Objectives

To understand the general organization of organs of the digestive system and how they function to obtain metabolites necessary for growth and energy for the body, yet maintain a barrier between the environment and the internal milieu of the body.

To identify and describe functions of cellular structures, cells, and groups of cells in the digestive system.
Function of the Digestive System

Movement of food

Secretion of digestive juices

Absorption of digested foods, water, and electrolytes
<table>
<thead>
<tr>
<th>Function</th>
<th>Organ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple passage from one part to another</td>
<td>Esophagus</td>
</tr>
<tr>
<td>Storage of food or feces</td>
<td>Stomach or distal colon</td>
</tr>
<tr>
<td>Digestion</td>
<td>Stomach, small intestine</td>
</tr>
<tr>
<td>Absorption of end products</td>
<td>Small intestine, proximal colon</td>
</tr>
</tbody>
</table>
General Structure of the Digestive Tract

- Epithelium
- Lamina propria
- Muscularis mucosa
- Submucosa
- Muscularis externa
- Serosa
General Structure of the Digestive Tract

- Epithelium
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General Structure of the Digestive Tract

- Epithelium
- Lamina propria
- Muscularis mucosa
- Submucosa
- Muscularis externa

Large intestine
Stomach
Large intestine

Serosa

Muscularis externa

Inner, thicker circular layer

Outer longitudinal layer of the muscularis externa

Mesothelium

Stomach

Muscularis externa

Serosa

Inner, thicker circular layer

Outer longitudinal layer of the muscularis externa
Fig. 10-2  Tongue: Apex (longitudinal section, panoramic view). Stain: hematoxylin and eosin. Low magnification.
Filiform Papillae

Non-keratinized stratified squamous epithelium.

Skeletal muscle,

Mucus and Serous glands,
Figure 23–6. Scanning electron micrograph of the filiform papillae of rabbit tongue. (Micrograph courtesy of F. Fujita.)
Slide #12 (1101). Tongue, rabbit.

- Skeletal muscle
- Filiform papillae
- Foliate papillae that possess Taste buds
- Serous glands

Tongue, rabbit.
Esophagus

Non-keratinized stratified squamous epithelium.

Muscularis externa

Sub-mucosal glands

Skeletal muscle

Histo 29
Esophagus – skeletal and smooth muscle

- Epithelium
- Lamina propria
- Muscularis mucosa
- Submucosa
- Muscularis externa
- Serosa
Lamina propria
Muscularis mucosa
Non-keratinized stratified squamous epithelium
Submucosa
Sub-mucosal Mucus and Serous glands
Skeletal muscle,
Muscularis externa
If outer layer is not covered by mesothelium = adventitia
Perichondrium
Muscularis externa of the upper esophagus is composed mostly of skeletal muscle. The muscularis externa in middle to lower esophagus is composed mostly of smooth muscle.
Cardio-esophageal junction

Luminal epithelium changes from stratified squamous to simple columnar epithelium in the cardiac region.
The stomach have no goblet cells, no brush border on surface cells, and no villi.
145 Fundic stomach

- Mucosa
- Antibody-producing plasma cells
- Submucosa
- Gastric pits
- Ganglion cells of the Auerbach's plexus regulate the muscularis externa
- Ganglion cells of the Meissner's plexus regulates muscularis mucosa
- Muscularis externa
145 Fundic stomach

Gastric pits and gastric glands

Surface mucous cells

Mucous neck cells

Chief cells and parietal cells

Enteroendocrine cells
Mucus neck cells Fundic stomach, rabbit (toluidine blue)

Chief cells

Enteroendocrine cells

Parietal cell
Chief cell  Enteroendocrine cell  Parietal cells
EM 15  Parietal cell  produces

1. HCl
2. Bicarbonate
3. **Intrinsic factor** for vitamin B12 absorption by gut: needed in red blood cell formation
Fundic stomach, monkey (PAS)

- Mucous neck cells
- Parietal cells
- Chief cells
- Enteroendocrine cells
- Surface mucous cells
Fundic stomach, rabbit (toluidine blue)

- Parietal cells
- Gastric pits
- Mucous neck cells
- Surface mucous cells
- Enteroendocrine cells
- Lumen

secretory canaliculus
mitochondria
- Granules of surface mucous cells
- Mitochondria
- Nuclei
- Lumen

PAS
H&E
Toluidine blue
EM 14

- Large granules of chief cell
- Granules of an argentaffin cell
- Lamina propria
- Nuclei
Pyloric glands of the stomach contain mucous cells.
Fig. 11-11 Pyloric–Duodenal Junction (longitudinal section). Stain: hematoxylineosin. Low magnification.
147 Pyloroduodenal junction, baboon

Intestine

Lymphoid nodule

Stomach

Muscularis mucosa

Lamina propria

Muscularis externa
Pyloroduodenal junction, baboon

Stomach
- Gastric glands
- Gastric pits
- Lamina propria
- Muscularis mucosa
- Submucosa
- Muscularis externa

Intestine
- Villi
- Crypts of Lieberkühn (intestinal glands)
- Goblet cells and intestinal absorptive cells with a brush border

Junction
Fig. 12-2 Small Intestine: Jejunum-Trefoil (transverse section). Stain: hematoxylin-eosin. Low magnification.

Fig. 12-3 Intestinal Glands With Paneth Cells and Enteroendocrine Cells. Stain: hematoxylin-eosin, plastic section. High magnification.
Duodenum, monkey

Submucosal Brunner's glands

Goblet and absorptive cells

Enteroendocrine cell

Crypts of Lieberkühn

Lamina propria

Muscularis mucosa

Submucosa

Submucosal Brunner's glands
Duodenum

- Brunner’s glands
- Absorptive cells
- Goblet cells
- Paneth cell
- Enteroendocrine cell
- Intestinal villus
Mucus of goblet cells and the carbohydrates in the brush border are PAS positive for sugars.
EM 17 Basal portion of intestinal absorptive cell
1. Plasma cell
2. Lymphocyte
3. Smooth muscle
4. Intestinal absorptive cell
5. Macrophage
6. Lumen of capillary
7. Pericyte of capillary
EM 4. Apical portion of intestinal absorptive cell

1. Microvilli of brush border
2. Droplets of goblet cell
3. Terminal web
4. Lipid in SER
5. lumen
Basal portion of intestinal absorptive cell
1. Mitochondria
2. Nuclei of intestinal absorptive cell
3. Smooth muscle of muscularis mucosa
4. Basal lamina
Brush border of intestinal absorptive cells

Mitochondria
Intestinal absorptive cells in cytoplasm just above the nucleus.
Smooth muscle cells

Meissner's plexus cell bodies

Epithelium

(Auerbach's plexus) Nerve cell bodies

32409
Auerbach's plexus, found in between the circular and longitudinal smooth muscle layers in small intestine.
Ileum

148

Meissner’s plexus cell bodies in submucosa

Paneth cell

Small intestinal villi

Submucosa
250 Argentaffin cells of ileum, monkey

Paneth cell

Enteroendocrine cells also called Argentaffin cells
Compare luminal surfaces of the small and large intestines.
Fig. 12-6  Large Intestine: Colon and Mesentery (panoramic view, transverse section). Stain: hematoxylin-eosin.
Low magnification.
Large intestine or Colon, monkey
Solitary lymph follicles in the lamina propria seen throughout the GI tract help the immune system maintain a barrier between the environment and the internal milieu of the body. Other contributors include luminal epithelium, HCl in the stomach, and mucus produced by many goblet cells in the intestines.
Human appendix
In summary

Function of the Digestive System

Movement of food

Secretion of digestive juices

Absorption of digested foods, water, and electrolytes

The digestive system functions to obtain metabolites, yet maintain a barrier between the environment and the internal milieu of the body.
Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

Questions on the Digestive system

1. Which of these cells is/are found both in the stomach and intestines?
   a. enteroendocrine (argentaffin cells)
   b. fibroblasts
   c. goblet cell
   d. a and b
   e. a, b, and c

2. The digestive system functions to obtain metabolites necessary for growth and energy needs; however, it must maintain a barrier between the environment and the internal milieu of the body. Which of the following is the least effective feature of this barrier?
   a. composition of saliva
   b. acid environment of the stomach
   c. large volume of mucus produced into the lumen of the large intestine
   d. the chylomicron fat absorption mechanism via central lacteal
   e. nearby and abundant immune defense structures and mechanisms
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The end of
Medical School Histology Basics
Digestive System

VIBS 243 lab

Larry Johnson  Texas A&M University