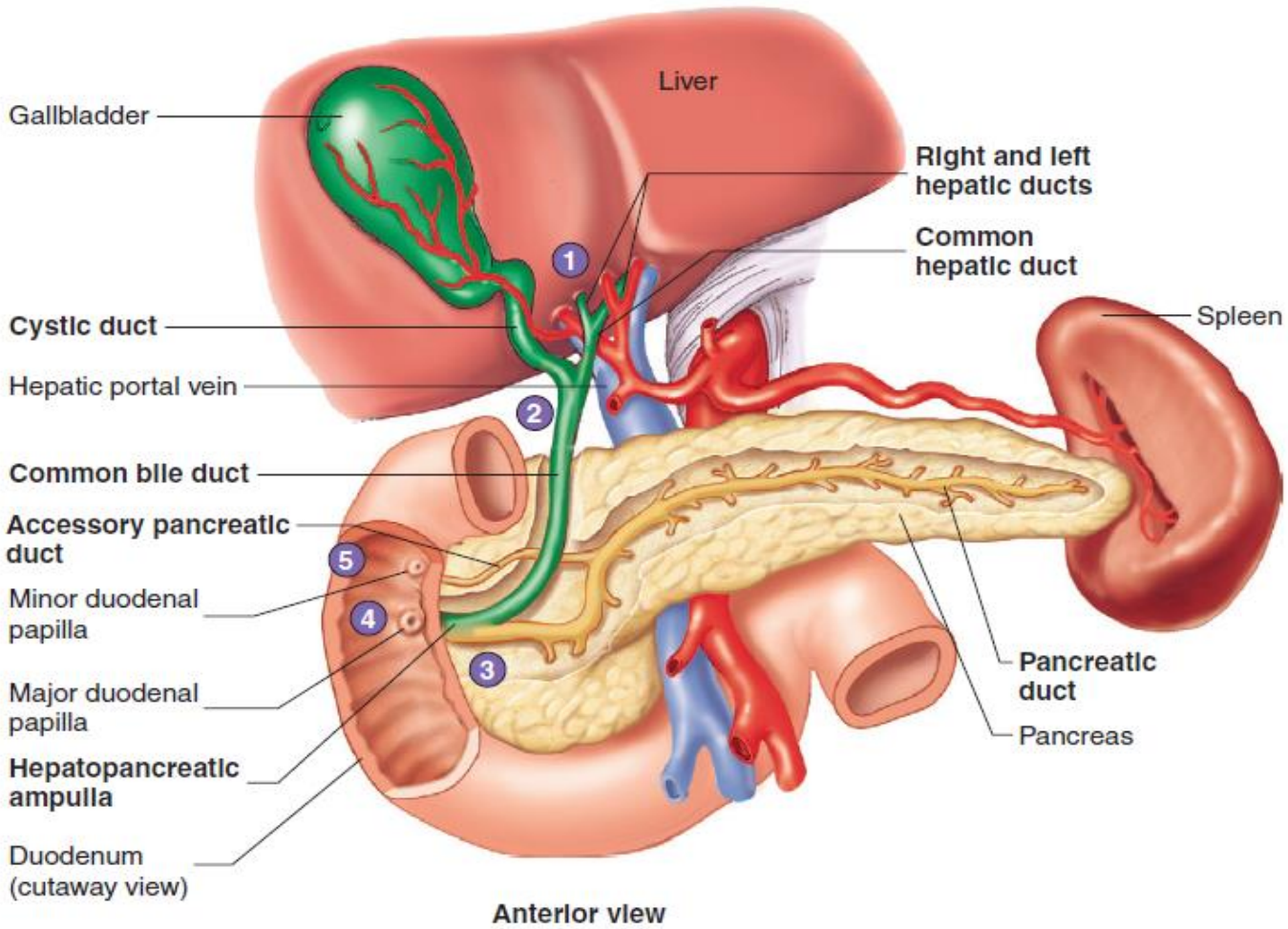
The Liver

Anatomy of the Liver

The **liver** is the largest internal organ of the body, weighing about 1.36 kg . It is in the right-upper quadrant of the abdomen. The liver consists of two major lobes, the **right lobe** and **left lobe,** which are separated by a connective tissue septum

The **porta** is on the inferior surface of the liver, where the various vessels, ducts, and nerves enter and exit the liver. The **hepatic portal vein,** the **hepatic artery,** and a small hepatic nerve plexus enter the liver through the porta . Lymphatic vessels and two hepatic ducts, one each from the right and left lobes, exit the liver at the porta. The hepatic ducts transport bile out of the liver. The right and left hepatic ducts unite to form a single **common hepatic duct** . The **cystic duct** from the gallbladder joins the common hepatic duct to form the **common bile duct,** which joins the pancreatic duct at the **hepatopancreatic ampulla** , an enlargement where the hepatic and pancreatic ducts come together. The hepatopancreatic ampulla empties into the duodenum at the major duodenal papilla.

The gallbladder is a small sac on the inferior surface of the liver that stores bile. Bile can flow from the gallbladder through the cystic duct into the common bile duct, or it can flow back up the cystic duct into the gallbladder.



Anterior view

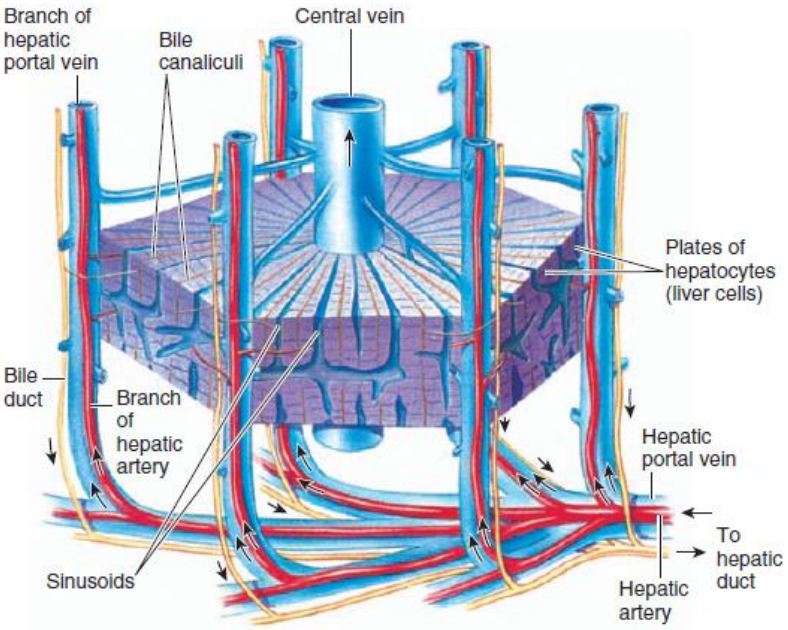
Histology of the Liver

A connective tissue capsule and visceral peritoneum cover the liver. At the porta, the connective tissue capsule sends a branching network of septa into the the liver to provide its main support. Vessels, nerves, and ducts follow the connective tissue branches throughout the liver.

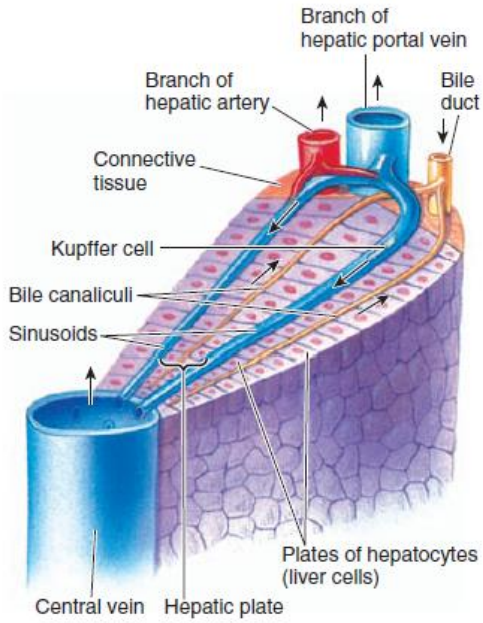
The connective tissue septa divide the liver into hexagon-shaped **lobules** with a **portal triad** at each corner . The triads are so named because three vessels—the hepatic portal vein, hepatic artery, and hepatic duct—are located in them.

A **central vein** is in the center of each lobule. Central veins of the lobules unite to form **hepatic veins,** which exit the liver on its posterior and superior surfaces and empty into the inferior vena cava.

Hepatic cords radiate out from the central vein of each lobule like the spokes of a wheel. The hepatic cords are composed of **hepatocytes,** the functional cells of the liver. The spaces between the hepatic cords are blood channels called **hepatic sinusoids.**



(b) Arrangement of vessels in a hepatic lobule



(c) Magnified view of a wedge of a hepatic lobule

Functions of the Liver:

1- Bile Production

The liver produces and secretes about 600–1000 mL of bile each day . Bile contains no digestive enzymes, but it plays a role in digestion because it neutralizes and dilutes stomach acid and emulsifies lipids.**Bile salts** emulsify lipids. Bile also contains excretory products, such as bile pigments; one bile pigment is bilirubin, which results from the breakdown of hemoglobin. Bile also contains cholesterol, lipids, lipid-soluble hormones, and lecithin.

2- Storage

Hepatocytes can remove sugar from the blood and store it in the form of **glycogen.** They can also store lipids, vitamins (A, B12, D, E, and K), copper, and iron. Hepatocytes help maintain blood sugar levels within very narrow limits. If a large amount of sugar enters the general circulation after a meal ,the hepatocytes remove glucose and other substances from the blood, store them, and then secrete them back into the circulation when needed.

3- Nutrient Intercoversion

Ingested nutrients are not always present in the proportion needed by the tissues. In this case, the liver can convert some nutrients into others. For example, if a person is on a diet that is excessively high in protein, an oversupply of amino acids and an undersupply of lipids and carbohydrates may be delivered to the liver. The hepatocytes break down the amino acids and cycle many of them through metabolic pathways, so that they can be used to produce ATP, lipids, and glucose .

Hepatocytes also transform substances that cannot be used by most cells into more readily usable substances. For example, they combine ingested dietary fats with choline and phosphorus in the liver to produce phospholipids, which are essential components of plasma membranes.

4- Detoxification

Many ingested substances are harmful to body cells. In addition, the body itself produces many by-products of metabolism that, if accumulated, are toxic. The liver forms a major line of defense by altering the structure of many of these harmful substances to make them less toxic or to make their elimination easier. Ammonia, for example, a by-product of amino acid metabolism, is toxic and not readily removed from the circulation by the kidneys. Hepatocytes remove ammonia from the circulation and convert it to urea, which is less toxic than ammonia. Urea is then secreted into the circulation and eliminated by the kidneys in the urine. The liver hepatocytes also remove other substances from the circulation and excrete them into the bile.

5- Phagocytosis

Hepatic phagocytic cells (Kupffer cells), which lie along the sinusoid walls of the liver, phagocytize “worn-out” and dying red and white blood cells, some bacteria, and other debris that enters the liver through the circulation.

6- Synthesis

The liver can produce new compounds, including blood proteins such as albumins, fibrinogen, globulins, heparin, and clotting factors, which are released into the circulation.

7- vitamin D hydroxylation

In addition, vitamin D is hydroxylated in the liver hepatocytes. The hydroxylated form of vitamin D, is transported through the circulation to the kidneys, where it is again hydroxylated. The double-hydroxylated vitamin D is the active form of the vitamin, which functions in calcium maintenance.