

The Normal Liver - What does it do? - A Simplified Guide A.Stevens ©

The liver is a complicated structure which can be regarded as a vast chemical factory that imports many raw materials, processes them and then exports the finished products. Like any efficient factory, the liver needs:-

- an efficient and constant **input system**, bringing raw materials in;
- an efficient **output system**, taking the finished products out to the sites where they are needed; and
- multiple **work units** capable of working 24 hours a day.

The Input System

The Input system comprises two blood vessels:-

- the **hepatic artery**, which brings oxygenated blood and some of the raw materials into the liver, as well as potentially toxic substances resulting from the breakdown of body cells, requiring detoxification in the liver, and
- the **hepatic portal vein** which is a closed vein system bringing blood directly from the intestine and spleen. The blood is rich in raw materials such as sugars, amino acids and fatty acids produced in the intestine by breakdown of carbohydrates, proteins and fats in food. It also contains some of the breakdown products of red blood cells in the spleen for processing in the liver and converting to **bile**.

These two blood vessels are shown in **Diagram 1**. They enter the liver at the back, whereupon both vessels branch extensively, taking blood to all parts of the liver and bringing the blood into contact with the rows of **work units** by thin walled channels called **sinusoids**, which are abutted to the work units (see **Diagram 2**.)

The Output System

The Output system has two components:-

- the **hepatic vein** which is a large vein taking blood from the liver back to the heart for redistribution throughout the body, taking the products of the liver to the sites where they are needed; and
- the **bile duct system** which takes the bile made in the liver to the **gall bladder**, where it is concentrated and stored until it is needed in the small intestine to assist in the digestion of food materials, particularly fats.

These output systems are also shown in **Diagram 1** opposite.

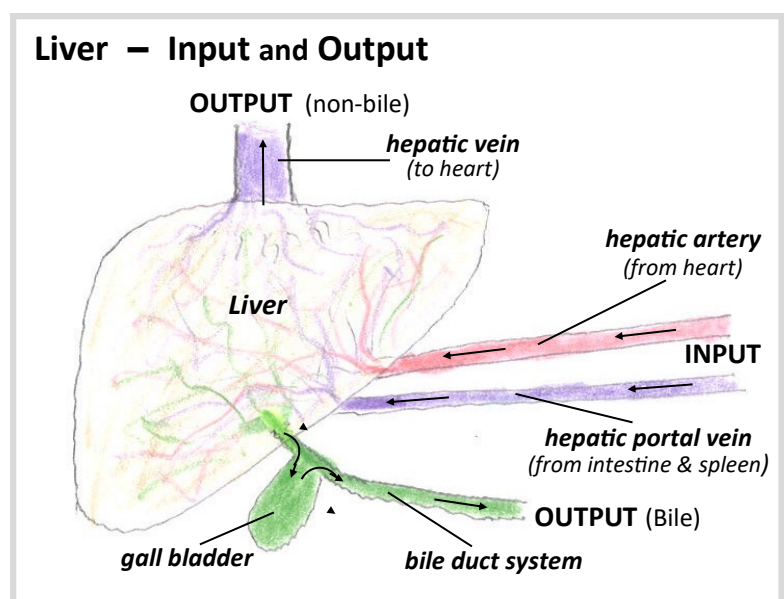


Diagram 1

The Work Units

The work units of the liver are cells called **hepatocytes** and there are many millions of them arranged in columns and sheets. The hepatocytes carry out many chemical functions:-

They make ("synthesize") lots of important substances essential for the body's normal functioning

Some of the things they synthesize include:-

- many proteins, particularly those which are carried in blood plasma, such as **albumin** and the many proteins which enable blood to clot to prevent blood loss. Another important pair of substances made in the liver are **transferrin** and **ceruloplasmin** which are the substances which bind to **iron** and **copper** respectively, and transport them around the body;
- important lipid ("fatty") substances, particularly cholesterol; and
- glucose and other carbohydrates from non-carbohydrate sources such as fats and amino acids.

They neutralise toxic substances, rendering them harmless to the body.

The body often ingests substances which are toxic, and the liver cells are able to neutralise them. The most well known ingested toxin is alcohol, which the liver is able to break down into harmless substances. This mechanism can fail when too much alcohol is ingested in too short a time for the liver cells to detoxify it, and the unmodified alcohol passes into the main blood circulation and into the brain where it damages brain cells, leading to neurological malfunction (drunkenness), and if a big enough dose of alcohol gets through, death by acute alcohol poisoning may ensue.

In addition to external toxins, the liver also has to handle internal toxins. When the body's cells die, which they do in great numbers every day, some of the breakdown products of cell death are toxic. In particular, the breakdown of proteins (the main structural components of cells) releases substances which contain nitrogen, many of which can be highly toxic (e.g. ammonia) and require detoxifying by the liver cells. Most of the nitrogen-containing substances produced by cell breakdown are converted in the liver to substances called **urea** and **creatinine** which are passed via the blood circulation to the kidneys where they are excreted harmlessly in the urine.

They can hold and store substances until they are needed.

The most important stored substances are glycogen (which can be converted quickly into glucose when needed e.g. when the blood sugar level falls), vitamins A, D and B12, and iron (in the form of ferritin.)

They produce bile.

When red blood cells reach the end of their useful lifespan (about 120 days), the old cells are trapped in the spleen where they are broken down, and the breakdown products of the haemoglobin they contain are carried to the liver in the **hepatic portal vein** (see **Diagram 1**); these products (**bilirubin**) are insoluble and have to be bonded to albumin for transport to the liver. The hepatocytes in the liver link the bilirubin to glucuronic acid, and the compound formed is soluble, forming the major component of bile.

Although most of the substances produced or detoxified by the hepatocytes pass back into the sinusoids for transport to the central and hepatic veins, the bile (and some of the cholesterol) pass into tiny canals (**bile canaliculi**) between adjacent hepatocytes, and from these into the bile duct system (see **Diagram 2**.)

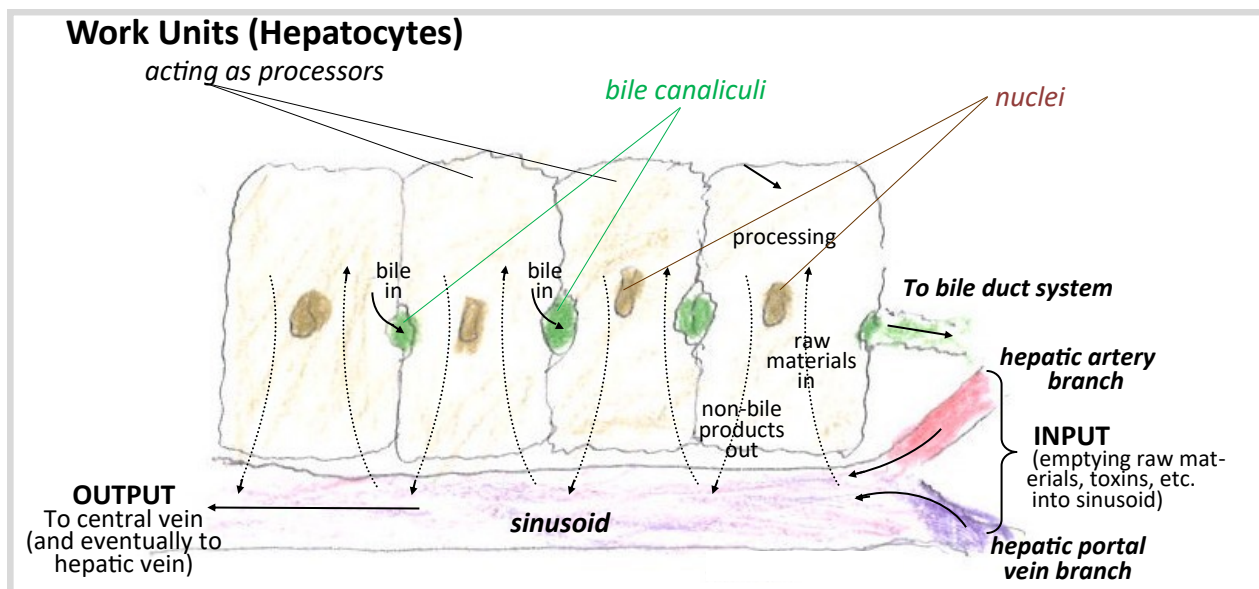


Diagram 2

Summary

- For the liver to work efficiently, input, work units and output systems all need to be working properly in a fully integrated way.

In my next *Simple Guide*, I will explain how, in **cirrhosis of the liver**, disruption of the input and output systems interferes with normal functioning of the liver, even though many of the hepatocytes are capable of functioning normally.