Gross Anatomy
Liver

• The largest single organ in the human body.
• In an adult, it weighs about three pounds and is roughly the size of a football.
• Located in the upper right-hand part of the abdomen, behind the lower ribs.
Gross Anatomy

- The liver is divided into four lobes: the **right** (the largest lobe), **left**, **quadrate** and **caudate** lobes.
- Supplied with blood via the portal vein and hepatic artery.
- Blood carried away by the hepatic vein.
- It is connected to the diaphragm and abdominaal walls by five ligaments.
- Gall Bladder
  - Muscular bag for the storage, concentration, acidification and delivery of bile to small intestine
- The liver is the only human organ that has the remarkable property of self-regeneration. If a part of the liver is removed, the remaining parts can grow back to its original size and shape.
Microscopic Anatomy

• Hepatocyte—functional unit of the liver
  – Cuboidal cells
  – Arranged in plates→lobules
  – Nutrient storage and release
  – Bile production and secretion
  – Plasma protein synthesis
  – Cholesterol Synthesis
Microscopic Anatomy

- Kupffer cells
  - Phagocytic cells
- Fat Storing Cells
- Sinusoids
  - Fenestrated vessel
  - Wider than capillaries
  - Lined with endothelial cells
  - Blood flow
- Branches of the hepatic artery
- Branches of the Hepatic portal vein, central vein
- Bile canaliculi
Microscopic Anatomy

- Sinusoidal Endothelial Cell
- Sinusoid
- Kupffer Cell
- Stellate Cell
- Hepatocyte
- Liver
- Central vein
- Hepatic lobule
Blood and Bile Flow in Opposite Directions

**Blood Flow**

- Deoxygenated blood from stomach or small intestine → Hepatic Portal Vein → venules → sinusoids → central vein → hepatic vein → vena cava

**Bile Flow**

- Bile produced in hepatocytes → secreted into canaliculi → bile ductules → common duct → gall bladder → bile duct → small intestine
Functions

• The liver has more than 200 functions, including:
  – Storage of Nutrients
  – Breakdown of erythrocytes
  – Bile Secretion
  – Synthesis of plasma Proteins
  – Synthesis of cholesterol
Storage of Nutrients

- Hepatocytes absorb and store excess nutrients in the blood
  - Glucose (glycogen)
  - Iron
  - Retinol (Vitamin A)
  - Calciferol (Vitamin D)

- Nutrients released when levels are too low
Breakdown of Erythrocytes

- RBC’s have a life span of 120 days.
- RBC’s weaken and rupture, releasing hemoglobin into the blood plasma.
- Hemoglobin is absorbed by phagocytosis by Kupffer cells in the liver.
- Hemoglobin is split into
  - Heme groups
    - Iron is removed from heme leaving a substance called bilirubin (bile pigment).
      - Iron is carried to bone marrow where it is used to new hemoglobin for RBC’s
      - Bilirubin becomes a component of bile
  - Globins
    - Hydrolysed to amino acids and returned to the blood

- An electron micrograph of a Kupffer cell from the liver. The Golgi apparatus (marked with arrows and *) is well developed. The dark granules associated with the Golgi saccules are lysosomes. At the cell surface, identify the filopodial processes.
Bile Secretion

• Bile Contents
  – $\text{HCO}_3^-$ (Bicarbonate)
  – Bile salts
  – Bile pigment
  – Cholesterol

• Stored in gall bladder
  – Concentrated
  – acidified

• Discharged into small intestine via bile duct
Synthesis of Plasma Proteins

• Produced by RER of Hepatocytes
• 3 main types
  – Albumin
  – Globulin
  – Fibrinogen
Synthesis of Cholesterol

- Produced by hepatocytes
- Some used for bile production
- Some transported for use in the rest of the body
  - Synthesis and repair of cell membranes or stored in the liver.
  - Precursor by testis, ovaries or the adrenal gland to make steroid hormones.
    - progestins
    - glucocorticoids
    - androgens
    - estrogens
    - mineralocorticoids
  - It is also a precursor to vitamin D.