

Course Outline

School Name: KEEWAYTINOOK INTERNET HIGH SCHOOL
Department Name: Science

Ministry of Education Course Title: Biology

Grade Level: 12

Ministry Course Code: SBI4U

Teacher's Name: Raj Budhram

Developed by: Raj Budhram

Date: August 2016

Revision Date: August 2021

Developed from:

Ontario Ministry of Education. (2008). *The Ontario curriculum, grades 11 and 12: Science*.
Toronto ON: Queen's Printer for Ontario.

Text: None

Prerequisite: SBI3U

Credits: One

Length: 110 hours

Principal's Name: Angela Batsford-Mermans

Principal's Approval:



Approval Date: September 15, 2021

Course Description/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

Scientific Investigation Skills and Career Exploration

- Demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analyzing and interpreting, and communicating);
- 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.

Biochemistry

- Analyse technological applications of enzymes in some industrial processes, and evaluate technological advances in the field of cellular biology;
- Investigate the chemical structures, functions, and chemical properties of biological molecules involved in some common cellular processes and biochemical reactions;
- Demonstrate an understanding of the structures and functions of biological molecules, and the biochemical reactions required to maintain normal cellular function.

Metabolic Processes

- 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;
- Investigate the products of metabolic processes such as cellular respiration and photosynthesis;
- Demonstrate an understanding of the chemical changes and energy conversions that occur in metabolic processes.

Molecular Genetics

- Analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology;
- Investigate, through laboratory activities, the structures of cell components and their roles in processes that occur within the cell;
- Demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture.

Homeostasis

- Evaluate the impact on the human body of selected chemical substances and of environmental factors related to human activity;
- Investigate the feedback mechanisms that maintain homeostasis in living organisms;
- Demonstrate an understanding of the anatomy and physiology of human body systems, and explain the mechanisms that enable the body to maintain homeostasis.

Population Dynamics

- 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;
- Investigate the characteristics of population growth, and use models to calculate the growth of populations within an ecosystem;
- Demonstrate an understanding of concepts related to population growth, and explain the factors that affect the growth of various populations of species.

Course Content

| Unit | Length |
|---------------------------------|-----------|
| 1. Biochemistry | 19 hours |
| 2. Cellular Metabolic Processes | 22 hours |
| 3. Molecular Genetics | 25 hours |
| 4. Homeostasis in the Body | 22 hours |
| 5. Population Dynamics | 22 hours |
| Total | 110 hours |

Unit Descriptions

Unit 1 – Biochemistry

In this unit, students explore the structure and function of biologically essential macromolecules, and the reactions that form and break them down. They explore how the properties of these groups of compounds make possible organelles, the cell membrane, enzymes, and their respective properties. They examine the ways in which enzymes are used in the production of foods and pharmaceuticals. Students will determine the nutrients that are provided by the foods that they currently eat (traditional and non-traditional), then they will determine whether their diets are balanced. If their diets are not balanced then they will need to determine what they need to do to ensure that their diets are balanced.

Unit 2 – Cellular Metabolic Processes

In this unit, students explore the biochemical pathways organisms use in photosynthesis and to create metabolically useful energy during cellular respiration. Students examine energy transformations in living cells through laboratory investigations and computer simulations. In this unit, students will investigate how they can improve their metabolism by exercising and eating a balanced diet. They will then devise an exercise plan for people in their communities and they will plan 5 days of meals using Canada's food guide, taking into consideration both traditional and non-traditional foods.

Unit 3 – Molecular Genetics

In this unit, students examine the structure and function of DNA and RNA, and their role in protein synthesis and control of gene expression. Students investigate the advances in knowledge about genetics during the 20th and 21st centuries, and explore a variety of genetic technologies. The unit culminates with individual research on ethical considerations in one of many current areas of controversy in biotechnology. Students will research the pros and cons of transgenic plants or animals, then they will give their opinions on the use of transgenic plants or animals in the future.

Unit 4 – Homeostasis

Through analysis of a variety of changing conditions, students examine the complexity of homeostatic mechanisms, including nervous and hormonal control of metabolic activity, the maintenance of water, ionic, thermal and acid-base equilibria, and reproduction. The concept of feedback mechanisms is key throughout. This unit links to the animal anatomy and physiology unit in SBI3U. Students will describe ways in which mining, forestry, and hydroelectric developments have affected the health of Indigenous people in Northern Ontario. Also, students will determine the effects of cigarette and marijuana smoking on the academic performance of students. Then students will discuss ways to deter others in their communities from cigarette and marijuana use.

Unit 5 – Population Dynamics

Designed as an overview of population dynamics, this unit focuses on the effects of relationships within ecosystems and other factors that regulate and limit population growth. The carrying capacity of the Earth will also be studied in terms of human population trends. Students will

compare the increase of the Indigenous population to the non-Indigenous population and the significant difference in average age between the two groups. Also, they will provide likely reasons for the difference in growth rates and the difference in average age between the two groups. Additionally, students will analyse the predator-prey relationship of wolves and moose and determine what they need to do to ensure that the population of both wolves and moose are sustainable in Northern Canada. Finally, students will learn that every organism in an ecosystem is important so they should continue to care for and protect all of the organisms in their ecosystem with consideration to the reciprocal nature of Indigenous understanding.

Teaching/Learning Strategies

This course is organized into an eight-week series of lessons and activities that is presented to students in remote northern communities via the internet. The eighth week is used for course consolidation, review, and the final examination. Teacher and students communicate over the internet through timely activity feedback, emails, messages, video and audio calls. Classroom mentors assume the role of liaison between the teacher and student while also supporting a holistic approach to motivate, engage and support each individual student.

A variety of strategies will be used in the online delivery of this course. Some instructional strategies include:

- Pre-teaching of key vocabulary;
- Creating graphic organizers;
- Cooperative learning;
- Group discussion;
- Case studies;
- Independent research.

Learning goals will be discussed at the beginning of each assignment and success criteria will be provided to students. The success criteria are used to develop the assessment tools in this course, including rubrics and checklists.

Evaluation

The final grade will be determined as follows (Ontario Ministry of Education, 2010):

- Seventy per cent of the grade will be based on evaluation 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.
- Thirty percent of the grade will be based on a final evaluation administered at or towards the end of the course. This evaluation will be based on evidence from one or a combination of the following: an examination, a performance, an essay, and/or another method of evaluation suitable to the course content. The final evaluation allows the student an opportunity to demonstrate comprehensive achievement of the overall expectations for the course (p. 47).

Ontario Ministry of Education. (2010). *Growing success: Assessment, evaluation and reporting in Ontario schools*. Toronto ON: Queen's Printer for Ontario.

| Type of Assessment | Category | Details | Weighting (%) |
|---------------------------|--------------------------|--|----------------------|
| Term Work (70%) | Knowledge/ Understanding | 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 | 12 |

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| | | <p>biochemical reactions required to maintain normal cellular function;</p> <p>Demonstrate an understanding of the chemical changes and energy conversions that occur in metabolic processes;</p> <p>Demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture.</p> <p>Demonstrate an understanding of the anatomy and physiology of human body systems, and explain the mechanisms that enable the body to maintain homeostasis;</p> <p>Demonstrate an understanding of concepts related to population growth, and explain the factors that affect the growth of various populations of species.</p> | |
| | Thinking | <p>Demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analyzing and interpreting, and communicating);</p> <p>Investigate the chemical structures, functions, and chemical properties of biological molecules involved in some common cellular processes and biochemical reactions;</p> <p>Investigate the products of metabolic processes such as cellular respiration and photosynthesis;</p> <p>Investigate, through laboratory activities, the structures of cell components and their roles in processes that occur within the cell;</p> <p>Investigate the feedback mechanisms that maintain homeostasis in living organisms;</p> <p>Investigate the characteristics of population growth, and use models to calculate the growth of populations within an ecosystem.</p> | 17.5 |
| | Communication | <p>Expression and organization of ideas and information;</p> <p>Communication for different audiences and purposes in oral, visual, and/or written forms;</p> <p>Use of conventions, vocabulary, and terminology of the discipline in oral, visual, and/or written forms.</p> | 17.5 |
| | Application | <p>Analyse technological applications of enzymes in some industrial processes, and evaluate technological advances in the field of cellular biology;</p> <p>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;</p> <p>Analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology;</p> <p>Evaluate the impact on the human body of selected chemical substances and of environmental</p> | 23 |

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| | | 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. | |
| Final Evaluation (30%) | Culminating Activity (15%) | Knowledge/Understanding | 2.5 |
| | | Thinking | 4 |
| | | Communication | 4 |
| | | Application | 4.5 |
| | Exam (15%) | Knowledge/Understanding | 2.5 |
| | | Thinking | 4 |
| | | Communication | 4 |
| | | Application | 4.5 |
| TOTAL | | | 100 |

Assessment/Evaluation Strategies

A variety of assessment and evaluation methods, strategies and tools are required as appropriate to the expectation being assessed. These include diagnostic, formative, and summative within the course and within each unit.

Assessment *for* learning and assessment *as* learning is obtained through a variety of means, including the following:

- Ongoing descriptive feedback
- Small-group conversations to develop their opinions and communication skills;
- Self-assessment (e.g., weekly self-assessment of learning, relative to specific course content as well as in contextual school, community and Land based learning);
- Peer assessment (e.g., peer feedback on personal goals related to course specific content and generalised throughout the school day);
- Mentor observations (e.g. of specific course expectations during Land based and cultural activities as well as during course specific activities);
- Conversations with student on a regular basis to verbalize observations, ask questions, and clarify understanding.

Evidence of student achievement (assessment *of* learning) is collected from various sources, including the following:

- Ongoing observations of most consistent work, with consideration given to most recent work;
- Conversations with students (e.g., discussion about why every organism is important in an ecosystem and how Indigenous people have always ensured the stability of their ecosystems);
- Summative unit activities (e.g., students will use the Canadian food guide for FNMI and devise a 5 days meal plan using mainly foods that are available in their communities);
- Culminating activity;
- Exam.

The Ministry of Education's 2010 document, *Growing Success*, outlines the seven fundamental principles that guide best practice in the assessment and evaluation of students. KiHS teachers use practices that:

- are fair, transparent, and equitable for all students;

- support all students, including those with special education needs, those who are learning the language of instruction (English or French), and those who are First Nation, Métis, or Inuit;
- are carefully planned to 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;
- are communicated clearly to students and parents at the beginning of the course and at other points throughout the school year or course;
- are ongoing, varied in nature, and administered over a period of time to provide multiple opportunities for students to demonstrate the full range of their learning;
- provide ongoing descriptive feedback that is clear, specific, meaningful, and timely to support improved learning and achievement;
- develop students' self-assessment skills to enable them to assess their own learning, set specific goals, and plan next steps for their learning (p.6).

Resources

Ontario Ministry of Education. (n.d.). *Indigenous education strategy*.
<http://www.edu.gov.on.ca/eng/aboriginal/>

Ontario Ministry of Education. (2008). *The Ontario curriculum, grades 11 and 12: Science*.
http://www.edu.gov.on.ca/eng/curriculum/secondary/2009science11_12.pdf

Ontario Ministry of Education. (2010). *Growing success: Assessment, evaluation and reporting in Ontario schools*. <http://www.edu.gov.on.ca/eng/policyfunding/growSuccess.pdf>

Ontario Ministry of Education. (2016). *Ontario schools, kindergarten to grade 12: Policy and program requirements*. <http://edu.gov.on.ca/eng/document/policy/os/index.html>

Ontario Ministry of Labour. (2017). *Youth workers*.
<https://www.labour.gov.on.ca/english/atwork/youngworkers.php>

Toulouse, P.R. (2016). What matters in Indigenous education: Implementing a vision committed to holism, diversity and engagement. <https://peopleforeducation.ca/wp-content/uploads/2017/07/MWM-What-Matters-in-Indigenous-Education.pdf>

Additional Resources

Agricult, G. (2013, Jan. 15). Great Pacific garbage patch [Video]. YouTube.
<https://www.youtube.com/watch?v=xZ773hCN2sU>

Angles and Acid. (2013, Mar. 4). *Investigating photosynthesis* [Video]. YouTube.
<https://www.youtube.com/watch?v=KpgZG9T0y34>

Biologyplus. (2011, Mar 14). *Experiment: Alcohol production by yeast* [Video]. YouTube.
<https://www.youtube.com/watch?v=znhalRdr5Zs>

Bozeman Science. (2011, July 30). *Gene regulation* [Video]. YouTube.
<https://www.youtube.com/watch?v=3S3ZOmleAj0>

Bozeman Science. (2012, May 11). DNA fingerprinting [Video]. YouTube.
<https://www.youtube.com/watch?v=DbR9xMXuK7c>

- Brightstorm. (2010, Sept. 1). Genetic mutation [Video]. <https://www.youtube.com/watch?v=5h-4mU8pyFc>
- Clore, J. (2011, Dec. 11). Dideoxy DNA sequencing [Video]. YouTube. <https://www.youtube.com/watch?v=bEFLBf5WEt>
- Cold Spring Harbor Laboratory. (n.d.). *Biology animations*. <https://dnlc.cshl.edu/resources/animations/>
- Drollinger, M. (2012, Nov. 21). What is selective breeding? [Video]. YouTube. https://www.youtube.com/watch?v=W_CnR0Ak604
- Igines. (2010, May 22). Restriction Enzymes Pt 1 [Video]. YouTube. <https://www.youtube.com/watch?v=IPdQwdGqyfQ>
- Kadir Khan. (2014, Aug 25). *To show experimentally that carbon dioxide is given out during respiration* [Video]. YouTube. https://www.youtube.com/watch?v=34ESzqzf_Uo
- KClassScienceChannel. (2013, Aug. 2). *Use iodine to test a leaf for starch: Plant physiology: Biology* [Video]. YouTube. https://www.youtube.com/watch?v=0s_xZqvwm_s
- ndsuvirtualcell. (2008, Jan. 30). *Transcription* [Video]. YouTube. <https://www.youtube.com/watch?v=WsofH466lqk>
- ndsuvirtualcell. (2008, Jan. 30). *Translation* [Video]. YouTube. <https://www.youtube.com/watch?v=5bLEDd-PSTQ>
- Ppornelubio. (2008, Mar 24). *Light dependent reactions* [Video]. YouTube. <https://www.youtube.com/watch?v=v590JJV96lc>
- RicochetScience. (2015, Oct. 1). *Nucleic acids* [Video]. YouTube. <https://www.youtube.com/watch?v=MA-ouz1LtpM>
- scienceclassisgreat. (2012, Aug. 26). Population dynamics: Predator-prey criss-crossing [Video]. YouTube. https://www.youtube.com/watch?v=b_svYGmlpxs
- ScienceTutorials2013. (2014, Apr. 1). *Experiment to prove oxygen evolve in photosynthesis* [Video]. YouTube. <https://www.youtube.com/watch?v=uv4pV3Plf4s>
- Useful Genetics. (2015, Aug. 16). *2A: Errors in DNA replication* [Video]. YouTube. <https://www.youtube.com/watch?v=WsY1t6ovYL8>
- yourgenome. (2015, June 26). *DNA replication: 3D* [Video]. YouTube. <https://www.youtube.com/watch?v=TNKWgcFPHqw>
- Yr82011. (2012, Oct. 24). *Effect of change in pH on the enzyme catalase* [Video]. YouTube. https://www.youtube.com/watch?v=_DZtsp3-7IU

Program Planning

This course is offered to Indigenous students living in isolated, northern Ontario communities. It is offered by qualified teachers in a blended classroom with a balance of academic, wellness, land-based learning, local language and culture to support the success of the whole student. This course uses the internet for instruction, demonstration and research. It utilizes a student-centered

semi-virtual classroom which capitalizes on the strengths of internet program delivery to minimize the disadvantages of geographic remoteness.

Students are presented with 1320 minutes of instruction/activity via the internet over the period of one week. All lessons, assignments, questions and course material is presented in this manner, with approved print materials available as a student resource in each classroom. The student and instructor communicate via the internet, while a classroom mentor (a fully qualified teacher) assists students in completing tasks in a timely manner and provides support as required.

Indigenous and local content is used throughout the course to meet students' learning needs. Opportunities for outdoor activities and land-based learning are also incorporated and students are encouraged to use local knowledge in their products. Considerations are made to the learning preferences of the student population and lessons can be adjusted for individual students as required. Opportunities have been provided for students to apply ideas and concepts encountered in this course to their lives as an individual and as a member of a First Nations community.

Teachers consult the Ontario Ministry of Education policies, guidelines and important initiatives when planning a comprehensive program in this area.