➢ Digestion in Large Intestine

Large intestine name is given on the basis of its large diameter (6-7 cm) which is 3 times greater than small intestine though length wise it is 3 times shorter than small intestine.

Length: It is 5 feet long.

Parts: Large intestine is divided into four parts i-e Caecum, Colon, Rectum and Anal Canal

i. **Caecum:** Caecum is about 5-9 cm in length. It lies between ileum and ascending colon. Ileum empties its food to caecum through ileo-colic valve. Caecum has a small finger like projection called appendix. Appendix is vestigial organ in human but has a small role in immunity in embryonic stages and can be sued as spare part, the displacement of ileo-colic valve is called displacement of navel. Appendix may get inflamed due to entry and putrefaction of food causing appendicitis. During appendicitis appendix has to be removed surgically. In case appendix bursts, it can cause death of the individual.

ii. **Colon:** It is the largest part of large intestine. It is 110-125 cm in length. It is composed of four parts.

   a. **Ascending colon:** It goes upward on the right side of abdomen to the level of liver.
   b. **Transverse colon:** It crosses abdomen below the liver and stomach
   c. **Descending colon:** It goes downward on the left of abdomen.
   d. **Sigmoid colon:** It enters into rectum.

iii. **Rectum:** It is the last part of large intestine. It is 11-17 cm long. It stores feces for a time being. When rectum is full of feces then stimulus is given to rectal walls for defecation reflex which is uncontrolled in infants. However, this reflex is conditioned in adults.

Gastro colic reflex: The gastro colic reflex is one of a number of physiological reflexes controlling the motility, or peristalsis, of the gastrointestinal tract. It involves an increase in motility of the colon in response to stretch in the stomach and byproducts of digestion in the small intestine. Thus, this reflex is responsible for the urge to defecate following a meal (2-3 times a day). The small intestine also shows a similar motility response. The gastro colic reflex helps make room for more food.

iv. **Anal Canal:** Anal canal is about 4 cm in length. It consist of internal and external sphincters. During defecation first internal sphincter relaxes which allows feces descending from rectum and then external sphincter relaxes which causes final removal from body.

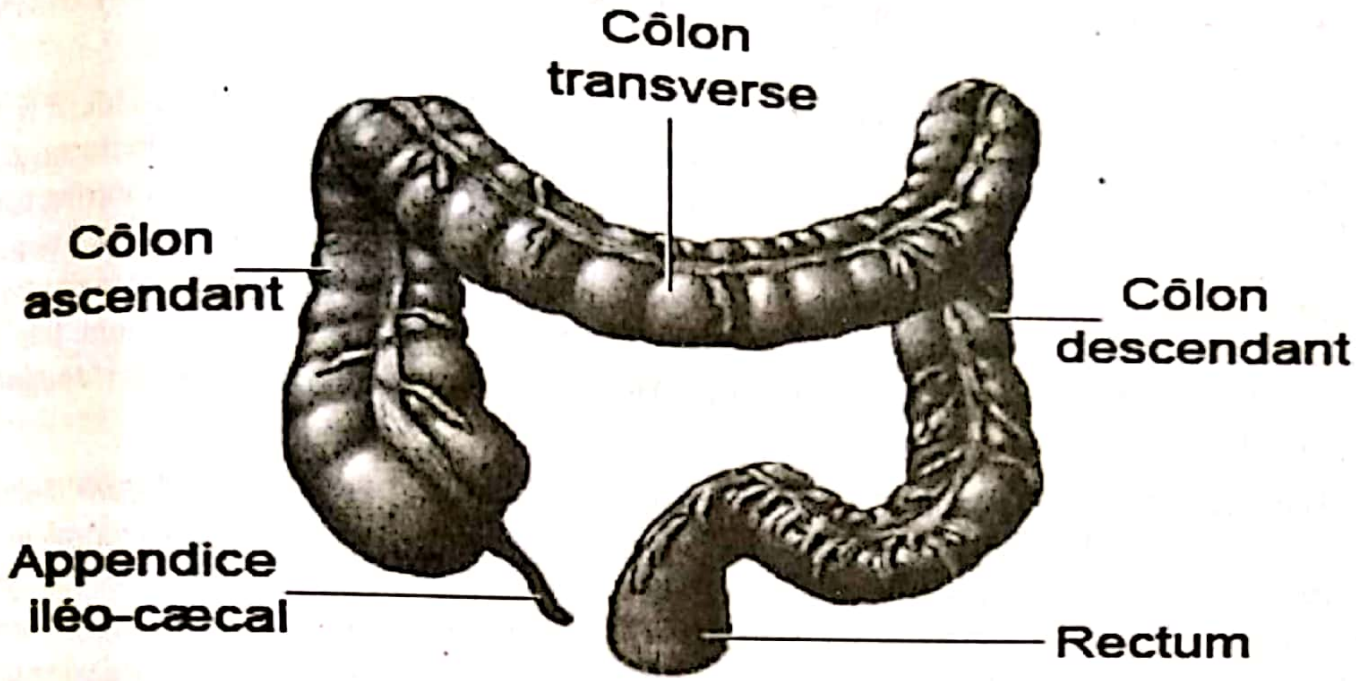
Colon functions: The following functions are performed by large intestine.

Reabsorption of water and salts: The food received from small intestine contains large amount of water, salts, minerals, vitamins, body secretions and undigested materials, from this solution mostly water, mineral, vitamins and salts are reabsorbed.

Synthesis of vitamin K: Large intestine contain bacteria which can synthesize vitamin K which is transported to blood. This vitamin is required for normal blood clotting.

Feces formation: Feces formation also occurring in large intestine (descending colon).

Constipation: The excessive reabsorption leads to disorder known as constipation in which feces dried and defecation delayed which is the cause of multiple disorders. It is usually caused due to more standing or more sitting. In constipation one can use laxative e.g. husk of aspaghole.



large intestine and its parts

Liver: The liver is the largest gland in the body weighing about 1.4 kg in an adult. It is situated under the diaphragm in the upper abdominal cavity and is held in place by several ligaments. It is a reddish-brown color and comprises of four anatomical lobes. When viewed from the front, the dominant left and right lobes can be seen. Gall bladder is situated in a depression on the posterior surface of the liver, a pear-shaped sac which stores bile synthesized by the liver. The liver performs many vital metabolic functions. It has the ability to store and metabolize useful substances such as nutrients, but it breaks down or detoxifying harmful substances to turn them inert and less harmful.

Blood Supply: The liver receives a blood supply from two sources. The first is the hepatic artery which delivers oxygenated blood from the general circulation. The second is the hepatic portal vein delivering deoxygenated blood from the small intestine containing nutrients. The blood flows through the liver tissue to the hepatic cells where many metabolic functions take place. The blood drains out of the liver via the hepatic vein. The liver tissue is not vascularized with a capillary network as with most other organs, but consists of blood filled sinusoids surrounding the hepatic cells.

Internal Structure: The liver lobes are made up of microscopic units called lobules which are roughly hexagonal in shape. These lobules comprise of rows of liver cells (hepatocytes) which radiate out from a central point. The hepatic cells are in close contact with blood-filled sinusoids and also lie adjacent to canaliculi into which bile is secreted. At the mid-point of the lobule is the central vein. Blood flows out of the sinusoids into the central vein and is transported out of the liver.

Hepatocytes: Hepatocytes are the predominant cell type in the liver. An estimated 80% of the liver mass is made of these cells. The hepatocytes are round in shape containing a nucleus and an abundance of cellular organelles associated with metabolic and secretory functions. Organelles include endoplasmic reticulum (smooth and rough) and Golgi apparatus for secretory functions.

Also there are high numbers of mitochondria to provide energy to support the many metabolic functions on the liver.

Gall Bladder: It is attached to the right lobe of the liver by connective tissue. Pear shape, it is 7-10 cm long. Bile is produced by the hepatic cells drains out of the lobules via the bile ducts. These unite to form the right and left hepatic ducts which join cystic (bile duct) duct transporting bile to and from the gall bladder. The gall bladder concentrates and then stores the bile until it is required to assist in the digestion of fats. When needed for digestion, bile travels through cystic duct into the common bile duct. This unites with the pancreatic duct to empty bile into the duodenum. Bile flow is under the control of the hormone cholecystokinin, and enters the duodenum through the sphincter of Oddi.

Liver Functions: The liver receives 30% of the resting cardiac output and acts as a giant chemical processing plant in the body. These chemical reactions, called metabolism, are central in the regulation of body homeostasis. The liver cells, called hepatocytes, contain thousands of enzymes essential to perform vital metabolic functions. The liver metabolizes 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.

Nutrients Metabolism: The liver is involved in the metabolism of nutrients. It receives digestive products in the form of glucose, amino acids, fatty acids and glycerol. The metabolism of carbohydrate, fat and protein takes place in the liver, although specific functions are carried out by fat depots and skeletal muscle. Metabolic end products are often stored in the liver and utilized at a later stage if required. How the hepatocytes deal with the nutrients depend on whether each nutrient is in abundance or whether levels are low in the body and they are therefore in demand. The hepatocytes alter their metabolic pathways accordingly.

Carbohydrate metabolism: Glucose is a vital energy source for cells and its levels in the blood stream must remain constant. The liver helps maintain blood glucose levels in response to the pancreatic hormones insulin and glucagon. After a meal, glucose enters the blood and levels of glucose rise. This excess glucose is controlled by glycogenesis.

Glycogenesis: The liver converts extra glucose into glycogen with the help of insulin for storage. The glucose that is not stored is used to produce energy by a process called glycolysis. This occurs in every cell in the body.

Glycogenolysis: In between meals or during starvation, blood glucose levels fall. The hepatocytes detect this change, and restore glucose levels by either glycogenolysis which converts glycogen back to glucose, or gluconeogenesis in which non-sugars such as amino-acids are converted to glucose.

Fat metabolism: The liver is involved in fat metabolism and synthesizes lipoproteins, cholesterol and phospholipids essential for many body functions. Lipids also provide a valuable alternative energy source to glucose and so the metabolic fate of fats and lipids will depend on the levels of intake in the diet and energy expenditure.

Lipogenesis: If fat is in excess, the liver prepares for storage. Lipogenesis is the metabolic process in which fats, composed of fatty acids and glycerol, are converted for storage in subcutaneous tissue and other storage depots.

Lipolysis: If energy and glucose levels are low, stored fat is converted back into glycerol and fatty acids by a process called lipolysis. This occur in adipose cells, but the fatty acids and glycerol are transported to the liver for use as an alternative energy supply.

Protein metabolism: Protein metabolism is conducted under following processes.

Protein synthesis: Amino acids are transported to the liver after digestion by absorption and most of the body's protein is synthesized here.

Gluconeogenesis: Amino acids are not deposited like glucose. Before amino acids can be utilized by gluconeogenesis, the first step is to remove the nitrogen-containing amino group NH_2 from excess of amino acids termed as deamination then the skeleton of amino acid can be converted into fats and stored in fat stores, or if required, made into glucose for energy by gluconeogenesis.

Deamination: Removal of NH_2 from amino acid is called deamination.

NH_3 production: In the hepatocytes, NH_2 (the amino group) quickly changes into ammonia NH_3, which is highly toxic to the body. The liver acts fast to convert ammonia into urea that then can be excreted in the urine and eliminated from the body.

Urea cycle: Hepatocytes have enzymes set for conversion of ammonia into urea through a series of chemical reactions known as urea cycle.

Detoxification: The liver is vital for the detoxification and destruction of endogenous and exogenous substances that are harmful to the body. The liver's own phagocytes which reside within the lobules, known as Kupffer cells (liver macrophages), digest and destroy cellular debris and any invading bacteria. Other exogenous substances such as drugs and alcohol are detoxified by the liver. Endogenous substances (produced by the body) e.g. H_2O_2 is also detoxified by the liver. Some hormones are inactivated, and bilirubin, a product of the breakdown of old red blood cells, is also detoxified and returned harmless by liver metabolic activities.

Storage function: The liver plays an important role in storage of many nutrients. The hepatocytes take up many types of vitamins and minerals from the blood and store them. These include vitamins A, B_{12}, D, E, K and minerals like iron and copper. Glycogen which is formed from excess glucose is also stored by the liver.

Bile production: The liver synthesizes bile which is important for fat digestion and is also a route of excretion from the body. Bile consists of water, bile salts, cholesterol, phospholipids, electrolytes and bile pigments which give it its typical yellowy-green color. Bile is stored and concentrated in the gall bladder. The presence of fats in the gut during meals stimulates the gall bladder to empty. Bile enters the duodenum emulsifying fats into smaller globules, which can then be broken down further by lipase enzymes. Metabolic wastes and drug products may form part of the bile which can then be excreted from the body through the digestive tract in the feces. Bilirubin, the toxic end product of hemoglobin breakdown, is excreted from the body in this way.