UNIT 2: Animal Nutrition

Recommended Prior Knowledge Students can come into this Unit with very little biological knowledge. However, they do need to understand some basic chemistry such as atoms, elements and compounds. An understanding of bonding and the role of ions in simple chemical reactions is an advantage,

Context The molecules that make up the bodies of living things are introduced here, and will be referred to in all of the subsequent Units.

Outline This Unit considers the molecules from which living organisms are made, and then looks in detail at how animals acquire the materials that they need to form the structure of their bodies, and also to supply energy. The way in which small molecules can be used to make larger ones is briefly considered, before thinking about how such large molecules need to be broken down again before they can be absorbed through the wall of the alimentary canal. The functions of the main digestive enzymes are considered, linking back to the work on enzymes in Unit 1. The use of food to supply energy will be covered in more detail in Unit 4, and the functions of the liver in glucose and amino acid metabolism, touched on very briefly here, will be treated in more depth in Units 5 and 6.

	Learning Outcomes	**Suggested Teaching Activities**	**Resources**
II 6	Nutrition • Define *nutrition* as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them.	Discuss the need for materials for growth and repair and for energy to maintain their activities such as movement and sensitivity. A simple definition of an organic substance is one whose molecules contain carbon and hydrogen. Cross link with plant nutrition in Unit 3, 6.2.1	
II 6.1	• List the chemical elements which make up: - carbohydrates - fats - proteins • Describe the synthesis of large molecules from smaller basic units, - simple sugars to starch and glycogen - amino acids to proteins - fatty acids and glycerol to fats and oils	Ensure that students have some understanding of the terms: element, atom, molecule. Beads that string together, or simple chemical modelling kits, can be used to illustrate the idea of small molecules joining together to make larger ones. A table or flash cards can identify the classes of foods. class source of food uses of food …….in body. Students can complete the table by using the information on food packets. Students should understand that starch is the carbohydrate stored only in plants. Animals store carbohydrate as glycogen.	

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II 6.1	Describe tests for: - starch (iodine solution), - reducing sugars (Benedict's solution), - protein (biuret test) - fats (ethanol) • List the principal sources of, and describe the importance of: - carbohydrates, - fats, - proteins, - vitamins (C and D only), - mineral salts (calcium and iron only), fibre (roughage) - water • Describe the deficiency symptoms for - vitamins (C and D only) - mineral salts (calcium and iron only). Supplement • Describe the use of microorganisms in the food industry, with reference to: - yoghurt - single cell protein • Describe: - uses - benefits - health hazards associated with: - food additives - food colourings	Students should have the opportunity to carry out each of these tests on a range of foods. It is a good practical lab in which students should realize the importance of safety when using a water bath. As an extension exercise, students can be given a solution containing a mixture of unknowns such as a reducing sugar and a protein. This can also give useful practice in recording qualitative results in a clearly presented results chart. Conclusions can also be written from the observed results. Food tests also enhance the students' understanding of the main classes of foods. The information on multivitamin tablet packets lists the vitamin contents and their requirements in the human body. Students can make yoghurt in the lab and should discuss the importance of sterile apparatus and of the constant temperature necessary for the process. The use of yeast for bread making can be linked to anaerobic respiration: Unit 4, 8.1. Students can vary the mass of yeast in a given volume of water that is added to a constant mass of flour to measure the increase in height of flour in a large test tube or plastic cup over time. Temperature or sugar can also be used as a variable. A good source of ideas for this is the booklet 'Practical Biotechnology'. The health benefits of preservatives, in terms of greatly reduced risk of food poisoning, should be emphasised. Antioxidants also increase storage times for many foods. Flavourings and flavour enhancers increase palatability. A few artificial colourings, such as tartrazine, have been associated with problems such as hyperactivity.	Refer to questions from papers 5 and 6 on food tests. Sanatogen vitamins. http://www.sanatogen.co.uk … http://www.nature.com/ijo/journal/v21/n9/abs/0800473a.html http://faculty.mansfield.edu/bganong/biochemistry/vitaminc.htm http://en.wikipedia.org/wiki/Fehling%27s_solution There are several books on biotechnology listed in the bibliography. http://www.curiculumsupport.education.nsw.gov.au this website has some suggestions on yeast growth. http://www.ncbe.reading.ac.uk/ncbe/protocols/pracbiotech.html

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II 6.3.1	Animal Nutrition Diet • State what is meant by the term balanced diet and describe a balanced diet related to: - age, - sex and - activity of an individual	Diets in most countries depend on a staple food such as bread, potatoes or rice, which is usually the main source of carbohydrate. Students should be aware of the main sources of each type of nutrient in their own country, but also be prepared to consider how diets differ in other parts of the world. The Association for Science Education., has a project called Science Across Europe, which includes a unit on diet, and encourages schools in different parts of the world to share information. Students can keep a record of the food that they eat during one day, and then consider whether they are obtaining the nutrients that they need.	Balanced diet http://www.sambal.co.uk/diet.html http://www.ase.org.uk/ Food Tables by Bender and Bender, OUP 0-19-832724-2 This information about nutrients and their energy contents.
	• Describe the effects of malnutrition in relation to: - starvation, - coronary heart disease, - constipation - obesity	Malnutrition should be considered as the result of eating an unbalanced diet, not just the lack of a particular type of nutrient. Controlled discussion on malnutrition can be useful and the problems associated with starvation can be linked to Unit 10, 5.1 The long term problems associated with obesity like onset diabetes should be discussed.	

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II 6.3.2	Food supply • Discuss the ways in which the use of modern technology has resulted in increased food production to include: - modern agriculture machinery - chemical fertilisers - pesticides - herbicides - artificial selection Supplement • Discuss the problems of world food supplies • Discuss the problems which contribute to famine: - unequal distribution of food - drought - flooding - increasing population.	Material to illustrate this topic, and to form the basis of discussion, can be collected from newspaper and television reports. Students may like to consider whether new technologies, such as the development of genetically modified varieties of crops, are likely to improve the situation or exacerbate it. Drought and flooding can be linked to Unit 10 5.1	Technology to Feed the World http://www.nationalacademies.org/webextra/crops/ A discussion of the problems of feeding the world's growing population, with excellent links to many other sites
II 6.3.3	Human alimentary canal • Define *ingestion* as taking substances e.g. food and drink into the body through the mouth • Define *egestion* as passing out of food that has not been digested as faeces, through the anus. • Identify the main regions of the alimentary canal and associated organs including: - mouth - salivary glands - oesophagus - stomach, - small intestine: duodenum and ileum, - pancreas	Students often do not understand that the alimentary canal is a long tube - albeit a coiled one - through which food passes. A long flexible rubber tube can demonstrate the idea. A schematic diagram on A3 paper can clarify the main events that take place from ingestion by the mouth to egestion from the anus. Arrows in different colours can show which enzymes are involved along the canal. Students should understand that food cannot be considered to have entered the body until it crosses the wall of the canal.	

	- liver - gall bladder - large intestine: colon and rectum, - anus • Describe the functions of the regions of the alimentary canal listed above, in relation to: - ingestion, - digestion, - absorption, - assimilation - egestion of food Cross reference 6.3.4 to 6.3.7 inclusive.	The need for digestion to take place before absorption occurs is shown by using Visking tubing (to represent the alimentary canal) containing a mixture of glucose, starch and water. The visking tubing is placed in a beaker or a large test tube of water (to represent the blood), and left for several hours to allow the glucose to diffuse across the tubing. The contents of the tubing and of the beaker can be tested for starch and for glucose. Students studying the supplement should be directed towards an understanding of the role of active transport in the absorption of glucose and amino acids from the capillaries of the villi into the hepatic portal vein.		
II **6.3.4**	Supplement Describe how fluoride reduces tooth decay and explain arguments for and against the addition of fluoride to public water supplies.	Although most health professionals strongly support the addition of fluoride to water supplies, there are also some arguments against this.	Fluorides and fluoridation http://www.ada.org The American Dental Association's site dealing with the fluoride issue. The Story of Fluoridation	

II 6.3.5	Chemical Digestion. • State the significance of chemical digestion in the alimentary canal, in producing small, soluble molecules that can be absorbed • State where, in the alimentary canal - amylase - protease - lipase enzymes are secreted • State the functions of a typical: - amylase - protease - lipase listing the substrate and end products.	This topic should be linked with earlier work on enzymes, in Unit 1, II.5. .. Students could draw a spider diagram of the alimentary canal. This can help them visualise from where the enzymes are secreted and where they act on specific substrates. The importance of optimum pH and temperature should be emphasised. Also the importance of enzymes in the whole process of digestion.		

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II 6.3.6	Absorption • Define a*bsorption* as the movement of digested food molecules through the wall of the intestine into the blood or lymph. • Identify the small intestine as the region for absorption of digested food. • Describe the significance of villi in increasing the internal surface area of the small intestine. Supplement • Describe the structure of the villus, including the role of capillaries and lacteals • State the role of the hepatic portal vein in the transport of absorbed food to the liver. • Identify the role of the small intestine and colon in the absorption of water(the small intestine absorbs 5-10 dm^3 per day, the colon 0.3-0.5dm^3 per day)	Core students do not need any detail of the villus structure but they need to understand that the dissolved substances, glucose and amino acids, are transported in the blood to the liver before they can be assimilated into the body. It helps the students to understand the importance of diffusion if the villus is compared with the alveoli in the lungs, Unit 4, 8.3. The two structures can be compared as having a single cell membrane, good blood supply, moist surface area and a large surface area for efficient diffusion. The absorption of glucose should be linked with earlier work on active transport, in Unit 1, II.3.	

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II 6.3.7	Assimilation • Describe *assimilation* as movement of digested food molecules into the cells of the body where they are used, becoming part of the cells. • Describe the role of the liver in the: metabolism of glucose to glycogen • amino acids into proteins • the destruction of excess amino acids. Describe the role of fat as an energy storage substance. Supplement • Define *deamination* as removal of the nitrogen-containing part of amino acids to form urea followed by the release of energy from the remainder of the amino acid • State that the liver is the site of breakdown of alcohol and other toxins.	For Core students, no detail of the hormonal control of glucose levels is required. They should, however, know that the liver stores excess glucose as glycogen (link back to section II 6.1) and converts this back to glucose again if blood glucose levels fall. The conversion of excess amino acids to urea should be dealt with very simply; this will be covered again in Unit 5,10.4 The importance of nitrogen in the body could be discussed in relation to DNA, hormones and enzymes.	