10.6: Accessory Organs of Digestion

Jaundiced Eyes

Did you ever hear of a person looking at something or someone with a “jaundiced eye”? It means to take a negative view, such as envy, maliciousness, or ill will. The expression may be based on the antiquated idea that liver bile is associated with such negative emotions as these, as well as the fact that excessive liver bile causes jaundice or yellowing of the eyes and skin. Jaundice is likely to be a sign of a liver disorder or blockage of the duct that carries bile away from the liver. Bile contains waste products, making the liver an organ of excretion. Bile also has an important role in digestion, making the liver an accessory organ of digestion.

Figure \(\PageIndex{1}\): (By Photo Credit: Content Providers(s): CDC/Dr. Thomas F. Sellers/Emory University [Public domain], via Wikimedia Commons; Jaundice eye.jpg)
What Are Accessory Organs of Digestion?

Figure \(\PageIndex{2}\): The liver, gallbladder, and pancreas are the major accessory organs of digestion. In this figure, the pink tubular structure that starts at the lower stomach and wraps around the pancreas is the duodenum of the small intestine. This is where the accessory organs secrete their digestive substances. The pancreas is just behind the stomach. The liver is above on the right side and the gall bladder is just under the liver. (By Blausen gallery 2014 [CC BY 3.0], via Wikimedia Commons; Gallbladder liver Pancreas)

Accessory organs of digestion are organs that secrete substances needed for the chemical digestion of food but through which food does not actually pass as it is digested. Besides the liver, the major accessory organs of digestion are the gallbladder and pancreas. These organs secrete or store substances that are needed for digestion in the first part of the small intestine, the duodenum, where most chemical digestion takes place. You can see the three organs and their locations in Figure \(\PageIndex{2}\).

Liver

The liver is a vital organ located in the upper right part of the abdomen. It lies just below the diaphragm to the right of the stomach. The liver plays an important role in digestion by secreting bile. However, the liver has a wide range of additional functions unrelated to digestion. In fact, some estimates put the number of functions of the liver at about 500! A few of them are described below.
Structure of the Liver

The liver is a reddish brown, wedge-shaped structure. In adults, the liver normally weighs about 1.5 kg (3.3 lb). It is both the heaviest internal organ and the largest gland in the human body. The liver is divided into four lobes of unequal size and shape. Each lobe, in turn, is made up of lobules, which are the functional units of the liver. Each lobule consists of millions of liver cells, called hepatic cells (or hepatocytes). They are the basic metabolic cells that carry out the various functions of the liver.

As shown in Figure (PageIndex{3}), the liver is connected to two large blood vessels: the hepatic artery and the portal vein. The hepatic artery carries oxygen-rich blood from the aorta, whereas the portal vein carries blood that is rich in digested nutrients from the GI tract and wastes filtered from the blood by the spleen. The blood vessels subdivide into smaller arteries and capillaries, which lead to the liver lobules. The nutrients from the GI tract are used to build many vital biochemical compounds, and the wastes from the spleen are degraded and excreted.

Functions of the Liver

The main digestive function of the liver is the production of bile. Bile is a yellowish alkaline liquid that consists of water, electrolytes, bile salts, and cholesterol, among other substances, many of which are waste products. Some of the components of bile are synthesized by hepatocytes; the rest are extracted from the blood.

As shown in the figure below, bile is secreted into small ducts that join together to form larger ducts, with just one large duct carrying bile out of the liver. If bile is needed to digest a meal, it goes directly to the duodenum through the common bile duct. In the duodenum, the bile neutralizes acidic chyme from the stomach and emulsifies fat globules into smaller
particles (called micelles) that are easier to digest chemically by the enzyme lipase. Bile also aids with the absorption of vitamin K. Bile that is secreted when digestion is not taking place goes to the gallbladder for storage until the next meal. In either case, the bile enters the duodenum through the common bile duct shown in the figure.

![Figure 4: The common bile duct carries bile from both the liver and gallbladder to the duodenum. It is simply labeled “bile duct” in this figure.](https://bio.libretexts.org/Courses/Community_College_of_Vermont/Human_Biology_(Gabor_Gyurkovics)/10%3A_Digestive_System/TextMaps/10.04_Bile_Ducts.png)

Besides its roles in digestion, the liver has many other vital functions. *(Sunshineconnelly at English Wikibooks [CC BY 3.0], via Wikimedia Commons; Liver gall bladder pancreas)*

- The liver synthesizes glycogen from glucose and stores the glycogen as required to help regulate blood sugar levels. It also breaks down the stored glycogen to glucose and releases it back into the blood as needed.
- The liver stores many substances in addition to glycogen, including vitamins A, D, B12, and K. It also stores the minerals iron and copper.
- The liver synthesizes numerous proteins and many of the amino acids needed to make them. These proteins have a wide range of functions. They include fibrinogen, which is needed for blood clotting; insulin-like growth factor (IGF-1), which is important for childhood growth; and albumen, which is the most abundant protein in blood serum and functions to transport fatty acids and steroid hormones in the blood.
- The liver synthesizes many important lipids, including cholesterol, triglycerides, and lipoproteins.
- The liver is responsible for the breakdown of many waste products and toxic substances. The wastes are excreted in bile or travel to the kidneys, which excrete them in the urine.

The liver is clearly a vital organ that supports almost every other organ in the body. Because of its strategic location and diversity of functions, the liver is also prone to many diseases, some of which cause loss of liver function. There is currently no way to compensate for the absence of liver function in the long term, although liver dialysis techniques can be used in the short term. An artificial liver has not yet been developed, so liver transplantation may be the only option for people with liver failure.

### Gallbladder

The **gallbladder** is a small, hollow, pouch-like organ that lies just under the right side of the liver (see the figure below). It is about 8 cm (3.1 in.) long and shaped like a tapered sac, with the open end continuous with the cystic duct. The gallbladder stores and concentrates bile from the liver until it is needed in the duodenum to help digest lipids. After the bile leaves the liver, it reaches the gallbladder through the cystic duct. At any given time, the gallbladder may store between 30 and 60 mL (1-2 oz) of bile. A hormone stimulated by the presence of fat in the duodenum signals the gallbladder to contract and force its contents back through the cystic duct and into the common bile duct to drain into the duodenum.
The biliary tract includes the liver, gallbladder, and the ducts that join them with the duodenum. It also includes the pancreas and the pancreatic duct, which enters the duodenum together with the common bile duct. (By niddk.nih.gov [Public domain], via Wikimedia Commons; BiliaryTract.gif)

Pancreas

The pancreas is a glandular organ that is part of both the digestive system and the endocrine system. As shown in Figure (Fig5), it is located in the abdomen behind the stomach, with the head of the pancreas surrounded by the duodenum of the small intestine. The pancreas is about 15 cm (6 in.) long, and it has two major ducts, the main pancreatic duct, and the accessory pancreatic duct. Both of these ducts drain into the duodenum.

As an endocrine gland, the pancreas secretes several hormones, including insulin and glucagon, which circulate in the blood. The endocrine hormones are secreted by clusters of cells called pancreatic islets (or islets of Langerhans). As a digestive organ, the pancreas secretes many digestive enzymes and also bicarbonate, which helps to neutralize acidic chyme after it enters the duodenum. The pancreas is stimulated to secrete its digestive substances when food in the stomach and duodenum triggers the release of endocrine hormones into the blood that reach the pancreas via the bloodstream. The pancreatic digestive enzymes are secreted by clusters of cells called acini, and they travel through the pancreatic ducts to the duodenum. In the duodenum, they help to chemically break down carbohydrates, proteins, lipids, and nucleic acids in chyme. The pancreatic digestive enzymes include:

- amylase, which helps to digest starch and other carbohydrates.
- trypsin and chymotrypsin, which help to digest proteins.
- lipase, which helps to digest lipids.
- deoxyribonucleases and ribonucleases, which help to digest nucleic acids.
Accessory organs of digestion are organs that secrete substances needed for the chemical digestion of food but through which food does not actually pass as it is digested. The accessory organs include the liver, gallbladder, and pancreas. These organs secrete or store substances that are carried to the duodenum of the small intestine as needed for digestion.

The liver is a large organ in the abdomen that is divided into lobes and smaller lobules, which consist of metabolic cells called hepatic cells, or hepatocytes. The liver receives oxygen in the blood from the aorta through the hepatic artery. It receives nutrients in blood from the GI tract and wastes in blood from the spleen through the portal vein.

The main digestive function of the liver is the production of the alkaline liquid called bile. Bile is carried directly to the duodenum by the common bile duct or to the gallbladder first for storage. Bile neutralizes acidic chyme that enters the duodenum from the stomach and also emulsifies fat globules into smaller particles (micelles) that are easier to digest chemically.

Other vital functions of the liver include regulating blood sugar levels by storing excess sugar as glycogen; storing many vitamins and minerals; synthesizing numerous proteins and lipids; and breaking down waste products and toxic substances.

The gallbladder is a small pouch-like organ near the liver. It stores and concentrates bile from the liver until it is needed in the duodenum to neutralize chyme and help digest lipids.

The pancreas is a glandular organ that secretes both endocrine hormones and digestive enzymes. As an endocrine gland, the pancreas secretes insulin and glucagon to regulate blood sugar. As a digestive organ, the pancreas secretes digestive enzymes into the duodenum through ducts. Pancreatic digestive enzymes include amylase (starches); trypsin and chymotrypsin (proteins); lipase (lipids); and ribonucleases and deoxyribonucleases (RNA and DNA).
Review

1. Name three accessory organs of digestion. How do these organs differ from digestive organs that are part of the GI tract?
2. Describe the liver and its blood supply.
3. Explain the main digestive function of the liver.
4. Besides its role as a digestive organ, what other vital functions does the liver have?
5. What is the gallbladder? How does it aid in digestion in the duodenum?
6. Which two body systems include the pancreas? What type of secretions does the pancreas release as part of each body system?
7. List pancreatic enzymes that work in the duodenum and the substances they help digest.
8. What are two substances produced by accessory organs of digestion that help neutralize chyme in the small intestine, and where are they produced?
9. People who have their gallbladder removed sometimes have digestive problems after eating high-fat meals. Why do you think this happens?
10. True or False. The liver is a gland.
11. True or False. Substances secreted by the pancreas enter into the duodenum from the common bile duct.
12. True or False. Bile contains wastes.
13. Which accessory organ of digestion synthesizes cholesterol?

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