: inner circular, outer longitudinal
- serosa: covers SI, merges with mesentary

I. Large Intestine
- regions: cecum and appendix (ileocecal valve - entry from S.I.), colon
  - ascending (R side)
  - transverse
  - descending (L side)
  - sigmoid
  - rectum: (includes anal canal)
- unique features:
  - teniae coli: 3 longitudinal bands of smooth muscle
  - haustra: pouches
  - omental appendices (epiploic appendages): fat bodies, hang from teniae coli
  - mucosa: simple columnar epithelium
  - simple tubular glands with many goblet cells, no villi
Study Questions

1. List the major digestive processes and indicate where each process occurs in the digestive system.

2. List the four layers (tunics) of the GI tract. Describe the general structure of these layers, including the specific tissues that comprise each layer.

3. Describe the major features and structures of the oral cavity.

4. Identify the three major pairs of salivary glands and compare their histology.

5. Define peristalsis and describe how this process functions in the GI tract.

6. Differentiate the organs and regions of the GI tract, from the esophagus to the colon, in terms of structure and function. Identify some of the distinguishing anatomical and histological features of each organ and region. For example:
   - Which regions have stratified squamous and which have simple columnar epithelium?
   - Which regions have skeletal muscle and which have smooth muscle in the muscularis?
   - Which specific regions have glands in the submucosa?
   - How does the muscularis of the stomach differ from that of the small intestine?
   - What are villi and where are they found?
   - What are the teniae coli and haustra?

7. List three substances that are secreted by the gastric glands.

8. Describe the features of the small intestine that serve to maximize surface area for absorption of nutrients.