

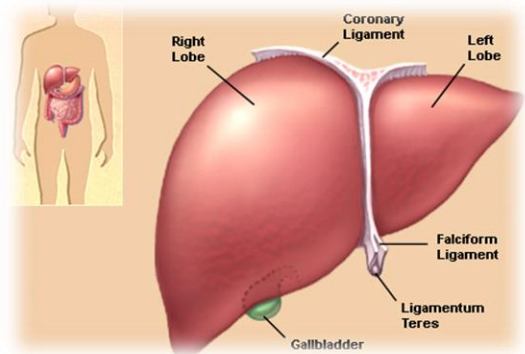
## The Liver

### Introduction

The liver is a large, meaty organ that sits on the right side of the upper abdomen. It is the second largest organ in the body, after the skin. Weighing one and a half kilograms on average, the liver is reddish brown in colour and feels rubbery to the touch. It is protected by the ribcage and therefore it is not easy to palpate.

The liver is a fascinating organ and has many vital complex functions, which include:

- detoxification;
- protein synthesis, or the production of proteins;
- production of digestive biochemicals;
- glycogen storage;
- hormone production; and
- drug metabolism.

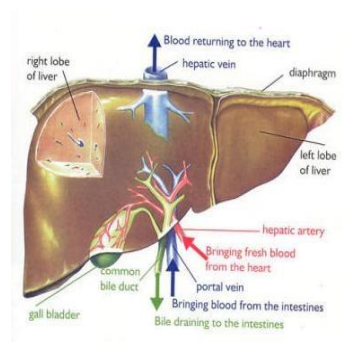


### Anatomy

The liver is the largest gland in the body and is covered in connective tissue. It has two large sections, called the right and the left lobes. The right lobe has two smaller lobes attached to it, called the quadrate and caudate lobes. The gallbladder sits under the liver, along with parts of the pancreas and intestines. The liver and these organs work together to digest, absorb, and process food.

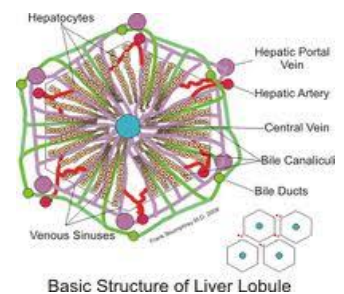
### Blood Flow

The liver is connected to two blood vessels, the hepatic artery and the portal vein. The hepatic artery carries oxygen rich blood from the aorta and distributes it to the liver, pancreas and gallbladder as well as to the stomach and duodenal portion of the small intestine. The portal vein carries blood containing digested nutrients from the entire gastrointestinal tract and also from the spleen and pancreas to the liver. These blood vessels subdivide into capillaries, which then lead to a lobule.



### Lobules

Each lobule is made up of millions of hepatic cells which are the basic metabolic cells of the liver. Lobules are the functional units of the liver. Blood enters the lobules then flows through small channels called sinusoids that are lined with primary liver cells or hepatocytes. The hepatocytes remove toxic substances, including alcohol, from the blood, which then exits the lobule through the central vein or the hepatic venule.



### Bile Ducts

Bile is produced by the liver to aid digestion of lipids in the small intestine. Bile is drained from the liver cells by many small ducts that unite to form the main bile duct of the liver, the hepatic duct. This joins the cystic duct, which leads from the gallbladder, to form the common bile duct, which drains into the duodenum, which is the start of the small intestine.

## Physiology

Metabolism is central in the regulation of body homeostasis. The liver metabolises both beneficial and harmful substances. It stores nutrients and other useful substances, as well as detoxifying or breaking down harmful compounds. These can be then excreted from the body in bile via the liver, in urine via the kidney, or by other means.

## Detoxification and Drug Metabolism

The liver is vital for the detoxification of substances which are both exogenous or those from outside the body and endogenous or those produced by the body, that are harmful to the body. Kupffer cells, which are present in the lobules, are phagocytes which digest and destroy cellular debris and any invading bacteria. Other exogenous substances such as drugs and alcohol are detoxified by the liver, from the bloodstream. It does this by absorbing the harmful substances, chemically altering them, and then excreting them in the bile. Amino acids are broken down, some hormones are inactivated and bilirubin, a product of the breakdown of old red blood cells, is also detoxified and rendered harmless by liver metabolism. With drug metabolism, enzymes in the liver change drug components into substances known as metabolites. Metabolites are then bound to other substances for excretion through the lungs, or bodily fluids such as saliva, sweat, breast milk, and urine, or through reabsorption by the intestines. The primary mode of excretion is through the kidneys.

## Protein Synthesis

There are some proteins found in the blood that are produced in the liver, such as albumin which helps maintain calcium levels and other important substances in the bloodstream. Albumin also helps regulate the movement of water between the bloodstream and the body's tissues. The liver also produces globin, one of two components that make haemoglobin, the oxygen carrying substance in red blood cells. Certain globulins, that include antibodies, are produced in the liver, as are the proteins that make up the complement system, a part of the immune system that combines with antibodies to fight invading microorganisms.

## Glycogen Storage

The liver stores energy in the form of glycogen, which is made from glucose. The liver removes glucose from the blood when blood glucose levels are high. Through a process called glycogenesis, the liver combines the glucose molecules in long chains to create glycogen, a carbohydrate that provides a stored form of energy. When the amount of glucose in the blood falls below the level required to meet the body's needs, the liver reverses this reaction, transforming glycogen into glucose.

## Hormone Production

The liver is a major site of the production of the glycoprotein, thrombopoietin. Thrombopoietin is a glycoprotein hormone that regulates the production of platelets by the bone marrow. The liver also produces insulin like growth factor 1 (IGF-1), a polypeptide protein hormone that plays an important role in childhood growth and continues to assist in the synthesis of some substances in adults.

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