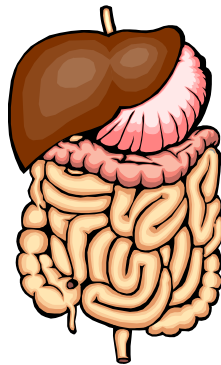


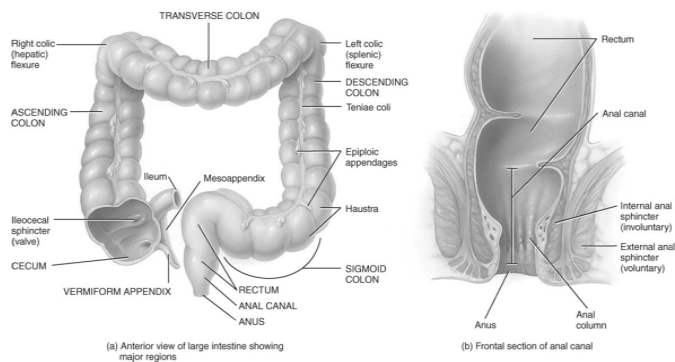
Bio& 242, Human A&P 2: Unit 1/Lecture 3



Anatomy of the Large Intestine

- The **large intestine** (*colon*) extends from the ileocecal sphincter to the anus.
- Its subdivisions include the **cecum**, **colon**, **rectum**, and **anal canal**.
- Hanging inferior to the cecum is the
- **appendix**.
 - Inflammation of the appendix is called *appendicitis*.
 - A ruptured appendix can result in gangrene or peritonitis, which can be life-threatening conditions.





Anatomy of Large Intestine

- **5 feet long by 2½ inches in diameter**
- **Ascending & descending colon are retroperitoneal**
- **Rectum = last 8 inches of GI tract anterior to the sacrum & coccyx**
- **Anal canal = last 1 inch of GI tract**
 - **internal sphincter**----smooth muscle & involuntary
 - **external sphincter**----skeletal muscle & voluntary control

Mechanical Digestion in Large Intestine

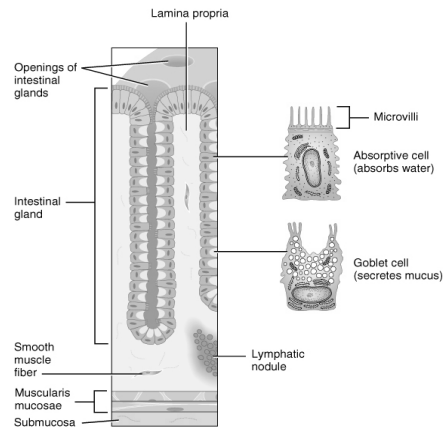
- Mechanical movements of the large intestine include ***haustral churning, peristalsis, and mass peristalsis.***
- Peristaltic waves (3 to 12 contractions/minute)
 - ***haustral churning***---relaxed pouches are filled from below by muscular contractions (elevator)
 - ***gastroilial reflex*** = when stomach is full, gastrin hormone relaxes ileocecal sphincter so small intestine will empty and make room
 - ***gastrocolic reflex*** = when stomach fills, a strong peristaltic wave moves contents of transverse colon into rectum by ***Mass peristalsis***

Chemical Digestion in Large Intestine

- No enzymes are secreted only mucous
- Bacteria ferment
 - undigested carbohydrates into carbon dioxide & methane gas
 - undigested proteins into simpler substances (indoles)----odor
 - turn bilirubin into simpler substances that produce color
- Bacteria produce vitamin K and B in colon
- Converts chyme into feces

Functions of the Large intestinal Mucosa

1. **Goblet cells:** create mucus that lubricates colon and protects mucosa.
2. **Absortive cells:** Maintains water balance, solidifies feces, absorbs vitamins and some ions



(b) Sectional view of the large intestinal mucosa showing intestinal glands and cell types

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Absorption & Feces Formation in the Large Intestine

- Some electrolytes---Na⁺ and Cl⁻
- After 3 to 10 hours, 90% of H₂O has been removed from chyme
- **Feces** are semisolid by time reaches transverse colon
- Feces = dead epithelial cells, undigested food such as cellulose, bacteria (live & dead)

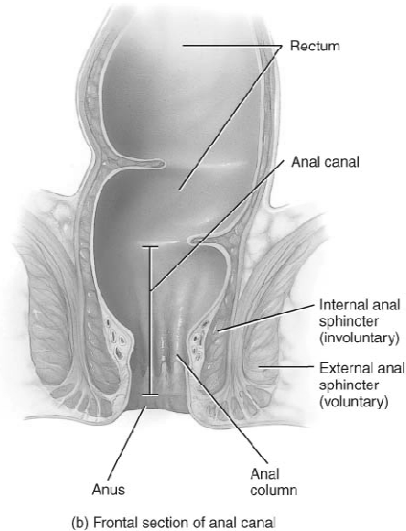
Absorption and Feces Formation in the Large Intestine

- The large intestine absorbs water, electrolytes, and some vitamins.
- *Feces* consist of water, inorganic salts, sloughed-off epithelial cells, bacteria, products of bacterial decomposition, and undigested parts of food.
- Although most water absorption occurs in the small intestine, the large intestine absorbs enough to make it an important organ in maintaining the body's water balance.

Defecation Reflex

- The elimination of feces from the rectum is called ***defecation***.
- Defecation is a reflex action aided by voluntary contractions of the diaphragm and abdominal muscles. The external anal sphincter can be voluntarily controlled (except in infants) to allow or postpone defecation.

Defecation



- Gastrocolic reflex moves feces into rectum
- Stretch receptors signal sacral spinal cord
- Parasympathetic nerves contract muscles of rectum & relax internal anal sphincter
- External sphincter is voluntarily controlled

Defecation Problems

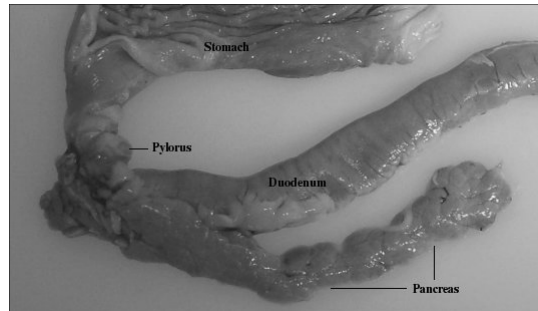
- **Diarrhea** = chyme passes too quickly through intestine
 - H₂O not reabsorbed
- **Constipation**--decreased intestinal motility
 - too much water is reabsorbed
 - remedy = fiber, exercise and water

Clinical Concerns

- Colonoscopy is the visual examination of the lining of the colon using an elongated, flexible, fiberoptic endoscope.
- Occult blood test is to screen for colorectal cancer.

PANCREAS

- The **pancreas** is divided into a **head**, **body**, and **tail** and is connected to the duodenum via the pancreatic duct (duct of Wirsung) and accessory duct (duct of Santorini).
- **Pancreatic islets** (*islets of Langerhans*) secrete hormones and **acini** secrete a mixture of fluid and digestive enzymes called pancreatic juice.



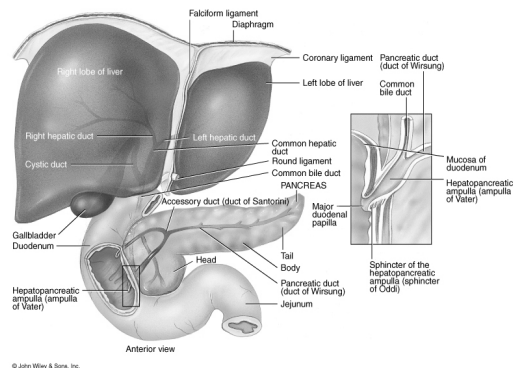
Accessory organs of the GI Tract

Pancreas:

Produces 1.2L to 1.5L of pancreatic juices daily.

Pancreatic juice consists of a bicarbonate solution containing salts and digestive enzymes.

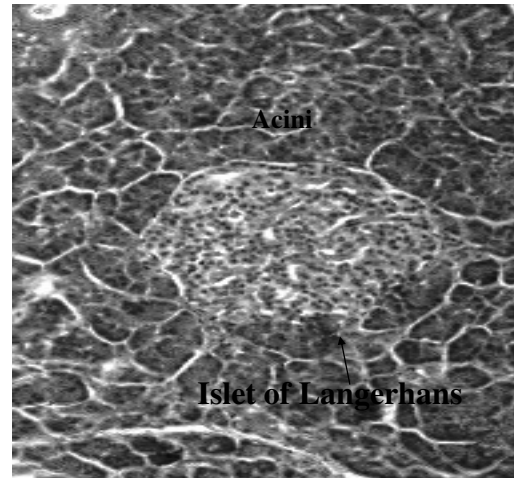
Bicarbonate helps buffer acidic chyme from the stomach



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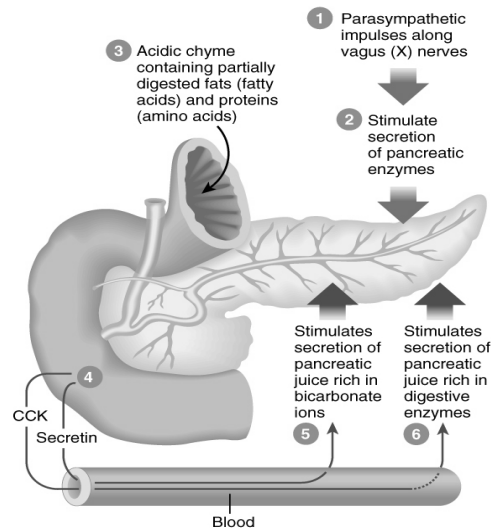
Histology of the Pancreas

- **Acinar cells:** Secrete pancreatic juice, a mixture of bicarbonate fluid and digestive enzymes.
- **Islet of Langerhans:**
 - Alpha cells- glucagon
 - Beta cells- insulin
 - Delta cells- somatostatin
 - F-cells- pancreatic polypeptide



Neural and Hormonal Control of the Pancreas

- Secretin:**
acidity in intestine causes increased sodium bicarbonate release
- GIP:**
fatty acids & sugar causes increased insulin release
- CCK:**
fats and proteins cause increased digestive enzyme release



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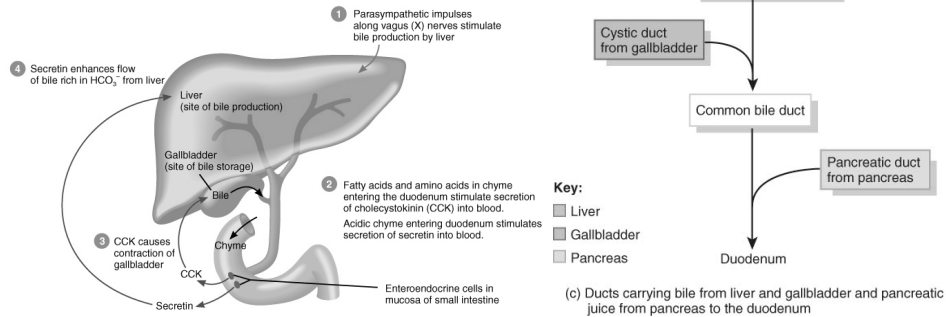
LIVER AND GALLBLADDER

- The **liver** is the heaviest gland in the body and the second largest organ in the body after the skin.
- Anatomy of the Liver and Gallbladder
- The **liver** is divisible into left and right lobes, separated by the falciform ligament. Associated with the right lobe are the caudate and quadrate lobes.
- The **gallbladder** is a sac located in a depression on the posterior surface of the liver.

Histology of the Liver

- The lobes of the liver are made up of **lobules** that contain *hepatic cells* (*liver cells* or **hepatocytes**), **sinusoids**, **stellate reticuloendothelial** (*Kupffer's*) *cells*, and a **central vein**.
- **Bile** is secreted by hepatocytes.
- **Bile** passes into **bile canaliculi** to bile ducts to the right and left **hepatic ducts** which unite to form the common hepatic duct.
- **Common hepatic duct** joins the **cystic duct** to form the **common bile duct** which enters the **hepatopancreatic ampulla**.

Pathway of Bile Secretion

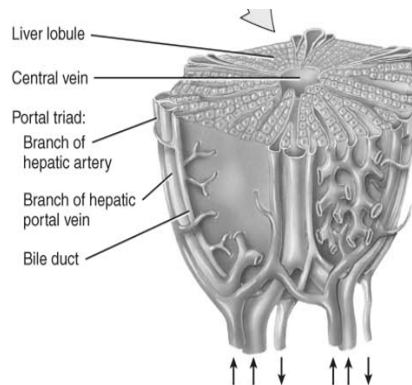


- Bile capillaries
- Hepatic ducts connect to form common hepatic duct
- Cystic duct from gallbladder & common hepatic duct join to form common bile duct
- Common bile duct & pancreatic duct empty into duodenum

Accessory organs of the GI Tract

Liver:
 Produces .8L to 1.0L of bile per day
 – yellow-green in color & pH 7.6 to 8.6

- **Components**
 - water & cholesterol
 - bile salts = Na & K salts of bile acids
 - bile pigments (bilirubin) from hemoglobin molecule
 - globin = a re-useable protein
 - heme = broken down into iron and bilirubin



Bile - Overview

- Hepatic cells (hepatocytes) produce *bile* that is transported by a duct system to the gallbladder for concentration and temporary storage.
- Bile is partially an excretory product (containing components of worn-out red blood cells) and partially a digestive secretion.
- Bile's contribution to digestion is the emulsification of triglycerides.
- The fusion of individual crystals of cholesterol is the beginning of 95% of all *gallstones*. Gallstones can cause obstruction to the outflow of bile in any portion of the duct system. Treatment of gallstones consists of using gallstone-dissolving drugs, lithotripsy, or surgery.

Bile - Overview

- The liver also functions in carbohydrate, lipid, and protein metabolism; removal of drugs and hormones from the blood; excretion of bilirubin; synthesis of bile salts; storage of vitamins and minerals; phagocytosis; and activation of vitamin D.
- In a liver biopsy a sample of living liver tissue is removed to diagnose a number of disorders.

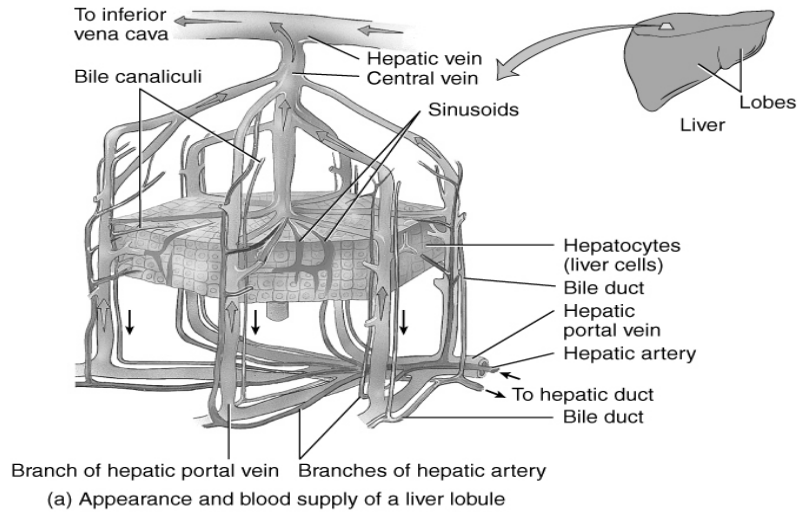
Major Functions of the liver

1. **Carbohydrate metabolism:** maintains blood sugar levels.
 - a. Low Sugars levels: (control- glucagon)
glycogenolysis glycogen > glucose
 - b. High sugars levels: (control- insulin)
glycogenesis glucose > glycogen
2. **Lipid metabolism**
 - a. Produce fats: **lipogenesis**
 - b. Break down fats: **lipolysis, beta oxidation**
 - c. Synthesize cholesterol
 - d. Stores triglycerides

Major Functions of the Liver

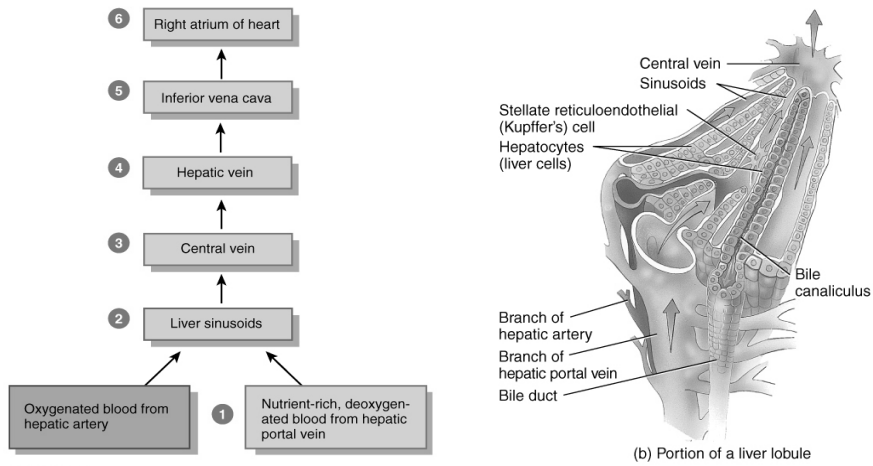
3. **Protein metabolism:**
 - a. Synthesize most plasma proteins such as clotting proteins
 - b. **Deaminate** amino acid: remove NH₂
4. Processes drugs, hormones, and alcohol
5. Excretes **bilirubin** (derived from the heme unit of recycled red blood cells)
6. **Storage of Vitamins** (A, B12, D, E, and K) and iron
7. **Phagocytosis** of aged red and white blood cells and some bacteria by Kupffer's (reticuloendothelial) cells
8. **Activation** of Vitamin D
9. **Stores** iron and copper

Lobule: The Functional Unit of the Liver



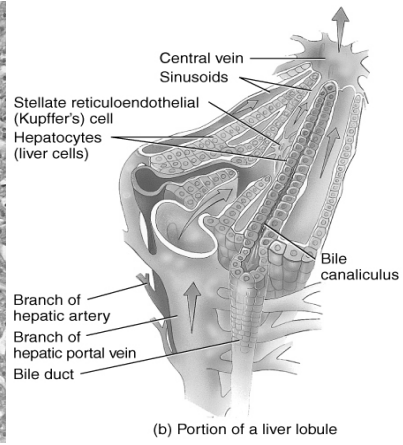
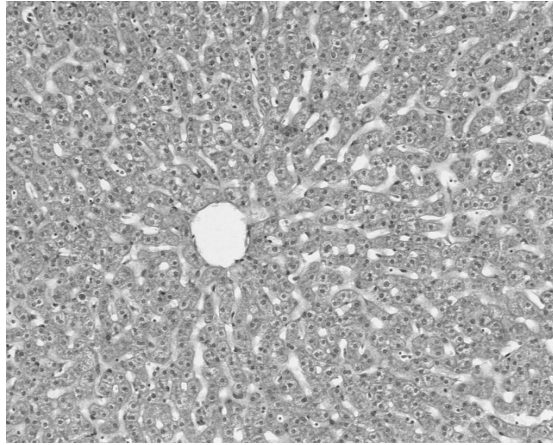
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Hepatic Blood and Lobular Structure



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Histology of a lobule demonstrating the central vein



Histology of a lobule demonstrating the hepatic triad

