5.1 DIGESTION AND NUTRITION

5.1.1 Explain why digestion of large food molecules is essential.

Cross reference with topic 2.

Large food molecules need to be digested before being absorbed. The process of absorption of food molecules requires them to pass into a cell lining the gut. To do so, molecules must be small and soluble. Therefore large molecules like polysaccharides, proteins and lipids need to be broken down into their building blocks before they can be absorbed.

5.1.2 Explain the need for enzymes in digestion.

Cross reference with topic 2. The need for increasing the rate of digestion at body temperature is the important point.

Like many other biological reactions, the breakdown of these large molecules is a slow process. Enzymes lower the required activation energy and make this process sufficiently fast.

5.1.3 State the source, substrate, products and optimum pH conditions for one amylase, one protease and one lipase.

Any human enzymes can be selected. Details of structure or mechanisms of action are not required.

The three kinds of macronutrients are carbohydrates, lipids and proteins. Since enzymes are highly specific, each molecules has at least one enzyme to break it down into its components. But as we can recognise three kinds of macronutrients, we can recognise three groups of enzymes:

- the amylases digest carbohydrates,
- the proteases digest proteins and
- the lipases digest lipids.

Examples of each are given below.

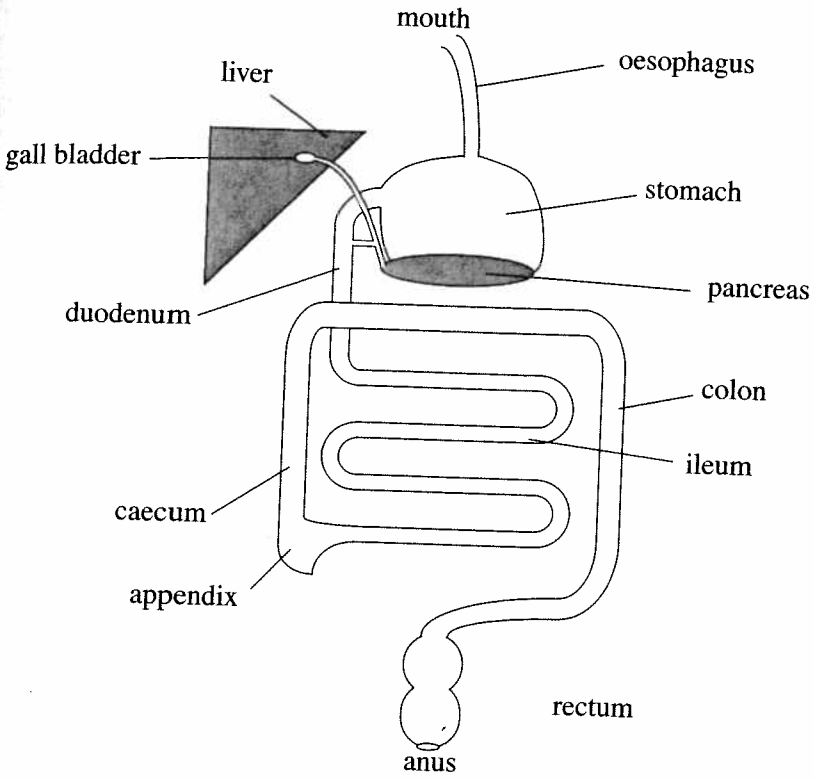
enzyme	salivary amylase	pepsin	phospholipase A2
source	saliva	gastric juice	pancreatic juice
substrate	starch	proteins	phospholipid
product	maltose	polypeptide	glycerol, phosphate, fatty acids
optimum pH	7-8	2-3	8

Saliva is produced by the salivary glands.

Gastric juice is produced by cells in the wall of the stomach; the pepsin producing cells are called **chief cells**.

5.1.4 Draw a diagram of the digestive system. The diagram should show the mouth, esophagus, stomach, small intestine, large intestine, anus, liver, pancreas and gall bladder.

Schematic diagram of the human digestive system (alimentary canal and associated glands).



1.5 Outline the function of the stomach, small intestine and large intestine.

od is chewed in the mouth. It then travels to the stomach where it remains for a few urs. While the food is in the stomach, it is mixed with acid and enzymes and chemical estion takes place. During this time, the peristaltic movements on the muscles in the ll of the stomach will mix the food until it is almost a fluid that is called chyme. After ne time, the circular muscle between the stomach and the small intestine (called oric sphincter) opens briefly and a small amount of acid chyme is allowed into the denum. This is repeated at intervals until the stomach is empty.

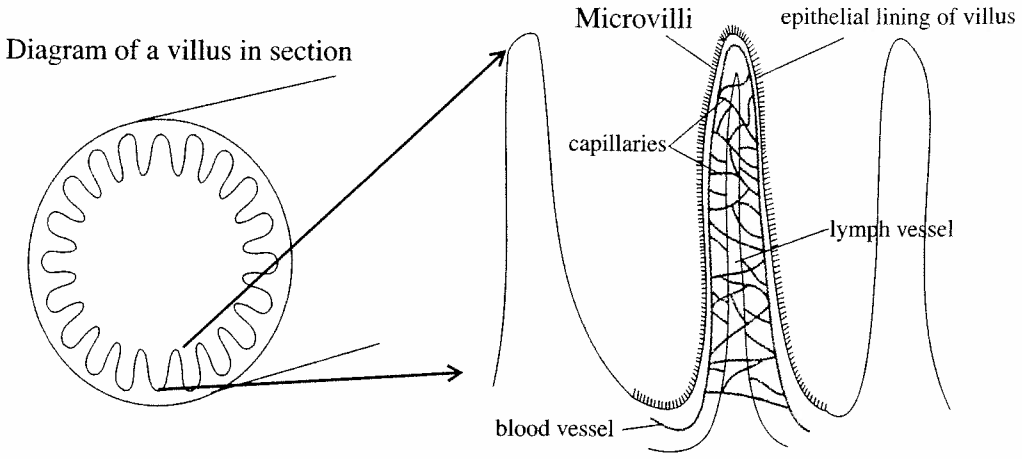
The main functions of the stomach are storage of food and chemical digestion of proteins. The main functions of the small intestine are chemical digestion of carbohydrates, lipids and proteins and absorption of the products of digestion. The main functions of the large intestine are the reabsorption of water and the production of vitamin K (by bacteria with which we have a mutualistic relationship).

5.1.6 Distinguish between absorption and assimilation.

Absorption: the taking in of chemical substances through cell membranes or layers of cells.
Assimilation: the conversion of nutrients into protoplasm that in animals follows digestion and absorption.

5.1.7 Explain how the structure of the villus is related to its role in absorption of the end products of digestion.

The **small intestine** is a very important place for chemical digestion but it is also the major site of absorption. For this reason the wall of the small intestine is not just simply a smooth inner surface of a tube, as you may have imagined from the schematic and simplified diagrams, but covered with **villi** (sing. villus), which are small fingerlike projections made of many cells. The cells of the villus often also have projections into the lumen of the gut: **microvilli** (compare with plant root hairs). The purpose of villi and microvilli is to increase the surface area of the small intestine.



The intestinal glands produce enzymes for digestion. Alkaline fluid (to neutralise the gastric acid) and mucus (to help the food move along) is also produced in this area. Mitosis takes place mostly in the cells between the villi. The daughter cells move up and reach the tip of the villus after a few days and are shed into the lumen. The villi have a good blood supply to facilitate absorption and subsequent transport of the products of digestion. A lot of the absorption of the products of digestion takes place by active transport. So the cells in the villi have a lot of mitochondria to provide the energy for this process.