Cambridge IGCSE Biology (2023-2025)

EP Curriculum Map

1 Characteristics and Classification of Living Organisms

1.1 Characteristics of Living Organisms

Specification Point	Lessons
1.1.1.Describe the characteristics of living organisms by defining the terms: – movement as an action by an organism causing a change of position or place – respiration as the chemical reactions in cells that break down nutrient molecules and release energy for metabolism – sensitivity as the ability to detect and respond to changes in the internal or external environment – growth as a permanent increase in size and dry mass – reproduction as the processes that make more of the same kind of organism – excretion as the removal of the waste products of metabolism and substances in excess of requirements – nutrition as taking in of materials for energy, growth and development	1. Living or Non-Living? 2. Who is MRS GREN? Characteristics of All Living Things

1.2 Concept and Uses of Classification Systems

Specification Point	Lessons
1.2.1 State that organisms can be classified into groups by the features that they share	1. Linnaean Classification 2. Biological Classification 3. Species and Hybrids 4. Classification Systems 5. Binomial Nomenclature 6. Introduction to Comparative Genomics **1.2.4 Dichotomous Keys** 1. Introduction to Dichotomous Keys 2. Branching Dichotomous Keys 3. Circular Dichotomous Keys 4. Tabular Dichotomous Keys
1.2.2 Describe a species as a group of organisms that can reproduce to produce fertile offspring	
1.2.3.Define the binomial system of naming species as an internationally agreed system in which the scientific name of an organism is made up of two parts showing the genus and species	
1.2.4 Construct and use dichotomous keys based on identifiable features	
1.2.5 Explain that classification systems aim to reflect evolutionary relationships	
1.2.6 Explain that the sequences of bases in DNA are used as a means of classification	
1.2.7.Explain that organisms which share a more recent ancestor (are more closely related) have base sequences in DNA that are more similar than those that share only a distant ancestor	

1.3 Features of Organisms

Specification Point	Lessons
1.3.1 State the main features used to place animals and plants into the appropriate kingdoms	1. The Five Kingdoms 2. The Animal Kingdom: Vertebrates 3. The Animal Kingdom: Arthropods 4. The Structure of Viruses
1.3.2 State the main features used to place organisms into groups within the animal kingdom, limi...	
1.3.3 Classify organisms using the features identified in 1.3.1 and 1.3.2	
1.3.4 State the main features used to place all organisms into one of the five kingdoms: animal, ...	
1.3.5 State the main features used to place organisms into groups within the plant kingdom, limit...	
1.3.6 Classify organisms using the features identified in 1.3.4 and 1.3.5	
1.3.7 State the features of viruses, limited to a protein coat and genetic material	

2 Organisation of the Organism

2.1 Cell Structure

Specification Point	Lessons
2.1.1 Describe and compare the structure of a plant cell with an animal cell, limited to cell wall, cell membrane nucleus, cytoplasm, chloroplasts, ribosomes, mitochondria, vacuoles	1. Prokaryotic Cells 2. Eukaryotic Cells 3. Comparing Prokaryotic and Eukaryotic Cells 4. Animal Cell Structure 5. Plant Cell Structure 6. Comparing Animal and Plant Cells 7. Specialised Plant Cells 8. Specialised Animal Cells 9. Hierarchy of Organisation
2.1.2 Describe the structure of a bacterial cell, limited to: cell wall, cell membrane, cytoplasm...	
2.1.3 Identify the cell structures listed in 2.1.1 and 2.1.2 for plant, animal and bacterial cells	
2.1.4 Describe the functions of the structures listed in 2.1.1 and 2.1.2 for plant, animal and bacterial cells	
2.1.5 State that new cells are produced by division of existing cells	
2.1.6 State that specialised cells have specific functions, limited to: a) ciliated cells – movement of mucus in the trachea and bronchi (b) root hair cells – absorption (c) palisade mesophyll cells – photosynthesis (d) neurones – conduction of electrical impulses (e) red blood cells – transport of oxygen (f) sperm and egg cells (gametes) – reproduction	
2.1.7 Describe the meaning of the terms cell, tissue, organ, organ system and organism as illustrated by examples given in the syllabus	

2.2 Size of Specimens

Specification Point	Lessons
2.2.1 State and use the formula: magnification = image size ÷ actual size	1. The Size of Cells
2.2.2 Calculate magnification and size of biological specimens using millimetres as units	
2.2.3 Convert measurements between millimetres (mm) and micrometres (μm)	

3 Movement Into and Out of Cells

3.1 Diffusion

Specification Point	Lessons
3.1.1.Define diffusion as the net movement of particles 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	1. Diffusion 2. Diffusion and Cell Size 3. Factors that Influence Diffusion 4. Diffusion Experiments
3.1.2.State that the energy for diffusion comes from the kinetic energy of random movement of molecules and ions	
3.1.3 State that some substances move into and out of cells by diffusion through the cell membrane	
3.1.4 Describe the importance of diffusion of gases and solutes in living organisms	
3.1.5.Investigate the factors that influence diffusion, limited to surface area, temperature, concentration gradients and distance	

3.2 Osmosis

Specification Point	Lessons
3.2.1 Describe the role of water as a solvent in organisms with reference to digestion, excretion and transport	1. The Importance of Water 2. Passive Transport - Osmosis 3. Osmosis Experiments
3.2.2 State that water diffuses through partially permeable membranes by osmosis	
3.2.3 State that water moves into and out of cells by osmosis through the cell membrane	
3.2.4 Investigate osmosis using materials such as dialysis tubing	
3.2.5.Investigate and describe the effects on plant tissues of immersing them in solutions of different concentrations	
3.2.6.State that plants are supported by the pressure of water inside the cells pressing outwards on the cell wall	
3.2.7.Describe osmosis as the net movement of water molecules from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution), through a partially	

permeable membrane	
3.2.8.Explain the effects on plant tissues of immersing them in solutions of different concentrations by using the terms turgid, turgor pressure, plasmolysis and flaccid	
3.2.9.Explain the importance of water potential and osmosis in the uptake of water by plants	

3.3 Active Transport

Specification Point	Lessons
3.3.1.Describe active transport as the movement of particles through a cell membrane from a region of lower concentration to a region of higher concentration using energy from respiration	1. Active Transport
3.3.2.Explain the importance of active transport as a process for movement across membranes: – e.g. ion uptake by root hairs and uptake of glucose by epithelial cells of villi and kidney tubules	
3.3.3 State that protein carriers move molecules or ions across a membrane during active transport	

4 Biological Molecules

4.1 Biological Molecules

Specification Point	Lessons
4.1.1 List the chemical elements that make up: carbohydrates, fats and proteins	1. Metabolic Requirements 2. Lab Activity: Food Tests 3. Structure of DNA 4. Nitrogenous Bases
4.1.2.State that large molecules are made from smaller molecules, limited to: (a) starch, glycogen and cellulose from glucose (b) proteins from amino acids (c) fats and oils from fatty acids and glycerol	
4.1.3.Describe the use of: (a) iodine solution test for starch (b) Benedict's solution test for reducing sugars (c) biuret test for proteins (d) ethanol emulsion test for fats and oils (e) DCPIP test for vitamin C	
4.1.4. Describe the structure of a DNA molecule: (a) two strands coiled together to form a double helix (b) each strand contains chemicals called bases (c) bonds between pairs of bases hold the strands together (d) the bases always pair up in the same way: A with T, and C with G (full names are not required)	

5 Enzymes

5.1 Enzymes

Specification Point	Lessons
5.1.1.Describe a catalyst as a substance that increases the rate of a chemical reaction and is not changed by the reaction	1. Enzyme Structure and Uses 2. Enzyme Function 3. Factors Affecting Enzymes **Lab Activity: Investigating Enzymes** Investigating Enzymes
5.1.2.Describe enzymes as proteins that are involved in all metabolic reactions, where they function as biological catalysts	
5.1.3.Describe why enzymes are important in all living organisms in terms of reaction rate necessary to sustain life	
5.1.4.Describe enzyme action with reference to the complementary shape of an enzyme and its substrate and the formation of a product (knowledge of the term active site is not required)	
5.1.5.Investigate and describe the effect of changes in temperature and pH on enzyme activity	
5.1.6.Explain enzyme action with reference to: active site, enzyme-substrate complex, substrate and product	
5.1.7.Explain the specificity of enzymes in terms of the complementary shape and fit of the active site with the substrate	
5.1.8.Explain the effect of changes in temperature on enzyme activity in terms of kinetic energy, shape and fit, frequency of effective collisions and denaturation	
5.1.9.Explain the effect of changes in pH on enzyme activity in terms of shape and fit and denaturation	

6 Plant Nutrition

6.1 Photosynthesis

Specification Point	Lessons
6.1.1.Describe photosynthesis as the process by which plants manufacture carbohydrates from raw materials using energy from light	1. Photosynthesis 2. Products of Photosynthesis 3. Factors Affecting the Rate of Photosynthesis 4. Photosynthesis vs Cellular Respiration 5. Investigating Photosynthesis 6. Gas exchange in plants 7. Investigating Photosynthesis: Aquatic Plants and Gas Exchange 8. Investigating Photosynthesis: Leaves and Starch **Lab Activity: Photosynthesis and Starch** 1. Photosynthesis and Starch
6.1.2.State the word equation for photosynthesis: carbon dioxide + water → glucose + oxygen, in the presence of light and chlorophyll	
6.1.3 State that chlorophyll is a green pigment that is found in chloroplasts	
6.1.4.State that chlorophyll transfers light energy into chemical energy in molecules, for the synthesis of carbohydrates	
6.1.5.Outline the subsequent use and storage of the carbohydrates made in photosynthesis, limited to: (a) starch as an energy store (b) cellulose to build cell walls	

(c) glucose used in respiration to provide energy (d) sucrose for transport in the phloem (e) nectar to attract insects for pollination	2. Student Worksheet PDF 3. Lab Report Material PDF 4. Teacher Worksheet PDF 5. Laboratory Technician Guide PDF 6. Editable Documents - Word (.docx)
6.1.6. Explain the importance of: (a) nitrate ions for making amino acids (b) magnesium ions for making chlorophyll	
6.1.7.Investigate the need for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls	
6.1.8.Investigate and describe the effects of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis, e.g. in submerged aquatic plants	
6.1.9 Investigate and describe the effect of light and dark conditions on gas exchange in an aquatic plant using hydrogencarbonate indicator solution	
6.1.10 State the balanced chemical equation for photosynthesis as: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$	
6.1.11.Identify and explain the limiting factors of photosynthesis in different environmental conditions	

6.2 Leaf Structure

Specification Point	Lessons
6.2.1 State that most leaves have a large surface area and are thin, and explain how these features are adaptations for photosynthesis	1. Leaf Structure and Photosynthesis
6.2.2.Identify in diagrams and images the following structures of a dicotyledonous plant: chloroplasts, cuticle, guard cells and stomata, upper and lower epidermis, palisade mesophyll, spongy mesophyll, air spaces, vascular bundles, xylem and phloem	
6.2.3 Explain how the structures listed in 6.2.2 adapt leaves for photosynthesis	

7 Human Nutrition

7.1 Diet

Specification Point	Lessons
7.1.1 Describe what is meant by a balanced diet	1. Digestion and Nutrition 2. Diet and Nutrients 3. What's on the Label? 4. An Apple a Day Keeps the Doctor Away 5. Improving the Nutritional Value of Meals
7.1.2.State the principal sources and describe the dietary importance of: (a) carbohydrates (b) fats and oils (c)proteins (d)vitamins, limited to C and D (e) mineral ions, limited to calcium and iron (f) fibre (roughage) (g) water	
7.1.3 State the causes of scurvy and rickets	

7.2 Digestive System

Specification Point	Lessons
7.2.1.Identify in diagrams and images the main organs of the digestive system, limited to: regions of the alimentary canal: mouth, oesophagus, stomach, small intestine (duodenum and ileum), and large intestine (colon, rectum, anus) (b) associated organs: salivary glands,pancreas, liver, gall bladder	1. Overview of the Digestive System 2. Digestive System As A Whole 3. Extension: Comparing Digestion in Other Animals 4. Stomach and Small Intestine 5. Extension: The Microbes That Control What We Do
7.2.2.Describe the functions of the organs of the digestive system listed in 7.2.1, in relation to: (a) ingestion - the taking of substances, e.g. food and drink, into the body (b) digestion - the breakdown of food (c) absorption - the movement of nutrients from the intestines into the blood (d) assimilation - uptake and use of nutrients by cells (e) egestion - the removal of undigested food from the body as faeces	

7.3 Physical Digestion

Specification Point	Lessons
7.3.1.Describe physical digestion as the breakdown of food into smaller pieces without chemical change to the food molecules	Ingestion: The Mouth and Oesophagus
7.3.2 State that physical digestion increases the surface area of food for the action of enzymes in chemical digestion	
7.3.3 Identify in diagrams and images the types of human teeth: incisors, canines, premolars and molars	
7.3.4 Describe the structure of human teeth, limited to enamel, dentine, pulp, nerves and cement, as well as the gums	
7.3.5 Describe the functions of the types of human teeth in physical digestion of food	
7.3.6 Describe the function of the stomach in physical digestion	
7.3.7 Outline the role of bile in emulsifying fats and oils to increase the surface area for chemical digestion	

7.4 Chemical Digestion

Specification Point	Lessons
7.4.1.Define chemical digestion as the breakdown of large, insoluble molecules into small, soluble molecules	Digestion: The Stomach and the Small Intestine
7.4.2 State the role of chemical digestion in producing small soluble molecules that can be absorbed	
7.4.3 Describe the functions of enzymes as follows: (a) amylase breaks down starch to simple reducing sugars (b) proteases break down protein to amino acids (c) lipase breaks down fats and oils to fatty acids and glycerol	

7.4.4 State where, in the digestive system, amylase, protease and lipase are secreted and where they act	
7.4.5.Describe the functions of hydrochloric acid in gastric juice, limited to killing harmful microorganisms in food and providing an acidic pH for optimum enzyme activity	
7.4.6 Describe the digestion of starch in the digestive system: (a) amylase breaks down starch to maltose (b) maltase breaks down maltose to glucose on the membranes of the epithelium lining the small intestine	
7.4.7.Describe the digestion of protein by proteases in the digestive system: (a) pepsin breaks down protein in the acidic conditions of the stomach (b) trypsin breaks down protein in the alkaline conditions of the small intestine	
7.4.8.Explain that bile is an alkaline mixture that neutralises the acidic mixture of food and gastric juices entering the duodenum from the stomach, to provide a suitable pH for enzyme action	

7.5 Absorption

Specification Point	Lessons
7.5.1 State that the small intestine is the region where nutrients are absorbed	1. Absorption and Assimilation of Nutrients 2. Egestion
7.5.2 State that most of the water is absorbed from the small intestine but that some is also absorbed from the colon	
7.5.3.Explain the significance of villi and microvilli in increasing the internal surface area of the small intestine	
7.5.4 Describe the structure of a villus	
7.5.5 Describe the roles of capillaries and lacteals in villi	

8 Transport in Plants

8.1 Xylem and Phloem

Specification Point	Lessons
8.1.1.State the functions of xylem and phloem: (a) xylem – transport of water and mineral ions, and support (b) phloem – transport of sucrose and amino acids	Xylem and Phloem
8.1.2.Identify in diagrams and images the position of xylem and phloem as seen in sections of roots, stems and leaves of non-woody dicotyledonous plants	

8.1.3 Relate the structure of xylem vessels to their function, limited to: (a) thick walls with lignin (details of lignification are not required) (b) no cell contents (c) cells joined end to end with no cross walls to form a long continuous tube	

8.2 Water Uptake

Specification Point	Lessons
8.2.1 Identify in diagrams and images root hair cells and state their functions	1. Water Uptake
8.2.2 State that the large surface area of root hairs increases the uptake of water and mineral ions	
8.2.3 Outline the pathway taken by water through root, stem and leaf as root hair cell, root cortex cells, xylem and mesophyll cells	
8.2.4.Investigate, using a suitable stain, the pathway of water through the above-ground parts of a plant	

8.3 Transpiration

Specification Point	Lessons
8.3.1 Describe transpiration as the loss of water vapour from leaves	1. Xylem and Phloem 2. Transpiration 3. Investigating Transpiration
8.3.2 State that water evaporates from the surfaces of the mesophyll cells into the air spaces and then diffuses out of the leaves through the stomata as water vapour	
8.3.3 Investigate and describe the effects of variation of temperature and wind speed on transpir...	
8.3.4.Explain how water vapour loss is related to: the large internal surface area provided by the interconnecting air spaces between mesophyll cells and the size and number of stomata	
8.3.5.Explain the mechanism by which water moves upwards in the xylem in terms of a transpiration pull that draws up a column of water molecules, held together by forces of attraction between water molecules	
8.3.6.Explain the effects on the rate of transpiration of varying the following factors: temperature, wind speed and humidity	
8.3.7 Explain how and why wilting occurs	

8.4 Translocation

Specification Point	Lessons
8.4.1 Describe translocation as the movement of sucrose and amino acids in phloem from sources to...	1. Xylem and Phloem 2. Translocation of Materials in Plants

8.4.2 Describe: (a) sources as the parts of plants that release sucrose or amino acids (b) sinks ...	
8.4.3 Explain why some parts of a plant may act as a source and a sink at different times	

9 Transport in Animals

9.1 Circulatory Systems

Specification Point	Lessons
9.1.1.Describe the circulatory system as a system of blood vessels with a pump and valves to ensure one-way flow of blood	Introduction to the Circulatory System
9.1.2 Describe the single circulation of a fish	
9.1.3 Describe the double circulation of a mammal	
9.1.4 Explain the advantages of a double circulation	

9.2 Heart

Specification Point	Lessons
9.2.1 Identify in diagrams and images the structures of the mammalian heart, limited to: the muscular wall, the septum, the left and right ventricles and atria, one-way valves and coronary arteries	1. Structure and Function of the Heart 2. Coronary Heart Disease 3. Exercise 4. Investigating Physical Activity
9.2.2 State that blood is pumped away from the heart in arteries and returns to the heart in veins	
9.2.3.State that the activity of the heart may be monitored by ECG, pulse rate and listening to sounds of valves closing	
9.2.4 Investigate and describe the effect of physical activity on the heart rate	
9.2.5.Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible risk factors as diet, lack fo exercise, stress, smoking, genetic predisposition, age and sex	
9.2.6 Discuss the roles of diet and exercise in reducing the risk of coronary heart disease	
9.2.7 Identify in diagrams and images the atrioventricular and semilunar valves in the mammalian heart	
9.2.8.Explain the relative thickness: (a) of the muscle walls of the left and right ventricles (b) the muscle walls of the atria compared to that of the ventricles	
9.2.9 Explain the importance of the septum in separating oxygenated and deoxygenated blood	
9.2.10.Describe the functioning of the heart in terms of the contraction of muscles of the atria and ventricles and the action of the valves	
9.2.11 Explain the effect of physical activity on the heart rate	

9.3 Blood Vessels

Specification Point	Lessons
9.3.1.Describe the structure of arteries, veins and capillaries, limited to: relative thickness of wall, diameter of the lumen and the presence of valves in veins	Blood Vessels
9.3.2 State the functions of capillaries	
9.3.3 Identify on diagrams and images the main blood vessels to and from the: (a) heart, limited to vena cava, aorta, pulmonary artery and pulmonary vein (b) lungs, limited to the pulmonary artery and pulmonary vein (c) kidney, limited to the renal artery and renal vein	
9.3.4.Explain how the structure of arteries and veins is related to the pressure of the blood that they transport.	
9.3.5 Explain how the structure of capillaries is related to their functions	
9.3.6 Identify, in diagrams and images, the main blood vessels to and from the liver as: hepatic artery, hepatic veins and hepatic portal vein	

9.4 Blood

Specification Point	Lessons
9.4.1 List the components of blood as: red blood cells, white blood cells, platelets and plasma	1. Blood 2. Blood Cells
9.4.2 Identify red and white blood cells in photomicrographs and diagrams	
9.4.3.State the functions of the following components of blood: (a) red blood cells in transporting oxygen, including the role of haemoglobin (b) white blood cells in phagocytosis and antibody production (c) platelets in clotting (details are not required) (d) plasma in the transport of blood cells, ions, nutrients, urea, hormones and carbon dioxide	
9.4.4 State the roles of blood clotting as preventing blood loss and the entry of pathogens	
9.4.5 Identify lymphocytes and phagocytes in photomicrographs and diagrams	
9.4.6 State the functions of: (a) lymphocytes – antibody production (b) phagocytes – phagocytosis	
9.4.7 Describe the process of clotting as the conversion of fibrinogen to fibrin to form a mesh	

10 Diseases and Immunity

Specification Point	Lessons
10.1.1 Describe a pathogen as a disease-causing organism	1. Introduction to Infectious Diseases 2. Disease Transmission
10.1.2.Describe a transmissible disease as a disease in which the	

pathogen can be passed from one host to another	3. Infection From Others 4. Extension: Spread of Disease 5. Non-Specific Defence Against Disease 6. Specific Defence Against Disease 7. Active and Passive Immunity 8. Vaccines 9. A Preventable Disease: Cholera 10. Extension: Disease Prevention 11. Application: Case Studies 12. Innate Immunity **Further Resources: The History of Medicine** 1. Ancient Medicine 2. Medieval, Renaissance and Enlightenment-era Medicine 3. Modern Medicine 4. Indigenous Medicine in the Northern Hemisphere 5. Indigenous Medicine in the Southern Hemisphere
10.1.3.State that the pathogen is transmitted: (a) by direct contact, including through blood and other body fluids (b) indirectly, including from contaminated surfaces, food, animals, and air	
10.1.4.Describe the body defences, limited to: skin, hairs in the nose, mucus, stomach acid and white blood cells	
10.1.5 Explain the importance of the following in controlling the spread of disease: (a) a clean water supply (b) hygienic food preparation (c) good personal hygiene (d) waste disposal (e) sewage treatment (details of the stages of sewage treatment are not required)	
10.1.6 Describe active immunity as defence against a pathogen by antibody production in the body	
10.1.7 State that each pathogen has its own antigens, which have specific shapes	
10.1.8 Describe antibodies as proteins that bind to antigens leading to direct destruction of pathogens or marking of pathogens for destruction by phagocytes	
10.1.9 State that specific antibodies have complementary shapes which fit specific antigens	
10.1.10 Explain that active immunity is gained after an infection by a pathogen or by vaccination	
10.1.11.Outline the process of vaccination: (a) weakened pathogens on their antigen are put into the body (b)the antigens stimulate an immune response by lymphocytes which produce antibodies (c) memory cells are produced that give long-term immunity	
10.1.12 Explain the role of vaccination in controlling the spread of diseases	
10.1.13.Explain that passive immunity is a short-term defence against a pathogen by antibodies acquired from another individual, including across the placenta and in breast milk	
10.1.14 Explain the importance of breast-feeding for the development of passive immunity in infants	
10.1.15 State that memory cells are not produced in passive immunity	
10.1.16 Describe cholera as a disease caused by a bacterium which is transmitted in contaminated water	
10.1.17 Explain that the cholera bacterium produces a toxin that causes secretion of chloride ions into the small intestine, causing osmotic movement of water into the gut, causing diarrhoea, dehydration and loss of ions from the blood	

11 Gas Exchange in Humans

11.1 Gas Exchange in Humans

Specification Point	Lessons
11.1.1.Describe the features of gas exchange surfaces in humans, limited to large surface area, thin surface, good blood supply and good ventilation with air	1. Introduction to the Respiratory System 2. Breathing 3. Gas Exchange 4. Breathing and Gas Exchange
11.1.2.Identify in diagrams and images the following parts of the breathing system: lungs, diaphragm, ribs, intercostal muscles, larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries	
11.1.3. Investigate the differences in composition between inspired and expired air using limewater as a test for carbon dioxide limited to oxygen, carbon dioxide and water vapour	
11.1.4. Describe the differences in composition between inspired and expired air, limited to oxygen, carbon dioxide and water vapour	
11.1.5 Investigate and describe the effects of physical activity on the rate and depth of breathing	
11.1.6 Identify in diagrams and images the internal and external intercostal muscles	
11.1.7 State the function of cartilage in the trachea	
11.1.8.Explain the role of the ribs, the internal and external intercostal muscles and the diaphragm in producing volume and pressure changes in the thorax leading to the ventilation of the lungs	
11.1.9 Explain the differences in composition between inspired and expired air	
11.1.10.Explain the link between physical activity and rate and depth of breathing in terms of the increased carbon dioxide concentration in the blood, which is detected by the brain, leading to an increased rate and greater depth of breathing	
11.1.11.Explain the role of goblet cells, mucus and ciliated cells in protecting the gas exchange system from pathogens and particles	

12 Respiration

12.1 Respiration

Specification Point	Lessons
12.1.1.State the uses of energy in living organisms, including: muscle contraction, protein synthesis, cell division, active transport, growth, the passage of nerve impulses and the maintenance of a constant body temperature	1. Introduction to Metabolism 2. Investigating Respiration

12.1.2 Investigate and describe the effect of temperature on respiration in yeast	

12.2 Aerobic Respiration

Specification Point	Lessons
12.2.1 Describe aerobic respiration as the chemical reactions in cells that use oxygen to break down nutrient molecules to release energy	Aerobic Respiration
12.2.2 State the word equation for aerobic respiration as: glucose + oxygen → carbon dioxide + water	
12.2.3 State the balanced chemical equation for aerobic respiration as: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$	

12.3 Anaerobic Respiration

Specification Point	Lessons
12.3.1.Define anaerobic respiration as the chemical reactions in cells that break down nutrient molecules to release energy without using oxygen	1. Anaerobic Respiration 2. Oxygen Debt
12.3.2.State that anaerobic respiration releases much less energy per glucose molecule than aerobic respiration	
12.3.3 State the word equation for anaerobic respiration in yeast as: glucose → alcohol + carbon dioxide	
12.3.4 State the word equation for anaerobic respiration in muscles during vigorous exercise as: glucose → lactic acid	
12.3.5.State the balanced chemical equation for anaerobic respiration in the microorganism yeast as C6H12O6 → 2C2H5OH + 2CO2	
12.3.6 State that lactic acid builds up in muscles and blood during vigorous exercise causing an oxygen debt	
12.3.7.Outline how the oxygen debt is removed after exercise, limited to: (a) continuation of fast heart rate to transport lactic acid in blood from the muscles to the liver (b) continuation of deeper breathing supplying oxygen for aerobic respiration of lactic acid (c) aerobic respiration of lactic acid in the liver	

13 Excretion in Humans

Specification Point	Lessons
13.1.1 State that carbon dioxide is excreted through the lungs	1. Introduction to Excretory System 2. Excretory Organs 3. The Kidneys & Urine Production 4. The Nephron
13.1.2 State that the kidneys excrete urea and excess water and ions	
13.1.3 Identify in diagrams and images the kidneys, ureters, bladder and urethra	
13.1.4.Identify in diagrams and images the structure of the kidney, limited to the cortex and medulla	

13.1.5.Outline the structure and functioning of a nephron, including: (a) the role of the glomerulus in the filtration from the blood of water, glucose, urea and ions (b) the role of the nephron in the reabsorption of all of the glucose, some of the ions and most of the water back into the blood (c) the formation of urine containing urea, excess water and excess ions (details of these processes are not required)	
13.1.6.Describe the role of the liver in the assimilation of amino acids by converting them to proteins	
13.1.7 State that urea is formed in the liver from excess amino acids	
13.1.8 Describe deamination as the removal of the nitrogen-containing part of amino acids to form...	
13.1.9 Explain the importance of excretion, limited to toxicity of urea	

14 Coordination and Response

14.1 Coordination and Response

Specification Point	Lessons
14.1.1 State that electrical impulses travel along neurones	1. The Human Nervous System 2. The Reflex Arc 3. The Synapse **Lab Activity: Testing Reflexes** 1. Testing Reflexes 2. Student Worksheet PDF 3. Teacher Guide PDF 4. Laboratory Technician Guide PDF 5. Editable Documents - Word (.docx)
14.1.2.Describe the mammalian nervous system in terms of: (a) the central nervous system (CVS) consisting of brain and spinal cord (b) the peripheral nervous system (PNS) consisting of the nerves outside the brain and the spinal cord	
14.1.3 Describe the role of the nervous system as coordination and regulation of body functions	
14.1.4 Identify in diagrams and images sensory, relay and motor neurones	
14.1.5.Describe a simple reflex arc in terms of: receptor, sensory neurone, relay neurone, motor neurone and effector	
14.1.6.Describe a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with the responses of effectors (muscles and glands)	
14.1.7 Describe a synapse as a junction between two neurones	
14.1.8.Describe the structure of a synapse, including the presence of vesicles containing neurotransmitter molecules, the synaptic gap and receptor proteins	
14.1.9.Describe the events at a synapse as: (a) an impulse stimulates the release of neurotransmitter molecules from vesicles into the synaptic gap (b) the neurotransmitter molecules diffuse across the gap (c) neurotransmitter molecules bind with receptor proteins on the next neurone (d) an impulse is then stimulated in the next neurone	
14.1.10 State that synapses ensure that impulses travel in one direction only	

14.2 Sense Organs

Specification Point	Lessons
14.2.1.Define sense organs as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals	1. Sensory Organs 2. The Eye 3. The Eye: How it Works **Lab Activity: Eye Dissection** 1. Eye Dissection 2. Student Worksheet PDF 3. Teacher Guide PDF 4. Laboratory Technician Guide PDF 5. Editable Documents - Word (.docx)
14.2.2.Identify in diagrams and images the structures of the eye, limited to cornea, iris, pupil, lens, retina, optic nerve and blind spot	
14.2.3.Describe the function of each part of the eye, limited to: (a) cornea – refracts light (b) iris – controls how much light enters pupil (c) lens – focuses light onto retina (d) retina – contains light receptors, some sensitive to light of different colours (e) optic nerve – carries impulses to the brain	
14.2.4 Explain the pupil reflex, limited to changes in light intensity and pupil diameter	
14.2.5.Explain the pupil reflex in terms of antagonistic action of circular and radial muscles in the iris	
14.2.6.Explain accommodation to view near and distant objects in terms of the contraction and relaxation of the ciliary muscles, tension in the suspensory ligaments, shape of the lens and refraction of light	
14.2.7 Describe the distribution of rods and cones in the retina of a human	
14.2.8.Outline the function of rods and cones, limited to: (a) greater sensitivity of rods for night vision and (b) three different kinds of cones absorbing light of different colours for colour vision	
14.2.9 Identify in diagrams and images the position of the fovea and state its function	

14.3 Hormones

Specification Point	Lessons
14.3.1.Describe a hormone as a chemical substance, produced by a gland and carried by the blood, which alters the activity of one or more specific target organs	1. Introduction to the Endocrine System 2. Control Systems: Nervous vs Endocrine 3. Action of Hormones
14.3.2.Identify in diagrams and images specific endocrine glands and their secretions, limited to (a) adrenal glands and adrenaline, (b) pancreas and insulin, (c) testes and testosterone and (d) ovaries and oestrogen	
14.3.3.Describe adrenaline as the hormone secreted in 'fight or flight' situations and its effects, limited to (a) increased breathing rate (b) increased heart rate (c) increased pupil diameter	
14.3.4 Compare nervous and hormonal control, limited to speed of action and duration of effect	
14.3.5 State that glucagon is secreted by the pancreas	
14.3.6.Describe the role of adrenaline in the control of metabolic activity, limited to: (a) increasing the blood glucose concentration	

(b) pulse rate	

14.4 Homeostasis

Specification Point	Lessons
14.4.1 Describe homeostasis as the maintenance of a constant internal environment	1. Basics of Homeostasis 2. Homeostatic Terms 3. Stimulus-Response Model 4. Negative and Positive Feedback 5. Regulating Blood Sugar 6. Modelling Human Thermoregulation 7. Maintaining the Internal Environment
14.4.2 State that insulin decreases blood glucose concentration	
14.4.3 Explain the concept of homeostatic control by negative feedback with reference to a set point	
14.4.4.Describe the control of the glucose concentration of the blood by the liver and the roles of insulin and glucagon from the pancreas	
14.4.5 Outline the treatment of Type 1 diabetes	
14.4.6 Identify in diagrams and images of the skin: hairs, hair erector muscles, sweat glands, receptors, sensory neurones, blood vessels and fatty tissue	
14.4.7.Describe the maintenance of a constant internal body temperature in mammals in terms of insulation, sweating, shivering and the role of the brain	
14.4.8.Describe the maintenance of a constant internal body temperature in mammals in terms of vasodilation and vasoconstriction of arterioles supplying skin surface capillaries	

14.5 Tropic Responses

Specification Point	Lessons
14.5.1.Define gravitropism as a response in which parts of a plant grow towards or away from gravity	1. Tropisms 2. Investigation: Tropic Responses
14.5.2.Define phototropism as a response in which parts of a plant grow towards or away from the direction from which light is coming	
14.5.3 Investigate and describe gravitropism and phototropism in shoots and roots	
14.5.4.Explain phototropism and gravitropism of a shoot as examples of the chemical control of plant growth	
14.5.5.Explain the role of auxin in controlling shoot growth, limited to: (a) auxin is made in shoot tip (b) auxin spreads through the plant from the shoot tip (c) auxin is unequally distributed in response to light and gravity (d) auxin stimulates cell elongation	

15 Drugs

Specification Point	Lessons
15.1.1.Define a drug as any substance taken into the body that	1. Superbugs are the Real Super Villains

modifies or affects chemical reactions in the body	
15.1.2 Describe the use of antibiotics for the treatment of bacterial infections	
15.1.3 State that some bacteria are resistant to antibiotics which reduces the effectiveness of antibiotics	
15.1.4 State that antibiotics kill bacteria but do not affect viruses	
15.1.5 Explain how using antibiotics only when essential can limit the development of resistant bacteria such as MRSA	

16 Reproduction

16.1 Asexual Reproduction

Specification Point	Lessons
16.1.1.Define asexual reproduction as a process resulting in the production of genetically identical offspring from one parent	1. Asexual Reproduction
16.1.2 Identify examples of asexual reproduction in diagrams, images and information provided	
16.1.3.Discuss the advantages and disadvantages of asexual reproduction: (a) to a population of a species in the wild (b) to crop production	

16.2 Sexual Reproduction

Specification Point	Lessons
16.2.1.Describe sexual reproduction as a process involving the fusion of the nuclei of two gametes to form a zygote and the production of offspring that are genetically different from each other	1. Sexual Reproduction 2. Gametes and Fertilisation
16.2.2 Describe fertilisation as the fusion of the nuclei of gametes	
16.2.3 State that nuclei of gametes are haploid and that the nucleus of a zygote is diploid	
16.2.4.Discuss the advantages and disadvantages of sexual reproduction: (a) to a population of a species in the wild (b) to crop production	

16.3 Sexual Reproduction in Plants

Specification Point	Lessons
16.3.1.Identify in diagrams and images and draw the following parts of an insect-pollinated flower: sepals, petals, stamens, filaments and anthers, carpels, style, stigma, ovary and ovules	1. Sexual Reproduction in Plants 2. Pollination 3. Seed Dispersal & Germination 4. Fertilisation in Plants 5. Investigation: Seed Germination
16.3.2 State the functions of the structures listed in 16.3.1	
16.3.3.Identify in diagrams and images and describe the anthers and	

stigmas of a wind-pollinated flower	
16.3.4 Distinguish between the pollen grains of insect-pollinated and wind-pollinated flowers	
16.3.5 Describe pollination as the transfer of pollen grains from an anther to a stigma	
16.3.6 State that fertilisation occurs when a pollen nucleus fuses with a nucleus in an ovule	
16.3.7 Describe the structural adaptations of insect-pollinated and wind-pollinated flowers	
16.3.8 Investigate and describe the environmental conditions that affect germination of seeds, limited to the requirement for: water, oxygen and a suitable temperature	
16.3.9.Describe self-pollination as the transfer of pollen grains from the anther of a flower to the stigma of the same flower or a different flower on the same plant	
16.3.10.Describe cross-pollination as transfer of pollen grains from the anther of a flower to the stigma of a flower on a different plant of the same species	
16.3.11.Discuss the potential effects of self-pollination and cross-pollination on a population, in terms of variation, capacity to respond to changes in the environment and reliance on pollinators	
16.3.12 Describe the growth of the pollen tube and its entry into the ovule followed by fertilisation (details of production of endosperm and development are not required)	

16.4 Sexual Reproduction in Humans

Specification Point	Lessons
16.4.1.Identify on diagrams and state the functions of the following parts of the male reproductive system: the testes, scrotum, sperm ducts, prostate gland, urethra and penis	1. Male Reproduction 2. Female Reproduction 3. Pregnancy 4. Labour & Birth
16.4.2.Identify on diagrams and state the function of the following parts of the female reproductive system: the ovaries, oviducts, uterus, cervix and vagina	
16.4.3.Describe fertilisation as the fusion of the nuclei from a male gamete (sperm) and a female gamete (egg cell/ovum)	
16.4.4.Explain the adaptive features of sperm, limited to flagellum, mitochondria, and enzymes in the acrosome	
16.4.5.Explain the adaptive features of egg cells, limited to energy stores and the jelly coat that changes after fertilisation	
16.4.6 Compare male and female gametes in terms of: size, structure, motility and numbers	
16.4.7.State that in early development, the zygote forms an embryo which is a ball of cells that implants into the lining of the uterus	
16.4.8 Identify on diagrams and state the functions of the following	

in the development of the fetus: umbilical cord, placenta, amniotic sac and amniotic fluid	
16.4.9.Describe the function of the placenta and umbilical cord in relation to exchange of dissolved nutrients, gases and excretory products between the blood of the mother and the blood of the fetus	
16.4.10 State that some pathogens and toxins can pass across the placenta and affect the fetus	

16.5 Sexual Hormones in Humans

Specification Point	Lessons
16.5.1.Describe the roles of testosterone and oestrogen in the development and regulation of secondary sexual characteristics during puberty	1. Puberty 2. Hormonal Control of the Menstrual Cycle
16.5.2.Describe the menstrual cycle in terms of changes in the ovaries and in the lining of the uterus	
16.5.3.Describe the sites of production of oestrogen and progesterone in the menstrual cycle and in pregnancy	
16.5.4.Explain the role of hormones in controlling the menstrual cycle and pregnancy, limited to FSH, LH, progesterone and oestrogen	

16.6 Sexually Transmitted Infections

Specification Point	Lessons
16.6.1 Describe a sexually transmitted infection (STI) as an infection that is transmitted through sexual contact	1. Sexual Health (HIV & AIDS)
16.6.2 State that human immunodeficiency virus (HIV) is a pathogen that causes an STI	
16.6.3 State that HIV infection may lead to AIDS	
16.6.4 Describe the methods of transmission of HIV	
16.6.5 Explain how the spread of STIs is controlled	

17 Inheritance

17.1 Chromosomes, Genes and Proteins

Specification Point	Lessons
17.1.1.State that chromosomes are made of DNA, which contains genetic information in the form of genes	1. Basics of DNA 2. Genes and Genetic Information 3. Genes to Proteins
17.1.2 Define a gene as a length of DNA that codes for a protein	
17.1.3 Define an allele as an alternative form of a gene	

17.1.4 Describe the inheritance of sex in humans with reference to X and Y chromosomes	
17.1.5.State that the sequence of bases in a gene determines the sequence of amino acids used to make a specific protein (knowledge of the details of nucleotide structure is not required)	
17.1.6 Explain that different sequences of amino acids give different shapes to protein molecules	
17.1.7.Explain that DNA controls cell function by controlling the production of proteins, including enzymes, membrane carriers and receptors for neurotransmitters	
17.1.8.Explain how a protein is made, limited to: -the gene coding for the protein remains in the nucleus – messenger RNA (mRNA) is a copy of the gene - mRNA molecules are made in the nucleus and move to the cytoplasm – the mRNA passes through ribosomes – the ribosome assembles amino acids into protein molecules – the specific order of amino acids is determined by the sequence of bases in the mRNA (knowledge of the details of transcription or translation is not required)	
17.1.9.Explain that most body cells in an organism contain the same genes, but many genes in a particular cell are not expressed because the cell only makes the specific proteins it needs	
17.1.10 Describe a haploid nucleus as a nucleus containing a single set of chromosomes	
17.1.11 Describe a diploid nucleus as a nucleus containing two sets of chromosomes	
17.1.12.State that in a diploid cell, there is a pair of each type of chromosome and in a human diploid cell there are 23 pairs	

17.2 Mitosis

Specification Point	Lessons
17.2.1.Define mitosis as nuclear division giving rise to genetically identical cells (details of stages are not required)	1. Mitosis
17.2.2.State the role of mitosis in growth, repair of damaged tissues, replacement of cells and asexual reproduction	
17.2.3 State that the exact replication of chromosomes occurs before mitosis	
17.2.4.State that during mitosis, the copies of chromosomes separate, maintaining the chromosome number in each daughter cell	
17.2.5.Describe stem cells as unspecialised cells that divide by mitosis to produce daughter cells that can become specialised for specific functions	

17.3 Meiosis

Specification Point	Lessons
17.3.1 State that meiosis is involved in the production of gametes	1. Meiosis 2. Mitosis vs. Meiosis 3. Review: Mitosis vs. Meiosis
17.3.2.Describe meiosis as a reduction division in which the chromosome number is halved from diploid to haploid resulting in genetically different cells (details of stages of meiosis are not required)	

17.4 Monohybrid Inheritance

Specification Point	Lessons
17.4.1 Describe inheritance as the transmission of genetic information from generation to generation	1. Mendel 2. Alleles 3. Inheriting Alleles and Punnett Squares 4. Incomplete Dominance 5. Codominance 6. Pedigrees 7. Dominant/Recessive Interactions 8. Punnett Squares 9. Sex Linkage 10. Sex Linkage, Punnett Squares and Pedigrees
17.4.2 Describe genotype as the genetic make-up of an organism and in terms of the alleles present	
17.4.3 Describe phenotype as the observable features of an organism	
17.4.4 Describe homozygous as having two identical alleles of a particular gene	
17.4.5 State that two identical homozygous individuals that breed together will be pure-breeding	
17.4.6 Describe heterozygous as having two different alleles of a particular gene	
17.4.7 State that a heterozygous individual will not be pure-breeding	
17.4.8 Describe a dominant allele as an allele that is expressed if it is present in the genotype	
17.4.9 Describe a recessive allele as an allele that is only expressed when there is no dominant allele of the gene present in the genotype	
17.4.10 Interpret pedigree diagrams for the inheritance of a given characteristic	
17.4.11.Use genetic diagrams to predict the results of monohybrid crosses and calculate phenotypic ratios, limited to 1:1 and 3:1 ratios	
17.4.12 Use Punnett squares in crosses which result in more than one genotype to work out and sho...	
17.4.13 Explain how to use a test cross to identify an unknown genotype	
17.4.14 Describe codominance as a situation in which both alleles in heterozygous organisms contribute to the phenotype	
17.4.15 Explain the inheritance of ABO blood groups – phenotypes being A, B, AB and O blood groups and alleles being IA , IB and IO	
17.4.16 Describe a sex-linked characteristic as a feature in which the gene responsible is located on a sex chromosome and that this makes it more common in one sex than in the other	
17.4.17 Describe red-green colour blindness as an example of sex	

linkage	
17.4.18.Use genetic diagrams to predict the results of monohybrid crosses involving codominance or sex linkage and calculate phenotypic ratios	

18 Variation and Selection

18.1 Variation

Specification Point	Lessons
18.1.1 Describe variation as differences between individuals of the same species	1. Variation 2. Mutations **Lab Activity: Investigating Variation** Investigating Variation
18.1.2.State that continuous variation results in a range of phenotypes between two extremes; examples include body length and body mass	
18.1.3.State that discontinuous variation results in a limited number of phenotypes with no intermediates; examples include ABO blood groups, seed shape in peas and seed colour in peas	
18.1.4 State that discontinuous variation is usually caused by genes only and continuous variation is caused by both genes and the environment	
18.1.5 Investigate and describe examples of continuous and discontinuous variation	
18.1.6 Describe mutation as genetic change	
18.1.7 State that mutation is the way in which new alleles are formed	
18.1.8 State that ionising radiation and some chemicals increase the rate of mutation	
18.1.9 Describe gene mutation as a random change in the base sequence of DNA	
18.1.10 State that mutation, meiosis, random mating and random fertilisation are sources of genetic variation in populations	

18.2 Adaptive Features

Specification Point	Lessons
18.2.1.Describe an adaptive feature as an inherited feature that helps an organism to survive and reproduce in its environment	1. Adaptations
18.2.2 Interpret images or other information about a species to describe its adaptive features	
18.2.3 Explain the adaptive features of hydrophytes and xerophytes to their environments	

18.3 Selection

Specification Point	Lessons
18.3.1.Describe natural selection with reference to: (a) genetic variation within populations (b) production of many offspring (c) struggle for survival, including competition for resources (d) a greater chance of reproduction by individuals that are better adapted to the environment than others (e) these individuals pass on their alleles to the next generation	1. Natural Selection 2. Artificial Selection 3. Natural selection and Antibiotic resistance **Lab Activity: Survival of the Mutants** 1. Survival of the Mutants 2. Student Worksheet PDF 3. Lab Report Material PDF 4. Teacher Guide PDF 5. Laboratory Technician Guide PDF 6. Editable Documents - Word (.docx)
18.3.2.Describe selective breeding with reference to: (a) selection by humans of individuals with desirable features (b) crossing these individuals to produce the next generation (c) selection of offspring showing the desirable features	
18.3.3.Outline how selective breeding by artificial selection is carried out over many generations to improve crop plants and domesticated animals and apply these to given contexts	
18.3.4.Define adaptation as the process, resulting from natural selection, by which populations become more suited to their environment over many generations	
18.3.5.Describe the development of strains of antibiotic resistant bacteria as an example of natural selection	
18.3.6 Outline the differences between natural and artificial selection	

19 Organisms and their Environment

19.1 Energy Flow

Specification Point	Lessons
19.1.1 State that the Sun is the principal source of energy input to biological systems	1. Introduction to Functioning Ecosystems 2. Ecological Energy Efficiency
19.1.2.Describe the flow of energy through living organisms including light energy from the Sun and chemical energy in organisms and its eventual transfer to the environment	

19.2 Food Chains and Food Webs

Specification Point	Lessons
19.2.1.Describe a food chain as showing the transfer of energy from one organism to the next, beginning with a producer	1. Food Chains and Food Webs 2. Producers 3. Consumers and Decomposers 4. Trophic Levels 5. Investigating Ecosystems
19.2.2 Construct and interpret simple food chains	
19.2.3 Describe a food web as a network of interconnected food chains and interpret food webs	
19.2.4.Describe a producer as an organism that makes its own organic nutrients, usually using energy from sunlight, through	

photosynthesis	
19.2.5 Describe a consumer as an organism that gets its energy by feeding on other organisms	
19.2.6.State that consumers may be classed as primary, secondary, tertiary and quaternary according to their position in a food chain	
19.2.7 Describe a herbivore as an animal that gets its energy by eating plants	
19.2.8 Describe a carnivore as an animal that gets its energy by eating other animals	
19.2.9 Describe a decomposer as an organism that gets its energy from dead or waste organic material	
19.2.10.Use food chains and food webs to describe the impacts humans have through over-harvesting of food species and through introducing foreign species to a habitat	
19.2.11 Draw, describe and interpret pyramids of numbers and pyramids of biomass	
19.2.12 Discuss the advantages of using a pyramid of biomass rather than a pyramid of numbers to represent a food chain	
19.2.13 Describe a trophic level as the position of an organism in a food chain, food web or ecological pyramid	
19.2.14 Identify the following as the trophic levels in food webs, food chains, and ecological pyramids: producers, primary consumers, secondary consumers, tertiary consumers and quaternary consumers	
19.2.15 Draw, describe and interpret pyramids of energy	
19.2.14 Identify the following as the trophic levels in food webs, food chains, and ecological pyramids: producers, primary consumers, secondary consumers, tertiary consumers and quaternary consumers	
19.2.17 Explain why the transfer of energy from one trophic level to another is often not efficient	
19.2.18 Explain, in terms of energy loss, why food chains usually have fewer than five trophic levels	
19.2.19 Explain why it is more energy efficient for humans to eat crop plants than to eat livestock that have been fed on crop plants	

19.3 Nutrient Cycles

Specification Point	Lessons
19.3.1.Describe the carbon cycle, limited to photosynthesis, respiration, feeding, decomposition, formation of fossil fuels and combustion	1. Spheres 2. The Water Cycle 3. The Carbon Cycle 4. The Nitrogen Cycle
19.3.2.Describe the nitrogen cycle with reference to: – decomposition of plant and animal protein to ammonium ions – nitrification – nitrogen fixation by lightning and bacteria –	

absorption of nitrate ions by plants – production of amino acids and proteins – feeding and digestion of proteins – deamination – denitrification	
19.3.3.State the roles of microorganisms in the nitrogen cycle, limited to decomposition, nitrification, nitrogen fixation and denitrification (generic names of individual bacteria, e.g. Rhizobium, are not required)	

19.4 Populations

Specification Point	Lessons
19.4.1.Describe a population as a group of organisms of one species, living in the same area, at the same time	Populations
19.4.2 Describe a community as all of the populations of different species in an ecosystem	
19.4.3 Define ecosystem as a unit containing the community of organisms and their environment, interacting together	
19.4.4.Identify and state the factors affecting the rate of population growth for a population of an organism, limited to food supply, competition, predation and disease	
19.4.5.Identify the lag, exponential (log), stationary and death phases in the sigmoid population growth curve for a population growing in an environment with limited resources	
19.4.6.Interpret graphs and diagrams of human population growth	
19.4.7.Explain the factors that lead to each phase in the sigmoid curve of population growth, making reference, where appropriate, to the role of limiting factors	

20 Human Influences on Ecosystems

20.1 Food Supply

Specification Point	Lessons
20.1.1.Describe how humans have increased food production, limited to: (a) agricultural machinery to use larger areas of land and improve efficiency (b) chemical fertilisers to improve yields (c) insecticides to improve quality and yield (d) herbicide	1. Increasing Crop Yield 2. Human Impacts on Land *Further Resources* 1. Population and Food Security 2. Climate Change and Food Security 3. Water Scarcity and Food Security 4. Land Degradation and Food Security 5. Competitive Land Use and Food Security
20.1.2 Describe the advantages and disadvantages of large-scale monocultures of crop plants	
20.1.3 Describe the advantages and disadvantages of intensive	

livestock production	

20.2 Habitat Destruction

Specification Point	Lessons
20.2.1 Describe biodiversity as the number of different species that live in an area	1. Biodiversity Decline 2. Habitat Loss 3. Deforestation 4. Forest Biomes 5. Dams, Diversion and Depletion 6. Marine Biomes
20.2.2.Describe the reasons for habitat destruction, including: (a) increased area for housing, crop plant production and livestock production (b) extraction of natural resources (c) freshwater and marine pollution	
20.2.3.State that through altering food webs and food chains, humans can have a negative impact on habitats	
20.2.4.Explain the undesirable effects of deforestation as an example of habitat destruction, to include: reducing biodiversity, extinction, loss of soil, flooding and increase of carbon dioxide in the atmosphere	

20.3 Pollution

Specification Point	Lessons
20.3.1 Describe the effects of untreated sewage and excess fertiliser on aquatic ecosystems	1. Pollution 2. Water Pollution 3. Climate Change 4. Wetlands
20.3.2 Describe the effects of non-biodegradable plastics in the environment, in both aquatic and terrestrial ecosystems	
20.3.3 Describe the sources and effects of pollution of the air by methane and carbon dioxide, limited to the enhanced greenhouse effect and climate change	
20.3.4.Explain the process of eutrophication of water in terms of: – increased availability of nitrate and other ions – increased growth of producers – increased decomposition after death of producers – increased aerobic respiration by decomposers – reduction in dissolved oxygen – death of organisms requiring dissolved oxygen in water	

20.4 Conservation

Specification Point	Lessons
20.4.1.Define a sustainable resource as one which is produced as rapidly as it is removed from the environment so that it does not run out	1. Ecological Footprints 2. Sustainable Development 3. Conservation of Biodiversity 4. What happened to. . .? Why Species are Endangered or Extinct 5. Extension: Introduced Species
20.4.2.State that some resources can be maintained, limited to forests and fish stocks	
20.4.3.Explain why organisms become endangered or extinct, limited to climate change, habitat destruction, hunting, pollution	

and introduced species	
20.4.4.Describe how endangered species can be conserved, limited to (a) monitoring and protecting species and habitats, (b) education, (c) captive breeding programmes and (d) seed banks	
20.4.5 Explain how forests can be conserved using: education, protected areas, quotas and replanting	
20.4.6.Explain how fish stocks can be conserved using: education, closed seasons, protected areas, controlled net types and mesh size, quotas and monitoring	
20.4.7 Describe reasons for conservation programmes, to include: (a) maintaining or increasing biodiversity (b) reducing extinction (c) protecting vulnerable ecosystems (d) maintaining ecosystem functions, limited to nutrient cycling and resource provision, including food, drugs, fuel and genes	
20.4.8 Describe the use of artificial insemination (AI) and in vitro fertilisation (IVF) in captive breeding programmes	
20.4.9.Explain the risks to a species if the population size drops, reducing variation (knowledge of genetic drift is not required)	

21 Biotechnology and Genetic Modification

21.1 Biotechnology and Genetic Modification

Specification Point	Lessons
21.1.1.State that bacteria are useful in biotechnology and genetic engineering due to their rapid reproduction rate and their ability to make complex molecules	1. Recombinant DNA 2. Using Bacteria in Biotechnology and Genetic Engineering
21.1.2.Discuss why bacteria are useful in biotechnology and genetic engineering, limited to: (a) few ethical concerns over their manipulation and growth (b) presence of plasmids	

21.2 Biotechnology

Specification Point	Lessons
21.2.1.Describe the role of anaerobic respiration in yeast during production of ethanol for biofuels	1. Using Yeast 2. Using Enzymes 3. Fermenters
21.2.2.Describe the role of anaerobic respiration in yeast during bread-making	
21.2.3.Describe the use of pectinase in fruit juice production	
21.2.4.Investigate and describe the use of biological washing powders that contain enzymes	
21.2.5.Explain the use of lactase to produce lactose-free milk	
21.2.6.Describe how fermenters can be used for the large-scale	

production of useful products by bacteria and fungi, including insulin, penicillin and mycoprotein	
21.2.7.Describe and explain the conditions that need to be controlled in a fermenter, including: temperature, pH, oxygen, nutrient supply, and waste products	

21.3 Genetic Modification

Specification Point	Lessons
21.3.1.Describe genetic modification as changing the genetic material of an organism by removing, changing or inserting individual genes	1. Genetically Modified Organisms (GMOs) 2. Transgenesis: Food Production 3. Social and Ethical Implications
2 1.3.2Outline examples of genetic modification: (a) the insertion of human genes into bacteria to produce human proteins (b) the insertion of genes into crop plants to confer resistance to herbicides (c) the insertion of genes into crop plants to confer resistance to insect pests (d) the insertion of genes into crop plants to improve nutritional qualities	
21.3.3.Outline the process of genetic modification using bacterial production of a human protein as an example, limited to: (a) isolation of the DNA making up a human gene using restriction enzymes, forming sticky ends (b) cutting of bacterial plasmid DNA with the same restriction enzymes, forming complementary sticky ends (c) insertion of human DNA into bacterial plasmid DNA using DNA ligase to form a recombinant plasmid (d) insertion of plasmid into bacteria (specific detail is not required) (e) multiplication of bacteria containing recombinant plasmids (f) expression in bacteria of the human gene to make the human protein	
21.3.4.Discuss the advantages and disadvantages of genetically modifying crops, such as soya, maize and rice	