

RA 2 Introduction to Human Digestion

It is estimated that an adult consumes about 20,000kg of food between the ages of 18 and 38 years – about a metric tonne a year. Although babies grow rapidly from birth, growth is not the most significant reason for our ongoing eating. Our bodies require a constant source of energy for the vast number of biochemical reactions that constitute **metabolism**. Food provides the source of this energy. Human energy requirements are governed by **basal metabolic rate (BMR)**: the rate of energy use by an

inactive, unfed person in warm conditions. BMR varies depending on sex, age, size, and body composition. For an 75-80 kg male at rest, this is about 7140 kJ. The daily energy requirement of an individual is equal to BMR plus the energy needed for activity, and growth and repair of tissue. The digestive system prepares the food we eat for use by the body's cells through five basic activities: eating (ingestion), movement (of food through the gut), digestion (physical and chemical breakdown), absorption, and elimination.

Structures of the Human Digestive System

Word list: Liver; small intestine; gall bladder; stomach; salivary glands; colon (large intestine); oesophagus; pancreas; mouth and teeth; anus; rectum; appendix.

A	G
B	H
C	I
D	J
E	K
F	L

Functions of the Human Digestive System

In the boxes provided, write the letter (A-L) that represents the part of the gut responsible for each of the functions summarised below:

- (a) Main region for enzymatic digestion & nutrient absorption
- (b) Consolidation of the faeces before elimination
- (c) Main function (humans) is water and mineral absorption
- (d) Secretes acid and pepsin, stores and mixes food
- (e) A gland which produces an alkaline, enzyme-rich fluid
- (f) Produces bile and has many homeostatic functions

a Papillae
5 mm SEM

b Villi
100 μm SEM

c Villi Lumen
Muscle
500 μm

d Gastric gland
50 μm

1. In the spaces provided on the diagram above, name the parts labelled A-L (choose from the word list provided). Match each of the **functions** described (a) – (f) with the letter that represents the corresponding structure on the diagram:
2. On the diagram, mark with lines and labels: anal sphincter (**AS**), pyloric sphincter (**PS**), cardiac sphincter (**CS**):
3. Identify the region of the gut illustrated by the photographs (a) – (d) above (use the labelled parts and scale to assist you):
 - (a) _____
 - (b) _____
 - (c) _____
 - (d) _____

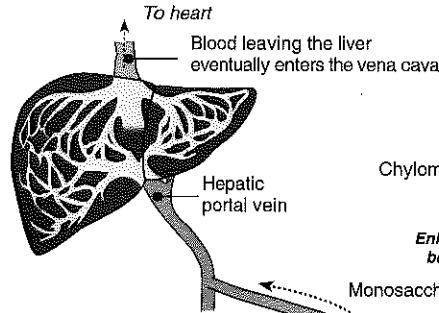
A 2

Nutrient Transport in Humans

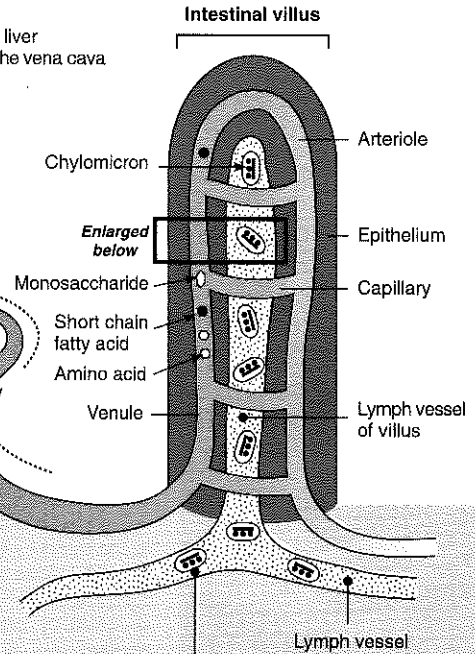
All chemical and physical digestion, from the mouth to the small intestine, is aimed at the breakdown of food molecules into forms that can pass through intestinal lining into the underlying blood and lymph vessels. The resulting breakdown products include: monosaccharides, amino acids, fatty acids,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

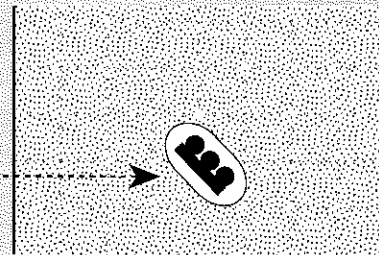


Absorption: Most of the simple molecules that are the final products of food breakdown are absorbed by the epithelial cells of the villi into the blood vessels and are transported directly to the liver where they are processed.

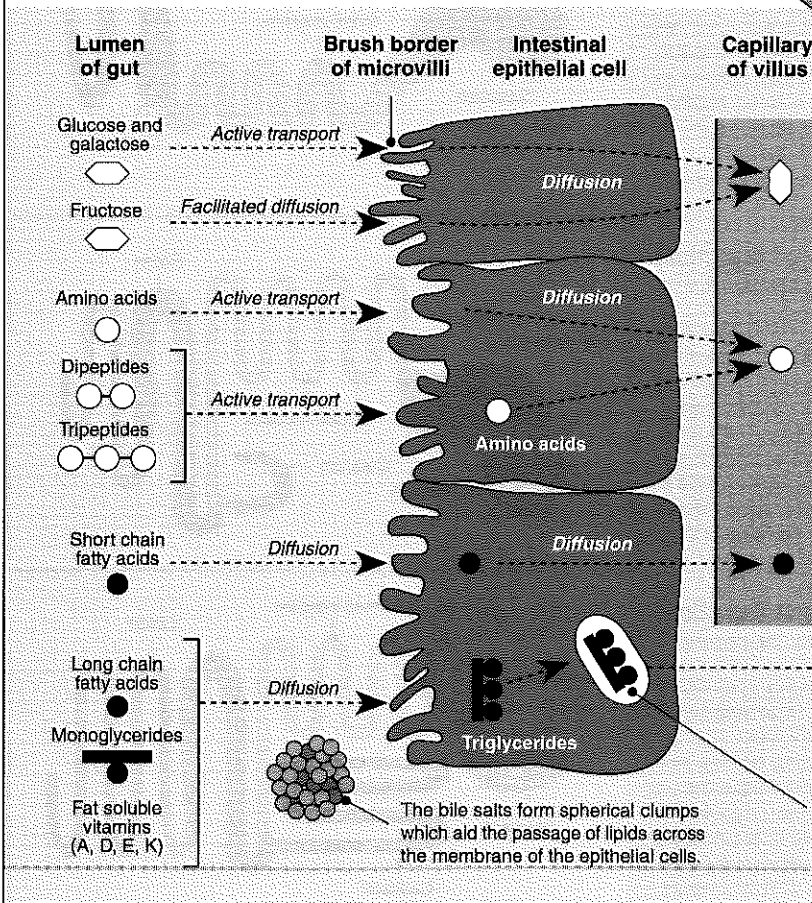


Transport of Lipids: Lipid molecules reach the liver by a more indirect route than other molecules. Once within the epithelial cells, long chain fatty acids and glycerol are recombined in the smooth endoplasmic reticulum to form triglycerides. The triglycerides are assembled into protein coated aggregates (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: _____

(b) Chylomicrons: _____

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