

VCE Biology

Key changes to the Study Design

Focus on Key Science Skills

- Increase in practical/activity hours from 7-10 hour to minimum of 10 per unit.
- Broader depth and elaboration of investigation methodologies to include case studies, simulations, literature reviews, data analysis, field experiments etc.
- Definition of terms now included in the study such as data, errors, and ethics.

Over-arching changes

- Overlap of some topics between Units 1–4 and Years 7–10 has been reduced and the **flow from junior science into VCE improved**.
- **Interconnectedness** of the content is emphasised throughout.
- **Aboriginal and Torres Strait Islander peoples' knowledge and perspectives** is an important consideration for teaching and learning across Units 1–4 and specifically mentioned with the dot points for Units 2 and 4. In particular how scientific thinking can be enhanced by considering how Aboriginal and Torres Strait Islander peoples have developed and refined their own knowledge about the world.
- An **increased focus on the development of key science skills**, scientific methodologies, ethical approaches and concepts, and the application of scientific knowledge.

ASSESSMENT CHANGE:

Unit 3 SACs NOW 20% Unit 4 SACs now 30% End-of-year exam now 50%

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Major additions to Study Design

New dot points that increase **interconnections** between content:

Unit 3

- ‘the function of CRISPR-Cas9 in bacteria and the application of this function in editing an organism’s genome’
- ‘potential uses and applications of CRISPR-Cas9 technologies to improve photosynthetic efficiencies and crop yields’
- ‘the role of Rubisco in photosynthesis, including adaptations of C3, C4 and CAM plants to maximise the efficiency of photosynthesis’
- ‘uses and applications of anaerobic fermentation of biomass for biofuel production’

Links:

CRISPR is covered as a gene editing tool, and Rubisco as an important enzyme in photosynthesis. A new dot point links this content – using CRISPR to improve photosynthesis. Anaerobic respiration/fermentation is covered as part of the biochemical pathways, and a new dot point links this process to biofuel production.

Unit 4

- ‘ways of using fossil and DNA evidence (mtDNA and whole genomes) to explain the migration of modern human populations around the world, including the migration of Aboriginal and Torres Strait Islander populations and their connection to Country and Place’

Links:

The increased focus on Aboriginal and Torres Strait Islander peoples’ knowledge and perspectives across Units 1–4 is demonstrated in this link to the migration of populations around the world and the evidence that supports it.

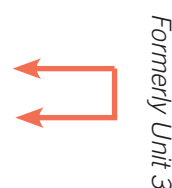
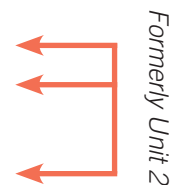
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Movement of topics within the Study Design

Topics that have been relocated in the new Study Design:

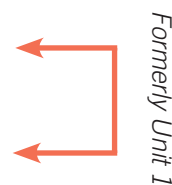
Unit 1 Area of Study 1 The cell cycle and cell growth, death and differentiation

- binary fission in prokaryotic cells
- the eukaryotic cell cycle, including the characteristics of each of the sub-phases of mitosis and cytokinesis in plant and animal cells
- properties of stem cells that allow for differentiation, specialisation and renewal of cells and tissues, including the concepts of pluripotency and totipotency
- apoptosis as a regulated process of programmed cell death
- disruption to the regulation of the cell cycle and malfunctions in apoptosis that may result in deviant cell behaviour: cancer and the characteristics of cancer cells



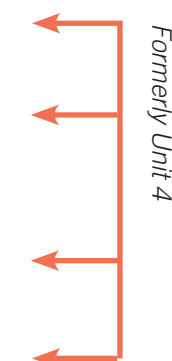
Unit 2 Area of Study 2 Adaptations and diversity

- structural, physiological and behavioural adaptations that enhance an organism's survival and enable life to exist in a wide range of environments
- survival through interdependencies between species, including impact of changes to keystone species and predators and their ecological roles in structuring and maintaining the distribution, density and size of a population in an ecosystem



Unit 3 Area of Study 1 DNA manipulation techniques and applications

- the use of enzymes to manipulate DNA, including polymerase to synthesise DNA, ligase to join DNA and endonucleases to cut DNA
- amplification of DNA using polymerase chain reaction and the use of gel electrophoresis in sorting DNA fragments, including the interpretation of gel runs for DNA profiling
- the use of recombinant plasmids as vectors to transform bacterial cells as demonstrated by the production of human insulin
- the use of genetically modified and transgenic organisms in agriculture to increase crop productivity and to provide resistance to disease



Movement of topics within the Study Design

Unit 4 Area of Study 1 How do organisms respond to pathogens?

- physical, chemical and microbiota barriers as preventative mechanisms of pathogenic infection in animals and plants
- the innate immune response including the steps in an inflammatory response and the characteristics and roles of macrophages, neutrophils, dendritic cells, eosinophils, natural killer cells, mast cells, complement proteins and interferons
- initiation of an immune response, including antigen presentation, the distinction between self-antigens and non-self antigens, cellular and non-cellular pathogens and allergens
- the role of the lymphatic system in the immune response as a transport network and the role of lymph nodes as sites for antigen recognition by T and B lymphocytes
- the characteristics and roles of the components of the adaptive immune response against both extracellular and intracellular threats, including the actions of B lymphocytes and their antibodies, helper T and cytotoxic T cells
- the difference between natural and artificial immunity and active and passive strategies for acquiring immunity
- vaccination programs and their role in maintaining herd immunity for a specific disease in a human population
- the development of immunotherapy strategies, including the use of monoclonal antibodies for the treatment of autoimmune diseases and cancer

Formerly Unit 3



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Major deletions from the previous Study Design

Many of the deletions in the new Study Design are to remove the overlap of content between Years 10 and 11 and between VCE units. For example, inheritance in Unit 2 has been reworded to reduce overlap and improve flow from Year 10, and the 'Plasma membranes' dot points have been removed from Unit 3 as it is covered in Unit 1.

Many of the 'Cellular signals' dot points that cover signal transduction have been deleted.

Deletions by Area of Study

Unit 1 Area of Study 1

- 'the distinction between photosynthetic autotrophs, chemosynthetic autotrophs and heterotrophs'

Unit 1 Area of Study 2

- 'successful adaptations as models for biomimicry to solve human challenges'
- 'classification of biodiversity, past and present, into taxonomic groups based on shared morphological and molecular characteristics, and naming using binomial nomenclature.'
- '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.'

Unit 2 Area of Study 1

- 'the disruption of the regulation of the cell cycle through **genetic predisposition or the action of mutagens** that give rise to uncontrolled cell division including cancer and **abnormal embryonic development**'

Note: red text deleted. Rest of dot point moved to Unit 1.

Unit 2 Area of Study 2

- '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.'

Unit 2 Area of Study 2 Cont.

- '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.'
- 'the nature and uses of genetic testing for screening of embryos and adults, and its social and ethical implications.'

Note: This is now included in AOS 3 where students research and explore a contemporary bioethical issue relating to the application of genetic knowledge, reproductive science, inheritance or adaptations and interdependencies beneficial for survival.

Unit 3 Area of Study 1

- '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'
- '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'
- 'cellular engulfment of material by endocytosis.'

Unit 3 Area of Study 2

- 'the sources and mode of transmission of various signalling molecules to their target cell, including plant and animal hormones, neurotransmitters, cytokines and pheromones'
- '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'

Note: red text deletion. Stimulus-response models covered in Unit 1

- '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)'
- 'the deficiencies and malfunctions of the immune system as a cause of human diseases including autoimmune diseases (including MS), immune deficiency diseases (HIV), and allergic reactions (pollen).'

Unit 4 Area of Study 1

- ‘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’

Note: red text deletion.

- ‘patterns of biological change over geological time including divergent evolution, convergent evolution and mass extinctions.’

Note: despite not being an explicit dot point, these terms do still link to content in Unit 4.

- 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.

Note: Galapagos finches are still in Unit 4 in the context of allopatric speciation.

- ‘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**’

Note: red text deletion and changed to looking at just brain size and limb structure.

Unit 4 Area of Study 2

- ‘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’
- ‘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.’

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