INTRODUCTION

A. Overview

Welcome to *Wading in for Water*, a youth leadership module developed by SEEDS Connections™ with the support of ConocoPhillips Canada. The primary focus of this module is to provide you with an instructional guide that has direct curricular connections to all of the learning outcomes identified in Science 14, Unit D, *Investigating Matter and Energy in the Environment* (Alberta Education, 2014, https://education.alberta.ca/media/3069383/pos_science_14_24.pdf). The secondary focus is to offer opportunities for students to complete the requirements of Environmental Stewardship (ENS 3910 Project D). In order for students to receive credits for ENS 3910, they must have other Career and Technology Studies (CTS) credits. More information can be found on the Alberta Education website for ENS: (http://www.learnalberta.ca/ProgramOfStudy.aspx?lang=en&ProgramId=948119#)

This guide is designed as an instructional support resource that includes individual lesson plans, recommended resources, and suggestions for student assessment. Completing this module will address all of the student learning outcomes prescribed in the Science 14 Program of Studies for Unit D. You will find that the lessons support the development of scientific literacy through student-driven inquiry, field investigations, and class contributions to a larger database of information regarding local and provincial water quality. The foundational statements of the Science 14 Program of Studies are woven into this module taking into consideration the following:

- Science, Technology and Society (STS): Within a Social and Environmental Emphasis, students will consider the interrelationships between science knowledge, the use of technologies to better understand and monitor water quality, and the social and environmental contexts within which decisions are made about local issues.

- Knowledge: Students will develop the science knowledge within life, physical, and earth sciences that are required to understand local water issues.
- Skills: Students will develop the appropriate and relevant skills to work in the laboratory and in the field to collect and analyze water samples from the local environment.
- Attitudes: Students will be encouraged to develop attributes that can be transferred to stewardship and leadership in the school community as they contribute to a database of information that will be accessible to others involved in similar investigations.

(Alberta Education 2014, p. 3)

B. UNESCO Sustainable Development Goals: Placing Learning in a Larger Context

> *Empowering learners to live responsible lives and to address complex global challenges means that education has to promote competencies like critical thinking, imagining future scenarios and making decisions in a collaborative way. This calls for new approaches to learning, the development of vibrant green economies and societies, and the emergence of a "global citizenship"*
>
> (UNESCO Education for Sustainable Development, retrieved from http://en.unesco.org/themes/education-sustainable-development)

UNESCO has identified seventeen (17) Sustainable Development Goals (SDGs) as part of the 2030 Agenda for Sustainable Development. (https://sustainabledevelopment.un.org/?menu=1300). Among the goals are Clean Water and Sanitation (SDG 6), Life below Water (SDG 14) and Life on Land (SDG 15), all of which relate to understanding matter and energy cycling in the environment, a core component of the Science 14 program. Placing learning within the context of the SDGs encourages students to develop empathy, consider and identify local and global issues, work together to generate possible solutions using their knowledge, skills and attributes, and design prototype solutions in the form of plans, proposals or models for consideration by their peers (see Design

Thinking). Teachers are encouraged to consider using the SDGs as themes for the unit to support the social and environmental emphasis (STS).

C. Alberta Education Student Values and Standards

In 2016, Alberta Education issued a document entitled *The Guiding Framework for the Design and Development of Kindergarten to Grade 12 Provincial Curriculum (Programs of Study)*, that provides core principles that will dictate how future programs of study in all subject areas will be written (https://education.alberta.ca/media/3575996/curriculum-development-guiding-framework.pdf).

> *There are many definitions of curriculum. This document* [The Guiding Framework] *refers to provincial curriculum, also known as programs of study: "what" students are expected to know, understand and be able to do in each subject and grade. Teachers have the flexibility to determine "how" students achieve the expected learning outcomes to bring the provincial curriculum to life in the classroom through meaningful learning activities.*
>
> (Alberta Education, 2016, p. 1)

The *Wading in for Water* module acknowledges the central focus of curricular outcomes (the 'what') while providing an authentic examination of a local water environment and opportunities for students to share their data and interpretations with others (the 'how'). *The Guiding Framework* clearly denotes the following three priorities:

a) Student values or beliefs about the desirable attributes that students in Alberta schools should demonstrate. These qualities, that address engaged, ethical and entrepreneurial citizenship, include:

- Democracy and Citizenship;
- Belonging and Identity;
- Integrity and Respect;

- Perseverance and Excellence; and
- Innovation and Stewardship.

(Alberta Education, 2016, p. 3)

b) Critical competencies that should be developed across all grade levels and disciplines. These competencies are believed to contribute to the student's personal development and community involvement. The competencies identified are, in no particular order:

- Critical Thinking;
- Problem Solving;
- Managing Information;
- Creativity and Innovation;
- Communication;
- Collaboration;
- Cultural and Global Citizenship;
- Personal Growth and Well-being.

(Alberta Education, 2016, pp. 28-31)

c) Standards for Alberta Programs of Study that provide key principles upon which all curricula will be developed. There are twelve (12) standards that fall under the categories of:

- Inclusion, Accessibility and Equity;
- Multiple Perspectives and Diversity;
- Comprehensive, Developmentally Appropriate Scope and Sequence and Learning Outcomes;
- Assessments; and
- Consistent Processes for Development and Review.

(Alberta Education, 2016, pp. 23-27)

The developers of this module have taken into account the approaches, instructional strategies, and assessment options that may support development of student values, competencies, and standards

described in *The Guiding Framework.* Teachers should also pay particular attention to everyday practices that keep these attributes at the core of instruction and assessment.

D. Place-Based Education

> *Placed-based education is the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science and other subjects across the curriculum. This approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens*
>
> (Sobel, 2004, p. 11).

Proponents of place-based education suggest that immersing students in the life of their communities will encourage them to take interest in and ownership of the ecological, cultural, historic, and economic viability of these places. Understanding their surroundings increases student agency to learn more and take action as they see fit. *Promise of Place* is a web site dedicated to promoting place-based education and community engagement (http://www.promiseofplace.org/what_is_pbe). It suggests that students who participate in outdoor education opportunities are more likely to:

- be more engaged and demonstrate improved academic achievement;
- develop increased links to the local community and environment; and
- search for information and contribute to solutions surrounding their local environments.

This *Wading in for Water* module has been specifically designed to address curricular outcomes (Science 14, Unit D) in such a way that students not only learn *about* the cycling of matter and energy in the environment, but through a focused investigation of a local water system they are able to make *informed contributions* to discussions and decisions surrounding water quality in their communities.

E. Design Thinking

> ***Design Thinking*** *is a mindset and approach to learning, collaboration, and problem solving. In practice, the design process is a structured framework for identifying challenges, gathering information, generating potential solutions, refining ideas, and testing solutions. Design Thinking can be flexibly implemented; serving equally well as a framework for a course design or a roadmap for an activity or group project.*
>
> *(*Retrieved from Harvard University Teaching and Learning Lab: http://tll.gse.harvard.edu/design-thinking)

Design Thinking (DT) promotes inquiry learning and distinguished by the process of taking an empathetic approach to understanding a problem, issue, or situation and taking into consideration who or what will be most impacted by the decisions or solutions proposed. Generally, there are five phases that design thinkers and innovators work through to solve problems:

a. **Discover and Empathize:** Determine what and who will be impacted by a problem or issue and consider what their needs are.
b. **Define and Interpret:** Analyze the information collected in the Discovery/Empathy phase and reframe the problem/issue into questions or statements that can be approached through inquiry and problem-solving.
c. **Ideate:** Often thought of as 'brainstorming', this phase involves divergent thinking in which individuals and groups generate possibilities and new ideas for solving the problem/issue. The key is to come up with as many ideas as possible without restrictions … those come later! A collaborative process is likely to yield a wide variety of creative, innovative ideas and approaches.
d. **Experiment and Prototype:** After choosing approaches from the ideate phase to pursue in more detail, it is time to experiment and create prototypes for solving the problem/issue. It is

important not to lose sight of the first three phases to ensure that the prototypes meet the desired outcomes. There are no right or wrong prototypes; however, prototypes can be assessed to determine their ability to solve the problem/issue. Failure is part of learning, testing, and creating and often results in more interesting, innovative, and creative solutions in the end.

e. **Refine/Gain Feedback/Communicate:** Testing the prototypes, gaining feedback from those who are impacted, and refining the final product are all part of solution-finding and more often than not, lead to new problems and issues to tackle!

The Design Thinking process has been adopted by many school jurisdictions and educational resource developers. The Calgary Board of Education has developed a useful infographic depicting the DT process and how it can be used for instruction and learning that is very useful: http://schools.cbe.ab.ca/b343/pdfs/2016-2017/Design_Thinking_Process_Branded.pdf

The *Wading in for Water* Action Project utilizes a design thinking approach to developing student-generated proposals for local water issues.

F. Organization of the Module

Wading in for Water consists of a unit plan template and lesson sketches developed for Science 14 Unit D: *Investigating Matter and Energy in the Environment.* Each lesson outline consists of the following components:

- **Setting the Stage** – includes correlation to Program of Studies knowledge, skill and attitude outcomes for the topic; planning notes including resources and materials required; and a description of the type of lesson (i.e. lab, field experience, brainstorming, etc.)
- **Topic Openers** - hooks for learning that may include videos, activities, demonstrations, questioning, classroom discussion among other strategies.

- **Lesson Sketch** – instructional outline including questions, discussion topics, activities, demonstrations, laboratory or field activities, videos, etc.
- **Closing Ideas** – suggestions for wrapping up the lesson and preparing for the next lesson
- **Notes** – add your own ideas based on your location, unique issues, and student interests.

NOTE: The hooks for learning and lesson sketches are suggestions only. Additional ideas and approaches that are more appropriate for your students' interests should be substituted as required. Student assessment strategies (diagnostic, formative, and summative) have not been identified nor developed, however the suggested instructional approaches provide for a variety of assessment opportunities throughout the unit.

G. Long Range Planning

Science 14 Unit D: *Investigating Matter and Energy in the Environment*	*Career and Technology Studies* *ENS 3910 Action Project (D)*
Timeframe: • Represents 25% of the Science 14 course • Consists of 14 lessons, including a local field study of an aquatic ecosystem, that should be completed in 14-15 classes • Represents ~ 18-22 hours	**Timeframe:** • 100% of ENS 3040, 100% of ENS 3910, ~20% ENS 3050 • Consists of 9 lessons (varying from one class to three classes for a total of 12-15 classes) and the implementation of the action project (dependent on student and teacher interest) • Additional materials will be made available for the completion of ENS 3050 (which will involve additional hours) as the credits for ENS 3910 are dependent on the completion of both ENS 3040 and ENS 3050. • Represents ~ 20 hours

To Do / To Consider / To Gather:

- Materials / Equipment Listing for the Field Study are found in Appendix D

Useful Websites and Resources:

- Field Experience: River Watch Program (http://www.riverwatch.ab.ca/)
- Alberta Lakes Management Society (http://alms.ca/)
- Alberta Irrigation Projects Association (http://aipa.ca/)
- The Clean Water Birthday Project (https://www.cleanwaterbirthdayproject.com/)

NOTE:

- Ideally students will be examining local water samples from ponds, creeks, sloughs, etc. These water samples may be maintained in an aquarium in the classroom/lab.
- If ordering aquatic microorganisms, do so prior to beginning the unit.

Safety and Risk Management:

Each School District has their own prescribed procedures for addressing risk management and safety of students, staff, and volunteers while they are engaged in off-site field experiences. Please review your locally developed guide and ensure that all the necessary considerations for your excursions meet the requirements of your department, school, and jurisdiction.

Student Assessment:

Specific student assessment materials are NOT included in this module. Teachers should determine the most appropriate Assessment for Learning (AfL) and Assessment of Learning (AoL) for their students. Consider a wide variety of strategies to provide multiple opportunities for students to demonstrate their understanding, skills and developing attributes or habits of mind.

NOTE: Consider the role that industry, community partners, environmental organizations, local and provincial governments, and others may play when engaging students in a balanced discussion about water in your community. There are both challenges and good news stories to share regarding each stakeholder's social responsibility and the ways in which emerging technologies and innovative thinking contribute to managing and caring for our water and other natural resources.