

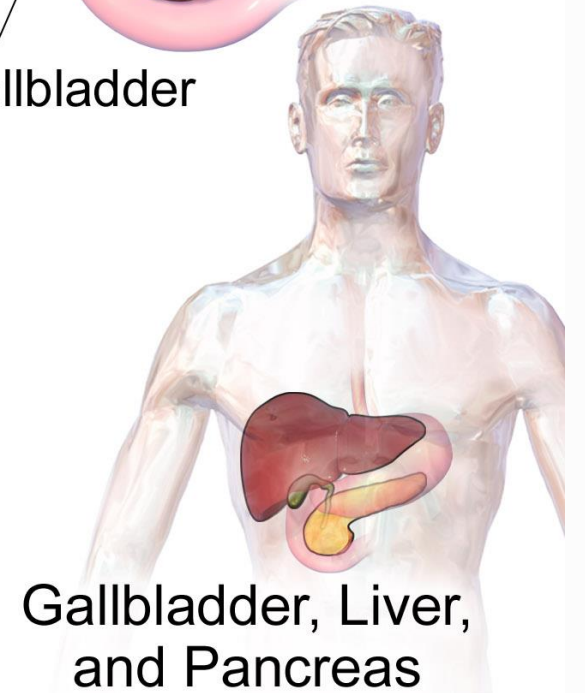
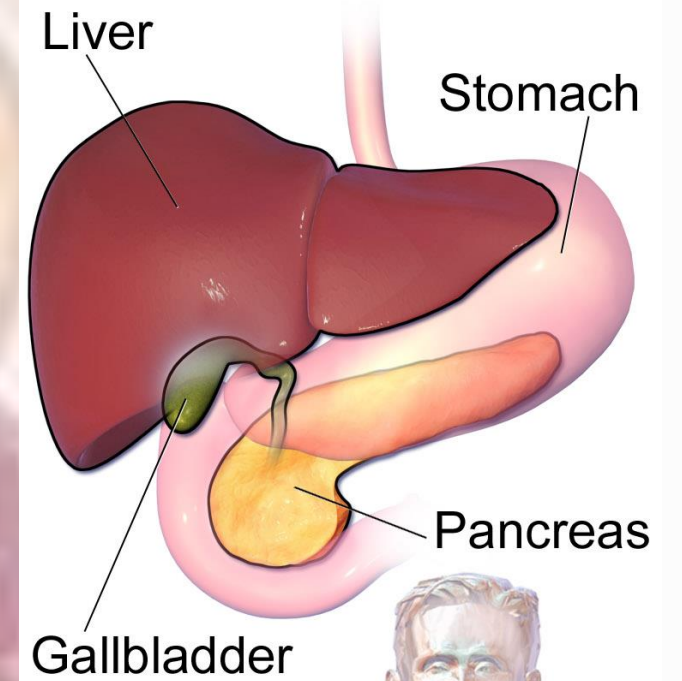
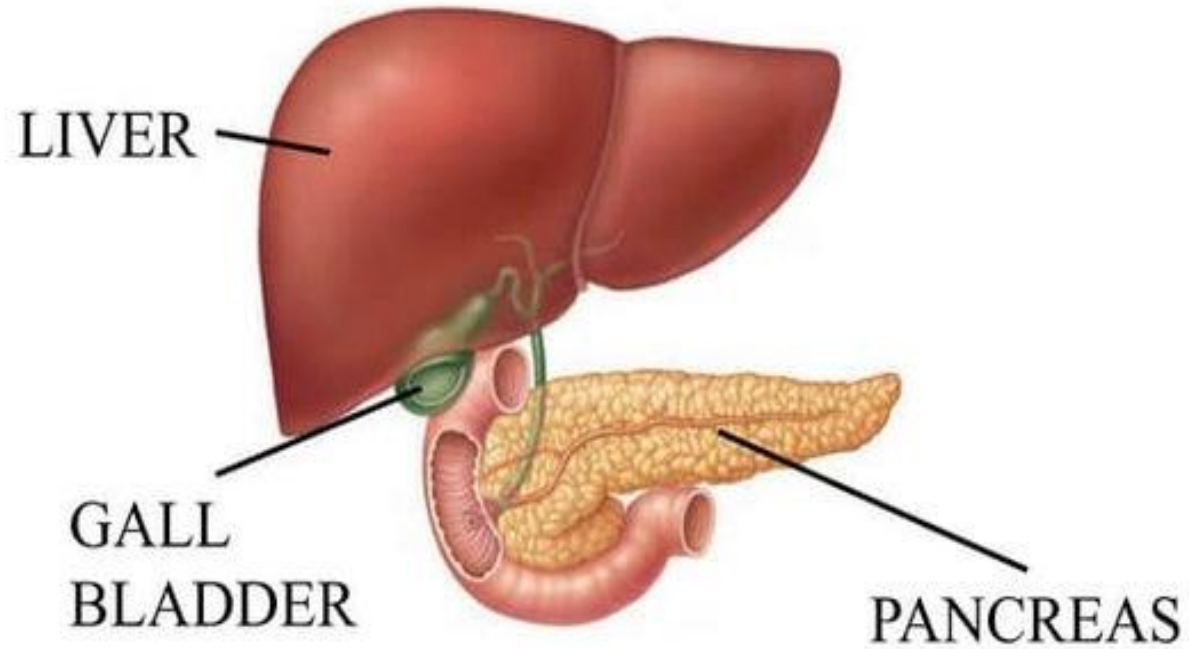
**HUMAN ANATOMY AND PHYSIOLOGY-II**

**DIGESTIVE SYSTEM**  
**(ACCESSORY ORGAN OF DIGESTIVE SYSTEM)**

Accessory Organs of the Digestive

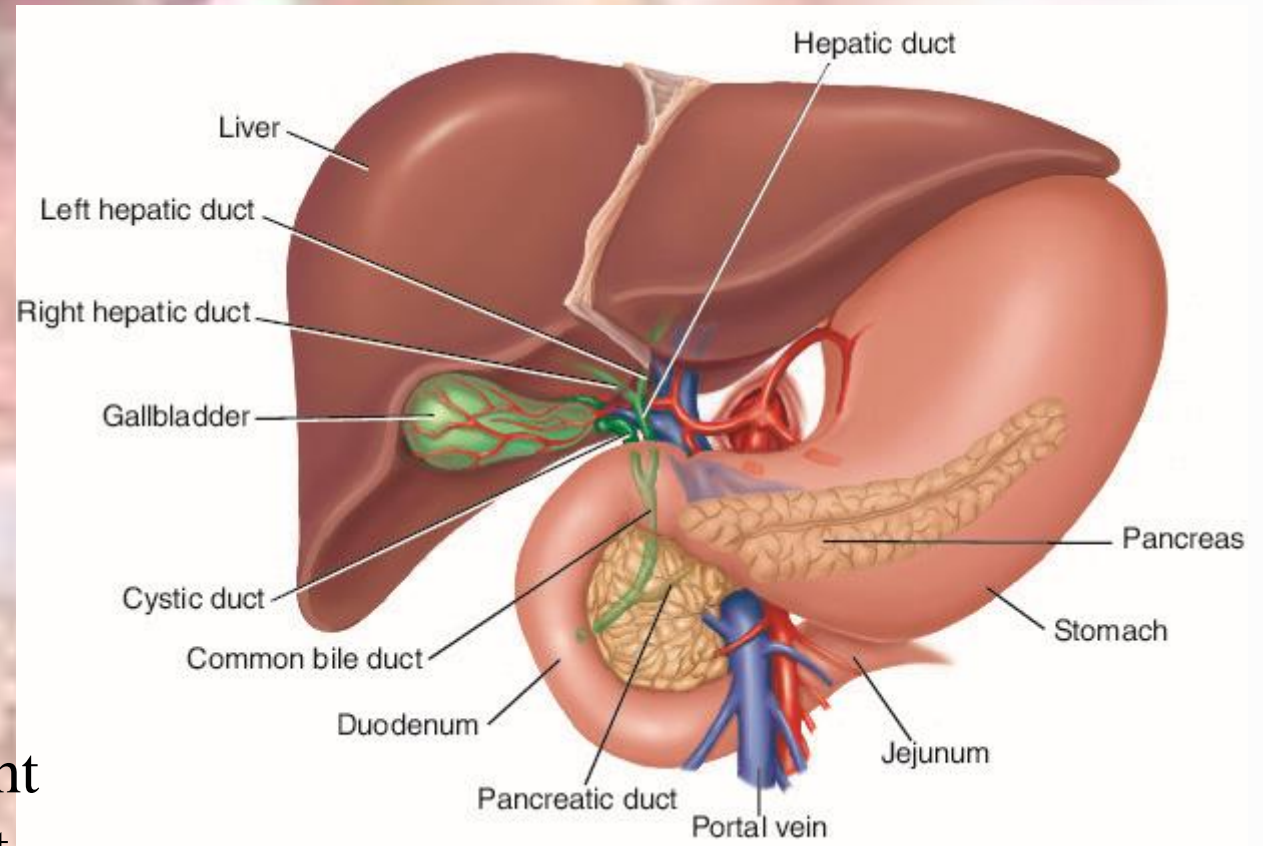
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# DIGESTIVE SYSTEM : ACCESSORY STRUCTURES



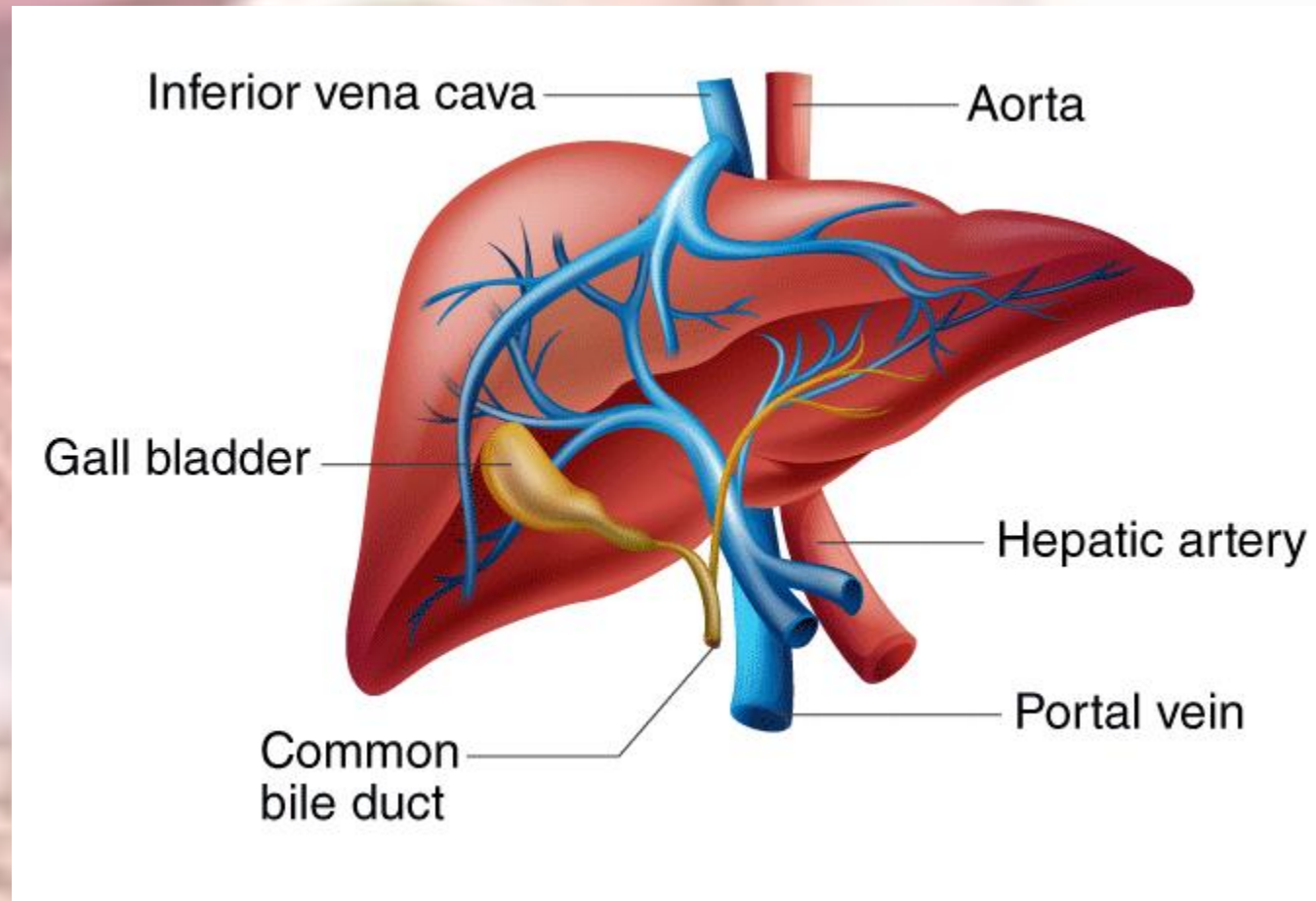


- enclosed in a thin inelastic capsule and incompletely covered by a layer of peritoneum.
- Folds of peritoneum form supporting ligaments attaching the liver to the inferior surface of the diaphragm.
- held in position partly by these ligaments and partly by the pressure of the organs in the abdominal cavity.
- HAS four lobes.
- The two most obvious are the large right lobe and the smaller, wedgeshaped, left lobe.
- The other two, the caudate and quadrate lobes, are areas on the posterior surface



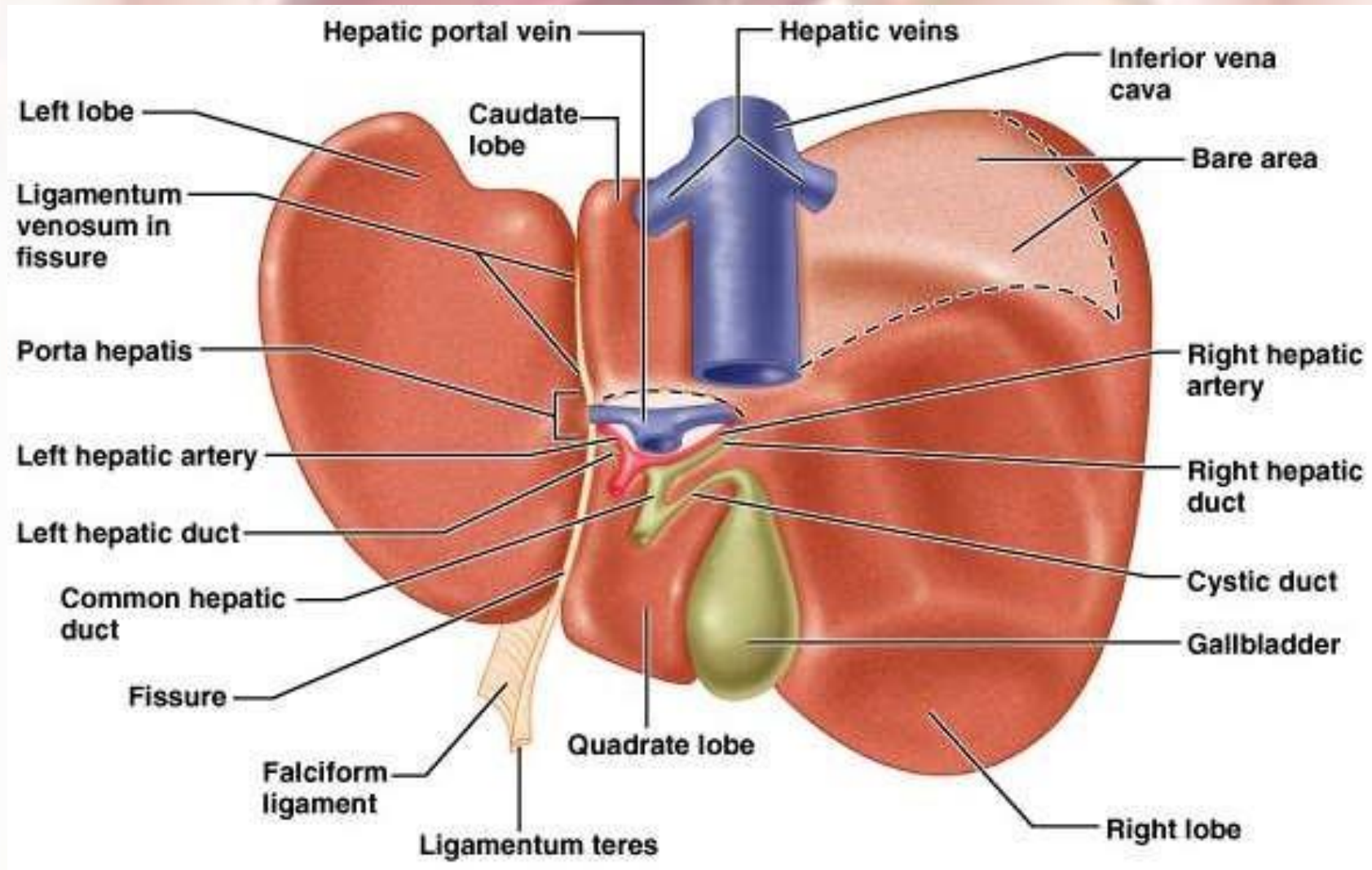
## • THE LIVER:

- Largest gland in the body (about 3 pounds)
- Over 500 functions
- Inferior to diaphragm in RUQ and epigastric area protected by ribs
- R and L lobes
  - Plus 2 smaller lobes
- Falciform ligament
  - Mesentery binding liver to anterior abdominal wall
- 2 surfaces
  - Diaphragmatic
  - Visceral
- Covered by peritoneum
  - Except “bare area” fused to diaphragm



**Blood supply :**The hepatic artery and the portal vein take blood to the liver Venous return is by a variable number of hepatic veins that leave the posterior surface and immediately enter the inferior vena cava just below the diaphragm.





# STRUCTURE:

- The lobes of the liver are made up of tiny functional units, called lobules, which are just visible to the naked eye .
- Liver lobules are hexagonal in outline and are formed by cubical-shaped cells, the hepatocytes, arranged in pairs of columns radiating from a central vein.
- Between two pairs of columns of cells are sinusoids (blood vessels with incomplete walls containing a mixture of blood from the tiny branches of the portal vein and hepatic artery .
- This arrangement allows the arterial blood and portal venous blood (with a high concentration of nutrients) to mix and come into close contact with the liver cells.
- Amongst the cells lining the sinusoids are hepatic macrophages (Kupffer cells) whose function is to ingest and destroy worn out blood cells and any foreign particles present in the blood flowing through the liver.

# FUCNTION OF LIVER

- Bile production :Salts emulsify fats, contain pigments as bilirubin
- Storage :Glycogen, fat, vitamins, copper and iron
- Nutrient interconversion
- Detoxification :Hepatocytes remove ammonia and convert to urea
- Phagocytosis :Kupffer cells phagocytize worn-out and dying red and white blood cells, some bacteria
- Synthesis :Albumins, fibrinogen, globulins, heparin, clotting factors



## ➤ Carbohydrate metabolism

- The liver has an important role in maintaining plasma glucose levels. After a meal when levels rise, glucose is converted to glycogen for storage under the influence of the hormone insulin.
- when glucose levels fall, the hormone glucagon stimulates conversion of glycogen into glucose again, keeping levels within the normal range

## ➤ Fat metabolism

- Stored fat can be converted to a form in which it can be used by the tissues to provide energy



## ➤ **Protein metabolism :**

### I. Deamination of amino acids

- ✓ This process: removes the nitrogenous portion from the amino acids not required for the formation of new protein; urea is formed from this nitrogenous portion which is excreted in urine
- ✓ breaks down nucleic acids to form uric acid, which is excreted in the urine.

II. Transamination: Removes the nitrogenous portion of amino acids and attaches it to other carbohydrate molecules forming new non-essential amino acids

➤ **Synthesis of plasma proteins** and most blood clotting factors from amino acids.

➤ **Breakdown of erythrocytes** and defence against microbes :This is carried out by phagocytic hepatic macrophages (Kupffer cells) in the sinusoids (breakdown of red blood cells also takes place in the spleen and bone marrow).

➤ **Detoxification of drugs and toxic substances:**

- ✓ These include ethanol (alcohol) and toxins produced by, e.g., microbes. Some drugs are extensively inactivated by the liver and are not very effective when given by mouth (orally), e.g. glyceryl trinitrate.
- ✓ This is because after absorption from the alimentary tract, they travel in the blood to the liver where they are largely metabolised so that levels in the blood leaving the liver are inadequate to achieve therapeutic effects. *This is known as 'first pass metabolism'*

➤ **Inactivation of hormones** :These include insulin, glucagon, cortisol, aldosterone, thyroid and sex hormones.

➤ **Production of heat:** The liver uses a considerable amount of energy, has a high metabolic rate and produces a great deal of heat. It is the main heat-producing organ of the body.

➤ **Secretion of bile** The hepatocytes synthesise the constituents of bile from the mixed arterial and venous blood in the sinusoids. These include bile salts, bile pigments and cholesterol.



- **Storage**

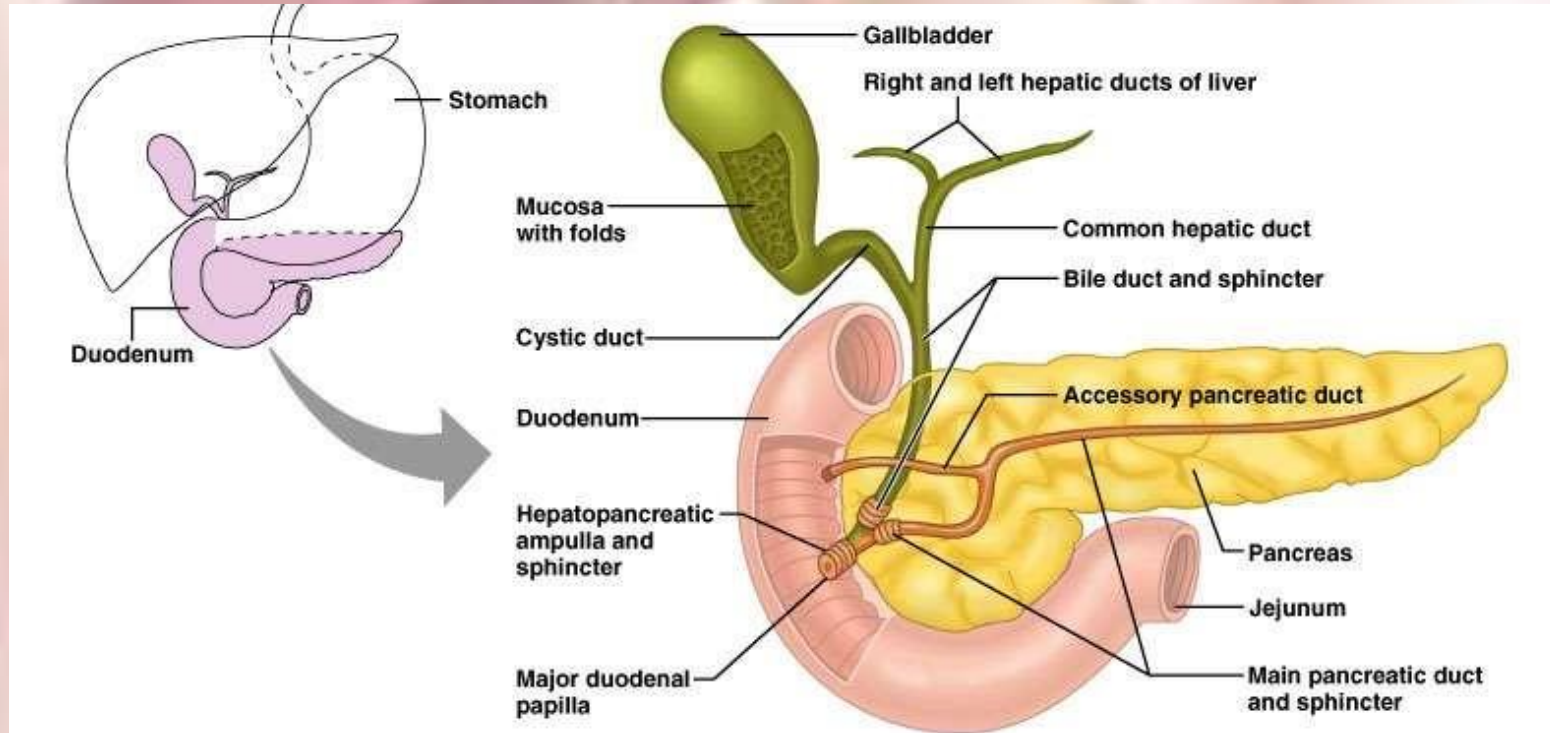
- Stored substances include: glycogen fat-soluble vitamins: A, D, E, K iron, copper some water-soluble vitamins, e.g. vitamin B12.

- **Composition of bile**

- Between 500 and 1000 ml of bile are secreted by the liver daily.
- Bile consists of: water mineral salts mucus bile pigments, mainly bilirubin bile salts, which are derived from the primary bile acids, cholic acid and chenodeoxycholic acid cholesterol.



# Gallbladder



- Bile is produced in the liver
- Bile is stored in the gallbladder
- Bile is excreted into the duodenum when needed (fatty meal)
- Bile helps dissolve fat and cholesterol
- If bile salts crystallize, gall stones are formed
  - Intermittent pain: ball valve effect causing intermittent obstruction
  - Or infection and a lot of pain, fever, vomiting, etc.

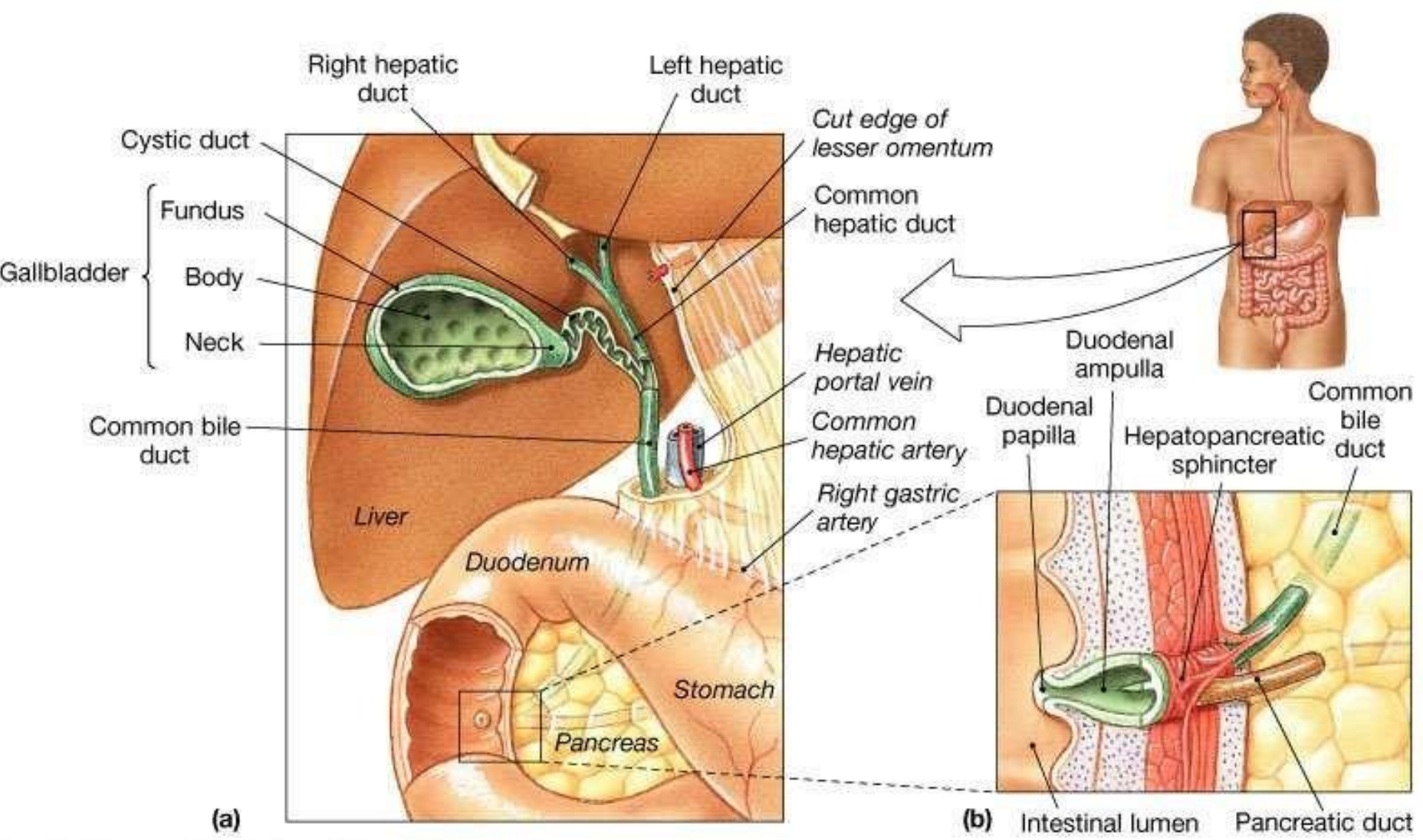
The wall of the gall bladder has the same layers of tissue as those described in the basic structure of the alimentary canal, with some modifications.

- i. Peritoneum** This covers only the inferior surface because the upper surface of the gall bladder is in direct contact with the liver and held in place by the visceral peritoneum that covers the liver.
  - ii. Muscle layer** There is an additional layer of oblique muscle fibres.
  - iii. Mucous membrane** This displays small rugae when the gall bladder is empty that disappear when it is distended with bile.
- ***Blood supply :The cystic artery, a branch of the hepatic artery, supplies blood to the gall bladder. Blood is drained away by the cystic vein that joins the portal vein.***

## • **Functions of the gall bladder**

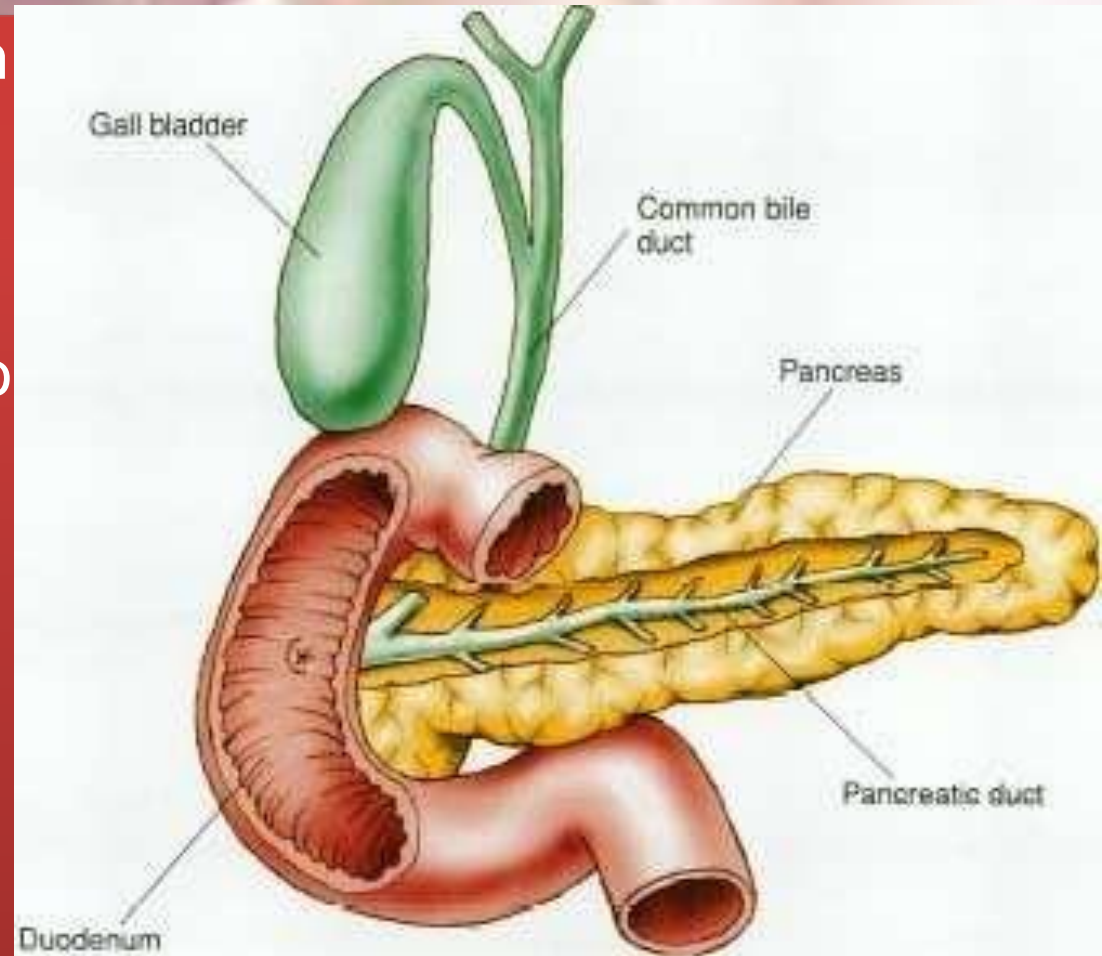
- These include: reservoir for bile concentration of the bile by up to 10- or 15-fold,
- by absorption of water through the walls of the gall bladder release of stored bile.
- When the muscle wall of the gall bladder contracts, bile passes through the bile ducts to the duodenum.
- Contraction is stimulated by: the hormone cholecystinin (CCK), secreted by the duodenum the presence of fat and acid chyme in the duodenum.
- Relaxation of the hepatopancreatic sphincter is caused by CCK and is a reflex response to contraction of the gall bladder.





# Pancreas

- Produces a wide spectrum of digestive enzymes that break down all categories of food
- Enzymes are secreted into the duodenum
- Alkaline fluid introduced with enzymes neutralizes acidic chyme
- Endocrine products of pancreas
  - Insulin
  - Glucagons



# Pancreas



- Secretions
  - Pancreatic juice (exocrine)
    - Trypsin
    - Chymotrypsin
    - Carboxypeptidase
    - Pancreatic amylase
    - Pancreatic lipases
    - Enzymes that reduce DNA
    - and ribonucleic acid
- Anatomy
  - Endocrine
    - Pancreatic islets produce insulin and glucagon
  - Exocrine
    - Acini produce digestive enzymes
  - Regions: Head, body, tail



## **The exocrine pancreas**

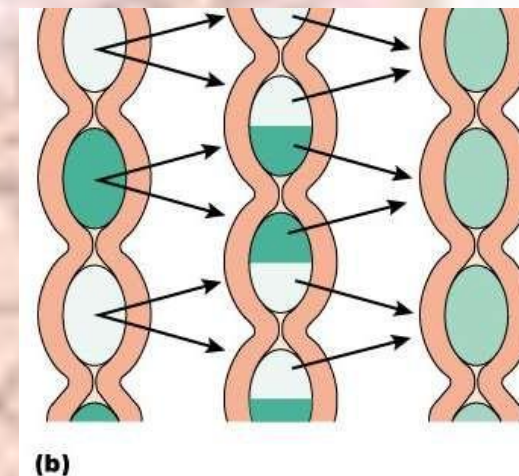
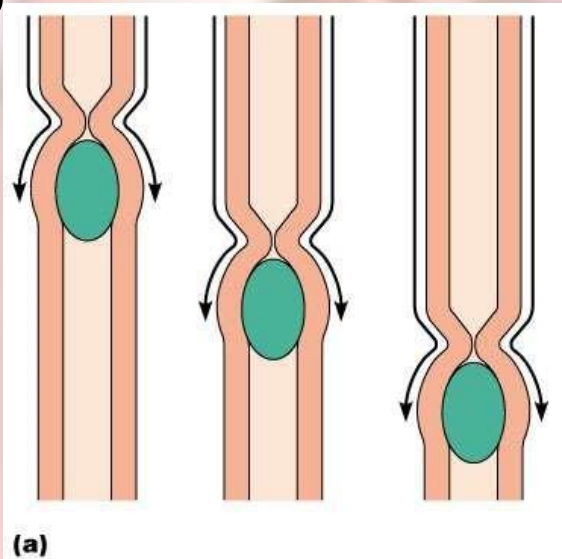
- This consists of a large number of lobules made up of small acini, the walls of which consist of secretory cells.
- The function of the exocrine pancreas is to produce pancreatic juice containing enzymes that digest carbohydrates, proteins and fats).
- As in the alimentary tract, parasympathetic stimulation increases the secretion of pancreatic juice and sympathetic stimulation depresses it.

## **The endocrine pancreas**

- Distributed throughout the gland are groups of specialised cells called the pancreatic islets (of Langerhans).
- The islets have no ducts so the hormones diffuse directly into the blood. The endocrine pancreas secretes the hormones insulin and glucagon, which are principally concerned with control of blood glucose levels

# Processes of the Digestive System

- Ingestion – getting food into the mouth
- Propulsion – moving foods from one region of the digestive system to another
- Peristalsis – alternating waves of contraction
- Segmentation – moving materials back and forth to aid in mixing



# Processes of the Digestive System

- Mechanical digestion
  - Mixing of food in the mouth by the tongue
  - Churning of food in the stomach
  - Segmentation in the small intestine
- Chemical Digestion
  - Enzymes break down food molecules into their building blocks
  - Each major food group uses different enzymes
    - Carbohydrates are broken to simple sugars
    - Proteins are broken to amino acids
    - Fats are broken to fatty acids and alcohols



# Processes of the Digestive System

- Absorption

- End products of digestion are absorbed in the blood or lymph
- Food must enter mucosal cells and then into blood or lymph capillaries

- Defecation

- Elimination of indigestible substances as feces

# Processes of the Digestive System

