NIAGARA ACADEMY
BIOLOGY, GRADE 12, UNIVERSITY PREPARATION
COURSE OUTLINE

COURSE CODE:	SBI4U
DEVELOPED BY:	V. Rows, September, 2002
REVISED BY:	V. Rows (2009), L. Cousineau (2012, 2013), M. Wilson (2014), M. Richter (2016), J. Pauls (2018, 2019)
DEVELOPED FROM:	The Ontario Curriculum Grades 11 and 12, Science, 2008, http://www.edu.gov.on.ca/eng/curriculum/secondary/2009science11_12.pdf
PREREQUISITE:	Biology, Grade 11, University Preparation
COURSE DURATION:	110 hours
COURSE VALUE:	1.0 credits

COURSE DESCRIPTION AND RATIONALE

This course provides students with the opportunity for in-depth study of the concepts and processes that occur in biological systems. Students will study theory and conduct investigations in the areas of biochemistry, metabolic processes, molecular genetics, homeostasis, and population dynamics. Emphasis will be placed on the achievement of detailed knowledge and the refinement of skills needed for further study in various branches of the life sciences and related fields.

OVERALL CURRICULUM EXPECTATIONS

A. Scientific Investigation Skills and Career Exploration: By the end of this course, students will:	
A1.	demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);
A2.	identify and describe a variety of careers related to the fields of science under study, and identify scientists, including Canadians, who have made contributions to those fields.

B. Biochemistry By the end of this course, students will:	
B1.	analyse technological applications of enzymes in some industrial processes, and evaluate technological advances in the field of cellular biology;
B2.	investigate the chemical structures, functions, and chemical properties of biological molecules involved in some common cellular processes and biochemical reactions;
B3.	demonstrate an understanding of the structures and functions of biological molecules, and the biochemical reactions required to maintain normal cellular function.

C. Metabolic Processes: By the end of this course, students will:	
C1.	analyse the economic and environmental advantages and disadvantages of an artificial selection technology, and evaluate the impact of environmental changes on natural selection and endangered species;
C2.	investigate evolutionary processes, and analyse scientific evidence that supports the theory of evolution;
C3.	demonstrate an understanding of the theory of evolution, the evidence that supports it, and some of the mechanisms by which it occurs.

D. Molecular Genetics:	
D1.	analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology;
D2.	investigate, through laboratory activities, the structures of cell components and their roles in processes that occur within the cell;
D3.	demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture.
E. Homeostasis:	
E1.	evaluate the impact on the human body of selected chemical substances and of environmental factors related to human activity;
E2.	investigate the feedback mechanisms that maintain homeostasis in living organisms;
E3.	demonstrate an understanding of the anatomy and physiology of human body systems and explain the mechanisms that enable the body to maintain homeostasis.

F. Population Dynamics: By the end of this course, students will:	
F1.	analyse the relationships between population growth, personal consumption, technological development, and our ecological footprint, and assess the effectiveness of some Canadian initiatives intended to assist expanding populations;
F2.	investigate the characteristics of population growth, and use models to calculate the growth of populations within an ecosystem;
F3.	demonstrate an understanding of concepts related to population growth and explain the factors that affect the growth of various populations of species.

COURSE CONTENT AND EVALUATION

Unit	Description	Evaluation	Hours
Unit One	**Biochemistry:** 1. Structure of Carbohydrates, Proteins, Lipids, DNA 2. Functional Groups 3. Roles of Cell Organelles 4. Protein Structure and Enzyme Operation 5. Biochemical Reactions 6. Membrane Structure and Transport	16%	26 hrs
Unit Two	**Metabolic Processes** 1. Glycolysis Process 2. Krebs Cycle 3. Electron Transport 4. Darik Reaction 5. Light Reactions 6. Laws of Thermodynamics 7. Comparison of Photosynthesis and Respiration	16%	26 hrs
Unit Three	**Molecular Genetics:** 1. DNA Replication 2. RNA Structure and Function 3. Process of Protein Synthesis 4. Role of Operons in Prokeryotes 5. Mechanism of Gene Expression 6. Types of Mutations 7. Cloning and Polymerization Chain Reaction 8. Genetic Engineering Tools 9. Work of Molecular Geneticist	16%	26 hrs
Unit Four	**Homeostasis:** 1. Anatomy and Physiology of Exocrine, Endocrine, and Nervous systems 2. Reproductive Hormones 3. Homeostasis Processes in the Water, Ions, Acid-base Balance 4. Thermal Equilibrium	12%	22 hrs
Unit Five	**Population Dynamics:** 1. Characteristics of Populations 2. Interactions and Interdependency 3. Population Variables 4. Energy Flow 5. Independent Study	10%	10 hrs
	Total Term Work	**70%**	**110 hrs**
Final Evaluation	**Culminating Activity** **Final Exam**	**10%** **20%**	
	Final Mark	**100%**	

Knowledge/ Understanding	Thinking/ Inquiry	Communication	Application/Making Connections
(17%)	**(25%)**	**(25%)**	**(33%)**
- Identify and describe careers related to the fields of science under study, and describe the contributions of scientists, including Canadians, to those fields; - Demonstrate an understanding of the structures and functions of biological molecules, and the biochemical reactions required to maintain normal cellular function; - Demonstrate an understanding of the chemical changes and energy conversions that occur in metabolic processes; - Demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture. - Demonstrate an understanding of the anatomy and physiology of human body systems, and explain the mechanisms that enable the body to maintain homeostasis; - Demonstrate an understanding of concepts related to population growth and explain the factors that affect the growth of various populations of species.	- Demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating); - Investigate the chemical structures, functions, and chemical properties of biological molecules involved in some common cellular processes and biochemical reactions; - Investigate the products of metabolic processes such as cellular respiration and photosynthesis; - Investigate, through laboratory activities, the structures of cell components and their roles in processes that occur within the cell; - Investigate the feedback mechanisms that maintain homeostasis in living organisms; - Investigate the characteristics of population growth and use models to calculate the growth of populations within an ecosystem.	- Expression and organization of ideas and information; - Communication for different audiences and purposes in oral, visual, and/or written forms; - Use of conventions, vocabulary, and terminology of the discipline in oral, visual, and/or written forms.	- Analyse technological applications of enzymes in some industrial processes, and evaluate technological advances in the field of cellular biology; - Analyse the role of metabolic processes in the functioning of biotic and abiotic systems, and evaluate the importance of an understanding of these processes and related technologies to personal choices made in everyday life; - Analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology; - Evaluate the impact on the human body of selected chemical substances and of environmental factors related to human activity; - Analyse the relationships between population growth, personal consumption, technological development, and our ecological footprint, and assess the effectiveness of some Canadian initiatives intended to assist expanding populations.

ASSESSMENT AND EVALUATION

Evaluation and Reporting of Student Achievement: Student achievement is communicated formally to students and parents by means of the Provincial Report Card, Grades 9–12. The report card provides a record of the student's achievement of the curriculum expectations in every course, at particular points in the school year or semester, in the form of a percentage grade. The percentage grade represents the quality of the student's overall achievement of the expectations for the course which are described in the achievement chart on pages 26-27 of The Ontario Curriculum Grades 11 and 12, Science, 2008, Website: http:// www.edu.gov.on.ca/eng/curriculum/secondary/2009science11_12.pdf

Learning Skills will also be assessed and reported on the Provincial Report Card, Grades 9-12. The quality of the learning skills demonstrated by a student are recorded in six categories – Responsibility, Organization, Independent Work, Collaboration, Initiative, Self-Regulation – are assessed throughout the semester using a four-point scale (E - Excellent, G - Good, S - Satisfactory, N - Needs Improvement), and the document page 11, Growing Success: Assessment, Evaluation and Reporting in Ontario Schools, 2010, as a guide (http://www.edu.gov.on.ca/eng/policyfunding/growSuccess.pdf).

Assessment for Learning will be used as a process for seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go, and how best to get there. Teachers will use diagnostic assessment before instruction and formative assessment will occur frequently and in an ongoing manner to monitor students' progress. Observation and conversation will be used to determine the needs of individual student learning.

Assessment as Learning will focus on the explicit fostering of student's capacity over time to be their own best assessors, but teachers need to start by presenting and modelling external, structured opportunities for students to assess themselves. Formative assessment be used by students to monitor their own and their peers' progress.

Assessment of Learning will be used as the assessment that becomes public and results in statements or symbols about how well students are learning. Summative assessment will be used by the teacher to summarize learning at a given point in time. (Ref: page 31 of Growing Success)

A student's achievement of the overall curriculum expectations will be evaluated in accordance with the achievement charts in the provincial curriculum and will be reported using percentage marks. It is expected that both mathematical calculations and professional judgement will inform the determination of percentage marks

The teacher will use assessment strategies that:

- are fair, transparent and equitable for all students;
- are clearly communicated to students at the beginning of the course and at other points throughout the semester
- are varied in nature, administered over a period of time and designed to provide opportunities for students to demonstrate the full range of their learning
- are appropriate for the learning activities used, the purposes of instruction and the needs and experiences of the students

- relate to the curriculum expectations and learning goals and, as much as possible, to the interests, learning styles and preferences, needs and experiences of all students
- accommodate students with special education needs, consistent with the strategies outlined in their Individual Education Plan
- accommodate the needs of students who are learning the language of instruction
- ensure that each student is given clear directions for improvement
- promote students' ability to assess their own learning and to set specific goals
- ensure that each student is given clear directions for improvement

A final grade is recorded for every course, and a credit is granted and recorded for every course in which the student's grade is 50% or higher. The final grade for each course in Grades 9–12 will be determined as follows:

- Seventy per cent of the grade will be based on evaluations conducted throughout the course. This portion of the grade should reflect the student's most consistent level of achievement throughout the course, although special consideration should be given to more recent evidence of achievement. Please see the chart below for an explanation of how course work marks will be obtained.
- Thirty per cent of the grade will be based on a final evaluation in the form of an examination, performance, essay, and/or other method of evaluation suitable to the course content and administered towards the end of the course. This final evaluation consists of the following: Culminating Activity 10% and Final Exam 20%.

TEACHING AND LEARNING STRATEGIES

Effective instructional approaches and learning activities draw on students' prior knowledge, capture their interest, and encourage meaningful practice both inside and outside the classroom. Students will be engaged when they are able to see the connection between the scientific concepts they are learning and their application in the world around them and in real-life situations. The following are specific strategies for teaching and learning.

- Assessment of prior knowledge and provision of differentiated instruction for individual students
- Teaching and modelling of learning strategies
- Problem posing and problem solving
- Individual and cooperative small group learning, teamwork
- Hands-on experiments
- Brainstorming
- Creation of scenarios for decision making
- Independent research
- Issue-based analysis
- Personal reflection
- Seminar presentations

- Use of technology
- Hands-on applications
- Constructive or creative dialogue

CONSIDERATIONS FOR PROGRAM PLANNING

The planning and administering of this course is based on the premise that all students can be successful language learners. The teacher will provide quality instruction that respects students' strengths and address their learning needs, using assessment information to plan instruction.

Teachers of science will incorporate appropriate strategies for instruction and assessment to facilitate the success of the ELL students in their classrooms. These strategies include:

- modification of some or all of the course expectations, based on the student's level of English proficiency;
- use of a variety of instructional strategies (e.g. extensive use of visual cues, manipulatives, pictures, diagrams, graphic organizers; attention to clarity of instructions; modelling of preferred ways of working in mathematics; previewing of textbooks; pre-teaching of key specialized vocabulary; encouragement of peer tutoring and class discussion; strategic use of students' first languages);
- use of a variety of learning resources (e.g., visual material, simplified text, bilingual dictionaries, culturally diverse materials);
- use of assessment accommodations (e.g., granting of extra time; use of alternative forms of assessment, such as oral interviews, learning logs, or portfolios; simplification of language used in problems and instructions).

Information and communications technology will be used throughout the course where it is appropriate. The program will also include opportunities for students to apply their language skills to work-related situations, to explore educational and career options, and to become self-directed learners.

RESOURCES

- Biology 12 Thomson-Nelson 2003 Maurice DiGiuseppe et al,
- TED Talks, www.TED.com
- Crash Course Science, https://www.youtube.com/user/crashcourse/
- Teachers Try Science, http://www.teacherstryscience.org/
- How Stuff Works, https://science.howstuffworks.com/
- Science News for Students, https://www.sciencenewsforstudents.org/