

# 4. Curriculum content

## BIOLOGY

Core	Supplement
<b>B1. Characteristics of living organisms</b>	
1 List and describe the characteristics of living organisms.	
<b>B2. Cells</b>	
<b>2.1 Cell structure and organisation</b>	
1 State that living organisms are made of cells. 2 Identify and describe the structure of a plant cell (palisade cell) and an animal cell (liver cell), as seen under a light microscope. 4 Describe the differences in structure between typical animal and plant cells. 5 Calculate magnification and size of biological specimens using millimetres as units.	3 Relate the structures seen under the light microscope in the plant cell and in the animal cell to their functions.
<b>2.2 Movement in and out of cells</b>	
1 Define <i>diffusion</i> as the net movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient, as a result of their random movement. 2 Describe the importance of diffusion of gases and solutes and of water as a solvent.	
<b>B3. Enzymes</b>	
1 Define <i>enzymes</i> as proteins that function as biological catalysts. 2 Investigate and describe the effect of changes in temperature and pH on enzyme activity.	3 Explain the effect of changes in temperature and pH on enzyme activity.

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<b>B4. Nutrition</b>	
<b>4.1 Nutrients</b>	
<ol style="list-style-type: none"> <li>1 List the chemical elements that make up:               <ul style="list-style-type: none"> <li>• carbohydrates,</li> <li>• fats,</li> <li>• proteins.</li> </ul> </li> <li>2 Describe the structure of large molecules made from smaller basic units, i.e.               <ul style="list-style-type: none"> <li>• simple sugars to starch and glycogen,</li> <li>• amino acids to proteins,</li> <li>• fatty acids and glycerol to fats and oils.</li> </ul> </li> <li>3 Describe tests for:               <ul style="list-style-type: none"> <li>• starch (iodine solution),</li> <li>• reducing sugars (Benedict's solution),</li> <li>• protein (biuret test),</li> <li>• fats (ethanol).</li> </ul> </li> <li>4 List the principal sources of, and describe the importance of:               <ul style="list-style-type: none"> <li>• carbohydrates,</li> <li>• fats,</li> <li>• proteins,</li> <li>• vitamins (C and D only),</li> <li>• mineral salts (calcium and iron only),</li> <li>• fibre (roughage),</li> <li>• water.</li> </ul> </li> <li>6 Describe the deficiency symptoms for:               <ul style="list-style-type: none"> <li>• vitamins (C and D only),</li> <li>• mineral salts (calcium and iron only).</li> </ul> </li> </ol>	<ol style="list-style-type: none"> <li>5 Describe the use of microorganisms in the manufacture of yoghurt.</li> </ol>

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<b>4.2 Plant nutrition</b>	
<ol style="list-style-type: none"> <li>1 Define <i>photosynthesis</i> as the fundamental process by which plants manufacture carbohydrates from raw materials using energy from light.</li> <li>3 State the word equation for the production of simple sugars and oxygen.</li> <li>5 Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls.</li> <li>7 Describe the intake of carbon dioxide and water by plants.</li> <li>8 Identify and label the cuticle, cellular and tissue structure of a dicotyledonous leaf, as seen in cross-section under the light microscope.</li> </ol>	<ol style="list-style-type: none"> <li>2 Explain that chlorophyll traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent storage.</li> <li>4 State the balanced equation for photosynthesis in symbols  <math display="block">6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow[\text{chlorophyll}]{\text{light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2</math> </li> <li>6 Investigate and state the effect of varying light intensity on the rate of photosynthesis (e.g. in submerged aquatic plants).</li> </ol>
<b>4.3 Animal nutrition</b>	
<ol style="list-style-type: none"> <li>1 State what is meant by the term balanced diet and describe a balanced diet related to age, sex and activity of an individual.</li> <li>3 Identify the main regions of the alimentary canal and associated organs including mouth, salivary glands, oesophagus, stomach, small intestine: duodenum and ileum, pancreas, liver, gall bladder, large intestine: colon and rectum, anus.</li> <li>4 Describe the functions of the regions of the alimentary canal listed above, in relation to ingestion, digestion, absorption, assimilation and egestion of food.</li> </ol>	<ol style="list-style-type: none"> <li>2 Describe the effects of malnutrition in relation to starvation, coronary heart disease, constipation and obesity.</li> </ol>

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<ol style="list-style-type: none"> <li>5 Define <i>digestion</i> as the break-down of large, insoluble food molecules into small, water-soluble molecules using mechanical and chemical processes.</li> <li>6 Identify the types of human teeth and describe their structure and functions.</li> <li>7 State the causes of dental decay and describe the proper care of teeth.</li> <li>8 State the significance of chemical digestion in the alimentary canal in producing small, soluble molecules that can be absorbed.</li> <li>9 Define <i>absorption</i> as movement of digested food molecules through the wall of the intestine into the blood.</li> <li>10 Identify the small intestine as the region for the absorption of digested food.</li> </ol>	
<b>B5. Transportation</b>	
<b>5.1 Transport in plants</b>	
<ol style="list-style-type: none"> <li>1 State the functions of xylem and phloem.</li> <li>2 Identify the positions of xylem tissues as seen in transverse sections of unthickened, herbaceous, dicotyledonous roots, stems and leaves.</li> <li>3 Identify root hair cells, as seen under the light microscope, and state their functions.</li> <li>5 Investigate, using a suitable stain, the pathway of water through the above-ground parts of a plant.</li> <li>6 Define <i>transpiration</i> as evaporation of water at the surfaces of the mesophyll cells followed by loss of water vapour from plant leaves, through the stomata.</li> <li>7 Describe the effects of variation of temperature, humidity and light intensity on transpiration rate.</li> </ol>	<ol style="list-style-type: none"> <li>4 Relate the structure and functions of root hairs to their surface area and to water and ion uptake.</li> </ol>

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<b>5.2 Transport in humans</b>	
<p>1 Describe the circulatory system as a system of tubes with a pump and valves to ensure one-way flow of blood.</p> <p>3 Describe the structure of the heart including the muscular wall and septum, atria, ventricles, valves and associated blood vessels.</p> <p>5 Describe the function of the heart in terms of muscular contraction and the working of the valves.</p> <p>6 Investigate the effect of physical activity on pulse rate.</p> <p>8 Identify red and white blood cells as seen under the light microscope on prepared slides, and in diagrams and photomicrographs.</p> <p>9 List the components of blood as red blood cells, white blood cells, platelets and plasma.</p> <p>10 State the functions of blood:</p> <ul style="list-style-type: none"><li>• red blood cells – haemoglobin and oxygen transport,</li><li>• white blood cells – phagocytosis and antibody formation,</li><li>• platelets – causing clotting (no details),</li><li>• plasma – transport of blood cells, ions, soluble nutrients, hormones and carbon dioxide.</li></ul>	<p>2 Describe the double circulation in terms of a low pressure circulation to the lungs and a high pressure circulation to the body tissues and relate these differences to the different functions of the two circuits.</p> <p>4 Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible causes (diet, stress and smoking) and preventive measures.</p> <p>7 Investigate, state and explain the effect of physical activity on pulse rate.</p>

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<b>B6. Respiration</b>	
<b>6.1 Respiration and energy</b>	
<ol style="list-style-type: none"> <li>1 Define <i>respiration</i> as the chemical reactions that break down nutrient molecules in living cells to release energy.</li> <li>2 State the uses of energy in the body of humans: muscle contraction, protein synthesis, cell division, growth, the passage of nerve impulses and the maintenance of a constant body temperature.</li> <li>3 State the word equation for aerobic respiration.</li> </ol>	<ol style="list-style-type: none"> <li>4 Define <i>aerobic respiration</i> as the release of a relatively large amount of energy in cells by the breakdown of food substances in the presence of oxygen.</li> <li>5 State the equation for aerobic respiration using symbols (<math>C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O</math>).</li> </ol>
<b>6.2 Gas exchange</b>	
<ol style="list-style-type: none"> <li>1 Identify on diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries.</li> <li>5 State the differences in composition between inspired and expired air.</li> <li>6 Use lime water as a test for carbon dioxide to investigate the differences in composition between inspired and expired air.</li> <li>7 Investigate and describe the effects of physical activity on rate and depth of breathing.</li> </ol>	<ol style="list-style-type: none"> <li>2 List the features of gas exchange surfaces in animals.</li> <li>3 Explain the role of mucus and cilia in protecting the gas exchange system from pathogens and particles.</li> <li>4 Describe the effects of tobacco smoke and its major toxic components (tar, nicotine, carbon monoxide, smoke particles) on the gas exchange system.</li> <li>8 Explain the effects of physical activity on rate and depth of breathing.</li> </ol>

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<b>B7. Coordination and response</b>	
<b>7.1 Hormones</b>	
<ol style="list-style-type: none"> <li>1 Define a <i>hormone</i> as a chemical substance, produced by a gland, carried by the blood, which alters the activity of one or more specific target organs and is then destroyed by the liver.</li> <li>2 State the role of the hormone adrenaline in chemical control of metabolic activity, including increasing the blood glucose concentration and pulse rate.</li> <li>3 Give examples of situations in which adrenaline secretion increases.</li> </ol>	
<b>7.2 Tropic responses</b>	
<ol style="list-style-type: none"> <li>1 Define and investigate <i>geotropism</i> (as a response in which a plant grows towards or away from gravity) and <i>phototropism</i> (as a response in which a plant grows towards or away from the direction from which light is coming).</li> </ol>	<ol style="list-style-type: none"> <li>2 Explain the chemical control of plant growth by auxins including geotropism and phototropism in terms of auxins regulating differential growth.</li> </ol>
<b>B8. Reproduction</b>	
<b>8.1 Asexual and sexual reproduction</b>	
<ol style="list-style-type: none"> <li>1 Define <i>asexual reproduction</i> as the process resulting in the production of genetically identical offspring from one parent.</li> <li>2 Define <i>sexual reproduction</i> as the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring.</li> </ol>	

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<b>8.2 Sexual reproduction in plants</b>	
<p>1 Identify and draw, using a hand lens if necessary, the sepals, petals, stamens, anthers, carpels, ovaries and stigmas of one, locally available, named, insect-pollinated, dicotyledonous flower, and examine the pollen grains under a light microscope or in photomicrographs.</p> <p>3 State the functions of the sepals, petals, anthers, stigmas and ovaries.</p> <p>4 Candidates should expect to apply their understanding of the flowers they have studied to unfamiliar flowers.</p> <p>5 Define <i>pollination</i> as the transfer of pollen grains from the male part of the plant (anther of stamen) to the female part of the plant (stigma).</p> <p>6 Name the agents of pollination.</p> <p>8 Investigate and state the environmental conditions that affect germination of seeds: requirement for water and oxygen, suitable temperature.</p>	<p>2 Use a hand lens to identify and describe the anthers and stigmas of one, locally available, named, wind-pollinated flower.</p> <p>7 Compare the different structural adaptations of insect-pollinated and wind-pollinated flowers.</p>



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<b>8.3 Sexual reproduction in humans</b>	
<p>1 Identify on diagrams of the male reproductive system, the testes, scrotum, sperm ducts, prostate gland, urethra and penis, and state the functions of these parts.</p> <p>3 Identify on diagrams of the female reproductive system, the ovaries, oviducts, uterus, cervix and vagina, and state the functions of these parts.</p> <p>4 Describe the menstrual cycle in terms of changes in the uterus and ovaries.</p> <p>5 Describe fertilisation in terms of the joining of the nuclei of male gamete (sperm) and the female gamete (egg).</p> <p>6 Outline early development of the zygote simply in terms of the formation of a ball of cells that becomes implanted in the wall of the uterus.</p> <p>10 Describe the methods of transmission of human immunodeficiency virus (HIV), and the ways in which HIV/AIDS can be prevented from spreading.</p>	<p>2 Compare male and female gametes in terms of size, numbers and mobility.</p> <p>7 Indicate the functions of the amniotic sac and amniotic fluid.</p> <p>8 Describe the function of the placenta and umbilical cord in relation to exchange of dissolved nutrients, gases and excretory products (no structural details are required).</p> <p>9 Describe the advantages and disadvantages of breast-feeding compared with bottle-feeding using formula milk.</p> <p>11 Outline how HIV affects the immune system in a person with HIV/AIDS.</p>

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<b>B9. Energy flow in ecosystems</b>	
<ol style="list-style-type: none"><li>1 State that the Sun is the principal source of energy input to biological systems.</li><li>2 Define the terms:<ul style="list-style-type: none"><li>• <i>food chain</i> as a chart showing the flow of energy (food) from one organism to the next beginning with a producer (e.g. mahogany tree → caterpillar → song bird → hawk),</li><li>• <i>food web</i> as a network of interconnected food chains showing the energy flow through part of an ecosystem,</li><li>• <i>producer</i> as an organism that makes its own organic nutrients, usually using energy from sunlight, through photosynthesis,</li><li>• <i>consumer</i> as an organism that gets its energy by feeding on other organisms,</li><li>• <i>herbivore</i> as an animal that gets its energy by eating plants,</li><li>• <i>carnivore</i> as an animal that gets its energy by eating other animals.</li></ul></li><li>6 Describe the carbon cycle.</li></ol>	<ol style="list-style-type: none"><li>3 Describe energy losses between trophic levels.</li><li>4 Define the terms:<ul style="list-style-type: none"><li>• <i>decomposer</i> as an organism that gets its energy from dead or waste organic matter,</li><li>• <i>ecosystem</i> as a unit containing all of the organisms and their environment, interacting together, in a given area e.g. decomposing log or a lake,</li><li>• <i>trophic level</i> as the position of an organism in a food chain or food web.</li></ul></li><li>5 Explain why food chains usually have fewer than five trophic levels.</li> <li>7 Discuss the effects of the combustion of fossil fuels and the cutting down of forests on the oxygen and carbon dioxide concentrations in the atmosphere.</li></ol>

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<b>B10. Human influences on the ecosystem</b>	
<p>1 List the undesirable effects of deforestation (to include extinction, loss of soil, flooding, carbon dioxide build up).</p> <p>2 Describe the undesirable effects of pollution to include:</p> <ul style="list-style-type: none"><li>• water pollution by sewage and chemical waste,</li><li>• air pollution by greenhouse gases (carbon dioxide and methane) contributing to global warming.</li></ul> <p>6 Describe the need for conservation of:</p> <ul style="list-style-type: none"><li>• species and their habitats,</li><li>• natural resources (limited to water and non-renewable materials including fossil fuels).</li></ul>	<p>3 Describe the undesirable effects of overuse of fertilisers (to include eutrophication of lakes and rivers).</p> <p>4 Discuss the causes and effects on the environment of acid rain, and the measures that might be taken to reduce its incidence.</p> <p>5 Explain how increases in greenhouse gases (carbon dioxide and methane) are thought to cause global warming.</p>