

IGCSE Co-ordinated Sciences 0654

Unit 4: Diet and digestion

Recommended Prior Knowledge

It will help if students have already studied Topic C4 Chemicals from plants. They should be confident in their understanding of what a molecule is, and should have a basic knowledge of energy transfer.

Context

This Unit covers Topics B8 and B9. There are links to be made with Topic B7 Respiration, where food as a fuel was considered. It links with C3 Petrochemicals in which polymers are covered, as well as the use of catalysts to increase the rate of reactions, and strongly with C4 Chemicals from plants, where the structure of carbohydrates and proteins is dealt with, and also movement through partially permeable membranes which relates to absorption of nutrients from the gut. The effect of temperature on enzyme-controlled reactions links with C10 Soil, rocks and rates.

Outline

This Unit begins by reviewing a balanced diet. Students are likely to have considerable knowledge of this already, and may also have had prior experience of testing foods for the presence of a range of nutrients. There is the opportunity to look at local dietary problems, whether these are due to too much or too little food, or the lack of a particular nutrient. The relationship between the structure and function of the alimentary canal is covered. There is considerable opportunity to develop practical skills, especially by means of various investigations into enzyme activity.

AO	Learning outcomes	Suggested Teaching activities	Learning resources
B8	Know that a balanced diet contains protein, fat, carbohydrate, vitamins, minerals (inorganic ions), roughage (fibre) and water.	Students will probably already know the list of nutrients required in a diet. Discuss the need for materials to build bodies and for energy to maintain activities.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 17
	Be able to perform tests for starch (iodine solution), reducing sugar (Benedict's reagent), protein (biuret test) and fat (ethanol test).	Students should carry out each of these tests on a range of foods. Ask them if they can see any patterns in their results – for example, do both animal- and plant-derived foods contain carbohydrates?	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G pages 18, 19 and 20
	Know that energy input should approximately equal energy output	Students can research the energy needs of people in various occupations, of different ages and different genders, and relate	Balanced diet http://www.sambal.co.uk

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	and that fat and carbohydrate provide most of the energy input of a balanced diet.	this to their dietary requirements.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 22
	Know that protein is an essential body-building food.	Extension candidates should be able to name a range of proteins and outline their functions in the body, for example haemoglobin, antibodies, enzymes, keratin.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 19
	Understand that proteins have a wide variety of roles in the human body and be able to describe a range of these roles.		
	Understand the uses in the human body of iron, calcium, vitamin C and vitamin D.		<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 21
	Know examples of food which are good sources of each of the components of a balanced diet.	Students can look at their own diets and identify the main sources of each type of nutrient.	US Agency for International Development's information on the nutritional contents of a variety of foods http://www.usaid.gov
	Appreciate local dietary problems (for example too much fat, insufficient protein) and how these may affect health.	Groups of extension students can use the internet and the media to select and research a problem associated with diet in one part of the world, and then report a summary of their findings to the class.	A discussion of the problems of feeding the world's growing population, with many links to other good sites http://www.nationalacademies.org
	Be able to discuss the problems and possible solutions of inadequate diet in one or more parts of the world.	They may like to consider whether new technologies, such as development of genetically modified crops, might be able to improve the situation.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 23
B9	Understand that digestion breaks large molecules of food into small	Students can carry out an investigation into the absorption of sugar (but not starch) using a 'model gut' made of visking	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 25

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	ones, which can then pass through the wall of the gut into the blood.	tubing. A 'meal' of glucose, starch and water is placed inside the tubing, which is then placed in a beaker of water (to represent the blood). After a while, the contents of the tubing and beaker can be tested for starch and glucose. This can lead to a discussion of the need for digestion before absorption can take place.	
	Appreciate that the gut is a coiled tube and is the site of digestion and absorption.	Students often do not understand that the alimentary canal is a long tube through which food passes. They also need to understand that food cannot be considered to have genuinely entered the body until it crosses the wall of the canal.	A quiz on the parts of the alimentary canal http://borg.com <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 29
	Know the internal structure of a human tooth and how the different types of human teeth are used when eating.	Students can think about the functions of the different types of teeth as they eat (best done for homework and not in the laboratory).	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 26–27
	understand the role of bacteria forming acids in the mouth leading to tooth decay	Students can carry out a survey of their own teeth and others, identifying those (if any) that have suffered from decay, and linking this to the use of the teeth and the likelihood of food remains being trapped on or between them. If you can obtain teeth (for example, children's milk teeth, or animal teeth), students can suspend one in an acidic solution (for example a fizzy drink) and observe the rate at which the enamel dissolves.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 28 http://www.mchoralhealth.org/OpenWide/mod1_1.htm Animation showing how bacteria cause tooth decay
	Be able to identify the gross structure of the alimentary canal and its associated organs (mouth, oesophagus, stomach, small and large intestine, rectum, anus, pancreas and liver).	Use models, if available, to demonstrate the position and general structure of the gut in the body.	http://borg.com Includes a quiz on the parts of the alimentary canal. <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 29

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	Appreciate that food is moved along the gut by peristalsis.	You can use a short length of rubber tubing with a marble inside it to show students how contraction of muscles behind a piece of food can push it along the alimentary canal.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 30 http://www.abpschools.org.uk Very simple animation showing peristalsis
	Appreciate that digestion is brought about by enzymes, acting as catalysts.	Ask students for a definition of a catalyst (studied in C3). Simple experiments with catalase are an excellent introduction to enzymes. Catalase is not a digestive enzyme, but students should realise that <i>all</i> metabolic reactions are catalysed by enzymes, not just digestion. Ensure that students understand that enzymes are molecules, not living things, and so they cannot be 'killed'.	Simple account of how enzymes work: http://www.activescience-gsk.com <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 12
	Appreciate that enzymes are used in many industrial processes and products.	Extension students should investigate a variety of uses of enzyme in industry, for example protease and lipases in washing powders, pectinase in the production of fruit juice. They can carry out simple experiments, for example the optimum temperature at which a biological washing powder breaks down proteinaceous stains; the yield of apple juice from crushed apples with and without the addition of pectinase.	Downloadable booklet 'Practical Biotechnology' with practical investigations using a variety of enzymes http://www.ncbe.reading.ac.uk <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G pages 14–16
	Understand how the rate of an enzyme reaction can be affected by temperature and pH.	Extension students should investigate the rate of reaction of an enzyme-catalysed reaction at different temperatures (using, for example, starch-amylase or hydrogen peroxide-catalase) and possibly also at different pH (using, for example, milk powder-trypsin). They should relate this work to their work on rates of reaction in C3 and C10, and be able to explain the effects that they observe.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G pages 14–16 <i>Teaching and Assessing Practical Skills in Science</i> , CUP. Hayward D, page 11
	Know the functions of amylase, protease and lipase.	Students should carry out experiments into the activity of these enzymes. The effect of amylase on starch can be shown by detecting the disappearance of starch or the appearance of	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 33

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	<p>Know the sites of production and action of amylase, protease and lipase in the human alimentary canal.</p> <p>Know that the small intestine is the site of absorption of the products of digestion.</p> <p>Know that villi in the small intestine increase surface area for absorption and that absorbed products are taken in the hepatic portal vein to the liver.</p>	<p>sugar. The effect of protease on proteins can be shown using pepsin and suspensions of milk powder, or photographic film (made of gelatin, which is a protein). The effect of lipase on fats is less easy to demonstrate, but if desired then the appearance of fatty acids can be shown by the pH change in the reacting mixture. Students could investigate the specificity of enzymes by adding, for example, amylase to a tube of starch suspension and protease to another.</p> <p>Extension students could use overlays to add this information to a diagram of the structure of the alimentary canal.</p>	<p>Biology for IGCSE and O Level, CUP, Jones M and Jones G pages 33</p> <p>Biology for IGCSE and O Level, CUP, Jones M and Jones G pages 31–32</p>