**Digestion and absorption**

The major parts of the digestive system

For diagram see GCSE revision sheet.

Use your textbook to write down the functions of:

Oesophagus……………………………………………………………………………………………………………………………

………………………………………………………………………………………………………………………………………………

Stomach………………………………………………………………………………………………………………………………..

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Ileum…………………………………………………………………………………………………………………………………….

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Large intestine……………………………………………………………………………………………………………………….

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Rectum………………………………………………………………………………………………………………………………….

………………………………………………………………………………………………………………………………………………

Salivary glands………………………………………………………………………………………………………………………

………………………………………………………………………………………………………………………………………………

Pancreas……………………………………………………………………………………………………………………………….

………………………………………………………………………………………………………………………………………………



Digestion and absorption of carbohydrates

Carbohydrates are digested by a group of enzymes called ................................................

When a polysaccharide is broken down, the type of reaction is…………………………………………

Starch is initially broken down by the enzyme amylase into maltose.

### Amylases are produced by the salivary glands in the mouth and by groups of cells in the pancreas.

### It is also present bound to the membrane of the epithelial cells of the ileum.

Amylase hydrolyses the glycosidic linkages of starch to form the disaccharide maltose and some glucose.

Maltose is then broken down by an enzyme called .............................................. into ..................................................

### Maltase is produced by the epithelial cells on the surface of the villi and is bound to the membrane of the microvilli of the epithelial cells.

Other carbohydrases are also found bound to the membranes of the microvilli:

Lactase breaks down …………………………… to ……………………………….. and ………………………………………

Sucrase breaks down …………………………… to ………………………………. and ………………………………………

The monosaccharides (glucose, fructose and galactose) are absorbed by active transport into the epithelial cells of the ileum, whence they diffuse into the blood capillaries of the villi. Active transport requires energy in the form of ATP, but it allows very rapid absorption, even against a concentration gradient.

The carbohydrates that make up plant fibres (cellulose, hemicellulose, lignin, etc) cannot be digested, so pass through the digestive system as fibre.

**2. Digestion and absorption of Proteins**

* Pepsin (in gastric juice) digests proteins to peptides, 6-12 amino acids long. Pepsin is an endopeptidase, which means it hydrolyses peptide bonds in the middle of a polypeptide chain. It is unusual in that it has an optimum pH of about 2 and stops working at neutral pH.
* Pancreatic endopeptidases continue to digest proteins and peptides to short peptides in the duodenum. Different endopeptidase enzymes cut at different places on a peptide chain because they have different target amino acid sequences, so this is an efficient way to cut a long chain up into many short fragments, and it provides many free ends for the next enzymes to work on.
* Exopeptidases in the membrane of the ileum epithelial cells complete the digestion of the short peptides to individual amino acids. Exopeptidases remove amino acids one by one from the ends of peptide chains. Carboxypeptidases work from the C-terminal end, aminopeptidases work from the N-terminal end, and dipeptidases cut dipeptides in half.
* The amino acids are absorbed by active transport into the epithelial cells of the ileum, and then they diffuse into the blood capillaries of the villi.

**3. Digestion and absorption of Triglycerides**

* Fats are emulsified by bile salts to form small oil droplets called micelles, which have a large surface area.
* Pancreatic lipase enzymes digest triglycerides to fatty acids and glycerol in the duodenum.
* Fatty acids and glycerol are lipid soluble and diffuse across the membrane (by lipid diffusion) into the epithelial cells of the villi in the ileum.
* Inside the epithelial cells, the monoglycerides and fatty acids are recombined to form triglycerides. These associate with cholesterol and lipoproteins to form structures called chylomicrons.
* The chylomicrons diffuse into the lacteal - the lymph vessel inside each villus. The emulsified fatty droplets give lymph its milky colour, hence name lacteal.
* They are carried through the lymphatic system to enter the bloodstream at the vena cava, and are then carried in the blood to all parts of the body. They are stored as triglycerides in adipose (fat) tissue.
* Fats are not properly broken down until they used for respiration in liver or muscle cells.

**The adaptations of the ileum for absorption**

Explain the adaptations of the ileum for absorption and how these allow it to carry out its function.

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Further reading and questions

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| Chapters 6.9 and 6.10 complete summary |