



# **National 5 Biology:**

## **Course content change comparison**

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<b>Cell biology</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>1 Cell structure</b></p> <p>a Cell ultrastructure and functions — cell wall, mitochondrion, chloroplast, cell membrane, cytoplasm, vacuole, nucleus, ribosome and plasmid using examples from typical plant, animal, fungal and bacterial cells.</p> <p>b Cell wall is made of cellulose in plant cells but of different materials in fungal and bacterial cells.</p> <p><b>2 Transport across cell membranes</b></p> <p>a The cell membrane consists of phospholipids and proteins and is selectively permeable.</p> <p>b Passive transport occurs down a concentration gradient and does not require energy. Examples of passive transport are diffusion and osmosis.</p>	<p>Fungal structure in terms of similarity to plant and animal cells but with a different cell wall structure.</p> <p>Structure of bacteria — absence of organelles and a different cell wall structure to plant and fungal cells.</p> <p>Chemical composition of cell walls for fungi and bacteria not required.</p> <p>Different concentrations of substances exist between cells and their environment.</p>	<p>Key area is split into 1 a and 1 b.</p> <p>Clarification of required depth of knowledge. No change to content.</p> <p>Minor rewording for clarification. Clarification of required depth of knowledge. No change to content.</p> <p>No change to content.</p> <p>Minor rewording for clarification. Clarification of required depth of knowledge. No change to content.</p>

<b>Cell biology (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>2 Transport across cell membranes (continued)</b></p> <p>c Diffusion is the movement of molecules down a concentration gradient from a higher to a lower concentration.</p> <p>d Osmosis is the movement of water molecules from a higher water concentration to a lower water concentration through a selectively permeable membrane.</p> <p>e Animal cells can burst or shrink and plant cells can become turgid or plasmolysed. Relationship between different concentrations of solutions and their effect on cells.</p> <p>f Active transport requires energy for membrane proteins to move molecules and ions against the concentration gradient.</p>	<p>Explain diffusion of important substances such as glucose, carbon dioxide and oxygen in terms of their concentration gradients.</p> <p>Details of the terms hypotonic, hypertonic and isotonic are not required.</p> <p>Details of how active transport takes place are not required.</p>	<p>Minor rewording for clarification. Clarification of required depth of knowledge. No change to content.</p> <p>Minor rewording for clarification. No change to content.</p> <p>Minor rewording for clarification. Required depth of knowledge provided. No change to content.</p> <p>Required depth of knowledge provided. No change to content.</p>

<b>Cell biology (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>3 DNA and the production of proteins</b></p> <p>a Structure of DNA: double-stranded helix held by complementary base pairs. DNA carries the genetic information for making proteins. The four bases: adenine, cytosine, guanine and thymine (A, C, G and T) make up the genetic code. A is always paired with T and C is always paired with G. The base sequence determines amino acid sequence in proteins. A gene is a section of DNA which codes for a protein.</p> <p>b Messenger RNA (mRNA) is a molecule which carries a complementary copy of the genetic code from the DNA, in the nucleus, to a ribosome, where the protein is assembled from amino acids.</p>	<p>Knowledge of uracil as a base in mRNA is not required.</p> <p>Further details of transcription and translation are not required.</p>	<p>Former key area 1.3 — Producing new cells — moved to Biology: multicellular organisms: key area 1.</p> <p>Formerly key area 1.4.</p> <p>Definition of a gene provided.</p> <p>Clarification of required depth of knowledge. No change to content.</p>

Cell biology (continued)		
Key areas	Depth of knowledge required	Changes to content
<p><b>4 Proteins</b></p> <p>a The variety of protein shapes and functions arises from the sequence of amino acids. Proteins have many functions such as structural, enzymes, hormones, antibodies and receptors.</p> <p>b Enzymes function as biological catalysts and are made by all living cells. They speed up cellular reactions and are unchanged in the process. The shape of the active site of an enzyme molecule is complementary to its specific substrate(s). Enzyme action results in product(s). Enzymes can be involved in degradation and synthesis reactions. Examples should relate enzymes to their specific substrate(s) and product(s).</p> <p>c Each enzyme is most active in its optimum conditions. Enzymes, and other proteins, can be affected by temperature and pH. Enzymes can be denatured, resulting in a change in their shape which will affect the rate of reaction.</p>	<p>Levels of protein structure such as secondary/tertiary are not required.</p> <p>An enzyme-substrate complex forms, facilitating the reaction.</p> <p>Diagrams to illustrate the stages in degradation and synthesis reactions.</p> <p style="text-align: center;">           substrate <math>\xrightarrow{\text{enzyme}}</math> product         </p>	<p>Formerly key area 1.5.</p> <p>New key area heading.</p> <p>Combined former key areas 1.5 a and 1.5 b. Clarification of required depth of knowledge. No change to content.</p> <p>Required depth of knowledge provided. No change to content.</p> <p>Reworded to introduce the idea of an enzyme being 'most active' rather than 'works best' in its optimum conditions.</p>

<b>Cell biology (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>5 Genetic engineering</b></p> <p>Genetic information can be transferred from one cell to another by genetic engineering. Stages of genetic engineering: identify section of DNA that contains required gene from source chromosome; extract required gene; extract plasmid from bacterial cell; insert required gene into bacterial plasmid; insert plasmid into host bacterial cell to produce a genetically modified (GM) organism. Use of enzymes in this process.</p> <p><b>6 Respiration</b></p> <p>a The chemical energy stored in glucose must be released by all cells through a series of enzyme-controlled reactions called respiration.</p> <p>b The energy released from the breakdown of glucose is used to generate ATP. The energy transferred by ATP can be used for cellular activities such as muscle cell contraction, cell division, protein synthesis and transmission of nerve impulses.</p>	<p>Names of particular enzymes are not required.</p> <p>How ATP is generated is not required.</p> <p>Examples of energy uses given are not exhaustive.</p>	<p>Formerly key area 1.6.</p> <p>Minor rewording for clarification. Natural exchange of genetic information and the term vector removed. Clarification of required depth of knowledge.</p> <p>Former key area 1.7 — Photosynthesis — moved to Biology: life on Earth, key area 3.</p> <p>Formerly key area 1.8.</p> <p>No change to content.</p> <p>Split into two key areas, 6 b and 6 c, to improve clarity.</p> <p>Required depth of knowledge provided. Details of ATP generation removed.</p>

Cell biology (continued)		
Key areas	Depth of knowledge required	Changes to content
<p><b>6 Respiration (continued)</b></p> <p>c Glucose is broken down to two molecules of pyruvate, releasing enough energy to yield two molecules of ATP. Further breakdown depends upon the presence/absence of oxygen. If oxygen is present, aerobic respiration takes place, and each pyruvate is broken down to carbon dioxide and water, releasing enough energy to yield a large number of ATP molecules.</p> <p>In the absence of oxygen, the fermentation pathway takes place. In animal cells, the pyruvate molecules are converted to lactate and in plant and yeast cells they are converted to carbon dioxide and ethanol.</p> <p>The breakdown of each glucose molecule via the fermentation pathway yields only the initial two molecules of ATP.</p> <p>d Respiration begins in the cytoplasm. The process of fermentation is completed in the cytoplasm whereas aerobic respiration is completed in the mitochondria.</p>	<p>Overall number of ATP molecules generated by aerobic respiration not required.</p> <p>Word summaries of the process of respiration:</p> <p>glucose + oxygen → carbon dioxide + water + energy</p> <p>glucose → carbon dioxide + ethanol + energy</p> <p>glucose → lactate + energy</p> <p>The higher the energy requirement of a cell the greater the number of mitochondria present in that cell.</p>	<p>Reworded for clarification. Overall number of ATP molecules generated removed.</p> <p>Reworded to substitute 'lactate' for 'lactic acid' to bring in line with current terminology. Clarification of required depth of knowledge.</p> <p>Reworded for clarification. Required depth of knowledge provided.</p> <p>Use of respirometers moved to list of techniques.</p>

<b>Biology: multicellular organisms</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>1 Producing new cells</b></p> <p>a Sequence of events of mitosis. Understanding of the terms chromatids, equator and spindle fibres.</p> <p>b Mitosis provides new cells for growth and repair of damaged cells and maintains the diploid chromosome complement.</p> <p>c Stem cells in animals are unspecialised cells which can divide in order to self-renew. They have the potential to become different types of cell. Stem cells are involved in growth and repair.</p> <p>d Specialisation of cells leads to the formation of a variety of cells, tissues and organs. Groups of organs which work together form systems.</p> <p>A hierarchy exists: cells → tissues → organs → systems</p>	<p>Names of the phases are not required.</p> <p>Diploid cells have two matching sets of chromosomes, which are replicated during mitosis.</p> <p>Stem cells can be obtained from the embryo at a very early stage. In addition, tissue stem cells can be found in the body throughout life. The terms pluripotent, totipotent and multipotent are not required.</p> <p>Multicellular organisms have more than one cell type and are made up of tissues and organs. Organs perform different functions. The cells in organs are specialised for their function and work together to form systems.</p> <p>Details of organs which make up individual systems are not required.</p>	<p>Combined former key area 1.3 with former key areas 2.1 and 2.2 a. Former key areas 1.3 d and 2.2 b removed. Formerly key area 1.3 a.</p> <p>Clarification of required depth of knowledge. No change to content.</p> <p>Minor rewording to combine former key areas 1.3 b and 1.3 c. Clarification of required depth of knowledge.</p> <p>Formerly key area 2.2 a. Reworded for clarification. Required depth of knowledge provided.</p> <p>Formerly key area 2.1.</p> <p>Reworded for clarification. Clarification of required depth of knowledge. No change to content.</p> <p>Exemplification of hierarchy included.</p>

<b>Biology: multicellular organisms (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>2 Control and communication</b></p> <p><b>a Nervous control</b></p> <p>i Nervous system consists of central nervous system (CNS) and other nerves. CNS consists of brain and spinal cord. Structure and function of parts of the brain — cerebrum, cerebellum and medulla. Neurons are of three types: sensory, inter and motor. Receptors detect sensory input/stimuli. Electrical impulses carry messages along neurons. Chemicals transfer these messages between neurons, at synapses.</p> <p>ii Structure and function of reflex arc.</p> <p><b>b Hormonal control</b></p> <p>i Endocrine glands release hormones into the bloodstream. Hormones are chemical messengers. A target tissue has cells with complementary receptor proteins for specific hormones, so only that tissue will be affected by these hormones.</p> <p>ii Blood glucose regulation. The roles of insulin, glucagon, glycogen, pancreas and liver.</p>	<p>A response to a stimulus can be a rapid action from a muscle or a slower response from a gland.</p> <p>Sensory neurons pass the information to the CNS. Inter neurons operate within the CNS, which processes information from the senses that require a response. Motor neurons enable a response to occur at an effector (muscle or gland).</p> <p>Reflexes protect the body from harm.</p> <p>Names and locations of individual endocrine glands, other than those mentioned in these course notes (pancreas, testes, ovaries), are not required.</p> <p>Detail of negative feedback is not required.</p>	<p>Formerly key area 2.3.</p> <p>Reworded to substitute 'inter' for 'relay' neuron to bring in line with current terminology. Clarification of required depth of knowledge.</p> <p>Required depth of knowledge provided. No change to content.</p> <p>Reworded for clarification. Required depth of knowledge provided. No change to content.</p> <p>Clarification of required depth of knowledge. No change to content.</p>

<b>Biology: multicellular organisms (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>3 Reproduction</b></p> <p>a Cells are diploid, except gametes, which are haploid.</p> <p>b The types of gametes, the organs that produce them, and where these are located in plants and animals. The basic structure of sperm and egg cells.</p> <p>c Fertilisation is the fusion of the nuclei of the two haploid gametes to produce a diploid zygote, which divides to form an embryo.</p> <p><b>4 Variation and inheritance</b></p> <p>a Comparison of discrete variation (single gene inheritance) and continuous variation (polygenic inheritance).</p>	<p>Knowledge of polyploidy is not required.</p> <p>Recognition of cells and organs involved from diagrams.</p> <p>Combining genes from two parents contributes to variation within a species.</p> <p>Single gene inheritance of characteristics showing discrete variation where measurements fall into distinct groups.</p> <p>Polygenic inheritance of characteristics showing continuous variation where there is a range of values between a minimum and a maximum.</p>	<p>Formerly key area 2.4.</p> <p>Split former key area 2.4 a into key area 3 a and 3 b. Clarification of required depth of knowledge. No change to content.</p> <p>Reworded for clarification. Required depth of knowledge provided. No change to content.</p> <p>Reworded for clarification.</p> <p>Formerly key area 2.5.</p> <p>Combined former key areas 2.5 a and 2.5 b. Reworded for clarification. Clarification of required depth of knowledge.</p>

<b>Biology: multicellular organisms (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>4 Variation and inheritance (continued)</b></p> <p>b Understanding of genetic terms: gene; allele; phenotype; genotype; dominant; recessive; homozygous; heterozygous and P, F<sub>1</sub> and F<sub>2</sub>.</p> <p>c Monohybrid crosses from parental generation through to F<sub>2</sub> generation.</p> <p>d Reasons why predicted phenotype ratios among offspring are not always achieved.</p> <p><b>5 Transport systems — plants</b></p> <p>a Plant organs are roots, stems and leaves. Leaf structure diagram showing upper epidermis, palisade mesophyll, spongy mesophyll, vein (consisting of xylem and phloem), lower epidermis, guard cells and stomata.</p> <p>b Parts of the plant involved in water transport. Water and minerals enter the plant through the root hairs and are transported in dead xylem vessels.</p> <p>Structure of xylem vessels.</p>	<p>Family trees and the identification of phenotypes and genotypes from them.</p> <p>Carry out monohybrid crosses. Use Punnett squares to explain inheritance.</p> <p>Xylem cells are lignified to withstand the pressure changes as water moves through the plant.</p>	<p>Split former key area 2.5 c into key area 4 b, 4 c and 4 d.</p> <p>Clarification of required depth of knowledge. No change to content.</p> <p>Clarification of required depth of knowledge. No change to content.</p> <p>No change to content.</p> <p>Split former key area 2.6 into three key areas: 5, 6 and 7.</p> <p>Formerly key area 2.6 a.</p> <p>Reworded for clarification. No change to content.</p> <p>Reworded for clarification. No change to content.</p> <p>Clarification of required depth of knowledge.</p>

<b>Biology: multicellular organisms (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>5 Transport systems — plants (continued)</b></p> <p>c The process of transpiration and how the rate of transpiration is affected by wind speed, humidity, temperature and surface area.</p> <p>d Sugar is transported up and down the plant in living phloem. Structure of phloem tissue.</p>	<p>Transpiration is the process of water moving through a plant and its evaporation through the stomata.</p> <p>The structures and processes involved as water moves through the plant from the soil to the air.</p> <p>Details of mechanism for opening/closing of stomata are not required.</p> <p>Details of transpiration pull and the forces involved are not required.</p> <p>External factors can increase or decrease the rate of transpiration. Details of how this takes place are not required.</p> <p>Phloem cells have sieve plates and associated companion cells.</p>	<p>Reworded for clarification. Required depth of knowledge provided.</p> <p>Required depth of knowledge provided. No change to content.</p>

<b>Biology: multicellular organisms (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>6 Transport systems — animals</b></p> <p>a In mammals the blood contains plasma, red blood cells and white blood cells. It transports nutrients, oxygen and carbon dioxide.</p> <p>b Red blood cells are specialised by being biconcave in shape, having no nucleus and containing haemoglobin. This allows them to transport oxygen efficiently in the form of oxyhaemoglobin.</p> <p>c White blood cells are part of the immune system and are involved in destroying pathogens. There are two main types of cells involved. Phagocytes carry out phagocytosis by engulfing pathogens. Some lymphocytes produce antibodies which destroy pathogens. Each antibody is specific to a particular pathogen.</p> <p>d Pathway of oxygenated and deoxygenated blood through heart, lungs and body. Diagram of heart to show the right and left atria, ventricles, location of four valves, location of associated blood vessels (aorta, vena cava, pulmonary artery, pulmonary vein and coronary arteries). Function of each of these parts.</p>	<p>Information about platelets is not required.</p> <p>oxygen + haemoglobin → oxyhaemoglobin</p> <p>Pathogens are disease-causing micro-organisms (bacteria, viruses, fungi).</p> <p>Process of phagocytosis — engulfing and digestion.</p> <p>Details of lysis/lysosomes are not required.</p> <p>Detail of antibody structure not required.</p> <p>Names of individual valves are not required.</p>	<p>Formerly key area 2.6 b.</p> <p>Reworded for clarification. Required depth of knowledge provided.</p> <p>Required depth of knowledge provided. No change to content.</p> <p>Restructured to introduce information to link with Higher Human Biology.</p> <p>Reworded for clarification. Clarification of required depth of knowledge. No change to content.</p>

<b>Biology: multicellular organisms (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>6 Transport systems — animals (continued)</b></p> <p>e Arteries have thick, muscular walls, a narrow central channel and carry blood under high pressure away from the heart. Veins have thinner walls, a wider channel and carry blood under low pressure back towards the heart. Veins contain valves to prevent backflow of blood. Capillaries are thin walled and have a large surface area, forming networks at tissues and organs to allow efficient exchange of materials.</p> <p><b>7 Absorption of materials</b></p> <p>a Oxygen and nutrients from food must be absorbed into the bloodstream to be delivered to cells for respiration. Waste materials, such as carbon dioxide, must be removed from cells into the bloodstream.</p> <p>b Tissues contain capillary networks to allow the exchange of materials at cellular level.</p> <p>c Surfaces involved in the absorption of materials have certain features in common: large surface area, thin walls, extensive blood supply. These increase the efficiency of absorption.</p>		<p>Reworded for clarification. No change to content.</p> <p>Formerly key area 2.6 b.</p> <p>Reworded for clarification. No change to content.</p> <p>Reworded for clarification. No change to content.</p>

<b>Biology: multicellular organisms (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>7 Absorption of materials (continued)</b></p> <p>d Lungs are gas exchange organs. They consist of a large number of alveoli providing a large surface area. Oxygen and carbon dioxide are absorbed through the thin alveolar walls to or from the many blood capillaries.</p> <p>e Nutrients from food are absorbed into the villi in the small intestine. The large number of thin walled villi provides a large surface area. Each villus contains a network of capillaries to absorb glucose and amino acids and a lacteal to absorb fatty acids and glycerol.</p>		<p>Formerly key area 2.6 b v.</p> <p>Content removed and reworded for clarification.</p> <p>Formerly key area 2.6 b vi.</p> <p>Content removed and reworded for clarification.</p> <p>Complete removal of former key area 2.7 — Effects of lifestyle choices on human transport and exchange systems.</p>

<b>Biology: life on Earth</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>1 Ecosystems</b></p> <p>a Definitions of ecological terms: species, biodiversity, population, producer, consumer, herbivore, carnivore, omnivore, predator, prey, food chain, food web.</p> <p>b An ecosystem consists of all the organisms (the community) living in a particular habitat and the non-living components with which the organisms interact.</p> <p>Interactions of organisms in food webs.</p> <p>c A niche is the role that an organism plays within a community. It relates to the resources it requires in its ecosystem, such as light and nutrient availability and its interactions with other organisms in the community. It involves competition and predation and the conditions it can tolerate such as temperature.</p>	<p>Effects of removal of organism(s) from a food web.</p>	<p>New key area heading.</p> <p>Former key area 3.1 c removed. Former key areas 3.2 a and 3.2 d are included here.</p> <p>Formerly key area 3.2 a.</p> <p>Reworded for clarification.</p> <p>Formerly key area 3.1 d.</p> <p>Reworded for clarification. Required depth of knowledge provided.</p> <p>Formerly key area 3.1 e.</p> <p>Reworded for clarification. Removal of reference to 'parasitism'.</p>

<b>Biology: life on Earth (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>1 Ecosystems (continued)</b></p> <p>d Competition in ecosystems occurs when resources are in short supply. Interspecific competition occurs amongst individuals of different species for one or a few of the resources they require. Intraspecific competition occurs amongst individuals of the same species and is for all resources required. Intraspecific competition is therefore more intense than interspecific competition.</p>		<p>Formerly key area 3.2 d.</p> <p>Reworded for clarification. No change to content.</p>
<p><b>2 Distribution of organisms</b></p> <p>a Competition for resources, disease, food availability, grazing and predation are biotic factors. Light intensity, moisture, pH and temperature are abiotic factors.</p> <p>b Measuring abiotic factors such as light intensity, soil moisture, pH and temperature. Possible sources of error and how to minimise them.</p> <p>c Sampling of plants and animals using quadrats and pitfall traps. Evaluation of limitations and sources of error in their use.</p>	<p>The need for representative sampling and adequate replication.</p>	<p>Formerly key area 3.3. Former key areas 3.1 a, 3.1 b and 3.5 c are included here.</p> <p>Formerly key area 3.1 b.</p> <p>No change to content.</p> <p>Formerly key area 3.3 d.</p> <p>No change to content.</p> <p>Formerly key areas 3.3 a and 3.3 b.</p> <p>Required depth of knowledge provided. No change to content.</p>

<b>Biology: life on Earth (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>2 Distribution of organisms (continued)</b></p> <p>d Using and constructing paired-statement keys to identify organisms.</p> <p>e The effect of biotic and abiotic factors on biodiversity and the distribution of organisms.</p> <p>f Indicator species are species that by their presence or absence indicate environmental quality/levels of pollution.</p>	<p>Factors which can cause an increase or a decrease in biodiversity.</p>	<p>Formerly key area 3.3 c.</p> <p>No change to content.</p> <p>Formerly key areas 3.1 a and 3.3 e.</p> <p>Minor rewording for clarification. Clarification of required depth of knowledge. Removal of 'human impact on biodiversity'.</p> <p>Formerly key area 3.5 c.</p> <p>No change to content.</p>

Biology: life on Earth (continued)		
Key areas	Depth of knowledge required	Changes to content
<p><b>3 Photosynthesis</b></p> <p>a Photosynthesis is a two-stage process:</p> <p>i Light reactions: the light energy from the sun is trapped by chlorophyll in the chloroplasts and is converted into chemical energy which is used to generate ATP. Water is split to produce hydrogen and oxygen. Oxygen diffuses from the cell.</p> <p>ii Carbon fixation: a series of enzyme-controlled reactions, which use hydrogen and ATP (produced by the light reactions) with carbon dioxide to produce sugar.</p> <p>b The chemical energy in sugar is available for respiration or the sugar can be converted into other substances, such as starch (storage) and cellulose (structural).</p> <p>c Limiting factors: carbon dioxide concentration, light intensity and temperature and their impact on photosynthesis and plant growth.</p> <p>Analysis of limiting factors graphs.</p>	<p>Word summary of the process of photosynthesis:</p> $\text{carbon + water} \xrightarrow{\text{light energy}} \text{sugar + oxygen}$ <p>dioxide</p>	<p>Formerly key area 1.7.</p> <p>Minor rewording for clarification. Knowledge of hydrogen acceptor molecules removed.</p> <p>Clarification of required depth of knowledge.</p> <p>No change to content.</p> <p>No change to content.</p>

<b>Biology: life on Earth (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>4 Energy in ecosystems</b></p> <p>a In transfers from one level to the next in a food chain, the majority of the energy is lost as heat, movement or undigested materials. Only a very small quantity is used for growth and is therefore available at the next level in a food chain.</p> <p>b Definitions and comparisons of pyramids of numbers and energy.</p>	<p>Irregular shapes of pyramids of numbers based on different body sizes can be represented as true pyramids of energy.</p>	<p>Formerly key area 3.2.</p> <p>Formerly key area 3.2 b.</p> <p>Minor rewording for clarification. Percentage figures removed.</p> <p>Formerly key area 3.2 c.</p> <p>Clarification of required depth of knowledge. Pyramids of biomass removed.</p>

<b>Biology: life on Earth (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>5 Food production</b></p> <p>a Increasing human population requires an increased food yield. This can involve the use of fertilisers and pesticides. Fertilisers provide chemicals such as nitrates which increase crop yield. Plants and animals which reduce crop yield can be killed by pesticides.</p> <p>b Nitrates dissolved in soil water are absorbed into plants. Nitrates are used to produce amino acids which are synthesised into plant proteins. Animals consume plants or other animals to obtain amino acids for protein synthesis. Fertilisers can be added to soil to increase the nitrate content of the soil.</p> <p>c Fertilisers can leach into fresh water, adding extra, unwanted nitrates. This will increase algal populations which can cause algal blooms. Algal blooms reduce light levels, killing aquatic plants. These dead plants, as well as dead algae, become food for bacteria which increase greatly in number. The bacteria use up large quantities of oxygen, reducing the oxygen availability for other organisms. Genetically modified (GM) crops can be used to reduce the use of fertilisers.</p>	<p>Details of the full nitrogen cycle are not required.</p>	<p>New key area heading. Former key area 3.2 e included here.</p> <p>Reworded for clarification. No change to content.</p> <p>Formerly key area 3.2 e. Reworded for clarification. Details of the nitrogen cycle removed.</p> <p>Reworded for clarification. No change to content.</p>

<b>Biology: life on Earth (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>5 Food production (continued)</b></p> <p>d Pesticides sprayed onto crops can accumulate in the bodies of organisms over time. As they are passed along food chains, toxicity increases and can reach lethal levels.</p> <p>The use of biological control and genetically modified (GM) crops as alternatives to the use of pesticides.</p>	<p>The build-up of toxic substances in living organisms is known as bioaccumulation.</p>	<p>Former key areas 3.5 d and 3.5 e combined.</p> <p>Reworded for clarification. Required depth of knowledge provided.</p>

<b>Biology: life on Earth (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>6 Evolution of species</b></p> <p>a A mutation is a random change to genetic material. Mutations may be neutral, confer an advantage or a disadvantage to survival. Mutations are spontaneous and are the only source of new alleles. Environmental factors, such as radiation and some chemicals, can increase the rate of mutation.</p> <p>b New alleles produced by mutation can result in plants and animals becoming better adapted to their environment. Variation within a population makes it possible for a population to evolve over time in response to changing environmental conditions.</p> <p>c Species produce more offspring than the environment can sustain. Natural selection or survival of the fittest occurs when there are selection pressures. The best adapted individuals in a population survive to reproduce, passing on the favourable alleles that confer the selective advantage. These alleles increase in frequency within the population.</p>	<p>An adaptation is an inherited characteristic that makes an organism well suited to survival in its environment/niche.</p>	<p>Formerly key area 3.4.</p> <p>High temperatures removed from the list of environmental factors.</p> <p>Removal of categories of adaptations. Clarification of required depth of knowledge.</p> <p>Minor rewording for clarification. No change to content.</p>

<b>Biology: life on Earth (continued)</b>		
<b>Key areas</b>	<b>Depth of knowledge required</b>	<b>Changes to content</b>
<p><b>6 Evolution of species (continued)</b></p> <p>d Speciation occurs after part of a population becomes isolated by an isolation barrier, which can be geographical, ecological or behavioural. Different mutations occur in each sub-population. Natural selection selects for different mutations in each group, due to different selection pressures. Each sub-population evolves until they become so genetically different that they are two different species.</p>	<p>Examples of each type of barrier, eg ecological — pH, salinity or different habitats.</p>	<p>Reworded for clarification. Reproductive barrier changed to behavioural barrier. Clarification of required depth of knowledge.</p>

Apparatus and techniques	Changes to content
<p>In addition to the key areas, candidates must have knowledge of the following pieces of apparatus and have opportunities to become familiar with the following techniques.</p> <p>Note: the apparatus and techniques noted below <b>can be assessed in the question paper</b>.</p> <p><b>Apparatus</b></p> <ul style="list-style-type: none"> <li>◆ beaker</li> <li>◆ balance</li> <li>◆ measuring cylinder</li> <li>◆ dropper/pipette</li> <li>◆ test tube/boiling tube</li> <li>◆ thermometer</li> <li>◆ funnel</li> <li>◆ syringe</li> <li>◆ timer/stopwatch</li> <li>◆ microscope</li> <li>◆ petri dish</li> <li>◆ quadrat</li> <li>◆ pitfall trap</li> <li>◆ light/moisture meter</li> <li>◆ water bath</li> </ul> <p><b>Techniques</b></p> <ul style="list-style-type: none"> <li>◆ measuring enzyme activity</li> <li>◆ using a respirometer</li> <li>◆ measuring transpiration using a potometer</li> <li>◆ measuring abiotic factors</li> <li>◆ measuring the distribution of a species</li> <li>◆ using a transect line</li> <li>◆ measuring the rate of photosynthesis</li> </ul> <p>Choosing from the suggested learning activities, or carrying out any other appropriate activities, allows candidates to become familiar with the apparatus and techniques listed above. Where it is not possible to carry out a particular technique other resources could be utilised.</p>	<p>Apparatus added due to the removal of outcome 1.</p> <p>Techniques added due to the removal of outcome 1.</p>