the **pancreas**, located adjacent to the duodenum, is a mixed exocrine and endocrine gland; it is usually readily identifiable by the presence of the interspersed endocrine **pancreatic islets** (*islets of Langerhans*); a thin capsule and septa divide the gland into lobules (not readily seen); the **exocrine pancreas** is a compound acinar gland of serous acini; large amounts of adipose may be present in the septa or within the thin CT surrounding the acini; **interlobular ducts** are lined by simple columnar epithelium and are surrounded by connective tissue.
I. Introduction
II. Keywords
III. Slides
   A. Oral Cavity
      1. Lip
      2. Soft palate
      3. Tongue
      4. Tooth
   B. Gastrointestinal Tract
      1. Esophagus
      2. Stomach
      3. Small Intestine
         a. Duodenum
         b. Jejunum
         c. Ileum
      4. Colon and Appendix
      5. Rectum and Anal Canal
   C. Accessory Organs
      1. Salivary Glands
         a. Sublingual
         b. Submandibular
         c. Parotid
      2. Pancreas
      3. Liver
      4. Gallbladder
IV. Summary

**Slide 154: Pancreas, H&E**

**serous acinus** of 5-10 cells facing a central lumen; apical ends of the cells are eosinophilic due to the secretory granules; the basal ends are basophilic due to the displaced nucleus and rER.

**intralobular duct** lined by simple cuboidal epithelium and a small amount of surrounding connective tissue.

**serous acini** of the exocrine pancreas drain into small **intercalated ducts** which have **centroacinar cells** that penetrate into the acini (these are a distinguishing feature of the pancreas but are often difficult to see); the intercalated ducts converge into larger **intralobular ducts** (there are no striated ducts within the pancreas) which converge into the larger **interlobular ducts**, within the CT septa and lined by columnar epithelium; the interlobular ducts finally drain into the **main pancreatic duct** which empties into the duodenum.
in humans, most pancreatic interlobular ducts converge to form the main pancreatic duct (of Wirsung) which combines with the common bile duct to form the ampulla of Vater, which is surrounded by a smooth muscle sphincter (sphincter of Oddi), of the major duodenal papilla; the above slide lacks several of the characteristic features of the major duodenal papilla and likely is showing the minor duodenal papilla and the accessory pancreatic duct (of Santorini) lined with tall simple columnar epithelium.
the liver is easily distinguished by the presence of the stromal portal tracts containing portal triads (branches of the hepatic artery proper, hepatic portal vein, and bile ducts); the bulk of the parenchyma of the liver is hepatocytes organized into plates of cells radiating from central veins (venules); the central veins which merge into larger hepatic veins and eventually drain into the inferior vena cava
the liver parenchyma is divided into polygonal hepatic lobules (generally hexagonal); in pigs, the lobules are demarcated by connective tissue septa providing nice visualization of the liver architecture; in humans, however, connective tissue in the liver is primarily confined to the portal tracts so lobules are visualized by finding a central vein and then identifying the surrounding portal tracts containing the portal triads.
Slide 29: Liver, H&E

a **portal tract** is the connective tissue encapsulating the **portal triad** which consists of three major structures: a branch of the **hepatic portal vein**, a branch of the **hepatic artery** (**hepatic artery proper**), and a **bile duct** (though not always appearing in a 1:1:1 ratio); lymphatic vessels (a few can be seen above) are also usually present within the tract.
Lab 15 – Digestive System
IUSM – 2016

I. Introduction
II. Keywords
III. Slides
   A. Oral Cavity
      1. Lip
      2. Soft palate
      3. Tongue
      4. Tooth
   B. Gastrointestinal Tract
      1. Esophagus
      2. Stomach
      3. Small Intestine
         a. Duodenum
         b. Jejunum
         c. Ileum
      4. Colon and Appendix
      5. Rectum and Anal Canal
   C. Accessory Organs
      1. Salivary Glands
         a. Sublingual
         b. Submandibular
         c. Parotid
      2. Pancreas
      3. Liver
      4. Gallbladder
IV. Summary

Slide 55 (464): Pig Liver, H&E

**hepatic plates** are cords of hepatocytes (one or two cells thick) radiating from the **central vein**; the plates are maintained by a meshwork of reticular fibers (type III collagen) and separated from each other by **hepatic sinusoids**; the sinusoids carry combined blood from the branches of the hepatic portal vein and the hepatic artery in the portal tracts to the central vein.
**Slide 24: Liver & Gallbladder, Trichrome**

**hepatic sinusoids** are situated between **hepatic plates** and receive combined blood from the hepatic artery and hepatic portal vein branches within the portal tracts; the sinusoids drain into the **central veins/venules** (**terminal hepatic venules**); between the sinusoids and hepatocytes is a narrow space (generally seen in EMs) called the **space of Disse** into which the hepatocytes project microvilli from their basal surfaces for increased surface area contact with the vascular contents (plasma) that leave the sinusoids into the **space of Disse**
hepatic sinusoids can be difficult to see in routine preparations but are easily distinguished when blood cells are present within them; within the lumens of the sinusoids the ovoid nuclei of a few Kupffer cells (perisinusoidal macrophages) are also present; these phagocytic cells remove debris and old RBCs from the circulation.
**Slide 141: Liver, H&E**

**hepatocytes** are large, polygonal epithelial cells; their microvilli-lined basal surface face the sinusoids and their microvilli-lined apical surface form the bile canaliculi into which they secrete bile; they are abundant cells – not only in number – but in cytoplasmic contents: they have abundant rough ER and free ribosomes, abundant smooth ER and Golgi, abundant mitochondria, abundant glycogen, abundant peroxisomes, abundant lipofuscin, and may have abundant lipids.
Lab 15 – Digestive System
IUSM – 2016

I. Introduction
II. Keywords
III. Slides
   A. Oral Cavity
      1. Lip
      2. Soft palate
      3. Tongue
      4. Tooth
   B. Gastrointestinal Tract
      1. Esophagus
      2. Stomach
      3. Small Intestine
         a. Duodenum
         b. Jejunum
         c. Ileum
      4. Colon and Appendix
      5. Rectum and Anal Canal
   C. Accessory Organs
      1. Salivary Glands
         a. Sublingual
         b. Submandibular
         c. Parotid
      2. Pancreas
      3. Liver
      4. Gallbladder
IV. Summary

Slide 24: Liver & Gallbladder, Trichrome

look here to see the gallbladder
the gallbladder is a hollow organ for storage and concentration of bile produced in the liver; in cross section it can appear similar to other “tubes” seen in lab, especially the small intestine; however, it has several defining characteristics: (1) it has rugae (transient folds of mucosa) instead of villi, (2) its epithelium lacks goblet cells, (3) its mucosa lacks a muscularis mucosae, (4) it does not have a well-defined submucosa layer, and (5) its muscularis layer is not organized with the same orientations of smooth muscle as seen in the GI tract
Lab 15 – Digestive System
IUSM – 2016

I. Introduction
II. Keywords
III. Slides
   A. Oral Cavity
      1. Lip
      2. Soft palate
      3. Tongue
      4. Tooth
   B. Gastrointestinal Tract
      1. Esophagus
      2. Stomach
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         b. Jejunum
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         a. Sublingual
         b. Submandibular
         c. Parotid
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      3. Liver
      4. Gallbladder

IV. Summary

Common Confusion:
Parotid Gland vs. Pancreas

Parotid Gland: major salivary gland located anterior to the ear; composed almost exclusively of serous acini that produce a thin watery secretion rich in enzymes.

Look for: (1) striated (intralobular) ducts are readily visible; (2) surrounded by CT capsule with defined septa.

Pancreas: exocrine and endocrine gland located in upper left posterior of abdomen; exocrine portion is purely serous and empties into the duodenum.

Look for: (1) pale-staining pancreatic islets (endocrine); (2) intralobular ducts are fewer and less readily seen; (3) surrounded by loose CT or very thin capsule with delicate septa; (4) at higher magnification, pale-staining centroacinar cells (where duct inserts into acinus) may be seen.
Lab 15 – Digestive System
IUSM – 2016

I. Introduction
II. Keywords
III. Slides
   A. Oral Cavity
      1. Lip
      2. Soft palate
      3. Tongue
      4. Tooth
   B. Gastrointestinal Tract
      1. Esophagus
      2. Stomach
      3. Small Intestine
         a. Duodenum
         b. Jejunum
         c. Ileum
      4. Colon and Appendix
      5. Rectum and Anal Canal
   C. Accessory Organs
      1. Salivary Glands
         a. Sublingual
         b. Submandibular
         c. Parotid
      2. Pancreas
      3. Liver
      4. Gallbladder

IV. Summary

**Common Confusion:**

Pancreas vs. Spleen

**Pancreas:** exocrine and endocrine gland located in the upper abdomen; exocrine portion is purely serous and empties into the duodenum

Look for: (1) exocrine gland, so ducts are present; (2) pale-staining pancreatic islets (endocrine) have homochromatic appearance; (3) at higher magnification, cells arranged in acinar configuration

**Spleen:** highly-vascular abdominal organ with abundant lymphoid tissue; filters the blood, providing immune functions and removal/destruction of old or faulty red blood cells

Look for: (1) no exocrine tissue, so lacks ducts; (2) white pulp has heterochromatic staining, e.g., pale germinal centers surrounded by dark mantle zone; (3) no acini present; (4) numerous trabeculae throughout
I. Introduction

II. Keywords

III. Slides

A. Oral Cavity
   1. Lip
   2. Soft palate
   3. Tongue
   4. Tooth

B. Gastrointestinal Tract
   1. Esophagus
   2. Stomach
   3. Small Intestine
      a. Duodenum
      b. Jejunum
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   4. Colon and Appendix
   5. Rectum and Anal Canal

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   1. Salivary Glands
      a. Sublingual
      b. Submandibular
      c. Parotid
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   3. Liver
   4. Gallbladder

IV. Summary

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**Common Confusion:**

**Small Intestine vs. Gallbladder**

**Small intestine:** largest segment of the GI tract, connecting the stomach to the large intestine; primarily responsible for nutrient absorption; it has three specific segments/regions: duodenum, jejunum, and ileum

Look for: (1) villi with fairly uniform appearance; (2) simple columnar epithelium with goblet cells; (3) muscularis mucosae layer of mucosa; (4) defined submucosa layer; (5) muscularis externa layer has inner circular and outer longitudinal layers; (6) specific segments of the small intestine may have other identifying characteristics such as plicae circulares, Brunner’s glands, and Peyer’s patches

**Gallbladder:** sac-like organ which stores bile produced by the liver; it concentrates the bile and releases it into the duodenum after a meal

Look for: (1) mucosal folds (rugae) with varying sizes and arrangement; (2) tall simple columnar epithelium without goblet cells; (3) lacks a muscularis mucosae layer and defined submucosa; (4) muscularis externa layer has fibers arranged in longitudinal, circular, and oblique orientations but they do not form distinct layers
### Lab 15 – Digestive System

**IUSM – 2016**

I. Introduction
II. Keywords

### III. Slides

A. Oral Cavity
   1. Lip
   2. Soft palate
   3. Tongue
   4. Tooth

B. Gastrointestinal Tract
   1. Esophagus
   2. Stomach
   3. Small Intestine
      a. Duodenum
      b. Jejunum
      c. Ileum
   4. Colon and Appendix
   5. Rectum and Anal Canal

C. Accessory Organs
   1. Salivary Glands
      a. Sublingual
      b. Submandibular
      c. Parotid
   2. Pancreas
   3. Liver
   4. Gallbladder

### IV. Summary

#### Characteristics of Segments of the Gastrointestinal Tract

<table>
<thead>
<tr>
<th>General Layer</th>
<th>Specific Layer</th>
<th>Esophagus</th>
<th>Stomach</th>
<th>Duodenum</th>
<th>Jejunum</th>
<th>Ileum</th>
<th>Large Intestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucosa</td>
<td>Epithelium</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Lamina propria</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Muscularis mucosae</td>
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<td></td>
</tr>
<tr>
<td>Submucosa</td>
<td>(w/ Meissner’s plexus)</td>
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</tr>
<tr>
<td>Muscularis</td>
<td>(w/ Auerbach’s plexus)</td>
<td>Intersseptal oblique</td>
<td>Inner circular</td>
<td>Outer longitudinal</td>
<td></td>
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</table>