LOCALLY DEVELOPED COURSE OUTLINE

Biology (Advanced) (2020)35-3

Submitted By:

The Calgary School Division

Submitted On:

Feb. 27, 2020

Course Basic Information

Outline Number	Hours	Start Date	End Date	Development Type	Proposal Type	Grades
35-3	62.50	09/01/2020	08/31/2024	Developed	Authorization	G12

Course Description

The Biology (Advanced) course is based on the Fall 2019 College Board: Advanced Placement Chemistry and Exam Descriptions. This course extends from Biology 20 and 30 to prepare students to complete the College Board: Advanced Placement Biology exam. College Board Advanced Placement cultivates academic success and provides experiences where students can earn advanced credit or advanced standing at thousands of colleges and universities on the basis of their Advanced Placement achievements. Students must have access to one of the widely accepted post-secondary Biology Textbooks. The College Board lists specific texts appropriate for the course. The lists are available at https://apcentral.collegeboard.org/.

Course Prerequisites

Biology 20

Sequence Introduction (formerly: Philosophy)

As an extension of Alberta Education's Programs of Study in Science 10, Biology 20 and Biology 30, the Biology (Advanced) course provides opportunities for students to deepen their understanding of biological principles and further develop their laboratory skills. Through an inquiry model, students will develop and refine hypotheses, test and collect evidence and draw conclusions or make predictions about natural phenomena. Students will develop and apply scientific practices throughout the course in both the classroom and laboratory settings. Students will be presented with inquiries that will require them to engage the world critically and analytically. Throughout the course, illustrative examples will be presented to students connecting what is being studied with the world that surrounds them.

Student Need (formerly: Rationale)

By extending the topics covered in the Alberta curriculum, the Biology (Advanced) course enables students to deepen their understanding of the scientific processes, hone their reasoning skills, and develop enduring understandings. This enables students to fortify knowledge and extend comprehension to novel situations both in class and beyond the school. The updated 2019 Course and Exam Description deemphasizes a traditional "content coverage" model of instruction in favor of one that focuses on enduring, conceptual understandings and the content that supports them. This approach enables students to spend less time on factual recall and more time on inquiry-based learning of essential concepts, helping them develop the reasoning skills necessary to engage in the science practices used throughout their study of Biology.

This course fosters belonging and identity by embracing opportunities to learn through interaction with others and provides students opportunities to develop perseverance and excellence, by demonstrating optimism, confidence, courage and resiliency when confronted with challenges or pursuing new ideas. Additionally, the nature of this course promotes Biological literacy and life-long learning thereby reinforcing values such as innovation and stewardship. It does this by encouraging thinking logically, creatively and critically to foster ingenuity, imagination and curiosity; by taking risks; by achieving goals through hard work; and fostering environmental stewardship in order to ensure a sustainable world with a hopeful future

Scope and Sequence (formerly: Learner Outcomes)

The big ideas serve as the foundation of the course and allow students to create meaningful connections among course concepts. Often, they are abstract concepts or themes that become threads that run throughout the course. Revisiting the big ideas and applying them in a variety of contexts allow students to develop deeper conceptual understandings. Following are the big ideas of the course and a brief description of each:

BIG IDEA 1: EVOLUTION The process of evolution drives the diversity and unity of life. Evolution is a change in the genetic makeup of a population over time, with natural selection as its major driving mechanism. Darwin's theory, which is supported by evidence from many scientific disciplines, states that inheritable variations occur in individuals in a population. Due to competition for limited resources, individuals with more favorable genetic variations are more likely to survive and produce more offspring, thus passing traits to future generations. A diverse gene pool is vital for the survival of species because environmental conditions change. The process of evolution explains the diversity and unity of life, but an explanation about the origin of life is less clear. In addition to the process of natural selection, naturally occurring catastrophic and human-induced events as well as random environmental changes can result in alteration in the gene pools of populations. Scientific evidence supports that speciation and extinction have occurred throughout Earth's history and that life continues to evolve within a changing environment, thus explaining the diversity of life.

BIG IDEA 2: ENERGETICS Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis. Cells and organisms must exchange matter with the environment. Organisms respond to changes in their environment at the molecular, cellular, physiological, and behavioral levels. Living systems require energy and matter to maintain order, grow, and reproduce. Organisms employ various strategies to capture, use, and store energy and other vital resources. Energy deficiencies are not only detrimental to individual organisms but they can cause disruptions at the population and ecosystem levels. Homeostatic mechanisms that are conserved or divergent across related organisms reflect either continuity due to common ancestry or evolutionary change in response to distinct selective pressures.

BIG IDEA 3: INFORMATION STORAGE AND TRANSMISSION Living systems store, retrieve, transmit, and respond to information essential to life processes. Genetic information provides for continuity of life, and, in most cases, this information is passed from parent to offspring via DNA. Nonheritable information transmission influences behavior within and between cells, organisms, and populations. These behaviors are directed by underlying genetic information, and responses to information are vital to natural selection and evolution. Genetic information is a repository of instructions necessary for the survival, growth, and reproduction of the organism. Genetic variation can be advantageous for the long-term survival and evolution of a species.

BIG IDEA 4: SYSTEMS INTERACTIONS Biological systems interact, and these systems and their interactions exhibit complex properties. All biological systems comprise parts that interact with one another. These interactions result in characteristics and emergent properties not found in the individual parts alone. All biological systems from the molecular level to the ecosystem level exhibit properties of biocomplexity and diversity. These two properties provide robustness to biological systems, enabling greater resiliency and flexibility to tolerate and respond to changes in the environment.

Guiding Questions (formerly: General Outcomes

1 Explore, examine evidence and draw conclusions regarding how the process of evolution drives the diversity and unity of life. This is referred to as Big Idea #1 - Evolution

2 Investigate and connect how biological systems utilize free energy and molecular building blocks to grow, to reproduce, and maintain dynamic homeostasis. This is referred to as Big Idea #2 - Energetics

3 Explore, examine evidence and draw conclusions regarding how living systems store, retrieve, transmit, and respond to information essential to life processes. This referred to as Big Idea #3 - Information Storage and Transmission

4 Investigate and connect ideas with regard to how biological systems interact and how these systems and their interactions possess complex properties. This is referred to as Big Idea #4 - System Interactions

Learning Outcomes (formerly: Specific Outcomes)

1 Explore, examine evidence and draw conclusions regarding how the process of evolution drives the diversity and unity of life. This is referred to as Big Idea #1 - Evolution	**35-3**
1.1 Describe and explain how evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence: Describe similarities and/or differences in compartmentalization between prokaryotic and eukaryotic cells; Describe the relationship between the functions of endosymbiotic organelles and their free-living ancestral counterparts; Describe the causes of natural selection; Explain how humans can affect diversity within a population; Explain the relationship between changes in the environment and evolutionary changes in the population; Explain how random occurrences affect the genetic makeup of a population; Describe the role of random processes in the evolution of specific populations; Explain the interaction between the environment and random or pre-existing variations in populations.	X
1.2 Describe and explain how organisms are linked by lines of descent from common ancestry: Describe the fundamental molecular and cellular features shared across all domains of life, which provide evidence of common ancestry; Describe structural and functional evidence on cellular and molecular levels that provides evidence for the common ancestry of all eukaryotes.	X

1.3 Describe and explain how life continues to evolve within a changing environment: Explain how a phylogenetic tree and/or cladogram can be used to infer evolutionary relatedness; Describe the conditions under which new species may arise; Describe the rate of evolution and speciation under different ecological conditions; Explain the processes and mechanisms that drive speciation; Describe factors that lead to the extinction of a population; Explain how the risk of extinction is affected by changes in the environment; Explain species diversity in an ecosystem as a function of speciation and extinction rates; Explain how extinction can make new environments available for adaptive radiation.	X

2 Investigate and connect how biological systems utilize free energy and molecular building blocks to grow, to reproduce, and maintain dynamic homeostasis. This is referred to as Big Idea #2 - Energetics	**35-3**
2.1 Describe and explain how the highly complex organization of living systems requires constant input of energy and the exchange of macromolecules: Explain how specialized structures and strategies are used for the efficient exchange of molecules to the environment; Describe the strategies organisms use to acquire and use energy; Explain how changes in energy availability affect populations and ecosystems.	X

2.2 Describe and explain how cells have membranes that allow them to establish and maintain internal environments that are different from their external environments: Describe the roles of each of the components of the cell membrane in maintaining the internal environment of the cell; Describe the Fluid Mosaic Model of cell membranes; Explain how the structure of biological membranes influences selective permeability; Describe the role of the cell wall in maintaining cell structure and function; Describe the mechanisms that organisms use to maintain solute and water balance; Describe the mechanisms that organisms use to transport large molecules across the plasma membrane; Explain how the structure of a molecule affects its ability to pass through the plasma membrane; Explain how concentration gradients affect the movement of molecules across membranes; Explain how osmoregulatory mechanisms contribute to the health and survival of organisms; Describe the processes that allow ions and other molecules to move across membranes; Describe the membrane bound structures of the eukaryotic cell; Explain how internal membranes and membrane bound organelles contribute to compartmentalization of eukaryotic cell functions.	X
2.3 Describe and explain how timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues: Describe positive and/ or negative feedback mechanisms; Explain how negative feedback helps to maintain homeostasis; Explain how positive feedback affects homeostasis; Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment.	X
2.4 Describe and explain how communities and ecosystems change on the basis of interactions among populations and disruptions to the environment: Explain how community structure is related to energy availability in the environment.	X

3 Explore, examine evidence and draw conclusions regarding how living systems store, retrieve, transmit, and respond to information essential to life processes. This referred to as Big Idea #3 - Information Storage and Transmission	**35-3**

3.1 Describe and explain how heritable information provides for continuity of life: Describe the role of checkpoints in regulating the cell cycle; Describe the effects of disruptions to the cell cycle	X
3.2 Describe and explain how differences in the expression of genes account for some of the phenotypic differences between organisms: Describe the types of interactions that regulate gene expression; Explain how the location of regulatory sequences relates to their function; Explain how the binding of transcription factors to promoter regions affects gene expression and/or the phenotype of the organism; Explain the connection between the regulation of gene expression and phenotypic differences in cells and organisms.	X
3.3 Describe and explain how cells communicate by generating, transmitting, receiving, and responding to chemical signals: Describe the ways that cells can communicate with one another; Explain how cells communicate with one another over short and long distances; Describe the components of a signal transduction pathway; Describe the role of components of a signal transduction pathway in producing a cellular response; Describe the role of the environment in eliciting a cellular response; Describe the different types of cellular responses elicited by a signal transduction pathway; Explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway	X
3.4 Describe and explain how the processing of genetic information is imperfect and is a source of genetic variation: Explain how alterations in DNA sequences contribute to variation that can be subject to natural selection.	X
3.5 Describe and explain how transmission of information results in changes within and between biological systems: Explain how the behavioral responses of organisms affect their overall fitness and may contribute to the success of the population.	X

4 Investigate and connect ideas with regard to how biological systems interact and how these systems and their interactions possess complex properties. This is referred to as Big Idea #4 - System Interactions	**35-3**

4.1 Describe and explain how living systems are organized in a hierarchy of structural levels that interact: Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule; Describe the structure and/ or function of subcellular components and organelles; Explain how subcellular components and organelles contribute to the function of the cell; Describe the structural features of a cell that allow organisms to capture, store, and use energy; Describe factors that influence growth dynamics of populations; Explain how the density of a population affects and is determined by resource availability in the environment	X
4.2 Describe and explain how competition and cooperation are important aspects of biological systems: Explain how invasive species affect ecosystem dynamics; Describe human activities that lead to changes in ecosystem structure and/ or dynamics; Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics.	X
4.3 Describe and explain how naturally occurring diversity among and between components within biological systems affects interactions with the environment: Explain the connection between variation in the number and types of molecules within cells to the ability of the organism to survive and/or reproduce in different environments; Explain how the genetic diversity of a species or population affects its ability to withstand environmental pressures; Describe the scientific evidence that provides support for models of the origin of life on Earth; Describe the relationship between ecosystem diversity and its resilience to changes in the environment; Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and long-term structure.	X

Facilities or Equipment

Facility

No required facilities.

Facilities:

Equipment

No required equipment

Learning and Teaching Resources

Students will require access to one of the widely accepted post-secondary Biology textbooks. The College Board lists specific texts appropriate for the course available https://apcentral.collegeboard.org

Sensitive or Controversial Content

No sensitive or controversial content.

Issue Management Strategy

Health and Safety

No directly related health and safety risks.

Risk Management Strategy

Statement of Overlap with Existing Programs

Provincial Courses with Overlap and/or Similarity

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Biology 20

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Biology 30

Identified Overlap/Similarity
These courses include the study of biological systems.

Reasoning as to Why LDC is Necessary
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.

Locally Developed Courses with Overlap and/or Similarity

None

Student Assessment

no identified student assessments

Course Approval Implementation and Evaluation

No specific processes.