

LABORATORY 23 - DIGESTIVE SYSTEM, continued - **PHARYNX, ESOPHAGUS AND STOMACH**
(Second of three laboratories)

OBJECTIVES: **LIGHT MICROSCOPY:** Recognize structure and characteristics of the pharynx, three regions of the esophagus (upper, middle and lower) and three regions of the stomach (cardiac, fundus/body and pyloric). Analyze the characteristics of the layers of each organ according to overall four-layered organization of the digestive tract. Recognize the glands that are found in each region of these organs and the cell types and distribution of cells present in the glands of the stomach. Correlate observations with functions of organs, tissues and cells.

ELECTRON MICROSCOPY: Recognize glands and epithelial cells in esophagus and stomach including gastric glands and the cells that they contain.

ASSIGNMENT FOR TODAY'S LABORATORY:

GLASS SLIDES

[SL 96](#) Oral pharynx
[SL 23](#), [16](#), [15A](#) Esophagus
[SL 48](#) Esophageal-cardiac junction
[SL 6](#) Body of stomach (PAS-eosin-azure II)
[SL 10](#) Body of stomach
[SL 118](#) Esophageal, cardiac region and body of stomach
[SL 97](#) Pyloric stomach (body-pyloric transition)

POSTED ELECTRON MICROGRAPHS

S-65 Gastric gland
22B Parietal cell

[Lab 23 Posted EMs](#)

Cells from the gastric surface and glands J. 15-14, 15-17, 15-18; W.14.11, 14.13

HISTOLOGY IMAGE REVIEW - available on computers in HSL

Chapter 14, Alimentary Canal

Frames: 907-939

SUPPLEMENTARY ELECTRON MICROGRAPHS

Rhodin, J. A.G., An Atlas of Histology

Copies of this text are on reserve in the HSL.

Esophagus and stomach pp.304 - 314

BASIC STRUCTURE OF DIGESTIVE SYSTEM ORGANS

The structure of the digestive tube may be described according to a general plan as explained in the lecture notes and texts. The basic four-layered model is modified in the different segments that comprise the gastrointestinal tract. The components of the wall of the digestive tube may be analyzed in the same manner throughout. Try to identify the components listed for each segment. The organization of the four-layered structure of the general plan consists of: I. Mucosa, II. Submucosa, III. Muscularis Externa, and IV. Adventitia or Serosa (J.15-1; W. 14.1 to 14.4).

- I. **MUCOSA** - The mucosa is present in all segments and is the layer that shows the greatest modifications, especially in the epithelium and the glands in the lamina propria. The mucosa consists of three parts.
 - A. **Epithelium**
 1. Observe whether the epithelium is stratified squamous or columnar.
 2. Note the functions in different locations: protective, absorptive, secretory (W. 14.3).
 3. Identify cell types.
 4. Identify epithelium on villi and pits and in glands in the regions where they are present.
 - B. **Lamina propria** - This region consists of connective tissue. In the stomach and intestine, glands are numerous in the lamina propria.
 1. Note the presence of diffuse lymphoid tissue.
 2. Is there smooth muscle present?
 - C. **Muscularis mucosa** - This third component of the mucosa consists of smooth muscle. It is present in most segments.
- II. **SUBMUCOSA** - This layer of connective tissue underlies the mucosa. Within this layer blood vessels are found, lymphoid tissue may be present (as in Peyer's patches in the ileum), and glands are present in some regions. A component of the enteric nervous system is widely distributed in this layer visible as a plexus of nerves (submucosal or Meissner's plexus) that includes neurons or autonomic ganglion cells.
- III. **MUSCULARIS EXTERNA** - This is the major muscle of the digestive tube. In the most proximal regions it consists mainly of skeletal muscle, but elsewhere it is smooth muscle. In most regions an inner circular and an outer longitudinal layer are present. The major component of the enteric nervous system is visible as an extensive plexus of nerves (myenteric or Auerbach's plexus) located between the two layers of muscle. Neurons of the enteric nervous system (autonomic ganglion cells) are numerous in this region.
- IV. **ADVENTITIA** or **SEROSA** - The fourth layer consists of loose connective tissue vessels and nerves. If the digestive tube is suspended by a mesentery in the abdomen and covered by mesothelium this layer is termed **Serosa**. When the digestive tube is retroperitoneal or not covered by mesothelium and the connective tissue is continuous with that of the body this layer is termed **Adventitia**.

As you pursue your study of the digestive system be sure to correlate the structure with the functions of each region.

ORGANS OF DIGESTIVE SYSTEM

A. PHARYNX

1. ORAL PHARYNX [SL 96](#) ([scan](#), [low](#)). In the mucosa of the oral pharynx the epithelium is mainly stratified squamous. In the lamina propria ([width of lamina propria indicated by red arrows](#)) note layers and abundance of elastic fibers. Is smooth or skeletal muscle associated with the pharynx?
2. Nasal pharynx was studied with the respiratory system.

B. ESOPHAGUS

1. Mucosa of the esophagus has:
 - a. A stratified squamous epithelium (non-keratinized).
 - b. The lamina propria contains less diffuse lymphoid tissue than that of the lower regions of the digestive system. Glands in the lamina propria are limited to the most proximal and most distal regions (at the levels of cricoid cartilage and cardiac-esophageal junction).
 - c. Muscularis mucosa ([med 1](#), [med 2](#)) begins in the esophagus. Note the orientation of this muscle layer ([width indicated by blue arrows](#)) that is part of the mucosa.
2. [SL 23](#). (W. 14.4) - ([scan](#), [med 1](#), [med 2](#)) This section is from the region of transition from upper to middle esophagus. In the muscularis externa observe the intermingling of skeletal ([red arrows](#)) and smooth ([blue arrows](#)) muscle. What is the orientation of each type of muscle? Sections from the upper esophagus would show only skeletal muscle, whereas sections from the middle esophagus show varying degrees of mixtures of skeletal and smooth muscle in both circular and longitudinal orientations.
3. [SL 16](#) ([scan](#), [low](#)). Lower esophagus. Identify the type(s?) of muscle found ([muscularis externa enclosed by red line, muscularis mucosa by blue line](#)). Preservation of the tissue in this slide is not good. Nevertheless, the muscle may be identified by its general characteristics.
4. [SL 15A](#) ([scan](#), [low](#)). Middle esophagus. Compare this region to the other regions of esophagus. This slide shows mucous glands in the esophagus. Identify the glands ([green arrows](#)).

C. D. & E. STOMACH In the following slides of the stomach certain features of the four layers should be noted.

1. The mucosa has invaginations on its surface called gastric pits or foveola.
 - a. The epithelium lining the surface of the stomach as well as the pits consists of only one cell type. Identify the primary product of these cells and the cell type.
 - b. Glands extend into the lamina propria from the base of the pits. The glands may be distinguished in the three regions: cardiac, fundus/body, pyloric. Review distinctions of these regions as you observe the slides.
 - c. The muscularis mucosa is prominent in the stomach.
2. The other layers of the stomach show less variation. However, three layers of muscularis externa are present (often difficult to distinguish) and in the pyloric region the thick pyloric sphincter is evident.

- C. ESOPHAGEAL CARDIAC JUNCTION [SL 48 \(scan, low\)](#). (J. 15-10; W. 14.6) - In this slide and the others of the stomach note change in epithelium from that lining the esophagus to that lining the stomach. In the lamina propria close to this junction esophageal cardiac glands may be present ([within red circle](#)) (small compound tubular glands that secrete mucus). In the lamina propria of the stomach, stomach cardiac glands ([blue arrows](#)) are present. Are the other layers continuous?
- D. BODY OF THE STOMACH (fundus has similar structure). (J. 15-10 to 15-13; W. 14.8 to 14.13). Glands in this region (gastric glands) may be divided into different regions: a constricted region, isthmus (or mouth) often considered to be part of the neck, a neck, and a base. Different cell types predominate in these regions so that the neck region is more eosinophilic and the base region is more basophilic. Identify the cell types and their locations including: surface mucous cells, parietal cells, mucous neck cells, and chief or zymogen cells.
1. [SL 6 \(scan\)](#). PAS-eosin-azure II. Identify all cell types.
 - a. The surface mucous cells may be overstained so that their mucous regions appear blue rather than magenta. The extent of the pits ([cross, long \(red arrows, approx. transition of pit to gland\)](#)) is readily detectable.
 - b. The glands include 1) a neck region that extends into the lamina propria. Large eosinophilic parietal cells are evident as well as small mucous neck cells that contain a few PAS positive mucous filled vesicles ([low](#)) and 2) a base region in which chief (zymogen) cells predominate (Why are they basophilic?) ([approx. regions of neck within red line and base within green line](#)). Parietal cells still persist in this region ([med, high](#)). ([Parietal cells, red circles; chief cells, white arrows; mucous neck cells, green arrows](#))
 - c. The muscularis mucosa lies just under the glands.
 2. [SL 10](#) - H and E. Compare with [SL 6](#). Try to identify the cell types in this section prepared by routine staining ([low, med, high 1, high 2, parietal cells, red circles; chief cells, white arrows; mucous neck cells, green arrows](#)).
 3. Electron microscope (J. 15-14 to 15-18; W. 14.11, 14.13) - Note characteristics of parietal and enteroendocrine cells and that chief cells resemble typical serous secreting cells elsewhere in body. What characteristics would you expect for mucus secreting cells?
 4. [SL 118](#) - Esophageal - Stomach Transition - Note distribution of mast cells ([med, oil](#)) basophilia of chief cells, parietal cells ([med](#)), cardiac mucus glands, metachromasia of [esophageal glands \(enclosed by red line\)](#), plasma cells and lymphocytes in lamina propria. Section is stained with Azure A.
- E. PYLORIC STOMACH (J. 15-19; W. 14.14).
[SL 97. Body-pyloric transition](#). This is a challenging slide. Examine the two ends of this tissue to determine which one is the gastric portion of the stomach, and which is the pyloric region (see #1 and #2 below). Then, move your slide from either end toward the center to locate the area of transition. ([pyloric gland, blue circle; gastric gland, red circle](#)). Note that this transition may not be definitively evident.
1. Body of stomach has gastric glands and the different cell types are evident.
 2. Pyloric region - gastric pits become elongated and mucous secreting cells occupy the glands. A few parietal cells may persist.

OBJECTIVES FOR LABORATORY 23: PHARYNX, ESOPHAGUS, STOMACH

1. Using the light microscope or digital slides, identify:

Basic structure of digestive tract (except pharynx)

Mucosa

Epithelium

Lamina propria

Muscularis mucosa

Submucosa

Submucosal plexus of nerves

Muscularis externa

Inner circular layer

Outer longitudinal layer

Myenteric plexus of nerves

Serosa or adventitia

Oral pharynx

Epithelium

Lamina propria

Muscularis

Esophagus

Upper

Middle

Lower

Stomach

Body and fundus

Gastric pits

Surface mucus cells

Gastric glands

Mucus neck cells

Parietal cells

Chief cells

Cardiac / pyloric regions

Pits and glands mucus secreting throughout (few parietal or chief cells)

Pyloric sphincter

Note: Stem cells and enteroendocrine cells not distinguishable without special stains
Esophageal-cardiac junction

2. On electron micrographs, identify:

Chief cells

Zymogen granules

Parietal cells

Canaliculi

Tubulovesicles