الكلية	العلوم
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المادة باللغة الانجليزية	Histology
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Organs Associated with the Digestive Tract

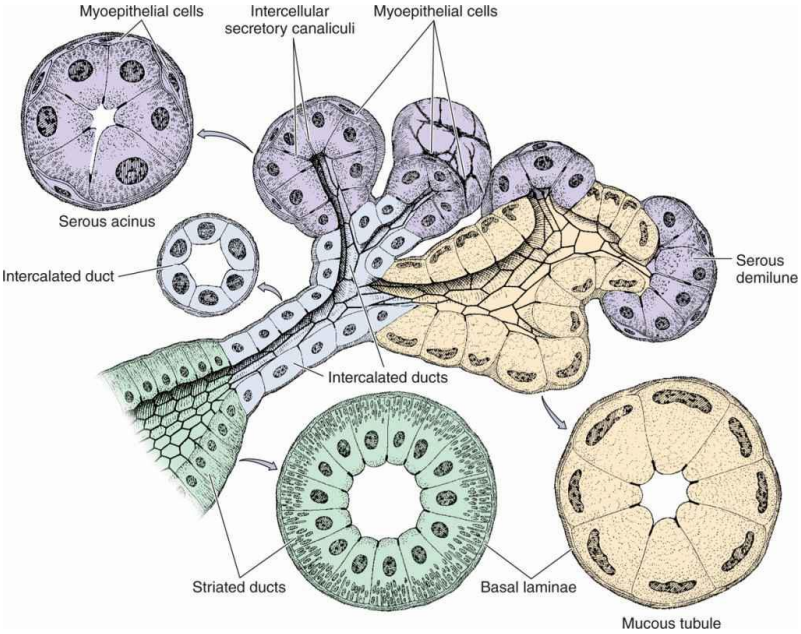
The organs associated with the digestive tract include the major salivary glands, the pancreas, the liver, and the gallbladder. Products of these organs facilitate transport and digestion of food within the gastrointestinal tract. The main functions of the salivary glands are to moisten and lubricate ingested food and the oral mucosa, to initiate the digestion of carbohydrates and lipids with amylase and lipase, and to secrete innate immune components such as lysozyme and lactoferrin.

SALIVARY GLANDS Exocrine glands in the mouth produce saliva, Salivary glands produce saliva, a watery mixture of enzymes and mucus. The enzymes and the mucus are produced by two distinct cell types, called serous cells and mucous cells. Release of saliva is facilitated by contraction of myoepithelial cells.

Saliva from the parotids is serous and watery. The submandibular and sublingual glands produce a seromucous secretion, while that of the minor glands is mostly mucous. Saliva is modified by the cells of the duct system draining the secretory units, with much Na + and Cl – reabsorbed while certain growth factors and digestive enzymes are added. Three epithelial cell types comprise the salivary

secretory units:

Serous cells are polarized protein-secreting cells, usually pyramidal in shape, with round nuclei, well-stained RER, and apical secretory granules Joined apically by tight and adherent junctions, serous cells form a somewhat spherical unit called an acinus (L. grape), with a very small central lumen .Serous acinar cells secrete enzymes and other proteins.



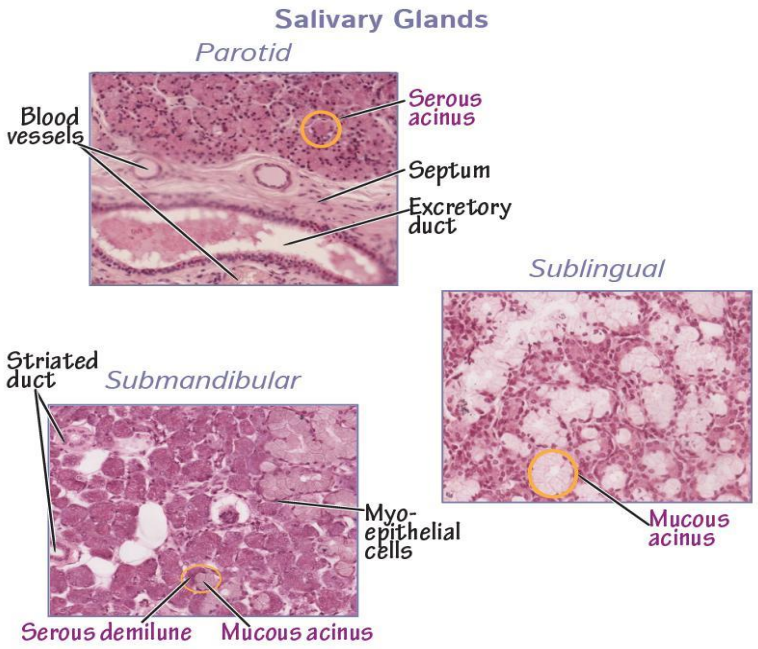
Mucous cells are somewhat more columnar in shape, with more compressed basal

.Mucous cells contain apical granules with hydrophilic mucins that provide lubricating properties in saliva .Mucous cells are most often organized as cylindrical tubules rather than acini. Mixed salivary glands have tubuloacinar secretory units with both serous and mucous secretion.

Myoepithelial cells, are found inside the basal lamina surrounding acini, tubules, and the proximal ends of the duct system . These small, flattened cells extend several contractile processes around the associated secretory unit or duct and their activity is important for moving secretory products into and through the ducts.

Features specific to each group of major salivary glands include the following

Parotid glands, located in each cheek near the ear, are branched acinar glands with exclusively serous acini . Serous cells of parotid glands secrete abundant α-amylase that initiates hydrolysis of carbohydrates and proline-rich proteins with antimicrobial and other protective properties.

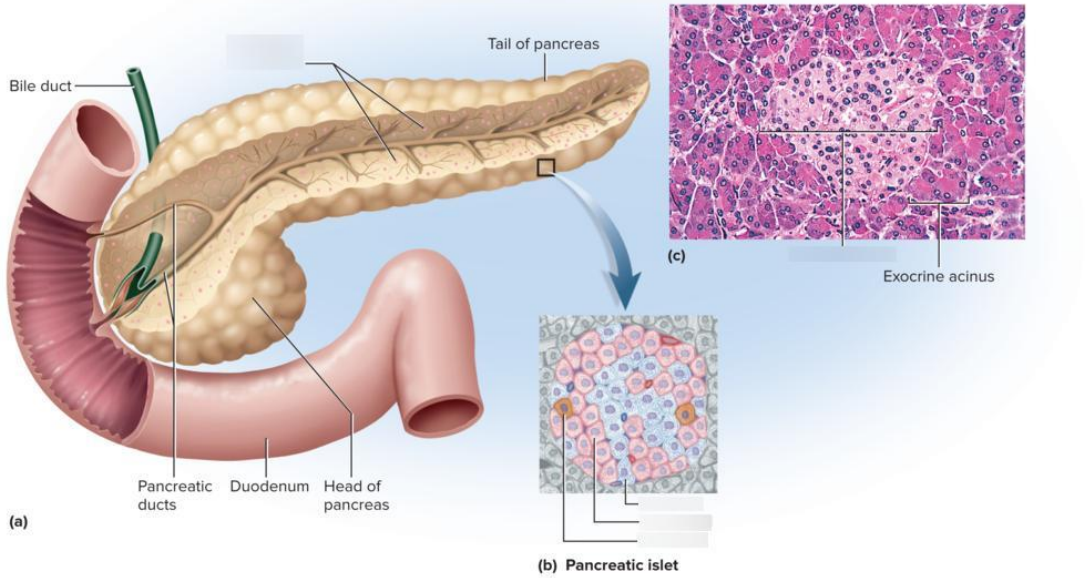


Submandibular glands, which produce two-thirds of all saliva, are branched tubuloacinar glands, having primarily serous acini, but with many mixed tubuloacinar secretory units . Serous cells of these mixed units are mostly in peripheral crescent-shaped groups called serous demilunes .

Sublingual glands, the smallest of the major glands, are also considered branched tubuloacinar glands, but here secretory tubules of mucous cells predominate and the main product of the gland is mucus . The few serous cells present in demilunes add amylase and lysozyme to the secretion.

PANCREAS

The pancreas is a mixed exocrine-endocrine gland that produces both digestive enzymes and hormones. It is an elongated retroperitoneal organ, with a large head near the duodenum and more narrow body and tail regions that extend to the left . The pancreas has a thin capsule of connective tissue, from which septa extend to cover the larger vessels and ducts and to separate the parenchyma into lobules . The secretory acini are surrounded by a basal lamina that is supported only by a delicate sheath of reticular fibers with a rich capillary network. Endocrine function of the pancreas involves primarily smaller cells similar to enteroendocrine cells located in variously sized clusters called the pancreatic islets (islets of Langerhans).



The digestive enzymes are produced by cells of serous acini in the larger exocrine portion of the pancreas . This somewhat resembles the parotid gland histologically, although the pancreas lacks striated ducts and the parotid glands lack islets of endocrine tissue. Each pancreatic acinus consists of several serous cells surrounding a very small lumen, without myoepithelial cells .The acinar cells containe round basal nuclei, and numerous zymogen granules apically, typical of protein-secreting cells.

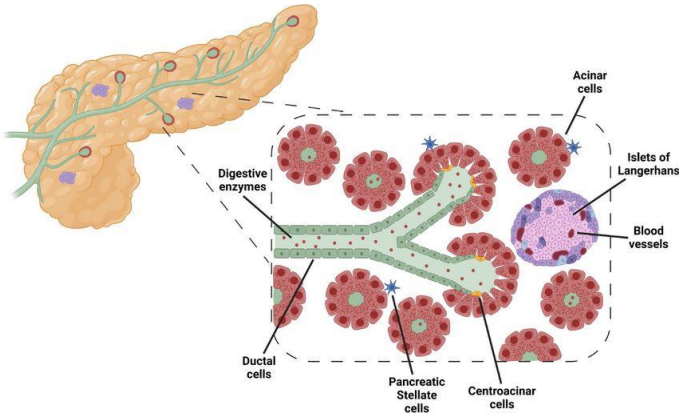
The exocrine pancreas secretes approximately 1.5 L of alkaline pancreatic juice per day and delivers it directly into the duodenum where the HCO_3^- ions neutralize the acidic chyme entering there from the stomach and establish the pH for optimal activity of the pancreatic enzymes. These digestive enzymes include several proteases, α-amylase, lipases, and nucleases (DNAase and RNAase). The proteases are secreted as inactive zymogens (trypsinogen, chymotrypsinogen, proelastase, kallikreinogen, and procarboxipeptidases). Trypsinogen is cleaved and activated by enteropeptidases in the

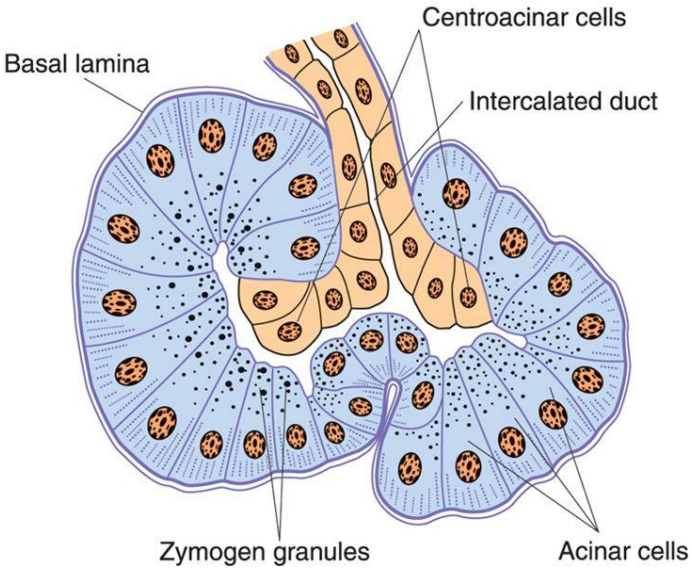
duodenum, generating trypsin that activates the other proteases in a cascade. Pancreatic tissue is protected against autodigestion by the following:

- Restricting protease activation to the duodenum.
- Trypsin inhibitor, which is copackaged in the secretory granules with trypsinogen, and
- The low pH in the acini and duct system due to HCO3 –secreted by the centroacinar and intercalated duct cells, which helps keep all the enzymes inactive.

Exocrine secretion in the pancreas is regulated mainly through two polypeptide hormones produced by enteroendocrine cells of the small intestine:

- Cholecystokinin (CCK) stimulates enzyme secretion by the acinar cells.
- Secretin promotes water and HCO3 – secretion by the duct cells.





Autonomic (parasympathetic) nerve fibers also stimulate secretion from both acinar and duct cells.

LIVER

The liver is one of the largest, most important.The bulk of the liver consists of hepatocytes, which are epithelial cells with a unique shape and a unique configuration.

The **liver** is essentially an ***exocrine gland***, secreting bile into the intestine. But also an *endocrine gland* and a *blood filter*. The liver has a ***diversity of functions*** not typically associated with glands. The liver is a metabolic factory, synthesizing and

breaking down a variety of substances. It's functions include all of the following:

- formation and secretion of **bile**.
- storage of **glycogen**, buffer for blood glucose.
- synthesis of **urea**.
- metabolism of **cholesterol** and fat.
- synthesis and endocrine secretion of many **plasma proteins**, including clotting factors.
- **detoxification** of many drugs and other poisons.
- cleansing of bacteria from blood.
- processing of several **steroid hormones** and **vitamin D**.
- **volume reservoir** for blood.
- catabolism of **hemoglobin** from worn-out red blood cells.

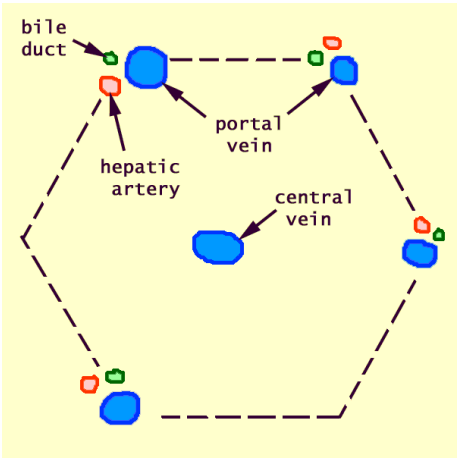
The liver receives a dual vascular supply.

- The **hepatic portal vein** brings to the liver all of the blood which has previously passed through the intestine and spleen.
- The **hepatic artery** brings fresh, oxygenated blood from the aorta.
  Portal venous blood from the intestine and spleen and arterial blood from the aorta mix together in hepatic **sinusoids** before leaving the liver in the **hepatic vein**.
  The liver receives over 25% of the total resting cardiac output and is responsible for over 20% of the body's resting oxygen consumption.

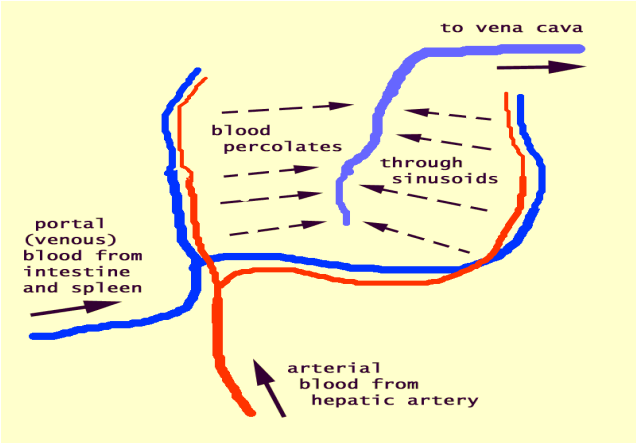
The liver is organized into lobules which take the shape of polygonal prisms. Each lobule is typically hexagonal in cross section and is centered on a branch of the hepatic vein (called, logically enough, the central vein).

Within each lobule, hepatocytes are arranged into hepatic cords separated by adjacent sinusoids.

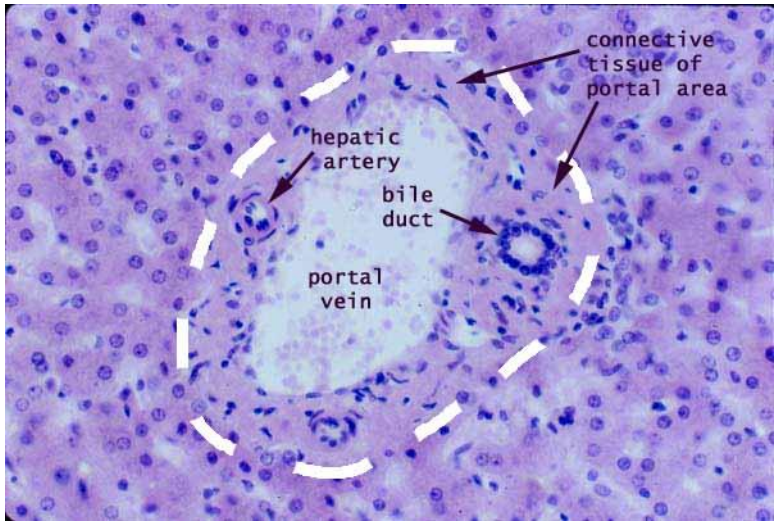
The fenestrated endothelium lining the sinusoids lies immediately adjacent to the cords, with no basement membrane and practically no intervening connective tissue.



All of the blood which passes through the intestine and spleen is delivered to the liver by the ***hepatic portal vein***.



This ***portal blood*** carries not only nutrients but also various contaminants (drugs, toxins from food, bacteria, byproducts of blood-cell recycling) which have been absorbed through the intestinal mucosa or produced in the spleen.The liver also receives arterial blood, carrying oxygen, from the **hepatic artery**.Both the hepatic portal vein and the hepatic artery branch in parallel along the corners of hepatic lobules, in regions called portal areas.



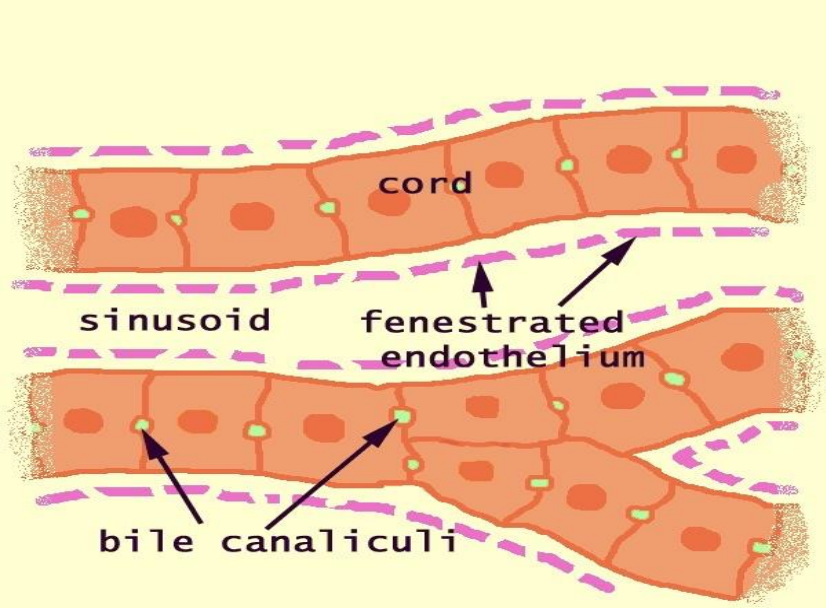
Organization of Liver Lobules

The liver is organized into **lobules** (portal lobules, hepatic lobules) which take the shape of irregular polygonal prisms. At the corners between adjacent lobules are the so-called **portal areas** (**portal canals**, **portal triads**). These are regions of connective tissue which include branches of the **bile duct**, the **portal vein**, and the **hepatic artery**.
Along the central axis of each lobule runs a **central vein**, which is a branch of the **hepatic vein**.
Occupying the bulk of the lobule are hepatocytes arranged into **cords**. separated by **sinusoids**.

Hepatic Cords

The bulk of the liver consists of epithelial **hepatocytes** arranged into cords, separated by vascular **sinusoids**.

The cords of hepatocytes represent the parenchyma of the liver.
However, these are not really strings of cells; they are more like intricately branching and interconnecting sheets, one cell thick, which extend parallel to the long axis of the lobule and radiate out from the its center.
A cord consists of hepatocytes. Each hepatocyte is attached to its neighbors all around and faces the sinusoids at either end.
The sinusoids are vascular spaces lined by a fenestrated endothelium (*i.e.*, an endothelium that is full of holes -- from *fenestra*, window). This endothelium has *no* underlying basement membrane. Therefore, the fenestrations permit blood plasma to wash freely over the exposed surfaces of the hepatocytes in the space of Disse.



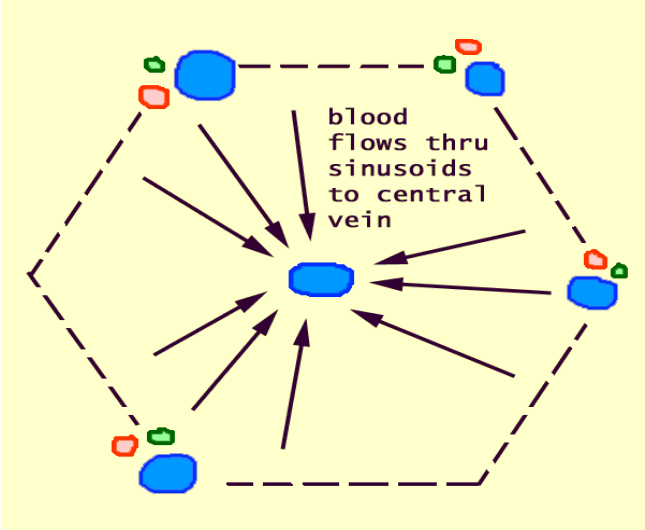
The space between the endothelium and the cords is named the space of Disse (after Joseph Disse, b. 1852). Its location is that of connective tissue, and it does contain a network of reticular fibers (collagen type III) which hold the hepatocytes together. since the fenestrations of the endothelium permit free movement of blood plasma, the "interstitial fluid" of the space of Disse *is* blood plasma.

Bile canaliculi, formed by apical surfaces of adjacent hepatocytes, form a network of tiny passages contained within each cord.

Hepatic Sinusoids and Space of Disse

Blood from both portal vein and hepatic artery (the liver's dual blood supply) mixes together in the hepatic sinusoids and then drains out of the lobule through the central vein, a branch of the hepatic vein.
The large sinusoidal volume permits sinusoidal blood to "percolate" comparatively

slowly through the liver parenchyma, thereby associating intimately with hepatocytes. This, in turn, provides time for efficient transfer of substances across the hepatocyte membrane.



Associated with the sinusoids are stellate **Kupffer cells** (the name commemorates Karl Wilhelm von Kupffer, b. 1829) -- liver macrophages which effectively catch and destroy bacteria which entered the blood in the intestine.
The **endothelium** which lines liver sinusoids is ***fenestrated*** (i.e., full of holes -- from *fenestra*, window) and lacks a basement membrane. The fenestrations permit blood plasma to wash freely over the exposed surfaces of the hepatocytes through the **space of Disse**.

Stellate **Ito cells** (named after Toshio **Ito**), located at intervals within the space of Disse, store fat and vitamin A.