

## DIGESTIVE SYSTEM: SMALL INTESTINE TO ANUS

Describe the role each part plays in the digestive system, and then label the location on the diagram on the back of this worksheet. Include details (ex: **enzymes, pH, macromolecules being digested**) where appropriate.

Part	Structural Features	Function(s)
<b>SMALL INTESTINE</b>	<b>Narrow but long (6m) tube connecting stomach &amp; large intestine.</b>	<b>Digestion of all nutrients into monomers &amp; absorption of those nutrients</b>
Duodenum	First 25cm of small intestine pH ~8 Connected to pancreas & liver	Receives digestive secretions from pancreas & liver Chemical digestion of lipids, carbohydrates, proteins, and nucleic acids.
Jejunum & Ileum	Last sections of small intestine Inner layer of villi to increase surface area for absorption	Absorption of nutrient monomers
<b>LARGE INTESTINE</b>	<b>Wide but short (3.5m) tube connecting small intestine to anus</b>	<b>Reabsorption of water Absorption of salts (minerals) and vitamins Formation of feces</b>
Appendix	Small organ attached to bottom of cecum	Unknown. May play a role in immune response
Cecum	First region of large intestine Connected via ileocecal sphincter	Receives food from small intestine and prevents back-flow
Colon	Ascending, Transverse, and Descending Colonized by many species of bacteria	Reabsorbs water to form feces Bacteria ferment fibre to produce gases, also synthesize many vitamins Absorption of salts (minerals) & vitamins A, D, E, K, B12
Rectum	Last portion of small intestine Wide and elastic walls	Stores feces and, once stretched, signals defecation response.
Anus	Sphincter connecting rectum to outside of body	Relaxes when rectum is full to allow defecation to occur
Pancreas	Sponge-like organ that sits below stomach. Connected to small intestine via common bile duct	Produces pancreatic juice & secretes to duodenum (NaHCO <sub>3</sub> neutralizes acid chime, enzymes digest proteins, sugars, fats) Regulates blood sugar levels
Liver	Large lobed organ. Connected to gall bladder and then small intestine via common bile duct	Produces bile (physical digestion of fats) Regulates blood contents before circulation to rest of body
Gall Bladder	Small organ nestled between lobes of liver Connected to liver and small intestine via common bile duct	Stores bile produced by liver & secretes to duodenum

### Explain how the liver, pancreas, and gall bladder contribute to the process of digestion:

**Liver** produces bile, which is stored in **gall bladder** & released to duodenum via common bile duct to physically digest fats into fat droplets

**Pancreas** produces pancreatic juice, which is released to duodenum via common bile duct to neutralize acid chime and chemically digest sugars, fats, and proteins.

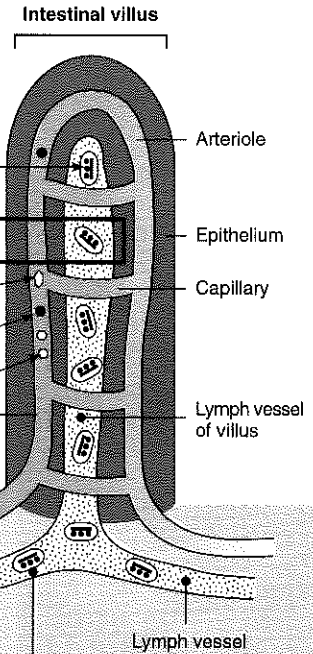
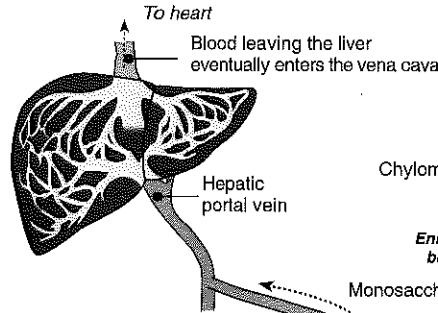
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# Nutrient Transport in Humans

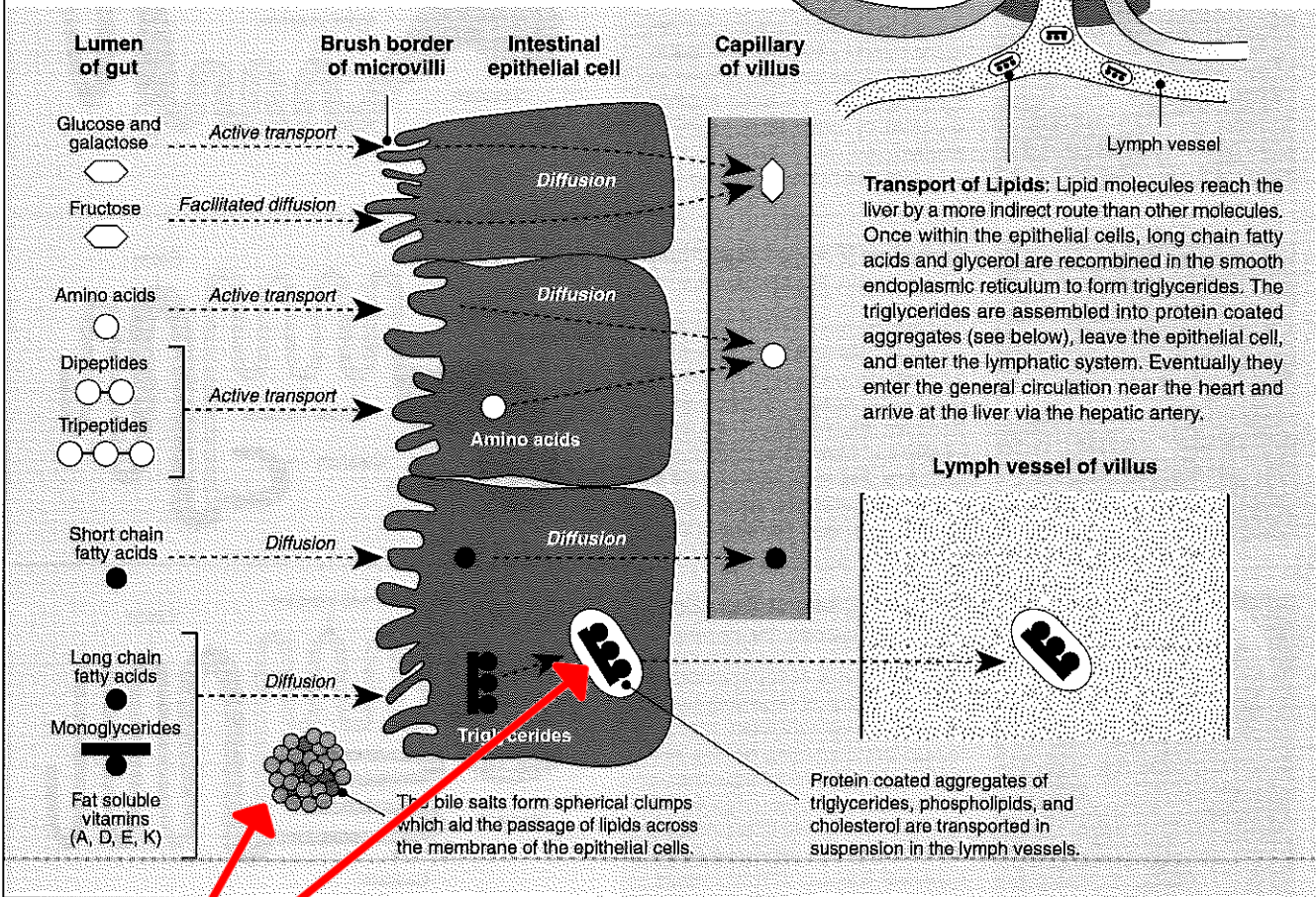
All chemical and physical digestion, from the mouth to the small intestine, is aimed at the breakdown of food molecules into forms that can pass through intestinal lining into the underlying blood and lymph vessels. The resulting breakdown products include: monosaccharides, amino acids, fatty acids, glycerol, and glycerides. Passage of these molecules from the gut into the

blood or lymph is called **absorption**. After absorption, nutrients are transported either directly or indirectly to the liver for storage or processing. The diagram below shows some of the features of nutrient absorption and transport. For simplicity, all nutrients are shown in the lumen of the intestine, even though some nutrients are digested on the surface of the epithelial cells themselves.

**The Hepatic Portal System:** The liver obtains oxygenated blood from the hepatic artery, but it also receives deoxygenated blood containing newly absorbed nutrients via the hepatic portal vein. The **hepatic portal system** refers to all the blood flow from the digestive organs that passes through the liver before returning to the heart. Hepatic portal blood is rich in nutrients: the liver monitors and processes this load before the blood passes into general circulation.



**Absorption:** Most of the simple molecules that are the final products of food breakdown are absorbed by the epithelial cells of the villi into the blood vessels and are transported directly to the liver where they are processed.



**Transport of Lipids:** Lipid molecules reach the liver by a more indirect route than other molecules. Once within the epithelial cells, long chain fatty acids and glycerol are recombined in the smooth endoplasmic reticulum to form triglycerides. The triglycerides are assembled into protein coated aggregates (see below), leave the epithelial cell, and enter the lymphatic system. Eventually they enter the general circulation near the heart and arrive at the liver via the hepatic artery.

**Lymph vessel of villus**

Protein coated aggregates of triglycerides, phospholipids, and cholesterol are transported in suspension in the lymph vessels.

1. State the function of the following in fat digestion:

- (a) Micelles: spherical clumps of fatty acids & glycerol associated with bile salts and phospholipids which are water soluble and can be absorbed by the villi
- (b) Chylomicrons: lipoprotein (special particles that are designed for the transport of lipids in the circulation)

2. Explain why it is important that venous blood from the gut is transported first to the liver via the hepatic portal circulation:

acts as a "gatekeeper" to blood by removing poisons and detoxifying blood, by removing & storing Vitamins A, D, E, K and B12, by manufacturing & adding plasma proteins, and by regulating the amount of cholesterol in the blood