

Let's Take Attendance

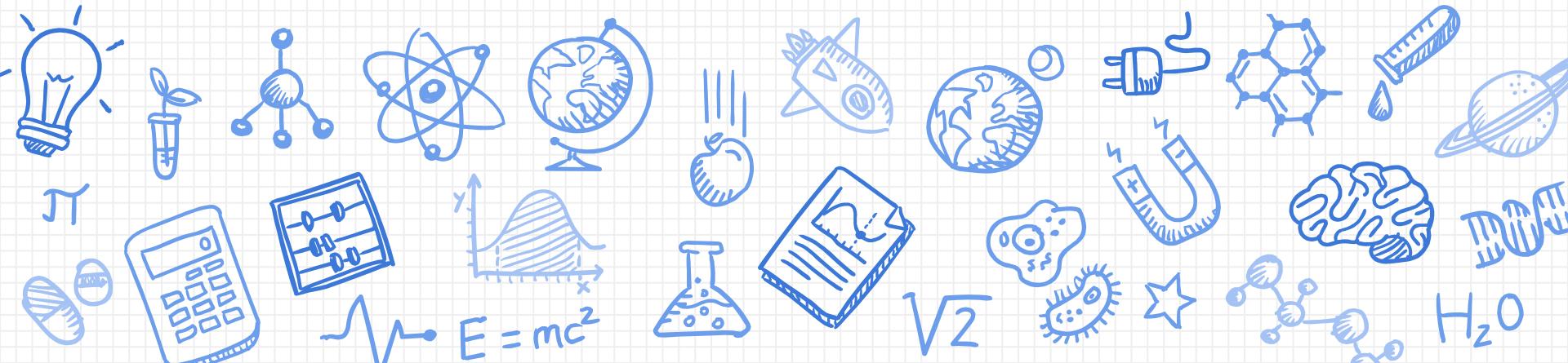
<http://sciovirtual.org/attendance>

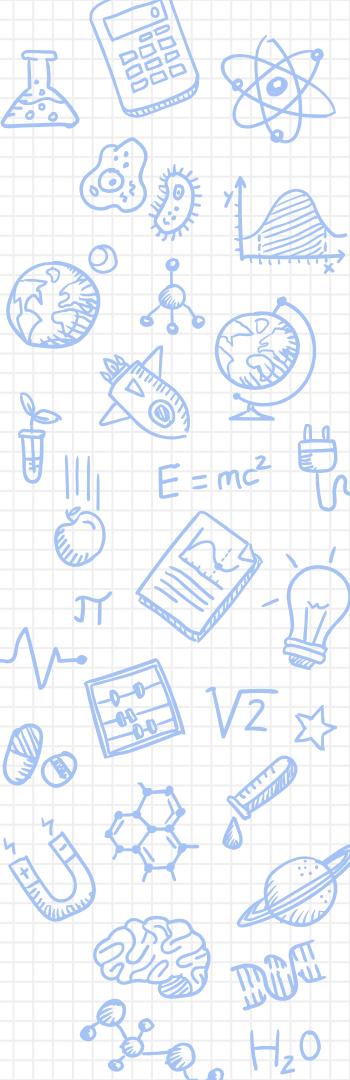
Attendance code: cardio49

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Absorption

Lesson 3

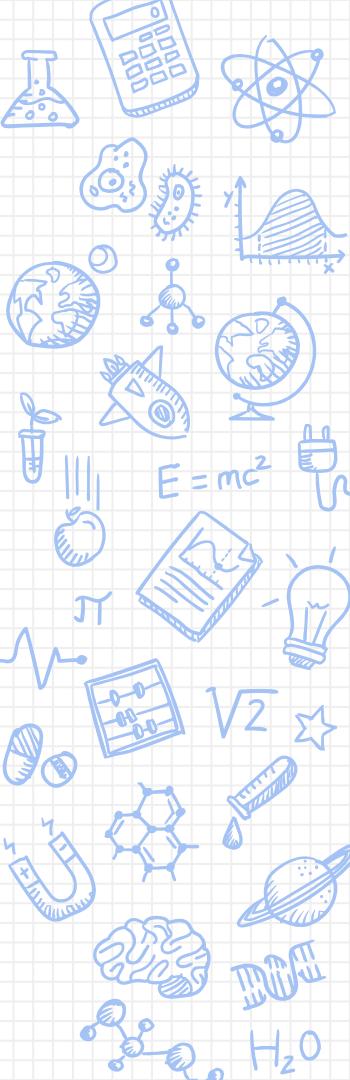




Review from Last time!!!

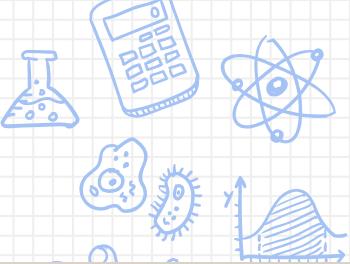
❖ Layers of GI tract

- Mucosa
 - Absorptive and secretory layer
- Submucosa
 - Vascular layer serving mucosa
- Muscularis
 - Smooth muscle layer allowing for peristalsis and contractions
- Serosa
 - Outer layer of GI tract



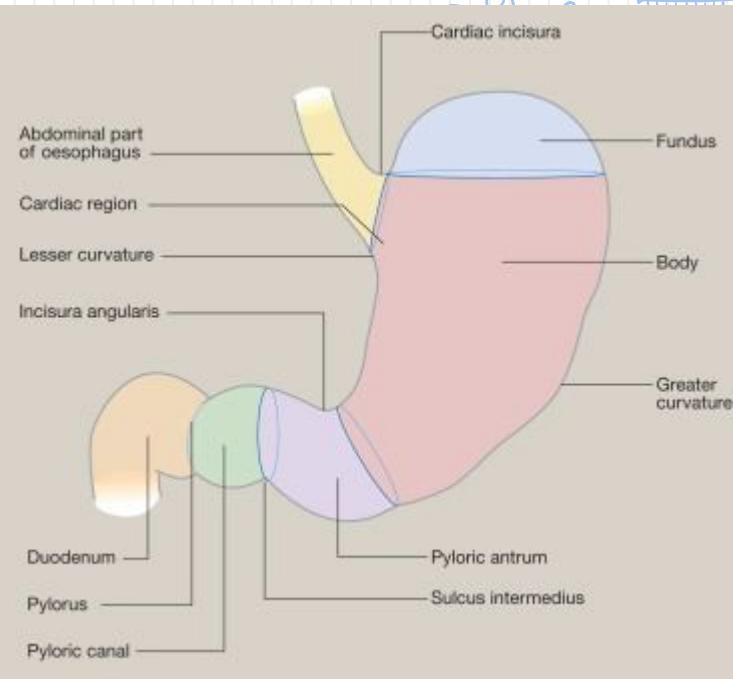
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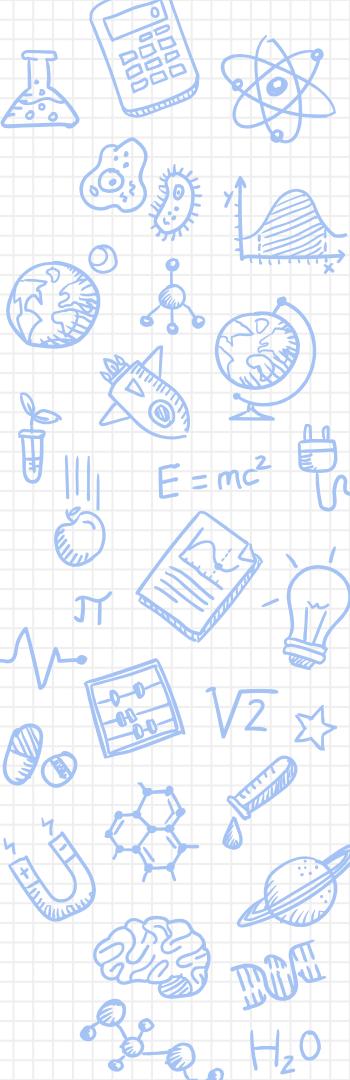
- ❖ Regulation
 - Parasympathetic
 - Promote digestive actions
 - Sympathetic
 - Inhibit digestive actions
 - Enteric Nervous system and paracrine regulators
 - Self-regulation
- ❖ Peristaltic contractions of esophagus push food from mouth to stomach
- ❖ Low pH of stomach aids digestion



Review from Last time!!!

- ❖ Mucus/goblet cells
 - Secrete mucus
- ❖ Parietal cells
 - Secrete HCL
- ❖ Chief/zymogenic cells
 - Secrete pepsinogen
- ❖ G cells
 - Secrete gastrin into blood(hormone)
- ❖ D cells
 - Secrete somatostatin into blood(hormone)





Absorption and Small Intestine

- ❖ Stomach partially digests foods
 - Mainly digests proteins only
- ❖ Small intestine completes digestion of other food macromolecules
 - Brush border enzymes
 - Enzymes from pancreas
- ❖ Small intestine absorbs monomers to build new things from them and generate energy
 - Generate ATP
 - Generate cell-specific polypeptides from absorbed amino acids for example

Regions of Small Intestine

❖ Duodenum

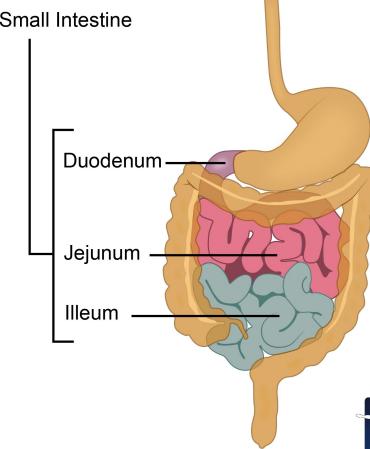
- Folate
- Iron
- Vitamin D3
- Sugars
- Amino acids
- Fatty acids

❖ Jejunum

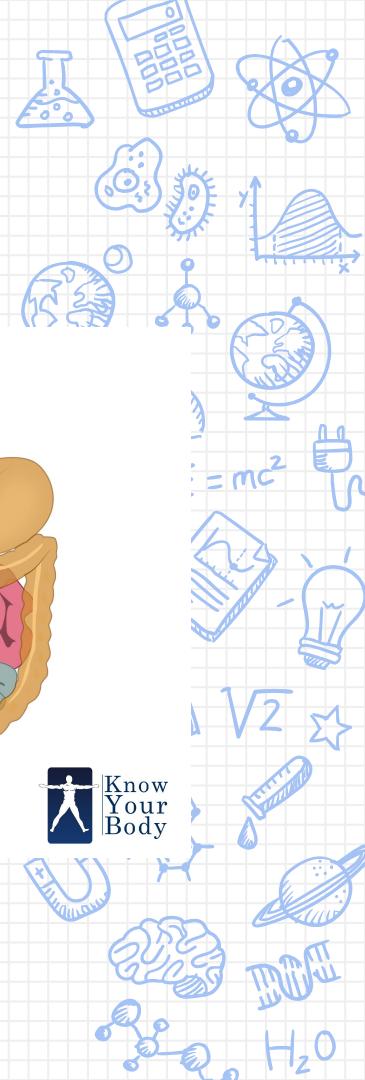
- Sugars
- Amino acids
- Fatty acids

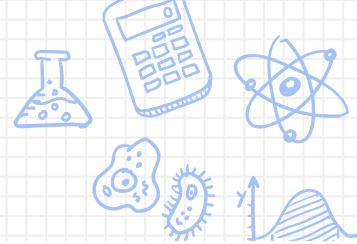
❖ Ileum

- Vitamin B12(intrinsic factor needed)
- Bile acids



KNOWYOURBODY.NET

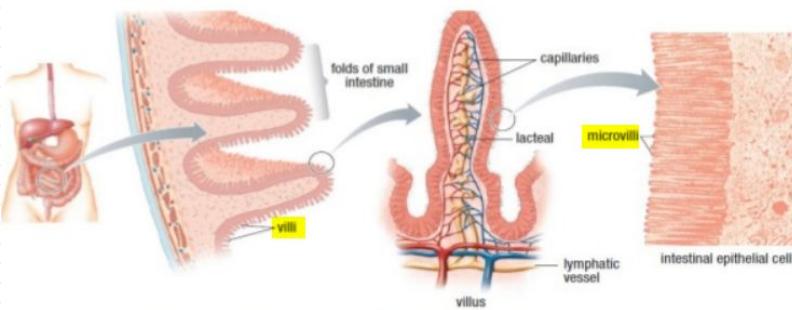




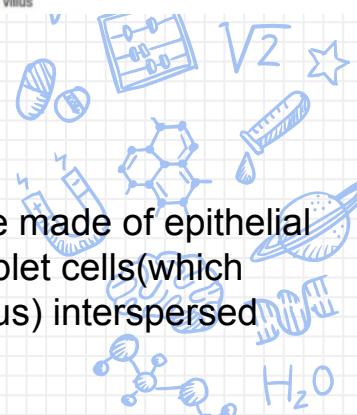
Structural adaptations

- ❖ Increases in surface area
 - Also seen in respiration and other organisms for a variety of functions!!
- ❖ More area for absorption of nutrients
- ❖ Villi made of multiple cells
- ❖ Each cell has many microvilli
 - Makes up brush border
- ❖ Contain blood vessels/capillaries
 - Carries nutrients
- ❖ Central lacteal
 - Carries fats

Villi and Microvilli

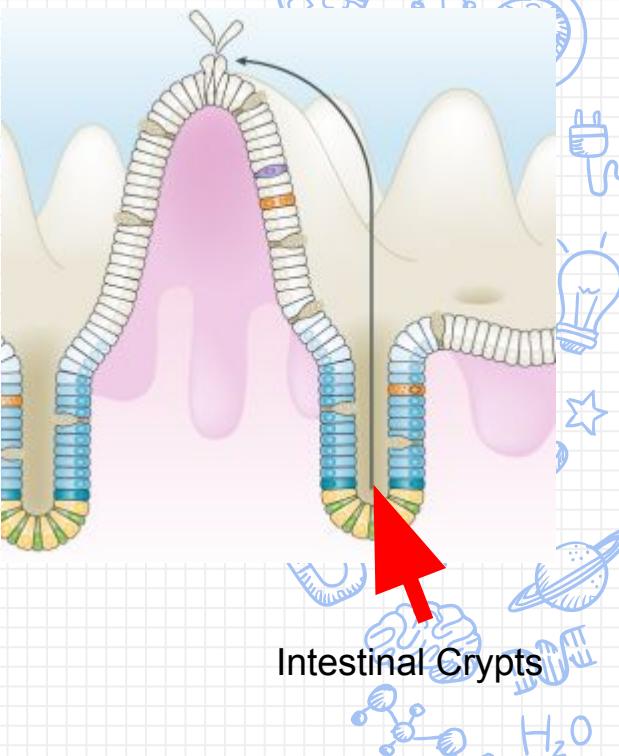


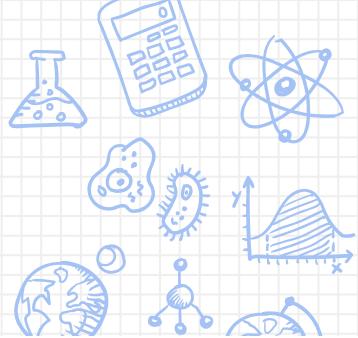
Note: Villi are made of epithelial cells with goblet cells (which secrete mucus) interspersed between



More on Villi!

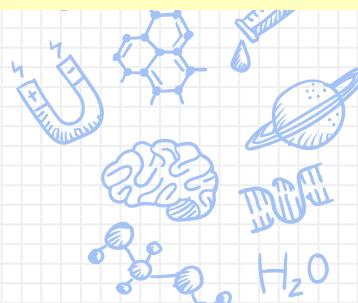
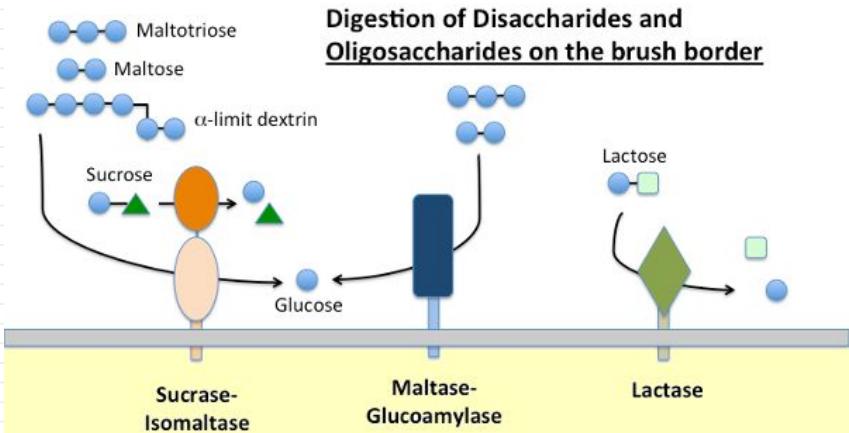
- ❖ Epithelial cells shed at top and generated at bottom continuously

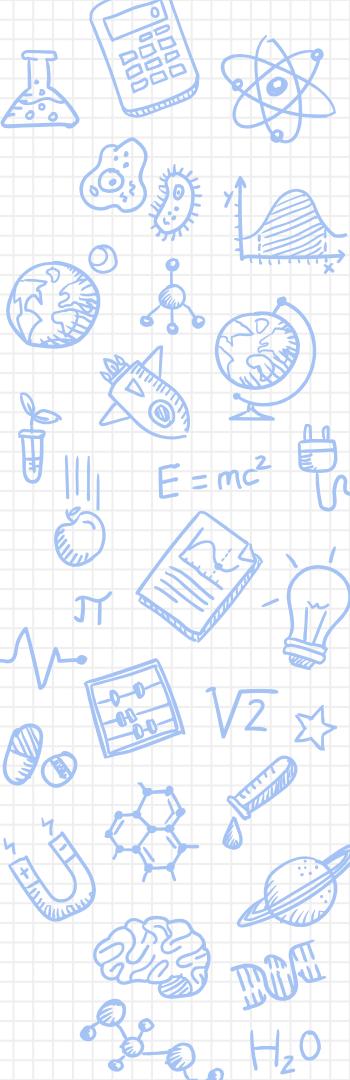




Intestinal Digestion: Intestinal enzymes

- ❖ Plasma membranes of microvilli contain digestive enzymes
 - Brush Border enzymes
 - Stay attached to microvilli membranes (not released into lumen)



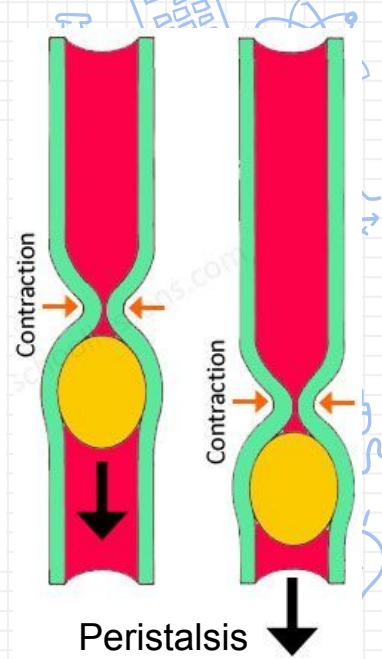
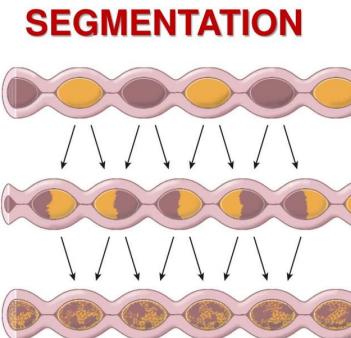


Pancreatic enzymes

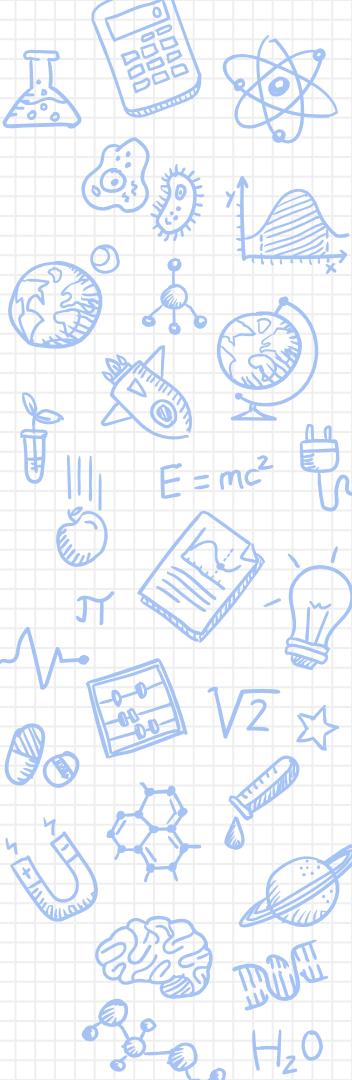
- ❖ Q: Where are these enzymes released from
- ❖ Release of pancreatic juice into small intestine
 - Contains amylase
 - Contains trypsin
 - Contains lipase

Intestinal Movement: Peristalsis

- ❖ Two main types: peristalsis and segmentation
- ❖ Peristalsis controls muscle contraction and relaxation
 - Smooth muscle contraction behind food pushing it forward and relaxation in front of food, allowing to enter the next portion of intestine



Note: Peristalsis pushes food in one direction, allowing for net movement. Segmentation involves contraction at multiple sites and does not cause net movement.



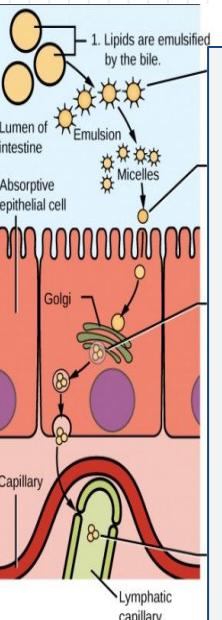
Intestinal Movement: Segmentation

- ❖ Segmentation involves simultaneous constriction at different segments
 - Mixes chyme

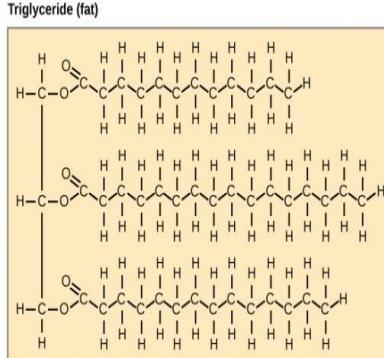
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Hepatic Portal Vein and Lacteal

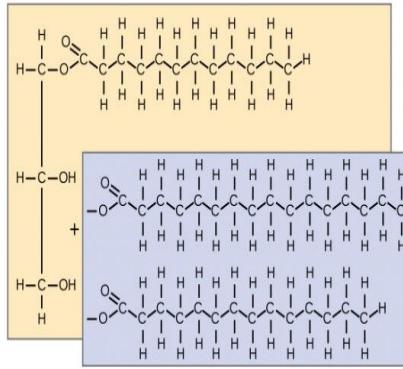
- ❖ Nutrients absorbed by villi are transported into capillaries in villi
 - ❖ Capillaries converge into Hepatic Portal Vein going to liver
 - Allows liver to regulate composition of nutrients
 - Allow liver to remove toxic ingested substances



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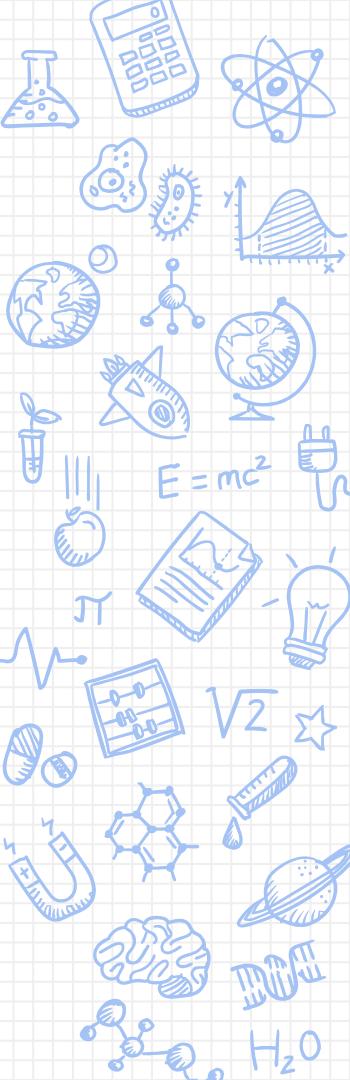


Monoallycerid



Fatty acids

(b)



Fat Absorption in Small Intestine

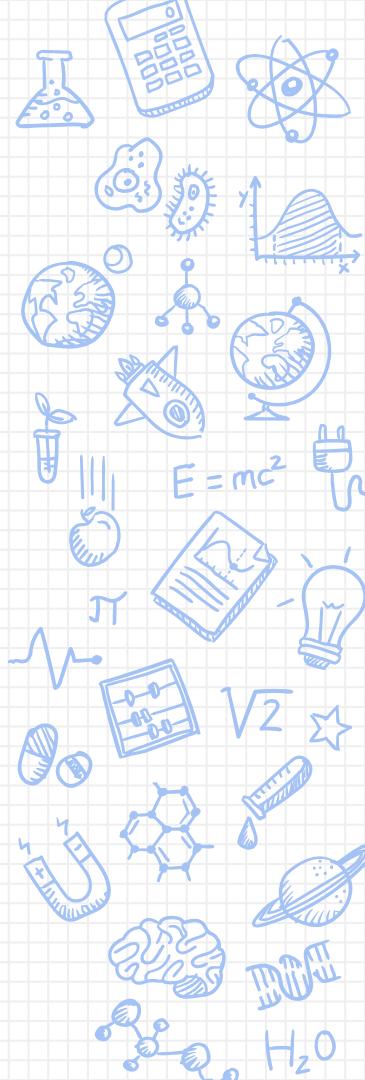
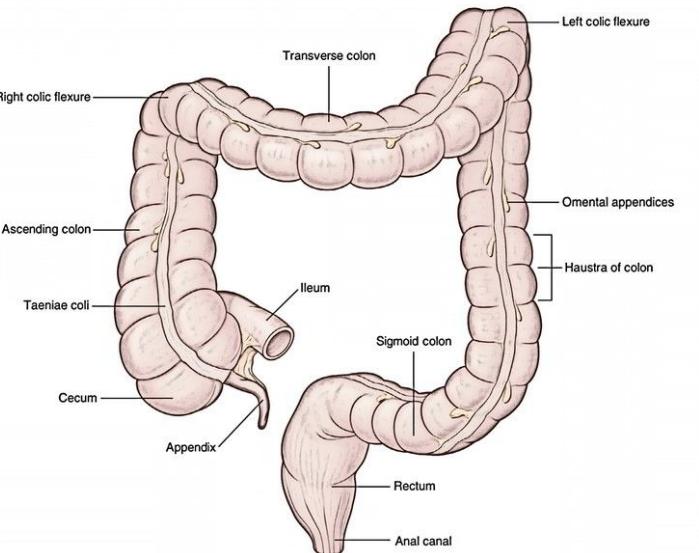
- ❖ Lipase breaks down triglyceride fats into monoglycerides and fatty acids
- ❖ Triglycerides are re-formed within villi and form chylomicrons
 - Triglycerides are combined with cholesterol, phospholipids, and proteins
 - Chylomicrons absorbed by lacteal in each villus, enter lymph and returned to heart
 - Lymph converges with blood at heart

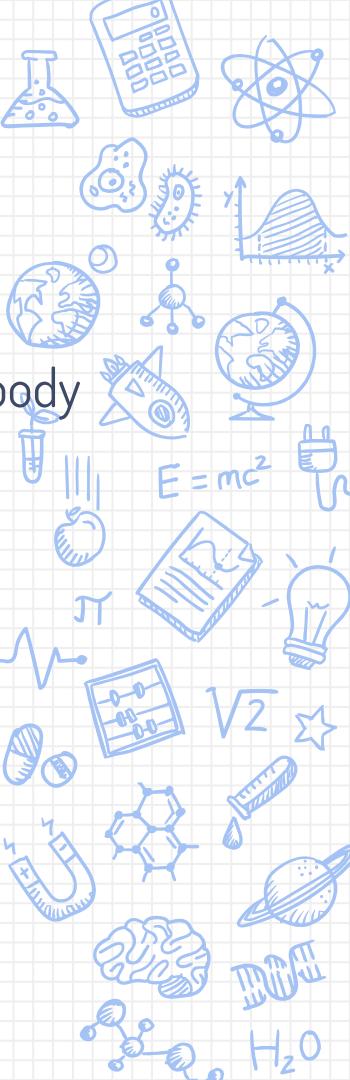


Large Intestine/Colon Anatomy

- ❖ Large Intestine absorbs water, mineral and vitamins and secretes the remains as feces
- ❖ Ileum passes chyme to large intestine and out of body
 - Ileum -> cecum -> ascending colon -> transverse colon -> descending colon -> sigmoid colon -> rectum -> anal canal -> anus -> toilet
- ❖ No villi
 - No brush border
- ❖ Cecum contains symbiotic bacteria helping in final digestion of chyme in large intestine

Large Intestine





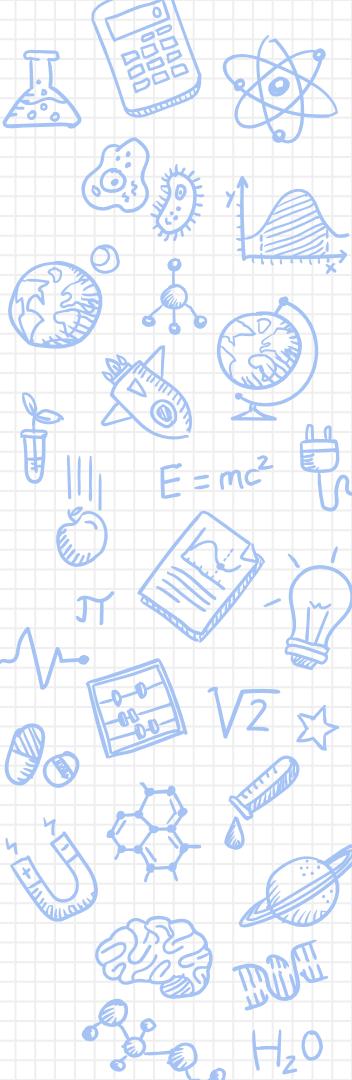
Intestinal Microbiota

❖ Bacteria in your gut help in digestion

- Around 10x more microorganisms cells in large intestine than in body
- Collectively called intestinal microbiota/microflora

❖ Microbiota provides nutrients

- Vitamin K
- B vitamins
- Produce short-chain fatty acids
 - Also helps in water absorption

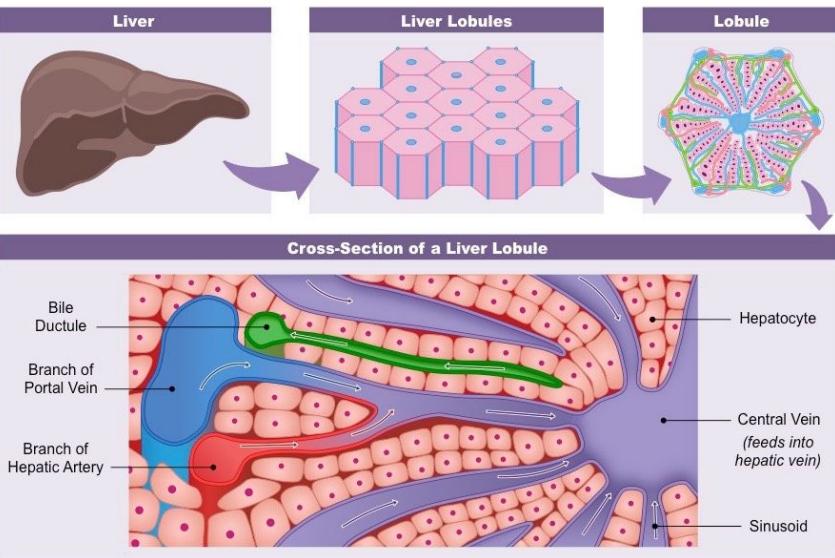


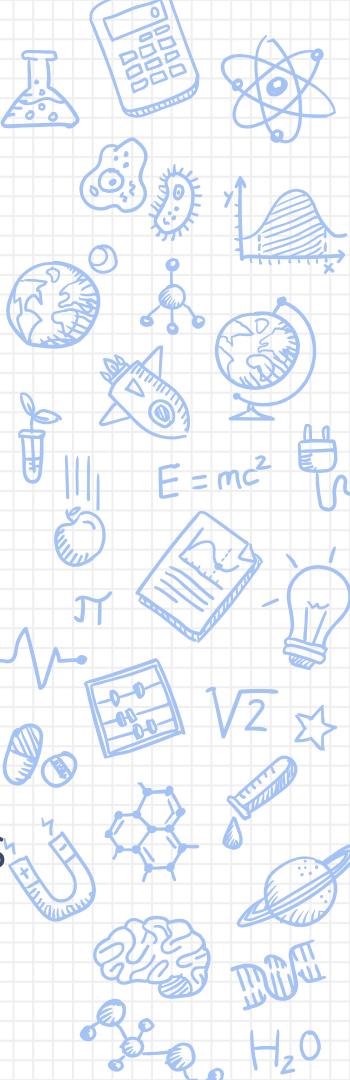
Accessory Organs of Digestive System

- ❖ Teeth
- ❖ Tongue
- ❖ Glandular organs
 - Salivary glands
 - Glands secreting digestive enzymes
- ❖ Liver
- ❖ Gallbladder
- ❖ Pancreas

Liver Structure

- ❖ Liver processes contents of hepatic portal vein
 - Detoxifies blood
 - Secretes glucose, fats and ketone bodies
 - Produces plasma proteins
- ❖ Liver is made of hepatocytes forming hepatic plates separated by sinusoids (capillary spaces)

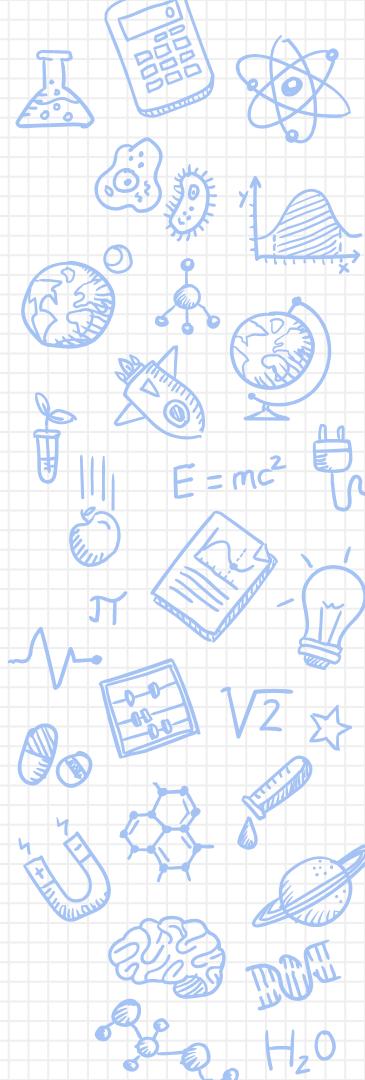
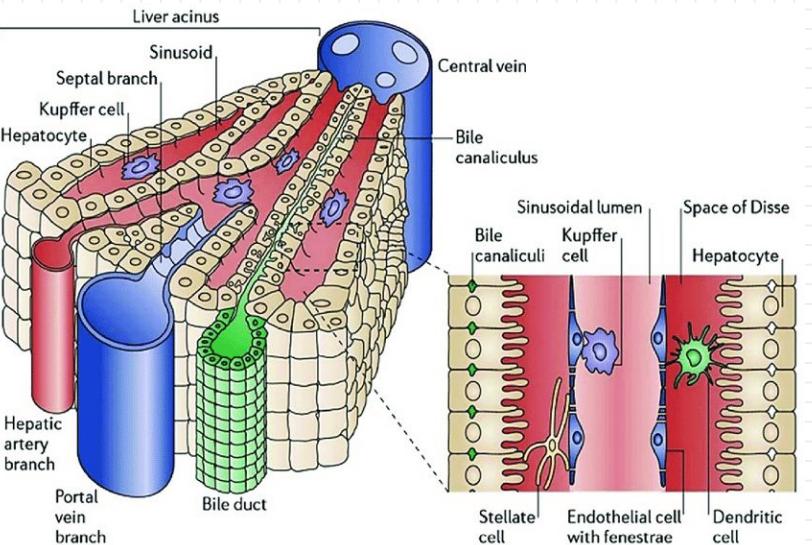




Liver Structure

- ❖ Hepatic plates organized into liver lobules
- ❖ Central vein in middle of each lobule
- ❖ Branches of hepatic portal vein and hepatic artery at periphery
 - Branches open into sinusoids which flow into central vein
 - Central vein converges to form hepatic vein
 - Returns blood to circulation
- ❖ Bile is made by hepatocytes and end up in hepatic ducts

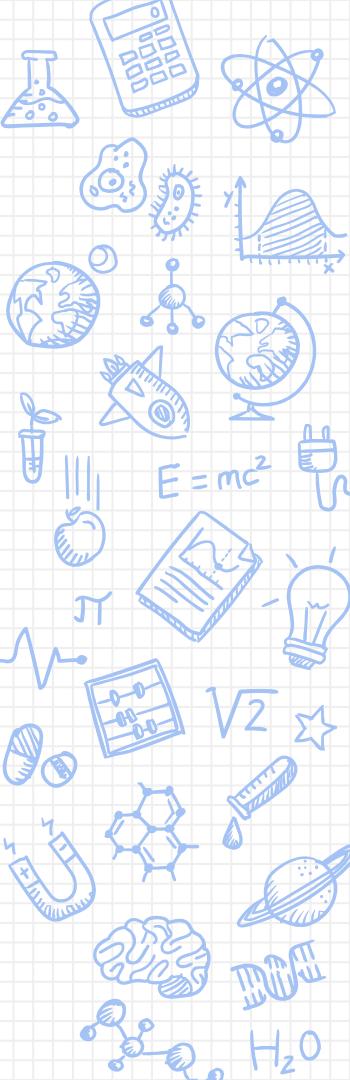
Liver Structure



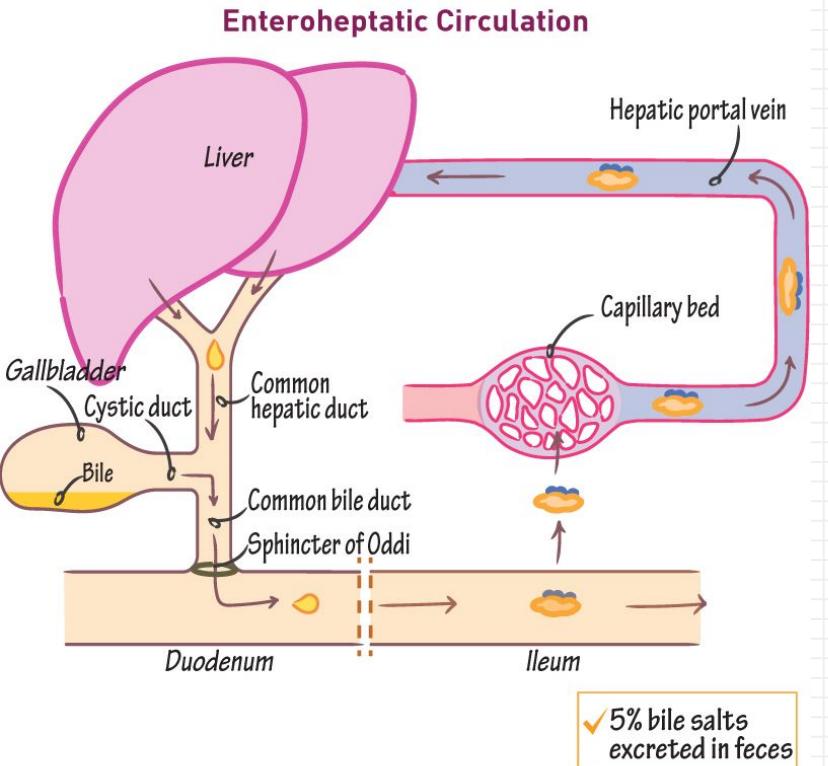


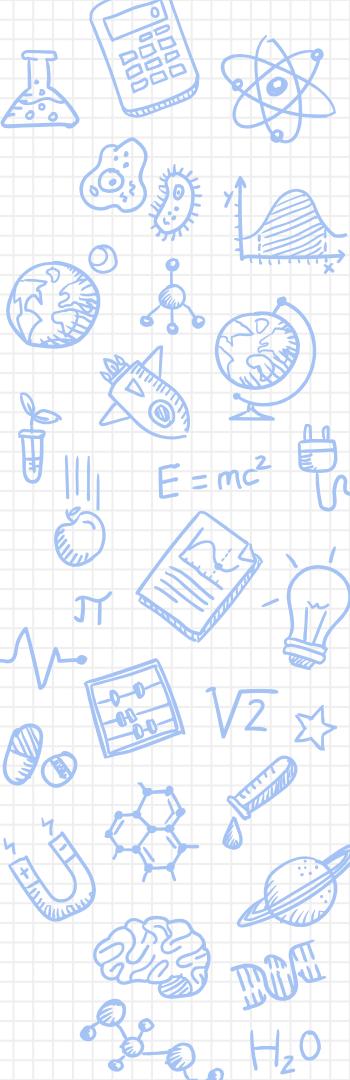
Liver Functionality

- ❖ Liver clears blood of certain compounds by removing them from blood and secretion into bile
 - Bile is released into intestines
- ❖ Some compounds released into bile enter enterohepatic circulation
 - Bile is secreted along with compounds into intestines
 - Compounds in bile are reabsorbed into hepatic portal vein
 - Compounds end up in liver which secretes them into bile again
 - Bile is secreted along with compounds into intestines
 - Some compounds circulate between intestines and liver (enterohepatic circulation)



Enter hepatic Circulation



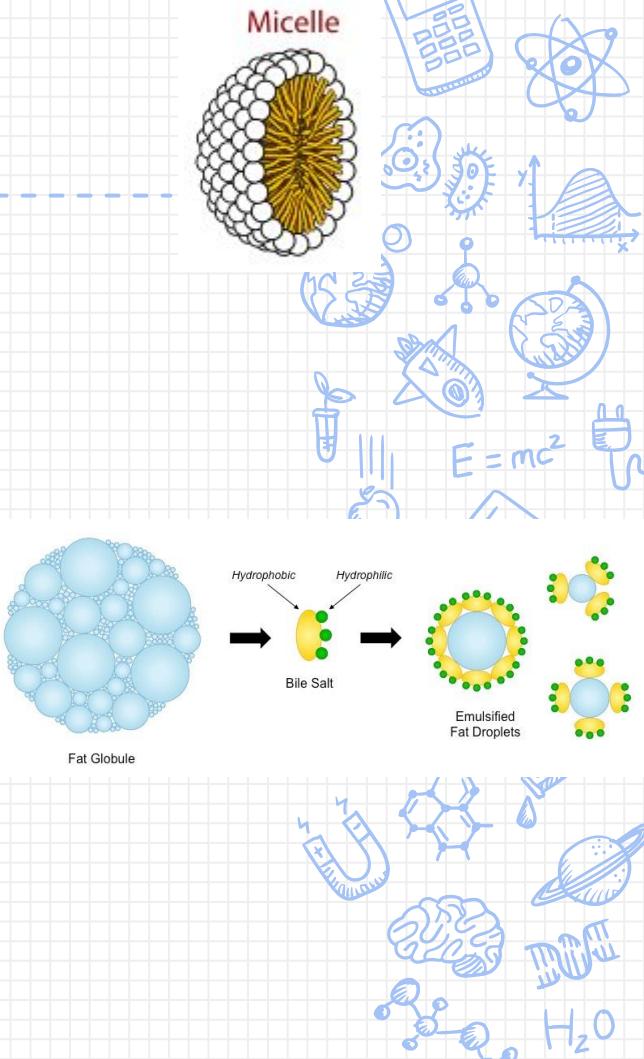


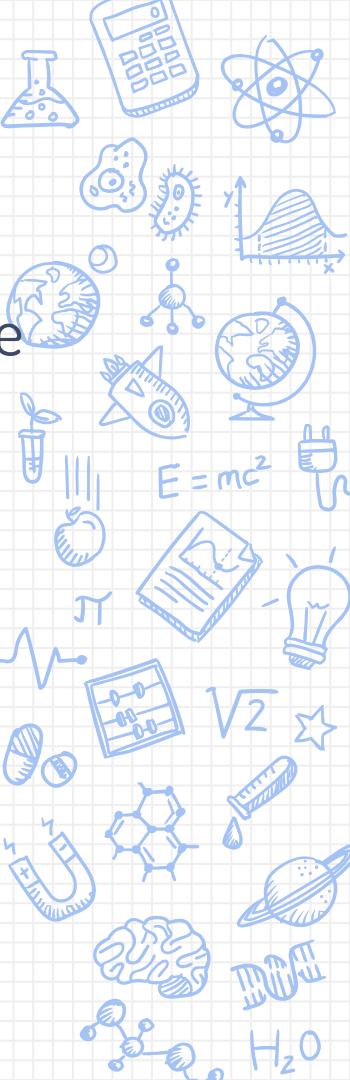
Bile Pigments

- ❖ Bile consists of bile pigment(bilirubin), bile salts, phospholipids, cholesterol, inorganic ions
- ❖ Bile pigment is produced by degraded hemoglobin and transported in blood attached to albumin carriers
- ❖ Liver processes bile pigment which is excreted or trapped in enterohepatic circulation

Bile acids

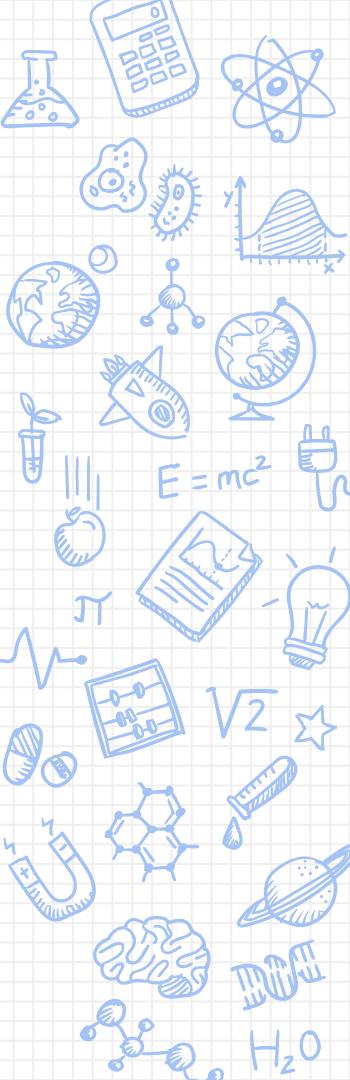
- ❖ Bile acids are derivatives of cholesterol
- ❖ Bile acids combined with amino acids to form bile salts
- ❖ Bile salts form micelles due to amphiphilic properties
- ❖ Lipids in small intestine enter bile salts and become emulsified
 - Large fat globules split into smaller globules with greater surface area allowing for lipase to better break them down





Other Liver Functions

- ❖ Liver can remove drugs, hormones and biologically active compounds by:
 - Excretion of these molecules in bile from which they can then enter the feces
 - Kupffer cells lining the sinusoids may phagocytose/engulf these compounds
 - Chemically alter these molecules within hepatocytes
- ❖ Liver regulates blood glucose levels
- ❖ Liver produces plasma proteins



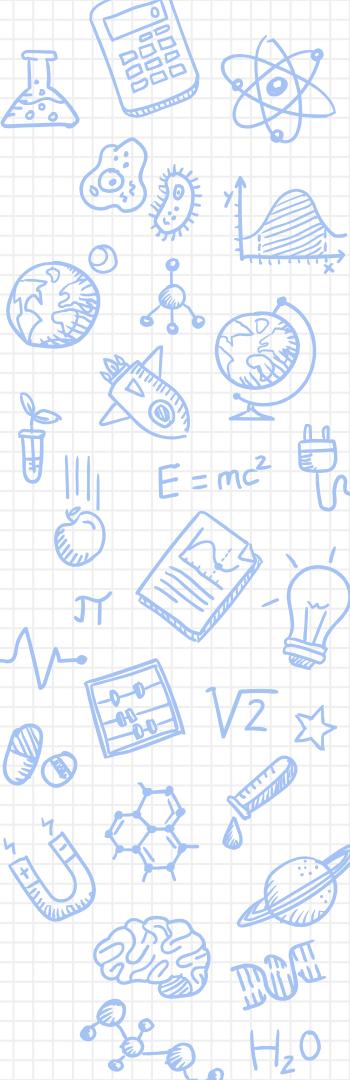
Gallbladder and Pancreas

- ❖ Gallbladder stores bile produced by liver
 - Located below liver
- ❖ Bile is released when chyme is in small intestine and stored in gallbladder otherwise
- ❖ Pancreas secretes pancreatic juice into duodenum containing digestive enzymes and bicarbonate
 - Digestive enzymes contribute to digestive function in conjunction with brush border enzymes
 - Bicarbonate neutralizes acidity of chyme



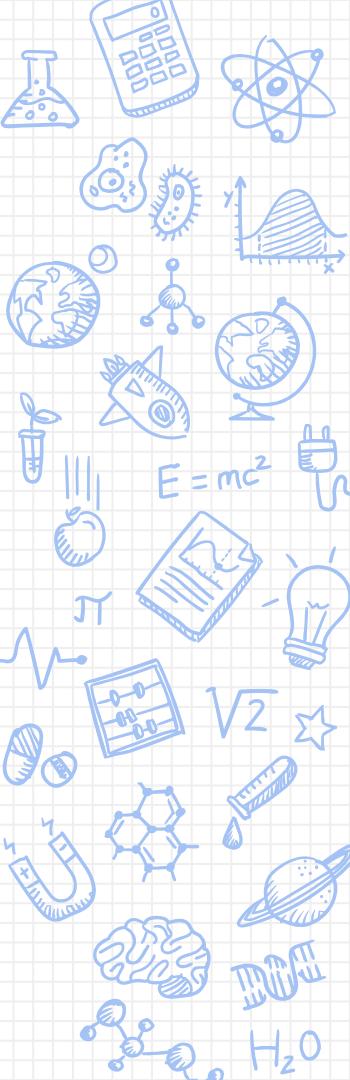
Final Review

- ❖ Small intestine split into 3 parts
 - Duodenum
 - Jejunum
 - Ileum
- ❖ Villi and microvilli increase absorption in small intestine
- ❖ Most nutrients (sugars, amino acids, nucleic acids) flow into hepatic portal vein to liver after absorption
- ❖ Triglycerides flow into lymphatic system directly to heart after absorption as chylomicrons
- ❖ Digestive enzymes from pancreas and brush border enzymes constitute small intestine digestive capabilities



Final Review

- ❖ Microbiome releases in large intestine produces vitamins and some nutrients from chyme
 - Essential for many aspects of good health
- ❖ Enterohepatic circulation is circulation of compounds between small intestine and liver
- ❖ Bile pigments derived from hemoglobin are excreted in urine, feces or trapped in enterohepatic circulation



Final Review

- ❖ Bile salts emulsify fats in small intestine
- ❖ Liver also detoxifies substances, regulates blood sugar and makes blood proteins
- ❖ Gallbladder stores bile
- ❖ Pancreas makes digestive enzymes and bicarbonate