Locally Developed Courses

Biology (Advanced)

For the 2024-2025 School Year

Introduction to the Biology (Advanced) Course Sequence

Subject: Sciences - Discipline: Biology

The Biology (Advanced) sequence is based on, but does not replicate, the 2020 College Board: Advanced Placement Biology Course and Exam Description. This course extends and enriches concepts from Science 10, Biology 20 and Biology 30. Approximately one-quarter of this course is intended to be laboratory-based instruction and investigations.

Student Need

By enriching and extending the topics covered in the Alberta Biology Program of Studies, the Biology (Advanced) course enables students to deepen their understanding of scientific processes, hone their reasoning skills, and develop enduring understandings about the natural world. This enables students to fortify knowledge and extend comprehension to novel situations both within and beyond the classroom. The course focuses on developing enduring conceptual understandings facilitated by content that enables students to spend less time on factual recall and more time on inquiry-based learning of essential concepts, helping them to develop the scientific reasoning skills necessary to engage in scientific processes.

Courses in the Biology (Advanced) Course Sequence

Biology (Advanced) 35 (LDC3202)

At the Biology (Advanced) 35 level, students explore high school biology concepts in greater detail that the Alberta Biology 20/30 Program of Studies while also examining concepts that are considered post-secondary biology materials. There is a greater emphasis on scientific methodology and inquiry than in the Alberta Biology 20/30 Program of Studies.

> High school chemicals, laboratory equipment, labware and laboratory space.
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> Student safety and risks must be considered before engaging in laboratory activities. The environmental effects of the disposal of hazardous waste, such as chemicals used and produced, and specimens, living or preserved, must also be considered.

Prerequisites:

- 1 of the following:
    - Biology 20 (SCN2231)
    - Biology 30 (SCN3230)

Versions Available: (Each version must be locally approved by Board Motion prior to offering to students.)

Credit Level	First School Year	Last School Year
3	2024-2025	2027-2028

Curriculum

Curriculum Elements		Biology (Advanced) 35-3
1	Topic Chemistry of Life	✓
1.1	General Outcome How do the chemical properties of macromolecules affect their structure and function?	✓
1.1.1	Specific Outcome Explain how the structure and function of proteins is based on the specific order of amino acids in a polypeptide primary structure, and how this determines the overall shape of a protein.	✓
1.1.2	Specific Outcome Describe how the interactions of chemical functional groups determine structure and function of different regions of a protein.	✓
1.1.3	Specific Outcome Describe the process of DNA and RNA synthesis in terms of nucleotides added to the 3’ end of the growing strand and the resulting formation of a covalent bond between nucleotides.	✓
1.1.4	Specific Outcome Describe the formation of protein primary, secondary, tertiary, and quaternary structure, and how these structures minimize free-energy and determine the overall function of a protein.	✓
2	Topic Cell Structure and Function	✓
2.1	General Outcome How do water and solute potentials promote cell and organism osmoregulation?	✓
2.1.1	Specific Outcome Apply water potential calculations in terms of pressure and solute potential, $\Psi w = \Psi p + \Psi s$, and apply this to explain the movement of water from areas of high water potential, low osmolarity, and low solute concentration to areas of low water potential, high osmolarity, and high solute concentration.	✓
3	Topic Cellular Energetics	✓
3.1	General Outcome How do changes in the internal and external cellular environment affect enzyme structure and function? How do variations in molecular structures affect survival and fitness?	✓
3.1.1	Specific Outcome Describe how Collision Theory explains how higher environmental temperatures increase the speed of movement of molecules in a solution, effectively increasing the frequency of collisions between enzymes and substrates and, consequentially, increasing the rate of reaction.	✓

Curriculum Elements		Biology (Advanced) 35-3
3.1.2	Specific Outcome Define the laws of thermodynamics and explain how the highly ordered highly ordered systems in living things do not violate the laws of thermodynamics.	✓
3.1.3	Specific Outcome Explain why the energy input into a system must exceed energy output in order to maintain and power cellular processes.	✓
3.1.4	Specific Outcome Describe how loss of energy flow or order in a living system results in death of cells, tissues, and organisms.	✓
4	Topic Cell Communication and the Cell Cycle	✓
4.1	General Outcome How do cells use signal transduction pathways to communicate? How is the cell cycle controlled and regulated?	✓
4.1.1	Specific Outcome Explain that cell signaling begins with the recognition of a ligand by a receptor protein in a target cell.	✓
4.1.2	Specific Outcome Explain how signal transduction pathways influence how a cell responds to its environment and results in changes in gene expression and cell function which may alter phenotype or result in programmed cell apoptosis.	✓
4.1.3	Specific Outcome Describe how non-dividing cells may exit the cell cycle or be held at a particular stage in the cell cycle.	✓
4.1.4	Specific Outcome Identify potential disruptions to the cell cycle and explain the effects on cells, tissues, and the whole organism.	✓
5	Topic **Heredity**	✓
5.1	General Outcome What evidence exists for the common ancestry of all organisms? What molecular evidence of shared ancestry and gene propagation exists?	✓
5.1.1	Specific Outcome Explain the shared, conserved, and fundamental cellular processes and features that support the concept of common ancestry for all organisms.	✓
5.1.2	Specific Outcome Explain that in animals mitochondria are transmitted by the egg and not by sperm and that as a result traits determined by mitochondrial DNA are maternally inherited.	✓

Curriculum Elements		Biology (Advanced) 35-3
5.1.3	Specific Outcome Describe and provide examples of environmental factors that influence gene expression and provide examples of the phenotypic plasticity this can lead to.	✓
5.1.4	Specific Outcome Describe that phenotypic plasticity occurs when individuals with the same genotype exhibit different phenotypes in different environments, and provide examples of this in prokaryotes, animals, plants, and fungi.	✓
6	Topic Gene Expression and Regulation	✓
6.1	General Outcome How are genes expressed and controlled in prokaryotic and eukaryotic organisms?	✓
6.1.1	Specific Outcome Explain how genetic information can be stored in and passed to subsequent generations through RNA. Relate this to epigenetics.	✓
6.1.2	Specific Outcome Describe and differentiate the chromosome arrangement in prokaryotes and eukaryotes.	✓
6.1.3	Specific Outcome Describe and differentiate the processes in eukaryotic cells by which the mRNA transcript undergoes enzyme-regulated modifications with the addition of a poly-A tail, the addition of a GTP cap, the excision of introns, and splicing and retention of exons.	✓
6.1.4	Specific Outcome Describe alternative splicing as the excision of introns, and explain how splicing and retention of exons can generate different versions of the resulting mRNA molecule.	✓
6.1.5	Specific Outcome Describe the process by which operons are transcribed in a single mRNA molecule in prokaryotes.	✓
6.1.6	Specific Outcome Describe the process by which groups of genes are influenced by the same transcription factors to coordinately regulate gene expression.	✓
6.1.7	Specific Outcome Explain the process by which related viruses combine and recombine genetic information when they infect the same host cell.	✓
6.1.8	Specific Outcome Identify and describe the genetic engineering techniques of electrophoresis, polymerase chain reaction (PCR), and bacterial transformation and explain how these processes can be used to alter the genetic code of a cell.	✓

Curriculum Elements		Biology (Advanced) 35-3
7	Topic Ecology	✓
7.1	General Outcome How do organisms communicate with each other in an ecosystem? What factors affect community and ecosystem dynamics?	✓
7.1.1	Specific Outcome Explain how endotherms use thermal energy generated by metabolism to maintain homeostatic body temperatures.	✓
7.1.2	Specific Outcome Explain why different organisms use differing reproductive strategies in response to energy availability.	✓
7.1.3	Specific Outcome Explain how heterotrophs use hydrolysis to metabolize carbohydrates, lipids, and proteins as sources of energy.	✓
7.1.4	Specific Outcome Describe how the effects of keystone species on the ecosystem are disproportionate relative to their abundance in the ecosystem.	✓

Statement of Overlap with Existing Programs

Similar / Overlapping Courses	Description of Similarity / Overlap - Rationale
Biology 20	Study of biological systems
	This course extends the study of biology and includes topics that expand on objectives in the provincial courses in both knowledge and skills. Biology Advanced offers an opportunity for students to explore basic knowledge and skill in Biology 20 and 30 in the context of evolution of cellular structure, the cellular survival and function, and regulation in both cellular and molecular contexts.
Biology 30	The study of biological systems
	This course extends the study of biology and includes topics that expand on objectives in the provincial courses in both knowledge and skills. Biology Advanced offers an opportunity for students to explore basic knowledge and skill in Biology 20 and 30 in the context of evolution of cellular structure, the cellular survival and function, and regulation in both cellular and molecular contexts.