

O Level Biology (5090)

Unit 3: Animal Nutrition

Recommended Prior Knowledge

Students need to know of the existence of chemical elements, particularly of carbon, oxygen, hydrogen and nitrogen, also that chemical energy is contained within the larger organic molecules. A knowledge of enzymes and enzyme action is necessary (Unit 1) as well as a very simple understanding of the circulatory system. Otherwise, this Unit could be used as a starting point for the course with the above requirements being dealt with as they arise in the learning outcomes.

Context

This Unit provides the underlying biochemical knowledge essential for studying almost all of the other Units in the course.

Outline

The Unit begins with a study of the three major classes of organic nutrients and their food tests. Diet and its importance are considered, as well as the processing of dietary intake within the body. The action of specific enzymes is considered and the Unit ends with a link to Unit 5 with a consideration of the role of the liver.

AO	Learning outcomes	Suggested activities and further guidance	Online resources	Other resources
5(a)	List the chemical elements that make up carbohydrates, fats and proteins.	That carbohydrates and fats contain carbon, hydrogen and oxygen only (but in different proportions) and that proteins contain the same three elements plus nitrogen can be illustrated using a collection of four different shapes cut from paper or thin card and moved around on an OHP. Explain that 'hydrate' relates to water and carbohydrates always contain H and O in the same ratio as in water.	Nutrition and food groups: http://www.s-cool.co.uk/gcse/biology/nutrition/nutrition.html	Textbooks Ian J. Burton – Topic 5 Nutrition M. & G. Jones – 4 How Animals Feed Mary Jones – Unit 5 Animal Nutrition – Diet
5(b)	Describe tests for Starch (iodine in potassium iodide solution), reducing sugars (Benedict's solution), protein (biuret test) and fats (ethanol emulsion test).	Students perform the tests on prepared solutions of starch, glucose and egg albumen and cooking oil. They should carry out a test in each case on pure water as a control. Observations and conclusions to be recorded in a table. Extend the practical to test common foodstuffs – making predictions about the presence or absence of components prior to testing.	Food tests practical procedure: http://www.biotopics.co.uk/nutrition/footes.html Food tests practical animation: http://lgfl.skool.co.uk/content/keystage3/biology/pc/learningsteps/FOTLC/launch.html	

5(c)	List the principle sources of, and describe the dietary importance of carbohydrates, fats, proteins, vitamins (C and D only), mineral salts (calcium and iron only), fibre (roughage) and water.	Consider the importance of the different chemical constituents of a diet before considering their sources. Use the online resources listed to research the components and to compare how the principle sources of each differ in different areas of the world. Students may present this information in the form of a three column table showing components, sources and dietary sources.	Vitamins: http://kidshealth.org/teen/misc/vitamin_chart.html http://kidshealth.org/teen/food_fitness/nutrition/vitamind.html Minerals: http://kidshealth.org/teen/misc/mineral_chart.html http://kidshealth.org/teen/food_fitness/nutrition/calcium.html	
5(d)	Name the diseases and describe the symptoms resulting from deficiencies of vitamin C (scurvy), vitamin D (rickets), mineral salts calcium (rickets) and iron (anaemia).	Descriptions of the deficiency diseases resulting from a lack of vitamins C and D should be supported if possible with pictures. The need for calcium in the development of strong bones and teeth should be mentioned. The role of iron in the manufacture of haemoglobin for oxygen transport should also be included.	Deficiency diseases: http://lgfl.skool.co.uk/content/keystage3/biology/pc/learningsteps/MALLC/launch.html	
5(e)	Understand the concept of a balanced diet.	Stress the importance of a diet containing the correct proportions of each constituent to satisfy the body's needs. Either too little or too much of any one or more constituents can be harmful - see 5(e), (f) and (g).	Dietary food groups activity: http://www.footprints-science.co.uk/Foodgroups.htm	
5(f)	Explain why diet, especially energy intake, should be related to age, sex and activity of an individual.	Present and analyse data showing the energy requirements for sedentary and physical life styles together with those of people of different ages. Consider how diet, other than energy, may differ at different stages of a person's life. Cross reference 16(y) in Unit 8.	Energy requirement data table: http://www.nhlbi.nih.gov/health/public/heart/obesity/wecan/images/chart2_87.gif	
5(g)	State the effects of malnutrition in relation to starvation, heart disease, constipation and obesity.	Link to work on the causes of famine in 5(h) yet use this objective to illustrate that eating too much of a food group over a prolonged period is also a form of malnutrition. Discuss the growing problem in developed countries of obesity leading to heart disease.	World Health Org. obesity site: http://www.who.int/dietphysicalactivity/publications/facts/obesity/en/	

5(h)	Discuss the problems that contribute to famine (unequal distribution of food, drought and flooding, increasing population).	Use a stimulus picture to initiate a group 'brainstorm' where students list all the factors they can think of which contribute to famine. These can then be collected, compared and discussed further.	Famine stimulus picture: http://i207.photobucket.com/albums/bb125/Cheeriotown/starvation.jpg	
5(i)	Identify the main regions of the alimentary canal and the associated organs: mouth (buccal) cavity, salivary glands, oesophagus, stomach, duodenum, gall bladder, liver, ileum, colon, rectum and anus.	Provide a labelled diagram of the appropriate components of the alimentary canal. Avoid providing more labels than the syllabus requires. Write a flow chart to show the order in which food travels through the labelled regions and list separately the associated organs through which food does not travel. The suggested online resources provide good source material in the form of diagrams and animations to support these activities.	Regions of the digestive system: http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/enzymes/enzymes_and_digestion1.shtml Digestive system and digestion – relevant to several learning outcomes. http://www.s-cool.co.uk/gcse/biology/nutrition/digestion.html	Textbooks Mary Jones – Unit 6 Animal Nutrition – Digestion Ian J. Burton - Topic 7 Animal Nutrition
5(j)	Describe the main functions of these parts in relation to ingestion, digestion, absorption, assimilation and egestion of food, as appropriate.	The terms ingestion and absorption are usually easily understood. Stress that only certain large molecules are digested (in order to be absorbed). Assimilation is less easily understood and should be described as the incorporation of absorbed chemicals into the structure of an organism. Egestion and excretion are often confused by students, so careful explanation will be required. Add annotations to the labelled diagram provided in 5(i) to show which function(s) occur(s) in each region labelled.	See suggested resources above.	

5(k)	Identify the different types of human teeth and describe their structure and functions.	<p>Include reference to milk and wisdom teeth. 'Cutting' and 'grinding' (as appropriate) should be used in place of 'chewing'. Use a model tooth to show internal structure. Provide students with diagrams of a tooth in LS and of a dental arcade.</p> <p>Students should label the structures shown on an LS of a tooth and name and label the functions of the different teeth in a lower or upper jaw.</p>	<p>Types of teeth: http://www.crickweb.co.uk/assets/resources/flash.php?&file=teeth http://www.crickweb.co.uk/assets/resources/flash.php?&file=teeth</p> <p>Internal tooth anatomy: http://www.enchantedlearning.com/subjects/anatomy/teeth/toothanatomy.shtml</p>	
5(l)	State the causes of dental decay and describe the proper care of teeth.	<p>Stress that sugar left on teeth, particularly whilst asleep, attracts bacteria and that it is the acid excreted by these bacteria as they feed on the sugar which dissolves the enamel.</p> <p>Use commercially available 'disclosing' tablets to reveal the plaque layer on students' teeth. Discuss the alkaline nature of toothpaste, and of saliva released when chewing sugar free gum, in neutralising the acid produced.</p>	<p>Tooth decay animation: http://www.mchoralhealth.org/OpenWide/media/flash/decay_flash.htm</p>	
5(m)	Describe peristalsis.	<p>A bead in a length of rubber tubing illustrates the action. Reference should be made to food being pushed along the entire length of the gut by waves of contraction of circular muscles and of the antagonistic effect of the longitudinal muscles.</p> <p>Use the online resource suggested to show students a video clip of peristalsis occurring in a patient.</p>	<p>Digestion, including peristalsis diagram and animation: http://www.passmyexams.co.uk/GCSE/biology/digestive_system.html</p> <p>Endoscopic peristalsis video: http://www.youtube.com/watch?v=o18UycWRsaA&feature=player_embedded</p>	

5(n)	Explain why most foods must be digested.	<p>Also see 5(j). Only small molecules can pass through the membranes of the cells lining the gut to be absorbed into the body. Until then, even when in the gut, they are still outside the body. Starch, proteins and fats are too large to be absorbed and must be broken down into the smallest constituent parts.</p> <p>Shapes cut from thin card and projected with an OHP can illustrate effectively how starch is constructed from a string of monosaccharide units, proteins from amino acids and fats from fatty acids and glycerol.</p>	<p>Macromolecules and end prods: http://www.passmyexams.co.uk/GCSE/biology/images/enzymes_digestion.jpg</p>	
5(o)	Describe digestion in the alimentary canal and the functions of a typical amylase, protease and lipase, listing the substrates and end-products.	<p>Where each molecule is dismantled may be related to a specific region of the alimentary canal and to a specific enzyme (and optimum pH). When food arrives in the ileum, only the end products of digestion are present (together with those chemicals that are not broken down, either because they are already small enough for absorption or because no enzymes are present for their breakdown). The role of bile in emulsifying fats should be included.</p> <p>Refer back to the diagram provided in 5(i) and explain how each region and organ achieves the breakdown demonstrated in 5(n).</p> <p>Students may answer a question such as 'describe fully the digestion of a potato fried in oil' to test their understanding and sequencing of the important facts.</p>	<p>Digestion diagrams and explanations: http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/enzymes/enzymes_and_digestion2.shtml http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/enzymes/enzymes_and_digestion3.shtml</p> <p>Digestion animated video: http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/enzymes/digestionact.shtml</p>	

5(p)	Describe the structure of a villus, including the roles of capillaries and lacteals.	<p>All food substances entering the body are absorbed by villi. Refer to the large surface area of each villus and of villi collectively. Display a large annotated diagram to show villus structure in LS. All absorbed substances pass into the blood capillaries, with the exception of the digested fats which pass into the lacteals.</p> <p>Make a large, labelled and annotated drawing of a villus.</p>	<p>Photomicrograph of villi: http://missinglink.ucsf.edu/lm/ID_S_101_histo_resource/images/246x10-cell_structure_labelled.jpg</p> <p>Labelled diagram of villus: http://www.bbc.co.uk/scotland/learning/bitesize/standard/biology/images/villus.gif</p>	
5(q)	Describe the significance of villi in increasing the internal surface area.	See 5(p)	See suggested resources above.	
5(r)	State the function of the hepatic portal vein as the route taken by most of the food absorbed from the small intestine.	Explain that lacteals unite to join the lymph system, which feeds into the circulatory system and by-passes the liver. Blood capillaries link directly with the liver via the hepatic portal vein.		
5(s)	<p>State:</p> <ul style="list-style-type: none"> - that large molecules are synthesised from smaller basic units - glycogen from glucose, proteins from amino acids, lipids (fats and oils) from glycerol and fatty acids; - the role of the liver in metabolism of glucose and amino acids; - the role of fat as a storage substance; - that the formation of urea and the breakdown of alcohol occur in the liver. 	<p>The breakdown of large molecules to small ones has already been considered. The reverse of this is a part of the process of assimilation. Stress that glucose in animals is built up into glycogen rather than starch.</p> <p>Conversion of glucose into glycogen and its storage occur in the liver. Refer to 11(j) and (k) in Unit 5 for details.</p> <p>Fat is a high-energy, insulating storage substance. It is stored in the dermis and round kidneys. It is not considered to be 'stored' around the heart.</p> <p>The breakdown of excess amino acids into a carbohydrate (stored as glycogen) and the excretory product urea in the liver should be mentioned. As a part of its role in removing poisons the liver also breaks down alcohol.</p>		