LOCALLY DEVELOPED COURSE OUTLINE

Biology (IB)25-3

Submitted By:

Red Deer Catholic Regional Division No. 39

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Course Basic Information

Outline Number	Hours	Start Date	End Date	Development Type	Proposal Type	Grades
25-3	75.00	09/01/2016	08/31/2020	Acquired	Reauthorization	G10 G11 G12

Course Description

The Biology IB provides an introduction to the range and depth of study of the IB Biology curriculum.

Course Prerequisites

Science 10, Math 10C, approval of the IB coordinator

Sequence Introduction (formerly: Philosophy)

This locally developed course, provides additional opportunities for students to develop and refine the learner competencies outlined in the Alberta Education's Inspiring Education

The Biology International Baccalaureate (IB) locally developed course advances learning outcomes beyond those found in Science 10 and extends content found in Biology 20. The purpose of this course is to provide an opportunity for students to acquire, develop, and advance their techniques in scientific investigation and scientific processes.

Biology IB is a rigorous course for students to develop a deeper understanding of the principles of Biology. Students will enhance their critical thinking and reflective skills through student-centered inquiry and investigations. Students will develop and advance their independent learning skills and research methods while connecting the relevance of the discipline to society and the global community. Students will articulate their understandings using technical language to develop their scientific literacy.

The course fosters a global perspective in which students are encouraged to consider potential societal implications of Biology. This is promoted through shared and collaborative academic experiences.

Student Need (formerly: Rationale)

The Biology IB provides an introduction to the range and depth of study of the IB Biology curriculum. This course supports and extends the Science 10 Biology unit and provides the foundation for the IB Biology courses which follow. This includes significant extension of laboratory content to enable students to enhance skills which will form the basis of student-designed laboratories in higher level IB courses. Upon completion, students have met the outcomes for Biology 20 and Biology 30 as well as outcomes for IB Biology, standard level. Biology IB extends the topics covered in the Alberta curriculum.

By extending the topics covered in the Alberta curriculum, Biology IB enables students to enhance skills of scientific analysis and presentation of information, evaluation and construction of arguments, and the ability to solve problems creatively. The IB Organization recognizes this course enables students to grow in their understanding of the natural world through Biology and their ability to change the world. It nurtures their ability to be creative and innovative and apply their insights to present and emerging demands in society. In Alberta's growing need for technical expertise, students enrolled in Biology IB will be exposed to and have opportunity to engage with content that supports these technical fields.

In keeping with the values defined within Alberta Education's Ministerial Order on Student Learning, the intent of this course is to respond to the needs of the Learner to reach their individual learning potential to become "Engaged Thinkers and Ethical Citizens with an Entrepreneurial Spirit, who contribute to a strong and prosperous economy and society."

Scope and Sequence (formerly: Learner Outcomes)

The IB programme, through its programme guide , details the aims of the study of Biology:

In studies of science, students should become aware of how scientists work and communicate with each other. While the “scientific method” may take on a wide variety of forms, it will generally involve the formation, testing and modification of hypotheses through observation and measurement, under the controlled conditions of an experiment. It is this approach, along with the falsifiability of scientific hypotheses that distinguishes the experimental sciences from other disciplines.

It is in this context that IB Biology should aim to:

 provide opportunities for scientific study and creativity within a global context which will stimulate and challenge students

 provide a body of knowledge, methods and techniques which characterize science and technology

 enable students to apply and use a body of knowledge, methods and techniques which characterize science and technology

 develop an ability to analyze, evaluate and synthesize scientific information

 engender an awareness of the need for, and the value of, effective collaboration and communication during scientific activities

 develop experimental and investigative scientific skills

 develop and apply the students’ information technology skills in the study of science

 raise awareness of the moral, ethical, social, economic and environmental implications of using science and technology

 develop an appreciation of the possibilities and limitations associated with science and scientists

 encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method

Laboratory Component

Students have regular opportunity to complete laboratory work within Biology 20. The Biology IB course will provide laboratory work which requires a greater degree of accuracy, precision which aligns with the expectations of IB programming.

Students will think analytically, reducing problems to identifiable, answerable questions as well as designing and carrying out experiments that answer questions. They will manipulate data acquired during an experiment and make conclusions, evaluate the quality and validity of such conclusions, and propose further questions for study. Students should be able to communicate accurately and meaningfully about observations and conclusions.

Recommended labs in the 25 curriculum:

The labs presented below are recommended to extend laboratory content beyond Science 10 levels which will enable students to enhance skills to form the basis of student-designed laboratories in higher level IB courses.

1 | Determination of the Impact of Human Error in Biological Research

2 | Effect of Salt Concentration on Leaf Length

3 | Application of Chi Square to Biological Research

4 | Application of Scientific Drawing to Biological Research

5 | Application of Optical Measurement to Biological Research

6 | Estimation of Diameter Through Wet-Mount Slides

7 | Preparation and Analysis of Plant and Animal Cell Wet-Mount Slides

8 | Demonstration: Effect of Cell Diameter on Surface Area to Volume Ratio

9 | Active Transport in Yeast Cells

10 | The Effect of Temperature on Diffusion Rate of Hydrochloric Acid

11 | Time Duration Assessment of Mitosis and Interphase of allium Root Tips

12 | Determination of Nutrients in a Cheeto®.

The following learner outcomes and assessment standards are from the International Baccalaureate (IB) Biology curriculum. IB has acknowledged that the learning outcomes from the IB Biology course have been written in the LDC to reflect the competencies in support of Alberta Education's Inspiring Education. The following statement is included to ensure that the IB copyright is honoured in this document.

Guiding Questions (formerly: General Outcomes

1 Apply the SI system of measurement in the study and analysis of data. Students will develop literacy of statistical analysis for application to laboratory explorations in Biology. (Statistical Analysis and Measurement in Science).

2 Explore the nature of scientific theories and the accumulation of evidence which allows a hypothesis to become theory; apply advances of technology to understandings of the cell and advances in the discipline; enhance understanding of key concepts within Cell Theory. (Cells).

3 Extend knowledge to the concepts of chemical elements and water, DNA, enzymes, cellular respiration, and photosynthesis through application of analytical, experimental, and investigative scientific skills. (The Chemistry of Life).

Learning Outcomes (formerly: Specific Outcomes)

1 Apply the SI system of measurement in the study and analysis of data. Students will develop literacy of statistical analysis for application to laboratory explorations in Biology. (Statistical Analysis and Measurement in Science).	**25-3**
1.1 Explore through laboratory exploration and measurement the ability to recognize that measurements are estimates of real values which cannot be known	X
1.2 Conclude through laboratory exploration and measurement the ability to describe how measurement relates to sources of variation	X
1.3 Conclude through laboratory exploration and measurement the understanding that variation is unavoidable, but can be quantified and the effects of variation can be described	X
1.4 Apply statistical analysis to sets of data, through laboratory exploration and measurements, including average value and standard deviation, and range	X
1.5 Evaluate how averaging minimizes variation through application of statistical analysis of sets of data, through laboratory exploration and measurements	X
1.6 Evaluate the value of calculating standard deviation through application of statistical analysis of sets of data, through laboratory exploration and measurements	X
1.7 Apply understanding of variation to laboratory exploration and measurements to: identify sources of error, classify sources of error as random or systematic, and describe the impact of each source of error on experimental results	X
1.8 Apply understanding of variation to laboratory exploration and measurements by describing methods of minimizing sources of error, and describe methods of evaluating the magnitude and acceptability of variation in data	X

2 Explore the nature of scientific theories and the accumulation of evidence which allows a hypothesis to become theory; apply advances of technology to understandings of the cell and advances in the discipline; enhance understanding of key concepts within Cell Theory. (Cells).	**25-3**
2.1 Examine historical development and evidence of cell theory through Biologists: Robert Hooke, Anton van Leeuwenhoek, Matthias Scheiden, Theodor Schwann, Rudolph Virchow, Jansen, Purkinje. (Cell theory).	X
2.2 Formulate understanding of cell theory including analysis of organelles. Include the following: living organisms are composed of cells, cells are the smallest unit of life, and cells come from pre-existing cells. (Cell theory).	X
2.3 Compare and evaluate the relative sizes of molecules, cell membrane thickness, viruses, bacteria, organelles and cells using appropriate SI units. (Cell theory).	X
2.4 Investigate and explain the importance of the surface area to volume ratio as a factor limiting cell size. Include the concept of the rate of heat production/waste production/resource consumption of a cell is a function of its volume, whereas the rate of exchange of materials and energy (heat) is a function of surface area. (Cell theory).	X
2.5 Investigate, identify organelles, and construct diagram of generalized prokaryotic cell as seen in electron photomicrographs. Include cell wall, plasma membrane, cytoplasm, pili, flagella, ribosomes and nucleoid. (Prokaryotic cell structure).	X
2.6 Construct organelle functions for generalized prokaryotic cells including: ribosome, mesosome, slime capsule, cell wall, flagellum, cell surface area, plasmid and nucleoid. (Prokaryotic cell structure).	X
2.7 Apply sedimentation units (Svedberg units) to construct and describe the structure of prokaryotic ribosomes (Prokaryotic cell structure).	X
2.8 Apply theory of endosymbiosis to assess the possible origin of eukaryotic cells (Eukaryotic cell structure).	X

2.9 Investigate electronic photomicrographs to illustrate ultrastructure of a generalized animal cell (Eukaryotic cell structure).	X
2.10 Compare and contrast similarities between prokaryotic and eukaryotic cells (Eukaryotic cell structure).	X
2.11 Apply understanding of prokaryotic and eukaryotic cells to formulate statements of two differences between the eukaryotic nucleus and a prokaryotic nuclear material (Eukaryotic cell structure).	X
2.12 Evaluate the composition and function of the plant cell walls in contrast to animal cell walls (Eukaryotic cell structure).	X
2.13 Construct and evaluate the fluid mosaic model of a cell membrane including illustrations of: phospholipids bilayer, cholesterol, glycoproteins, and intrinsic and extrinsic proteins (Cell membranes).	X
2.14 Assess and interpret how the hydrophobic and hydrophilic properties of phospholipids function assist in the maintenance of the structure of cell membranes (Cell membranes).	X
2.15 Apply concept of diffusion to the fluid mosaic model of a cell (Cell membranes).	X
2.16 Investigate the concept of osmosis as the passive movement of water molecules across a partially permeable membrane from a region of lower solute concentration to a region of higher solute concentration (Cell membranes).	X
2.17 Evaluate and describe active transport across membranes including the roles of protein carriers, ATP, and a concentration gradient (Cell membranes).	X
2.18 Evaluate cell membrane and apply understanding to comparison of endocytosis (pinocytosis/phagocytosis) and exocytosis (Cell membranes).	X
2.19 Apply cell theory to cellular division in that all cells arise from the division of other cells (Cell division).	X
2.20 Evaluate and describe the cell cycle as an alternation between interphase and mitosis (Cell division).	X
2.21 Formulate understanding that interphase is an active period in the life of a cell where many biochemical reactions, DNA transcription and DNA replication occur (Cell division).	X

2.22 Interpret and outline how replicated DNA molecules (chromosomes) are moved to opposite end of the cell by microtubules (Cell division).	X
2.23 Investigate the process of mitosis and identify the products as two genetically identical nuclei (Cell division).	X
2.24 Investigate uncontrolled cell division that results in formation of tumours (cancers) that can occur in any organ (Cell division).	X

3 Extend knowledge to the concepts of chemical elements and water, DNA, enzymes, cellular respiration, and photosynthesis through application of analytical, experimental, and investigative scientific skills. (The Chemistry of Life).	**25-3**
3.1 Formulate an understanding of the most frequently occurring chemical elements in living things (carbon, hydrogen and oxygen) (Chemical elements and water).	X
3.2 Apply understanding of elements to those required by living organisms including nitrogen, calcium, phosphorus, iron and sodium. Evaluate a role for each of the elements identified (Chemical elements and water).	X
3.3 Evaluate the differences difference between an atom and an ion (Chemical elements and water).	X
3.4 Investigate and apply polarity of water molecules and hydrogen bonding (where relevant), and properties of water that are of significance to living organisms including transparency, cohesion, solvent properties and thermal properties (Chemical elements and water).	X
3.5 Investigate and justify the significance to organisms of water as a coolant, transport medium and habitat, in terms of its properties (Chemical elements and water).	X
3.6 Distinguish between organic and inorganic compounds (Carbohydrates, lipids and proteins).	X
3.7 Construct diagram to identify the basic structure of a generalized amino acid (Carbohydrates, lipids and proteins).	X
3.8 Construct diagram to identify ring structure of glucose and ribose (Carbohydrates, lipids and proteins).	X

3.9 Construct diagram to identify the structure of glycerol and a generalized fatty acid (Carbohydrates, lipids and proteins).	X
3.10 Apply understanding of cell structures to outline the role of condensation and hydrolysis in the relationships between monosaccharides, disaccharides and polysaccharides; fatty acids, glycerol and glycerides; amino acids, dipeptides and polypeptides (Carbohydrates, lipids and proteins).	X
3.11 Construct diagram to identify the structure of a generalized dipeptide, showing the peptide linkage (Carbohydrates, lipids and proteins).	X
3.12 Assess and identify two examples for each of monosaccharides, disaccharides and polysaccharides (Carbohydrates, lipids and proteins).	X
3.13 Apply understanding of monosaccharides and polysaccharides to examine a function of each (Carbohydrates, lipids and proteins).	X
3.14 Apply understanding of lipids to examine state three functions (Carbohydrates, lipids and proteins).	X
3.15 Assess and apply understanding of energy storage to the use of carbohydrates and lipids in the function (Carbohydrates, lipids and proteins).	X
3.16 Evaluate the four levels of protein structure and conclude each level's significance (Carbohydrates, lipids and proteins).	X
3.17 Evaluate the difference between fibrous and globular proteins, with reference to two examples of each protein type (Carbohydrates, lipids and proteins).	X
3.18 Evaluate the significance of polar and non polar amino acids (Carbohydrates, lipids and proteins).	X
3.19 Evaluate and support with an example of each, the six functions of proteins (Carbohydrates, lipids and proteins).	X
3.20 Investigate and apply protein analysis in chromatography and electrophoresis (Carbohydrates, lipids and proteins).	X
3.21 Investigate and describe what the human body requires for a healthy diet (Carbohydrates, lipids and proteins).	X

3.22 Investigate and evaluate common packaged food items by interpreting the dietary information printed on them (Carbohydrates, lipids and proteins).	X
3.23 Investigate, calculate, compare and evaluate the nutritional content of foods and diets (Carbohydrates, lipids and proteins).	X
3.24 Demonstrate understanding of enzyme and active site	X
3.25 Investigate metabolic pathways as consisting of chains and cycles of enzyme catalyzed reactions (Enzymes).	X
3.26 Evaluate the role of allostery in the control of metabolic pathways by end product inhibition (Enzymes).	X
3.27 Investigate and evaluate enzyme substrate specificity (Enzymes).	X
3.28 Investigate and evaluate the effects of temperature, pH and substrate concentration on enzyme activity (Enzymes).	X
3.29 Demonstrate an understanding of denaturation as the structural change in a protein that results in loss (usually permanent) of its biological properties, referring to heat and pH as agents (Enzymes).	X
3.30 Investigate and apply enzymes in the use of pectinase in fruit juice production, lactase in production of lactose-free milk, and one other commercial application of enzymes in biotechnology (Enzymes).	X
3.31 Construct description of the basic characteristics of enzymes (Enzymes).	X
3.32 Investigate to determine Vmax and the value of the Michaelis constant (Km) by graphical means (Enzymes).	X
3.33 Investigate and evaluate the significance of Vmax and Km (Enzymes).	X
3.34 Investigate and formulate description of the concept of the active site in enzyme structure (Enzymes).	X
3.35 Evaluate and compare competitive inhibition and non competitive inhibition (Enzymes).	X
3.36 Evaluate and explain the effects of heavy metal ions, extremes of temperature, and pH changes on enzyme activity (Enzymes).	X

3.37 Investigate and evaluate the uses of enzymes in biotechnology (Enzymes).	X
3.38 Investigate and apply chemiosmosis to explain oxidative phosphorylation (Cellular respiration).	X
3.39 Evaluate the central role of acetyl CoA in carbohydrate fat metabolism, and protein metabolism (Cellular respiration).	X
3.40 Evaluate and contrast differences in absorption of red, blue and green light by chlorophyll (Photosynthesis).	X
3.41 Evaluate and assess the rate of photosynthesis that can be measured directly by the production of oxygen, or the uptake of carbon dioxide, or indirectly by the increase in biomass (Photosynthesis).	X
3.42 Investigate and evaluate the effects of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesis (Photosynthesis).	X
3.43 Evaluate and illustrate the action spectrum of photosynthesis (Photosynthesis).	X
3.44 Evaluate the relationship between the action spectrum and the absorption spectrum of photosynthetic pigments in green plants (Photosynthesis).	X
3.45 Investigate and evaluate the concept of limiting factors with reference to light intensity, temperature and concentration of carbon dioxide.	X
3.46 Investigate and evaluate the relationship between the distribution of tissues in the leaf and the functions of these tissues.	X

Facilities or Equipment

Facility

Standard high school biology labs are adequate for this course

Facilities:

Equipment

Standard high school biology equipment is adequate for this course

Learning and Teaching Resources

Freeman, S., K. Quillin, L. Allison, 2014. Biological Sciences. Pearson Benjamin Cur
San Francisco.

Sensitive or Controversial Content

Sensitive or controversial issues that may arise from course content will be dealt with in accordance with the Controversial Issues section of the Guide to Education and RDCRS #39 Administrative Procedures.
Schools will refer to Administrative Procedure 103 - Safe and Caring Learning Environments for students should controversial or sensitive issues arise.

Issue Management Strategy

Health and Safety

As with all science courses, teachers should refer to Safety in the Science Classroom from Alberta Education (particularly Chapter 5 – Biological Hazards, and chapter 7 – chemical hazards) to inform their practice regarding the health and safety of themselves and their students.

External resources such as guest speakers must be approved by school administration and may be subject to independent contract agreement as per Red Deer Catholic Regional Schools.
All Off-site activities are organized according to Red Deer Catholic Regional Schools Administrative Procedure 342 - Field Trips and Other Curricular Activities.
Also, Red Deer Catholic Regional Schools has Work-site Occupational Hazard Assessment and Control document for the school and it is to be referred to for the applicable work areas within the school including science areas.

Red Deer Catholic Regional Schools Administrative Procedure 113 – Occupational Health and Safety sets out responsibilities for safe learning and working conditions and following safe work practices developed by Safety Advisory Services.

Risk Management Strategy

Statement of Overlap with Existing Programs

Topics 2 and 3 overlap with portions of Science 10 and Biology 20. In Biology IB, overlapping topics are taught in greater detail. Problems have greater complexity and a higher degree of detail is required. The laboratory skill level is highly elevated, and 60 hours of Biology laboratory time, over the two years of IB are mandated.

Student Assessment

The International Baccalaureate Organization sets rigorous expectations and provides detailed criteria and support exemplars (www.ibo.org). As Biology is an experimental science, students will be assessed on a number of practical skills in addition to their content knowledge. These practical skills include their ability to develop experimental designs, collect and process data, evaluate and reach conclusions based upon data processing, as well as their manipulative skills. Rubrics pertaining to each of these skills assessment are found in the appendix from the IBO website (to which all IB schools have access).

Assessment practices for this course should invite student participation in articulating learning targets and setting criteria for success, in providing evidence of understanding and in developing appropriate grading practices. Assessment and grading practices should also reflect the context of particular student, school and classroom learning needs.

Teachers will set specific criteria and grading practices, with students, as they assess student learning based on the learning outcomes from the course. These criteria form the basis for assessing, grading and reporting student progress. Communicating student progress is an ongoing conversation between the teacher, the student and the parent, throughout the course, with the goal of improving student learning.

The validity of assessment will be enhanced if evidence of student achievement, related to the general and specific outcomes, is gathered over time, and through communication with students as they build understanding, revise misunderstandings and refine approaches to learning. Careful observation of students as they engage in learning tasks and critical examination of the work they produce allows teachers to build out a multi-dimensional picture of student learning.

Valid grading reflects a student's achievement towards the learning outcomes. The reporting of behavior, effort, attendance, neatness, group contribution, initiative etc. is reported separately (Webber, Aitken, Lupart, & Scott, 2009, Guskey, 2006, Reeves, 2004).

To be credible and defensible, assessment information that is used in grading a body of evidence, samples student performance, and is related to specified outcomes, based on professional judgment rather than being based on a calculated mean (average).

Assessment and grading practices should take into consideration the helical nature of learning - the recursive and increasingly complex skills and knowledge required of students as they demonstrate what they know and can do in relation to each of the specific and general outcomes. As the complexity of learning outcomes increases within each level of the course (15-25-25), evidence of a more comprehensive understanding is required.

Where a specific learner outcome spans all levels (15-25-35), students are expected to show an increasing level of sophistication and refinement of skills in demonstrating the outcome. Overall, general and specific outcomes can be achieved and assessed concurrently rather than sequentially.

Teachers should adhere to the following assessment standards when determining appropriate assessment and grading practices for this Locally Developed Course.

Assessment practices should reflect the following principles:

• Assessment of student performance is explicitly tied to the learning outcomes of the course

• Students are involved in understanding and articulating learning targets and criteria of success

• Students have opportunities to receive feedback in non-graded and formative learning activities and assignments before submitting assignments or engaging in activities for summative evaluation

• Assessments are purposefully designed in ways that motivate and challenge students, and are respectful of student diversity

• Students are provided choice in how they demonstrate learning

• Assessment data is gathered from a broad range of assessment activities and includes information from student work products and performances, from teacher observations of student learning processes, and from student reflections/student-provided evidence of success

• Assigned grades emphasize the most recent and most consistent evidence of student learning

• Assessment of Citizenship, Personal Development and Character is considered within all learning programs as included within the Calgary Board of Education Board of Trustees' Governance Policies.

References

Guskey, T. R. (May, 2006). Making high school grades meaningful. Phi Delta Kappa International,

87(9), pp. 670-675. Retrieved from http://www.jstor.org/stable/20442125

Reeves, D.B. (Dec 2004). The case against zeros. Phi Delta Kappan 86 (4). Retrieved

from

http://schools.esu13.org/bannercounty/Documents/caseagainstzero.pdf

Webber, C.F., Aitken, N. Lupart, J. & Scott, S. (2009). The Alberta student assessment study final

report. Edmonton, Canada:

Course Approval Implementation and Evaluation