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UNIT 1 Cells and Cell Processes Nutrition

Recommended Prior Knowledge Students can come to this Unit with very little prior knowledge. In order to understand diffusion and osmosis, they will need some understanding of particle theory. Some knowledge of catalysts will also be helpful, and they should know a little about simple chemical reactions and how to represent these by word equations. The concept of pH should also be understood at a simple level.

Context This Unit covers some fundamental topics that will be drawn on in all the Units that follow, and therefore the majority of it is covered by both Core and Extension candidates.

Outline The Unit first considers the special features that make living things different from non-living objects, and then looks at the structure and functions of animal and plant cells, which leads into the organisation of cells into tissues. Some particular examples of specialised cells are considered, which introduces the idea of structural adaptations for particular functions. Movement of substances within living organisms by diffusion, osmosis and active transport (the latter for extension candidates only) is considered. A simple treatment of enzyme function and some applications completes the Unit. Note that section I, parts 2 and 3, are not included here, but have been placed in Unit 9. However, some teachers may prefer to cover these topics in this unit.

	Learning Outcomes	Suggested Teaching Activities	Online Resources	Other resources
I 1	List and describe the characteristics of living organisms Define the terms *nutrition, excretion, respiration, sensitivity, reproduction, growth and movement*	Ask students to suggest characteristics that are shared by plants and themselves but not by non-living objects.		
II 1	Identify and describe the structure of a plant cell (palisade cell) and an animal cell (liver cell) as seen under a light microscope Describe the differences in structure between typical plant and animal cells	Palisade cells can be seen using prepared slides or transparencies of leaf sections. Freshwater filamentous algae can be mounted in a drop of water on a slide and viewed with a microscope. Liver cells are difficult to observe, but it may be possible to make temporary mounts of stained cheek cells.	Illustrations of cells http://www.cellsalive.com/	
II 1	Relate the structures seen under the light microscope in the plant cell and the animal cell to their functions.	Extension candidates should consider functions of features that are common to plant and animal cells, and those that are found in plant cells only. They should consider how the differences between animal and plant cells relate to their different methods of obtaining nutrients.		

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II 2	Define tissue and relate the structure of the following to their functions: Ciliated cells – in respiratory tract Root hair cells – absorption Xylem vessels – conduction and support Muscle cells – contraction Red blood cells – transport Define *organs* and *organ systems* as illustrated by examples covered in Sections II and III	Examine a temporary mount of epidermal tissue peeled from the inner surface of an onion bulb. The coverage of these examples of cells and of organs and organ systems could come later when they can be dealt with in context.	Examples of differentiated cells: http://www.iacr.bbsrc.ac.uk/notebook/courses/guide/organ.htm	
II 3	Calculate the magnification and size of biological specimens using millimetres as units	Use the temporary mount of epidermal tissue peeled from the inner surface of an onion bulb and appropriate scale to determine the size of cells.	Microscope magnification specifications & field of view http://www.microscope-microscope.org/advanced/magnification-1.htm	
II 4.1	Define diffusion as the movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient. Describe the importance of gaseous and solute diffusion and of water as a solvent.	Use a simple demonstration of diffusion, for example a potassium manganate IV crystal in a gas jar of water (diffusion of a solute), or ammonia and hydrochloric acid placed at opposite ends of a long glass tube, or simply a perfume container opened in one corner of the room (gaseous diffusion) Emphasise the random motion of particles. Consider the relevance of thjs to living organisms – for example, the diffusion of oxygen and carbon dioxide into and out of a plant leaf or across the surface of the alveoli in the human lungs.	Diffusion and osmosis animation and text: http://www.bbc.co.uk/scotland/revision/biology/investigating_cells/cells_and_diffusion_rev.shtml#diffusion Diffusion and osmosis interactive animations: http://physioweb.med.uvm.edu/bodyfluids/osmosis.htm	

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II 4.3	Define osmosis as the passage of water molecules from a region of their higher concentration to a region of their lower concentration, through a partially permeable membrane. Describe the importance of osmosis in the uptake of water by plants and its effects on plant and animal tissues.	Osmosis should be treated as a special case of diffusion, in which only *water* molecules are able to move from one side of a partially permeable membrane to another. Ensure that students understand what a *solution* is in terms of particles, so that they are able to imagine the water molecules and solute particles behaving independently of each other. Use visking tubing to demonstrate osmosis. Investigation of changes in mass or length of potato chips placed in a range of different sugar solutions provides good opportunity for quantitative treatment of results, as well as enhancing understanding of osmosis. Discuss differences in the effects of water uptake and loss on animal cells and plant cells in terms of the absence and presence of the plant cell wall. Turgor as an important mechanism of support in plants could be discussed. Relate water uptake by osmosis back to the structure of root hair cells covered earlier in this Unit.	Visking tubing expt – interactive http://www.mhhe.com/biosci/esp/2001_gbio/folder_structure/ce/m3/s3/cem3s3_3.htm	
II 4.3	Understand the concept of a water potential gradient.	Explain water potential as the tendency for water to leave a solution. The more water (that is them more dilute the solution) the higher the water potential. Water moves from a high water potential to a low water potential – that is, down a water potential gradient. Do not introduce the idea of negative water potentials at this level.		

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II 4.2	Define active transport and discuss its importance as an energy-consuming process by which substances are transported against a concentration gradient, e.g. ion uptake by root hairs and uptake of glucose by epithelial cells of villi.	No detail of the molecular mechanism of active transport needs to be considered. Students should understand that energy for this process is provided by respiration.		
II 5	Define *enzymes* as proteins which function as biological catalysts. Describe the effect of changes in temperature and pH on enzyme activity.	Simple experiments with catalase are an excellent introduction to enzymes. Revise the meaning of the term 'catalyst'. Ensure that students understand that enzymes are simple molecules, not living organisms. They cannot, therefore, be 'killed'. Investigate the effect of temperature on the effect of enzyme activity, for example using starch and amylase, or pepsin and milk powder. Explain the rise in activity with temperature in terms of kinetic theory, and the fall as temperature rises in terms of denaturation of the enzyme molecules. Consider the different optimum temperatures of different enzymes, not only those in humans.	Simple account of how enzymes work: http://www.activescience-gsk.com/miniweb/content/enzymes/how_do.htm	

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II 5	Describe the role of enzymes in the germination of seeds and their uses in biological washing products and in the food industry. Outline the use of microorganisms and fermenters to manufacture enzymes for use in biological washing powders.	The role of amylase in the breakdown of starch to maltose in seeds provides an example of enzymes in plants. Germinating barley seeds, dipped into a sterilising solution to destroy any micro-organisms on their surfaces, can be placed on sterile starch agar in a petri dish, which can later be tested for starch with iodine solution. Proteases, lipases and amylases, often with high optimum temperatures, are all used in biological washing powders. Investigations can be carried out into the effectiveness of these in removing different types of stains. Simple experiments on the effect of pectinase on the yield of juice from crushed apples can be carried out.	Downloadable booklet 'Practical Biotechnology', with practical investigations using a variety of enzymes http://www.ncbe.reading.ac.uk/NCBE/PROTOCOLS/pracbiotech.html	