VCE Biology

EP Curriculum Map

Unit 1: How do living things stay alive?

Area of Study 1: How do organisms function?

Cell size, structure and function

Content Descriptor	Lesson Names
Cells as the basic structural feature of life on Earth, including the distinction between prokaryotic and eukaryotic cells.	• Prokaryotic Cells • Eukaryotic Cells • Cell Organelles • Prokaryotic vs. Eukaryotic Cells
Surface area to volume ratio as an important factor in explaining the limitations of cell size and the need for internal compartments (organelles) with specific cellular functions.	• Cell Size
The ultrastructure of plant and animal cells in terms of their organelles and identification of these organelles using the light microscope and electron micrographs.	• Cell Organelles • History of Microscopes • Electron Micrographs

Crossing the plasma membrane

Content Descriptor	Lesson Names
The characteristics of the plasma membrane as a semi-permeable boundary between the internal and external environments of a cell.	• Cell Membrane Structure • Internal Membranes • Cell Membrane Model Development
Modes of transport of soluble substances across the plasma membrane including simple diffusion, facilitated diffusion, osmosis and active transport.	• Passive Transport - Diffusion • Passive Transport - Osmosis • Passive Transport - Facilitated Diffusion • Active Transport • Diffusion Experiments • Osmosis Experiments

Energy transformations

Content Descriptor	Lesson Names
The distinction between photosynthetic autotrophs,	• Photosynthesis

chemosynthetic autotrophs and heterotrophs.	• Photosynthesis and Respiration • Photosynthesis and Productivity
Photosynthesis as a chemical process in which solar energy is captured and transformed to chemical energy by fixing carbon to produce a carbohydrate and releasing oxygen as a by-product.	• Photosynthesis • Photosynthesis and Respiration • Photosynthesis and Productivity
Cellular respiration as a chemical process that commonly uses glucose to produce energy for the cell in both autotrophs and heterotrophs.	• Respiration in Cells • Photosynthesis and Respiration • The Carbon Cycle

Functioning systems

Content Descriptor	Lesson Names
A study of one selected mammalian system (circulatory, digestive, excretory or respiratory) with reference to how cells in the system are specialised and organised (cells into tissues, tissues into organs and organs into systems), how a specific malfunction can lead to biological consequences and how the system is interconnected to other systems for the survival of the organism.	• Hierarchy of Organisation • Introduction to the Circulatory System • Introduction to Respiration • Digestive System Overview • Introduction to Excretory System
A study of one selected vascular plant with reference to how its cells are specialised and organised (cells into tissues, and tissues into organs) for the intake, movement and loss of water from the plant.	• Gas Exchange in Plants • Leaf Structure and Photosynthesis • Xylem and Phloem Structure • Transpiration • Translocation

Area of Study 2: How do living systems sustain life?

Survival through adaptations and regulation

Content Descriptor	Lesson Names
The structural, physiological and behavioural adaptations that enhance an organism's survival and enable life to exist in a wide range of environments.	• Adaptations • Adaptations, Humans and Succession
Successful adaptations as models for biomimicry to solve human challenges.	• Mimicry
How regulation of factors is needed to maintain a relatively constant internal environment, explained by the stimulus-response model and the use of homeostatic mechanisms including feedback loops.	• Introduction to Homeostasis • Maintaining the Internal Environment • Endocrine System in Action

Factors regulated by homeostatic mechanisms in humans, including temperature, blood glucose and water balance.	• Introduction to Homeostasis • Maintaining the Internal Environment • Thermoregulation • Modelling Human Thermoregulation • Osmoregulation I • Osmoregulation II • Regulating Blood Glucose Levels
Malfunctions in homeostatic mechanisms that result in diseases, including Type 1 diabetes and hyperthyroidism in humans.	*Further development planned*

Organising biodiversity

Content Descriptor	Lesson Names
Classification of biodiversity, past and present, into taxonomic groups based on shared morphological and molecular characteristics, and naming using binomial nomenclature.	• Factors Affecting Biodiversity • Classification • Linnaean Classification • Classification Systems • Classifying Ecosystems
Strategies for managing Earth's biodiversity to support the conservation of species and as a reservoir for the bio-prospecting of new food sources and medicinal drugs..	• Sustainable Development • Conservation of Biodiversity • Indigenous Perspectives of Conservation • History of Conservation • Human Population & Changing Environments • Human Impacts on Land • Human Impacts on Wetlands • Human Impacts on Forest Biomes • Human Impacts on Marine Biomes

Relationships between organisms within an ecosystem

Content Descriptor	Lesson Names
The beneficial, harmful and benign relationships between species including amensalism, commensalism, mutualism, parasitism and predation.	• Ecological Relationships
Interdependencies between species as represented by food webs, including impact of changes to keystone species.	• Food Chains and Food Webs • Keystone Species • Ecological Energy Efficiency
The distribution, density and size of a population of a particular species within an ecosystem and the impacts of factors including available resources, predation, competition, disease, chance environmental events, births, deaths and migration.	• Introduction to Functioning Ecosystems • Predicting Population Changes • Adaptations, Humans and Succession

Unit 2: How is continuity of life maintained?

Area of Study 1: How does reproduction maintain the continuity of life?

The cell cycle

Content Descriptor	Lesson Names
Derivation of all cells from pre-existing cells through completion of the cell cycle.	• The Cell Cycle • Mitosis • Meiosis • Mitosis vs. Meiosis
The rapid procession of prokaryotic cells through their cell cycle by binary fission.	• The Cell Cycle • Cell Division in Bacteria
The key events in the phases (G1, S, G2, M and C) of the eukaryotic cell cycle, including the characteristics of the sub-phases of mitosis (prophase, metaphase, anaphase and telophase) and cytokinesis in plant and animal cells.	• The Cell Cycle

Asexual reproduction

Content Descriptor	Lesson Names
The types of asexual reproduction including fission, budding, vegetative propagation and spore formation.	• Asexual and Sexual Reproduction • Asexual Reproduction in Animals • Asexual Reproduction in Plants
The biological advantages and disadvantages of asexual reproduction.	• Asexual and Sexual Reproduction • Asexual Reproduction in Animals • Asexual Reproduction in Plants
Emerging issues associated with cloning, including applications in agriculture and horticulture.	• Asexual and Sexual Reproduction • Asexual Reproduction in Animals • Asexual Reproduction in Plants

Sexual reproduction

Content Descriptor	Lesson Names
How an offspring from two parents has a unique genetic identity.	• Asexual and Sexual Reproduction
The key events in meiosis that result in the production of gametes from somatic cells including the significance of crossing over of chromatids between homologous chromosomes in Prophase 1 and the non-dividing of the	• DNA Replication • Gametes and Fertilisation • Meiosis

centromere in Metaphase 1.	
The biological advantage of sexual reproduction, specifically the genetic diversity in offspring.	• Asexual and Sexual Reproduction

Cell growth and cell differentiation

Content Descriptor	Lesson Names
The types and function of stem cells in human development, including the distinction between embryonic and adult stem cells and their potential use in the development of medical therapies.	• Stem Cells
The consequences of stem cell differentiation in human prenatal development including the development of germ layers, types of tissues formed from germ layers and the distinction between embryo and foetus.	• Stem Cells and Differentiation
The disruption of the regulation of the cell cycle through genetic predisposition or the action of mutagens that gives rise to uncontrolled cell division including cancer and abnormal embryonic development.	• Cancer

Area of Study 2: How is inheritance explained?

Genomes, genes and alleles

Content Descriptor	Lesson Names
The distinction between a genome, gene and allele.	• Genes and Genetic Information • Alleles • Homologous Chromosomes
The genome as the sum total of an organism's DNA measured in the number of base pairs contained in a haploid set of chromosomes.	• Genomics
The role of genomic research since the Human Genome Project, with reference to the sequencing of the genes of many organisms, comparing relatedness between species, determining gene function and genomic applications for the early detection and diagnosis of human diseases.	• Genomics

Chromosomes

Content Descriptor	Lesson Names
The distinction between a genome, gene and allele.	• Genes and Genetic Information • Alleles • Homologous Chromosomes
The genome as the sum total of an organism's DNA measured in the number of base pairs contained in a haploid set of chromosomes.	• Genomics

Genomes and phenotypes

Content Descriptor	Lesson Names
The use of symbols in the writing of the genotypes for the alleles present at a particular gene locus.	• Inheriting Alleles and Punnett Squares • Making Punnett Squares
The distinction between a dominant and recessive phenotype.	• Phenotype and Survival
The relative influences of genetic material, environmental factors and interactions of DNA with other molecules (epigenetic factors) on phenotypes.	• Mutations • Genetic Disease • Epigenetics: Inheritance is Strange
Qualitative treatment of polygenic inheritance as contributing to continuous variation in a population, illustrated by the determination of human skin colour through the genes involved in melanin production or by variation in height.	• Polygenic Inheritance

Pedigree charts, genetic cross outcomes and genetic decision-making

Content Descriptor	Lesson Names
Pedigree charts and patterns of inheritance including autosomal dominant, autosomal recessive, X-linked and Y-linked traits.	• Pedigrees • Pedigree Charts • Sex Linkage • Sex Linkage, Punnett Squares and Pedigrees
The determination of genotypes and prediction of the outcomes of genetic crosses including monohybrid crosses, and monohybrid test crosses.	• Monohybrid Inheritance • Dominant/Recessive Interactions
The inheritance of two characteristics as either independent or linked, and the biological consequence of crossing over for linked genes.	• Incomplete and Co-dominance
The nature and uses of genetic testing for screening of embryos and adults, and its social and ethical implications.	• The Ethics of Genetics

Unit 3: How do cells maintain life?

Area of Study 1: How do cellular processes work?

Plasma membranes

Content Descriptor	Lesson Names
The fluid mosaic model of the structure of the plasma membrane and the movement of hydrophilic and hydrophobic substances across it based on their size and polarity.	• Cell Membrane Structure • Cell Membrane Model Development • Internal Membranes • Active Transport
The role of different organelles including ribosomes, endoplasmic reticulum, Golgi apparatus and associated vesicles in the export of a protein product from the cell through exocytosis.	• Cytosis
Cellular engulfment of material by endocytosis.	• Cytosis

Nucleic acids and proteins

Content Descriptor	Lesson Names
Nucleic acids as information molecules that encode instructions for the synthesis of proteins in cells.	• Basics of DNA • Structure of DNA • Proteins • Protein Synthesis • Nitrogenous Bases
Protein functional diversity and the nature of the proteome.	• Proteins
The functional importance of the four hierarchal levels of protein structure.	• Proteins • Introduction to Protein Synthesis • Protein Synthesis
The synthesis of a polypeptide chain from amino acid monomers by condensation polymerisation.	• Introduction to Protein Synthesis • Transcription and Translation
The structure of DNA and the three forms of RNA including similarities and differences in their subunits, and their synthesis by condensation polymerisation.	• Basics of DNA • Structure of DNA • DNA Replication
The genetic code as a degenerate triplet code and the steps in gene expression including transcription, RNA processing in eukaryotic cells and translation.	• Regulating Gene Expression • Transcription and Translation • The 'Redundant' Code

Gene structure and regulation

Content Descriptor	Lesson Names
The functional distinction between structural genes and regulatory genes.	• Genes
The structure of genes in eukaryotic cells including stop and start instructions, promoter regions, exons and introns.	• Genes • Genes and Genetic Information
Use of the lac operon as a simple prokaryotic model that illustrates the switching off and on of genes by proteins (transcriptional factors) expressed by regulatory genes.	• Regulating Gene Expression

Structure and regulation of biochemical pathways

Content Descriptor	Lesson Names
The role of enzymes as protein catalysts in biochemical pathways.	• Introducing Enzymes • Enzyme Structure
The mode of action of enzymes including reversible and irreversible inhibition of their action due to chemical competitors at the active site, and by factors including temperature, concentration and pH.	• Factors Affecting Enzymes • Examples of Enzyme Reactions
The cycling of coenzymes (ATP, NADH, and NADPH) as loaded and unloaded forms to move energy, protons and electrons between reactions in the cell.	*Further development planned*

Photosynthesis

Content Descriptor	Lesson Names
The purpose of photosynthesis.	• Photosynthesis
Chloroplasts as the site of photosynthesis, an overview of their structure and evidence of their bacterial origins.	• Photosynthesis
Inputs and outputs of the light dependent and light independent (Calvin cycle) stages of photosynthesis in C3 plants (details of the biochemical pathway mechanisms are not required).	• Light Reactions of Photosynthesis
Factors that affect the rate of photosynthesis, including light, temperature and carbon dioxide concentration.	• Factors Affecting the Rate of Photosynthesis

Cellular respiration

Content Descriptor	Lesson Names

The purpose of cellular respiration.	• Introduction to Metabolism
The location of, and the inputs and outputs of, glycolysis including ATP yield (details of the biochemical pathway mechanisms are not required).	• Glycolysis
Mitochondria as the site of aerobic cellular respiration, an overview of their structure and evidence of their bacterial origins.	• Aerobic Respiration • The Origin of the Mitochondria
The main inputs and outputs of the Krebs (citric acid) cycle and electron transport chain including ATP yield (details of the biochemical pathway mechanisms are not required).	• Aerobic Respiration • Citric Acid Cycle • Electron Transport Chain
The location of anaerobic cellular respiration, its inputs and the difference in outputs between animals and yeasts including ATP yield.	• Anaerobic Respiration
Factors that affect the rate of cellular respiration, including temperature, glucose availability and oxygen concentration.	• Aerobic Respiration

Area of Study 2: How do cells communicate?

Cellular signals

Content Descriptor	**Lesson Names**
The sources and mode of transmission of various signalling molecules to their target cell, including plant and animal hormones, neurotransmitters, cytokines and pheromones.	• The Endocrine System • Endocrine System in Action • Action of Hormones • Chemical Signalling in the Nervous System
The stimulus-response model when applied to the cell in terms of signal transduction as a three-step process involving reception, transduction and cellular response.	• Introduction to Homeostasis
Difference in signal transduction for hydrophilic and hydrophobic signals in terms of the position of receptors (on the membrane and in the cytosol) and initiation of transduction (details of specific chemicals, names of second messengers, G protein pathways, reaction mechanisms or cascade reactions are not required).	• Cytosis
Apoptosis as a natural, regulatory process of programmed cell death, initiated after a cell receives a signal from inside (mitochondrial pathway) or from outside (death receptor pathway) the cell resulting in the removal of cells that are no longer needed or that may be a threat to an organism, mediated by enzymes	*Further development planned*

(caspases) that cleave specific proteins in the cytoplasm or nucleus (details of specific cytoplasmic or nuclear proteins are not required)	
Malfunctions in apoptosis that result in deviant cell behaviour leading to diseases including cancer.	*Further development planned*

Responding to antigens

Content Descriptor	Lesson Names
An antigen as a unique molecule or part of a molecule that initiates an immune response including the distinction between non-self antigens, self-antigens and allergens.	• Introduction to Infectious Diseases
Invading cellular and non-cellular pathogens as a source of non-self antigens, and preventative strategies including physical, chemical and microbiological barriers in animals and plants that keep them out.	• Revision Lesson - Pathogens • Bacteria • Viruses • Fungi • Protists • Parasites • Prions • Innate Immunity
The characteristics and roles of components (macrophages, neutrophils, mast cells, dendritic cells, complement proteins) of the innate (non-specific) immune response to an antigen including the steps in the inflammatory response.	• Introduction to Immune Responses • Inflammation • Complement System
The role of the lymphatic system in the immune response including the role of secondary lymphoid tissue (with reference to lymph nodes) as the site of antigen recognition by lymphocytes, and as a transport system for antigen presenting cells including dendritic cells.	• The Lymphatic System
The characteristics and roles of components of the adaptive (specific) immune response including the actions of B lymphocytes and their antibodies (including antibody structure) in humoral immunity, and the actions of T helper and T cytotoxic cells in cell-mediated immunity.	• Adaptive immune response overview • Cell-Mediated and Antibody-Mediated (Humoral) Immunity

Immunity

Content Descriptor	Lesson Names
The deficiencies and malfunctions of the immune	• Malfunctions of the Immune System

system as a cause of human diseases including autoimmune diseases (illustrated by multiple sclerosis), immune deficiency diseases (illustrated by HIV) and allergic reactions (illustrated by reactions to pollen).	
The difference between natural and artificial immunity, and active and passive strategies for acquiring immunity.	• Revision Lesson - Pathogens • Vaccines
Vaccination programs and their role in maintaining herd immunity for a particular disease in the human population.	• Vaccines
The use of monoclonal antibodies in treating cancer..	• Malfunctions of the Immune System
Processes of evolution including through the action of mutations and different selection pressures on a fragmented population and subsequent isolating mechanisms (allopatric speciation) that prevent gene flow.	• Microevolutionary Change Mechanisms • Natural Selection • Mutations • Phenotype and Survival • Mechanisms of Isolation

Unit 4: How does life change and respond to challenges over time?

Area of Study 1: How are species related?

Changes in the genetic makeup of a population

Content Descriptor	Lesson Names
Processes of evolution including through the action of mutations and different selection pressures on a fragmented population and subsequent isolating mechanisms (allopatric speciation) that prevent gene flow.	• Microevolutionary Change Mechanisms • Natural Selection • Mutations • Phenotype and Survival • Mechanisms of Isolation
The qualitative treatment of the causes of changing allele frequencies in a population's gene pool including types of mutations (point, frameshift, block) as a source of new alleles, chromosomal abnormalities (aneuploidy and polyploidy), environmental selection pressures on phenotypes as the mechanism for natural selection, gene flow, and genetic drift (bottleneck and founder effects) and the biological consequences of such changes in terms of increased or reduced genetic diversity.	• Genetic Disease • Phenotypic Selection • Patterns of Diversification • Modes of Speciation • Instantaneous Speciation • Mechanisms of Isolation • Genetic Drift • Gene Flow and Allele Frequency
The manipulation of gene pools through selective breeding programs.	• Phenotypic Selection • Gene Flow and Allele Frequency

Changes in biodiversity over time

Content Descriptor	Lesson Names
Evidence of biological change over time including from palaeontology (the fossil record, the relative and absolute dating of fossils, types of fossils and the steps in fossilisation), biogeography, developmental biology and structural morphology.	• Theories and Evidence • Evidence from Living Species • Fossils and the Fossil Record • Geographical Distribution • Past Ecosystems I: A Brief History of the Earth • Past Ecosystems II: Evidence
Significant changes in life forms in Earth's geological history including the rise of multicellular organisms, animals on land, the first flowering plants and mammals.	• Past Ecosystems I: A Brief History of the Earth • Past Ecosystems II: Evidence
Patterns of biological change over geological time including divergent evolution, convergent evolution and mass extinctions.	• Darwin's Theory of Evolution • Evolution on Earth • Convergent and Divergent Evolution

	• Extinction
Molecular homology as evidence of relatedness between species including DNA and amino acid sequences, mtDNA (the molecular clock) and the DNA hybridisation technique.	• Comparative Studies • Evidence from Living Species

Determining relatedness between species

Content Descriptor	Lesson Names
Molecular homology as evidence of relatedness between species including DNA and amino acid sequences, mtDNA (the molecular clock) and the DNA hybridisation technique.	• Comparative Studies • Evidence from Living Species
The evolution of novel phenotypes arising from chance events within genomes, specifically sets of genes that regulate developmental processes and lead to changes in the expression of a few master genes found across the animal phyla, as demonstrated by the expression of gene BMP4 in beak formation of the Galapagos finches and jaw formation of cichlid fish in Africa.	• Darwin's Theory of Evolution • Evolution on Earth
The use of phylogenetic trees to show relatedness between species.	• Rate of Evolutionary Change

Human change over time

Content Descriptor	Lesson Names
Shared characteristics that define primates, hominoids and hominins.	• Hominid Biological Evolution • Hominid Evolutionary Pathways
Major trends in hominin evolution from the genus Australopithecus to the genus Homo including structural, functional and cognitive changes and the consequences for cultural evolution.	• Hominid Biological Evolution • Hominid Evolutionary Pathways • Hominid Cultural Evolution
The human fossil record as an example of a classification scheme that is open to interpretations that are contested, refined or replaced when new evidence challenges them or when a new model has greater explanatory power, including whether Homo sapiens and Homo neanderthalensis interbred and the placement of the Denisovans into the Homo evolutionary tree.	*Further development planned*

Area of Study 2: How do humans impact on biological processes?

DNA manipulation

Content Descriptor	Lesson Names
The use of enzymes including endonucleases (restriction enzymes), ligases and polymerases. Amplification of DNA using the polymerase chain reaction. The use of gel electrophoresis in sorting DNA fragments, including interpretation of gel runs.	• Enzymes in Biotechnology • Polymerase Chain Reaction • Gel Electrophoresis
The use of recombinant plasmids as vectors to transform bacterial cells.	• Recombinant DNA

Biological knowledge and society

Content Descriptor	Lesson Names
The distinction between genetically modified and transgenic organisms, their use in agriculture to increase crop productivity and to provide resistance to insect predation and/or disease, and the biological, social and ethical implications that are raised by their use.	• Genetically Modified Organisms (GMOs) • Transgenesis: Food Production
Techniques that apply DNA knowledge (specifically gene cloning, genetic screening and DNA profiling) including social and ethical implications and issues.	• DNA Sequencing • DNA Profiling and Forensics • Genetically Modified Organisms (GMOs) • Transgenesis: Food Production
The concept of rational drug design in terms of the complementary nature (shape and charge) of small molecules that are designed to bind tightly to target biomolecules (limited to enzymes) resulting in the enzyme's inhibition and giving rise to a consequential therapeutic benefit, illustrated by the Australian development of the antiviral drug Relenza as a neuraminidase inhibitor.	• Disease Treatment and Control
Strategies that deal with the emergence of new diseases in a globally connected world, including the distinction between epidemics and pandemics, the use of scientific knowledge to identify the pathogen, and the types of treatments.	• Modelling Disease Outbreak and Spread • Managing Pandemics in the Asia Region • Disease Treatment and Control • Superbugs are the Real Super Villains

The use of chemical agents against pathogens including the distinction between antibiotics and antiviral drugs with reference to their mode of action and biological effectiveness.	• Antibiotics • Disease Treatment and Control • Vaccination