Digestive System Liver, Gallbladder, and Pancreas Lec. 22

Histology

Second Year

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Digestive System Liver, Gallbladder, and Pancreas

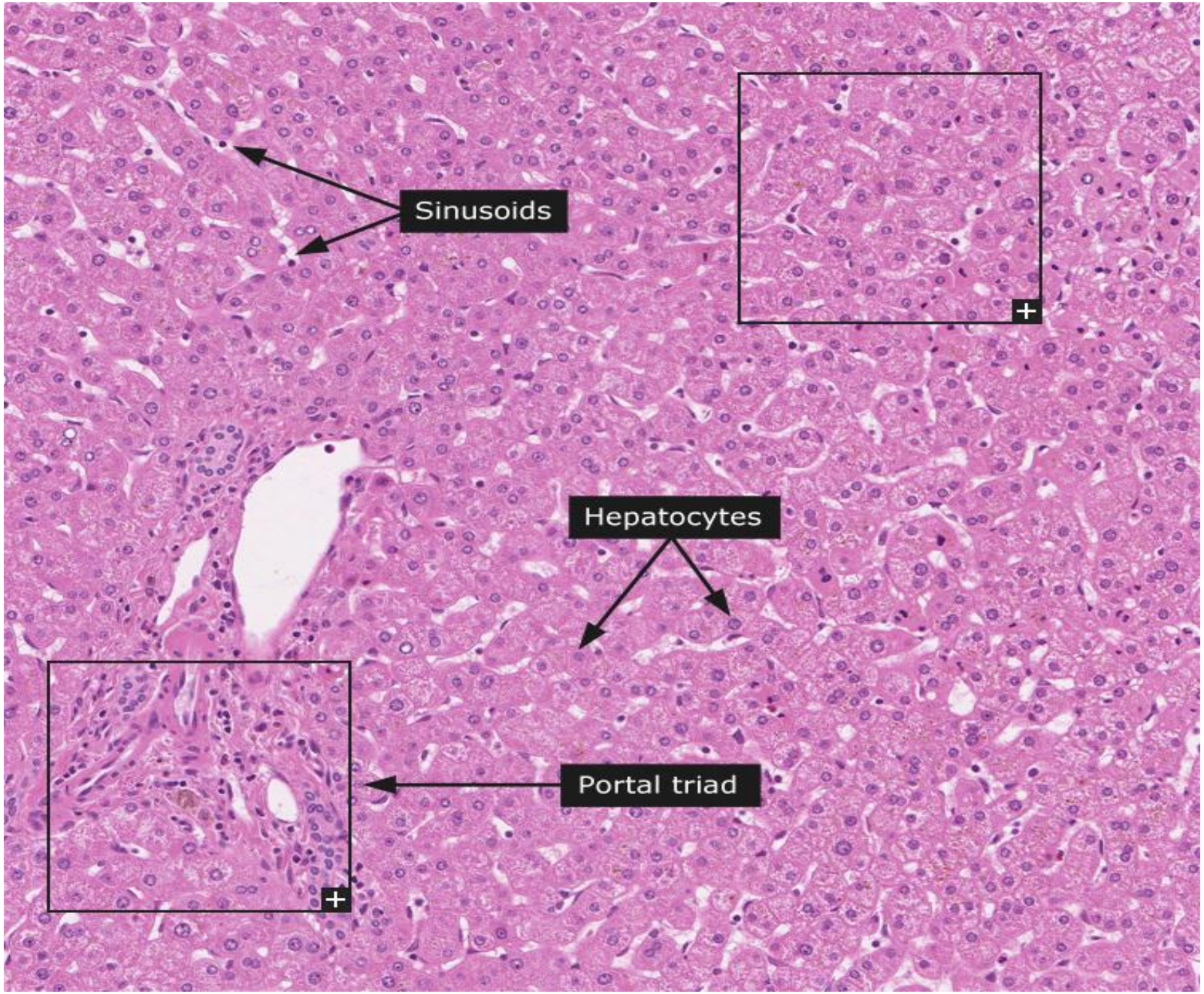
- The accessory organs of the digestive system are located outside of the digestive tube. Excretory glands from the salivary glands open into the oral cavity. The liver, gallbladder, and pancreas are also accessory organs of the digestive tract that deliver their secretory products to the small intestine by excretory ducts. The common bile duct from the liver and the main pancreatic duct from the pancreas join in the duodenal loop to form a single duct common to both organs. This duct then penetrates the duodenal wall and enters the lumen of the small intestine. The gallbladder joins the common bile duct via the cystic duct. Thus, bile from the gallbladder and digestive enzymes from the pancreas enter the duodenum via a common duct.

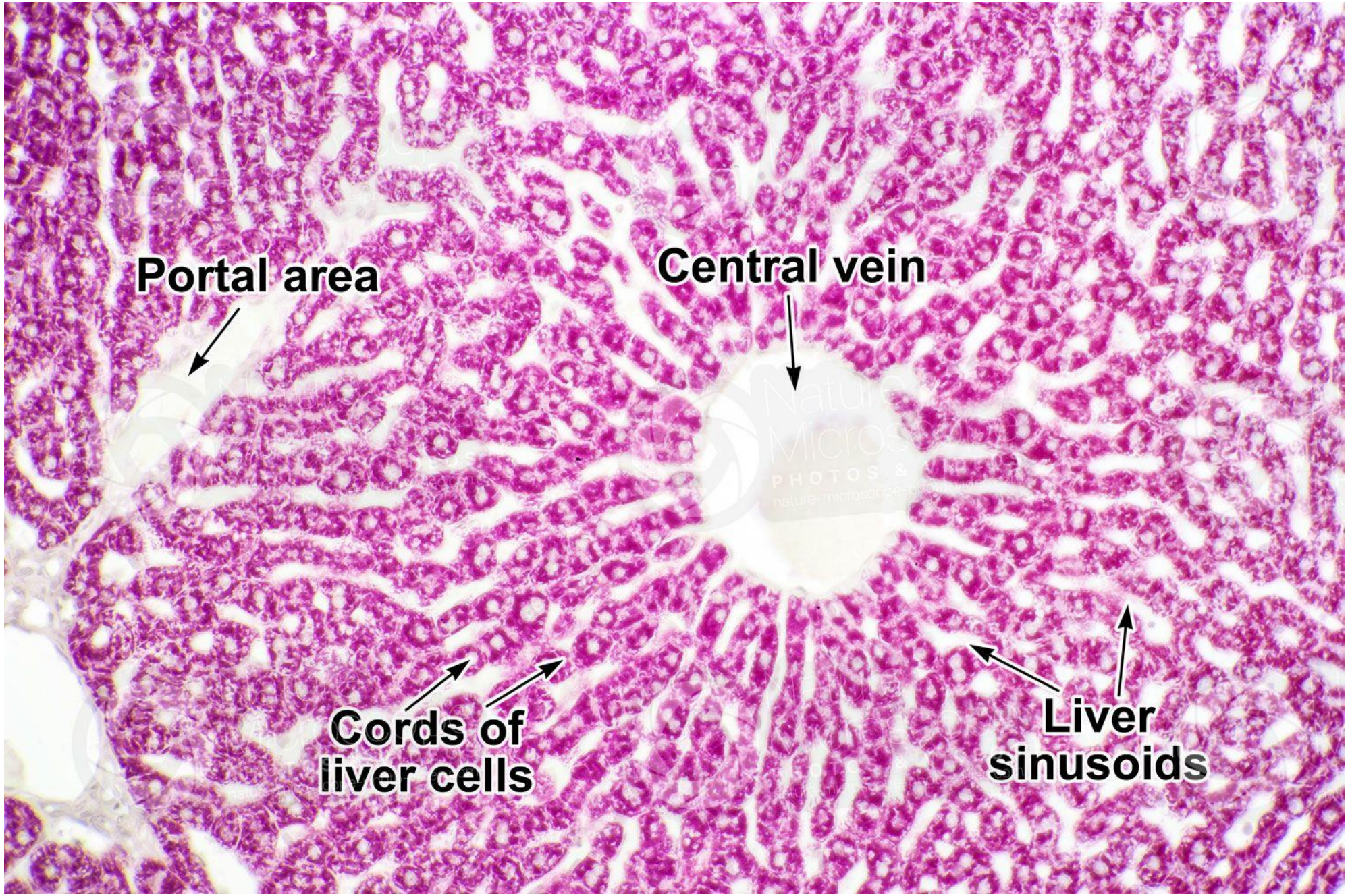
liver

- The liver is located in a very strategic position. All nutrients and liquids that are absorbed in the intestines enter the liver through the hepatic portal vein, except the complex lipid products, which are transported by the lymph vessels. The absorbed products first percolate through the liver capillaries called sinusoids. Nutrient-rich blood in the hepatic portal vein is first brought to the liver before it enters the general circulation. Because venous blood from the digestive organs in the hepatic portal vein is poor in oxygen, the hepatic artery from the aorta supplies liver cells with oxygenated blood, forming a dual blood supply to the liver.

- The liver exhibits repeating hexagonal units called liver (hepatic) lobules. In the center of each lobule is the central vein, from which radiate plates of liver cells, called hepatocytes, and sinusoids toward the periphery. Here, the connective tissue forms portal canals or portal areas, where branches of the hepatic artery, hepatic portal vein, bile duct, and lymph vessels can be seen. In human liver, three to six portal areas can be seen per lobule. Venous and arterial blood from the peripheral portal areas first mix in the liver sinusoids as it flows toward the central vein. From here, blood enters the general circulation through the hepatic veins that leave the liver and enter the inferior vena cava.

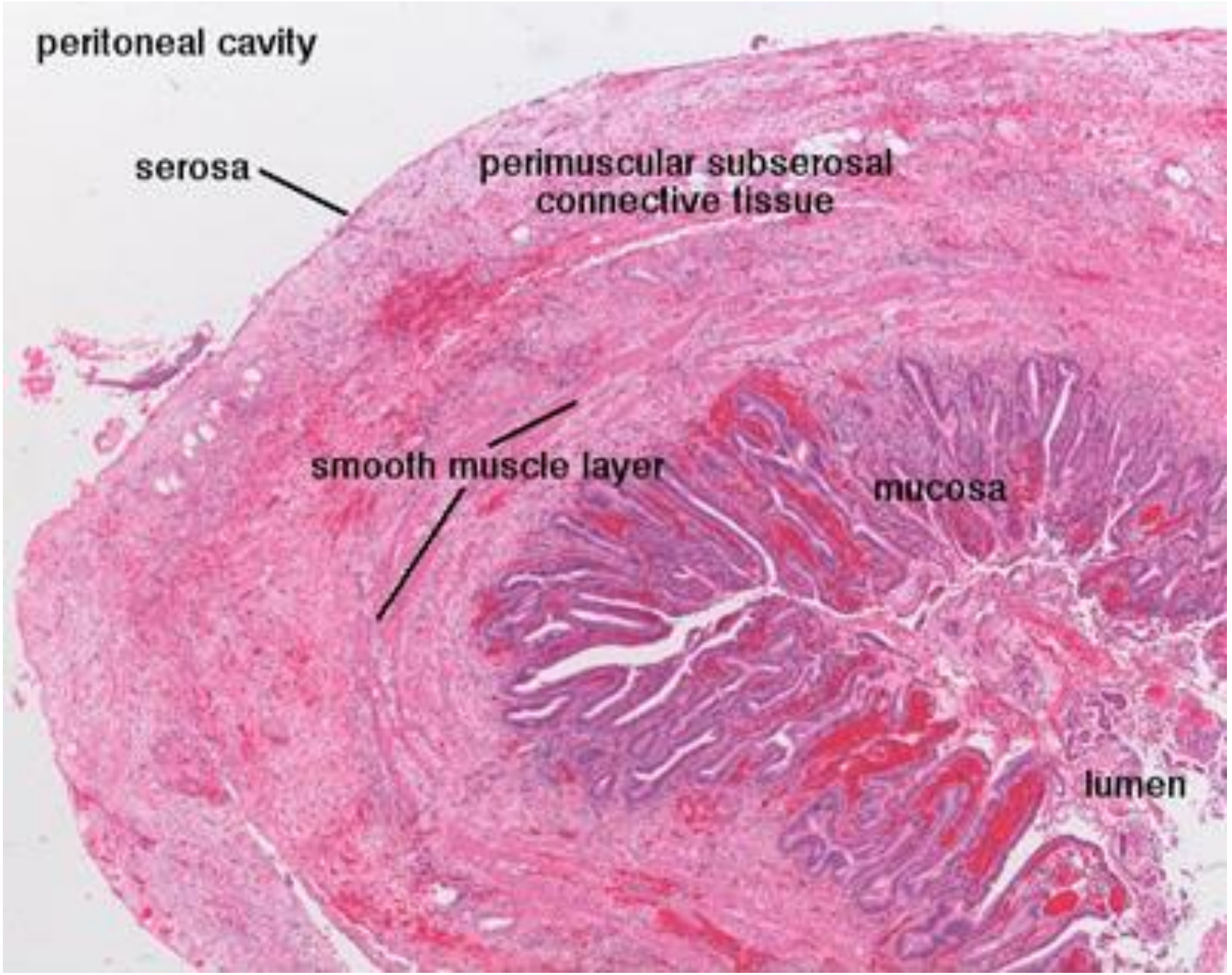
- The hepatic sinusoids are tortuous, dilated blood channels lined by a discontinuous layer of **fenestrated endothelial cells** that also exhibit fenestrations and discontinuous basal lamina. The hepatic sinusoids are separated from the underlying hepatocytes by a subendothelial perisinusoidal space. As a result, ingested material carried in the sinusoidal blood has a direct access through the discontinuous endothelial wall with the hepatocytes. The structure and the tortuous path of sinusoids through the liver allows for an efficient exchange of materials between hepatocytes and blood. In addition to the endothelial cells, the hepatic sinusoids also contain macrophages, called Kupffer cells, located on the luminal side of the endothelial cells. Hepatocytes secrete bile into tiny channels called **bile canaliculi** located between individual hepatocytes. The canaliculi converge at the periphery of liver lobules in the portal areas as **bile ducts**. The bile ducts then drain into larger hepatic ducts that carry bile out of the liver. Within the liver lobules, bile flows in bile canaliculi toward the bile duct in the portal area, whereas blood in the sinusoids flows toward the central vein. As a result, bile and blood do not mix.


Sinusoids
Hepatocytes
Portal triad


Portal area
Central vein
Cords of liver cells
Liver sinusoids

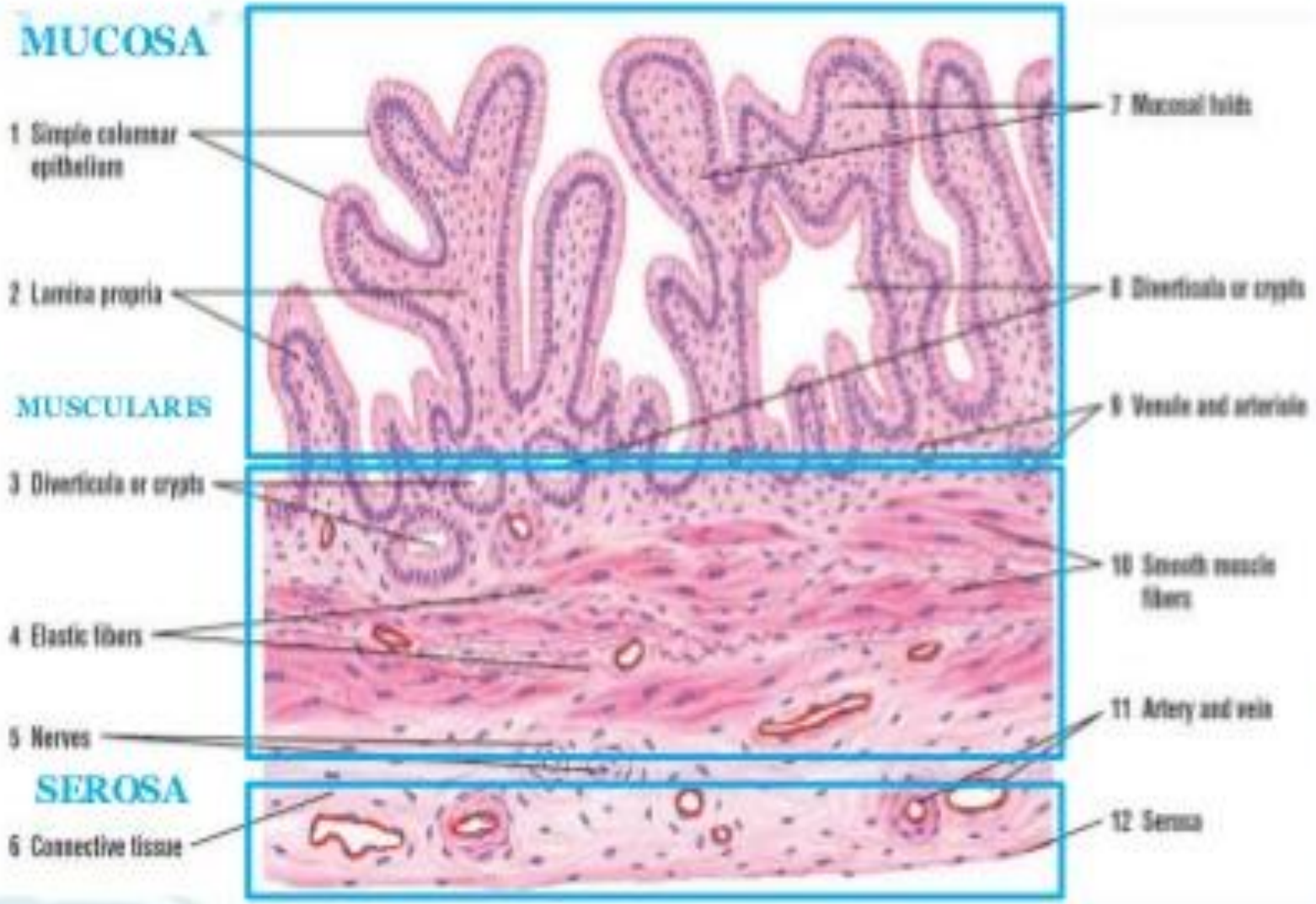
Gallbladder

- The gallbladder is a small, hollow organ attached to the inferior surface of the liver. Bile is produced by liver hepatocytes and then flows to and is stored in the gallbladder. Bile leaves the gallbladder via the cystic duct and enters the duodenum via the common bile duct through the major duodenal papilla, a fingerlike protrusion of the duodenal wall into the lumen. The gallbladder is not a gland because its main function is to store and concentrate bile by absorbing its water. Bile is released into the digestive tract as a result of hormonal stimulation after a meal. When the gallbladder is empty, the mucosa exhibits deep folds.


peritoneal cavity
serosa
perimuscular subserosal
connective tissue
smooth muscle layer
mucosa
lumen

GALLBLADDER

WALL OF GALLBLADDER



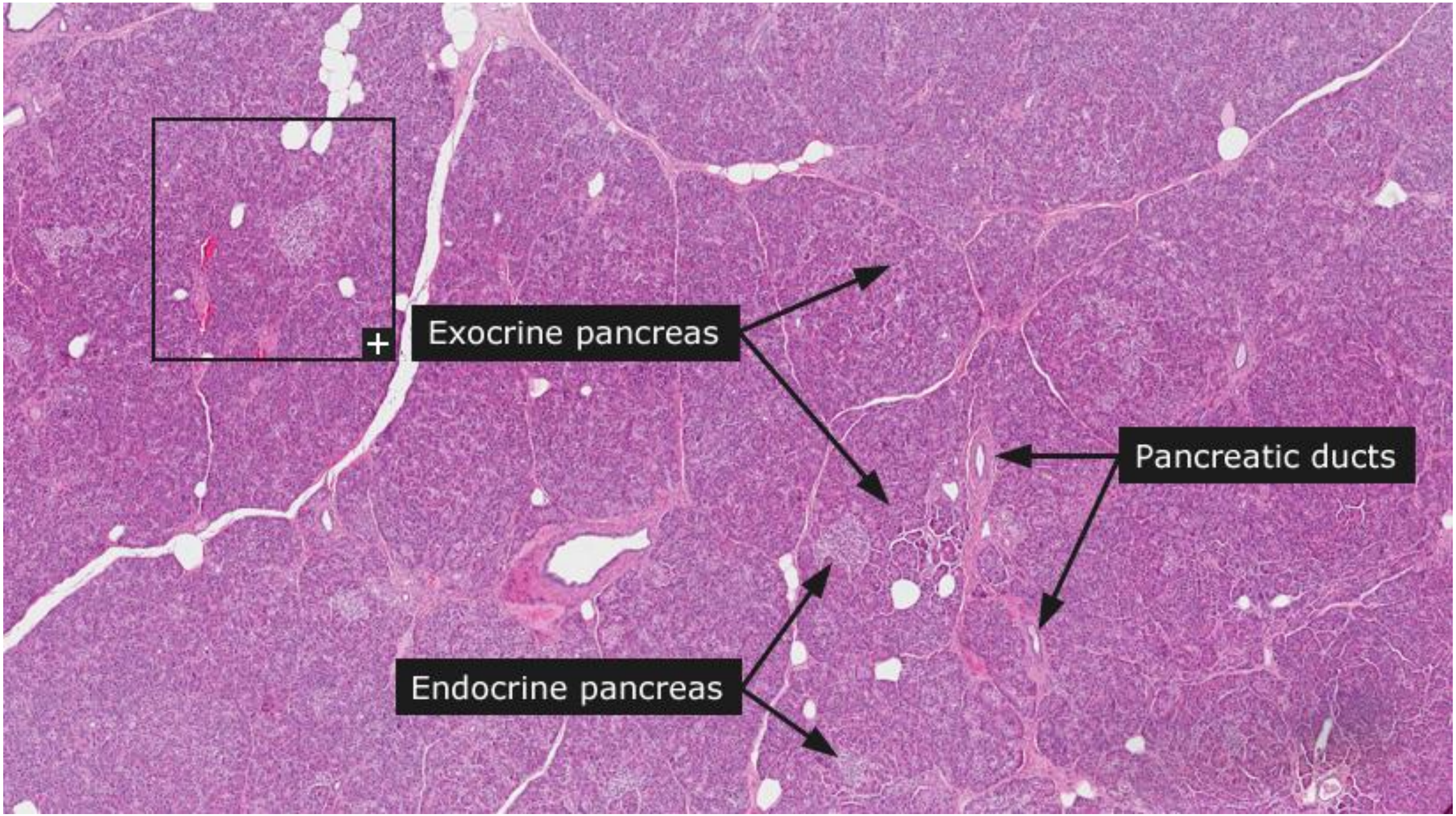
1. **Mucosa**
   - ✓ Simple Columnar Epithelium
   - ✓ Lamina propria
     - loose connective tissue
     - diffuse lymphatic tissue
     - venule and arteriole
2. **Muscularis**
   - ✓ smooth muscle fibers
   - ✓ Connective tissue layer
     - large blood vessels, artery and veins
     - lymphatics
     - nerves
3. **Adventitia or serosa**
   - ✓ covers the entire unattached gallbladder surface

Exocrine Pancreas

- The pancreas is a soft, elongated organ located posterior to the stomach. The head of the pancreas lies in the duodenal loop and the tail extends across the abdominal cavity to the spleen. Most of the pancreas is an exocrine gland. The exocrine secretory units or acini contain pyramid-shaped acinar cells, whose apices are filled with secretory granules. These granules contain the precursors of several pancreatic digestive enzymes that are secreted into the excretory ducts in an inactive form. The secretory acini are subdivided into lobules and bound together by loose connective tissue. The excretory ducts in the exocrine pancreas start from within the center of individual acini as pale-staining centroacinar cells, which continue into the short intercalated ducts. The intercalated ducts merge to form intralobular ducts in the connective tissue, which, in turn, join to form larger interlobular ducts that empty into the main pancreatic duct. Excretory ducts of the pancreas do not have striated ducts.

Endocrine Pancreas

- The endocrine units of the pancreas are scattered among the exocrine acini as isolated, pale-staining vascularized units called pancreatic islets (of Langerhans). Each islet is surrounded by fine fibers of reticular connective tissue. With special immunocytochemical processes, four cell types can be identified in each pancreatic islet: alpha, beta, delta, and pancreatic polypeptide (PP) cells. Alpha cells constitute about 20% of the islets and are located primarily around the islet periphery. The beta cells are most numerous, constituting about 70% of the islet cells, and are primarily concentrated in the center of the islet. The remaining cell types are few in number and are located in various places throughout the islets.


Exocrine pancreas
Pancreatic ducts
Endocrine pancreas