Grade 8 Let's make our planet better, one drop at a time!

Experience 2: Getting Wet

Overview

In this STEM-based, engaging activity, students get an opportunity to embark on a journey in which they will discover how various human developments impact our watersheds and our water and evaluate the quality of drinkable water and the factors that may affect it.

They will start by exploring the UN's and Canada's sustainability goals and their importance, putting emphasis on the goals relating to water quality and the importance of protecting water. This is important so they can see that the world appreciates that we do need to take immediate actions to remedy the situations and make our planet a better place to live. (1 period of 75 minutes)

They will then get to choose specific aspects of various drinking water sources and conduct tests and experiments to evaluate the quality of water from their community's bodies of water. They will compare their findings to Canadian standards. (2 periods of 75 minutes)

Students will then explore how developments and anthropogenic factors can impact Ontario's water quality. This will be accomplished through a case study to understand the impact of Enbridge's line 5 on the Great Lakes which has and will continue to have detrimental effects on all that rely on that fresh source of water. They will then use their findings to build a model of the affected watershed and of the pipeline. (3 periods of 75 minutes)

In the final step, familiarize themselves with the wastewater treatment process. They will then go on to code, using Scratch, an animation that will enable them to simulate a step or more in the process of wastewater treatment, to mimic a situation of an oil spill in Lake Erie or Lake Ontario or to raise awareness about an issue related to the water quality of their choice based on what they would like to emphasize (2 periods of 75 minutes).

Link to Long Range Plan Grade 8 Model 1; December/January. Big Idea: Water

Overview of learning	In this Experience, students will choose specific aspects of various drinking water sources and conduct tests and experiments to evaluate the quality of

experiences – why these activities	water from their community's bodies of water. They will compare their findings to the Canadian standards. (2 periods of 75 minutes) Big Idea: Water - Environmental and Social Impacts: LRP Grade 8 Model 1 - December/January French LRP Grade 8 Model 2 - December/January French
Prior Knowledge / Prior Skill Set(s)	Background Knowledge and Concepts (Teacher) - Additional teacher concept support ● Students should have a basic understanding of the main properties of fluids (for example that oil and water don't mix). ● Students should know that they will explore important issues studied in the module on hydrographic systems. ● Canada shares the Lakes with parts of the United States (for example a few years ago the Canadian and American authorities learned to make changes to the Boundary Waters Treaty of 1909, which would have diverted some of the water from the Great Lakes to other parts of the United States, or pick it up). ● The students need to understand what watersheds are and have an appreciation for their importance. ● They need to remember that access to resources and clean water is an important issue all over the world and is being highlighted by the United Nations. ● Students and teachers should have a basic understanding of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (see the Additional Resources section for more information). ● Teachers should be familiar with the 1977 Pipeline Treaty (see the Additional Resources section for more information). ● Students and teachers should be familiar with the Truth and Reconciliation Commission's Calls to Action (see the Additional Resources section for more information). ● Teachers should understand that the treaty partners in Ontario who are affected by the Line 5 and Highway 413 extensions (see Experience 3) are the Mississaugas of New Credit, Six Nations of the Grand River, Chippewas of Georgina Island First Nation, and the Mississaugas of Scugog Island First Nation.

	Background Knowledge and Skills (Students) – Addressing misconceptions and preconceptions ● The **Engineering Design Process** will be applied in this unit. The students should know how to conceive a design fitting established criteria and put to test their critical thinking skills. By going through this process, students will experience firsthand what it takes to create a successful product and what innovation is. ● Students will also use their **communication and presentation skills** to communicate and present their ideas and findings. ● Students will use their **social skills** as they will work in groups to explore various topics. ● Students will use and reinforce their **research skills** as they find answers to their questions and solutions to the presented problems. ● Students should also have basic **programming skills.**
Strand A - STEM Investigation and Communication Skills	**A1. STEM Investigation and Communication Skills** use a scientific research process, a scientific experimentation process, and an engineering design process to conduct investigations, following appropriate health and safety procedures  **A1.1 Scientific Research:** Review previous research on local watersheds  **A1.2 -** use a scientific experimentation process and associated skills to conduct investigations  **A1.3 Engineering Design:** Build a more sustainable or environmentally friendly form of transportation  **A1.4 Safety:** Lab Safety Rules  **A1.5 Communication:** Communicate their observations and conclusions of their model explain how this will affect ecosystems, watersheds and species

Overview / Big Ideas/Fundamental Concepts	In this 4 part lesson, the students will go through various learning experiences to deepen their knowledge about the impact of humans and developments on a vital source; water. In the first part, they will be introduced to the UN's sustainable development goals and develop their social and presentation skills as they learn about them. In the second part, they will use their research skills and scientific process to test the water quality of various sources in their neighborhood. They will learn that there are set water quality standards in our province and these must be respected for water to be drinkable (if testing drinking water) or healthy enough for aquatic organisms. In the third part, the students will do a case study. There are two options; option 1 will explore the case of Enbridge's pipeline 5 and the issues surrounding it. In option 2, they will explore the impact of the construction of Highway 413. In both options, the students will see how these developments affect the surrounding watersheds. They will get to make links to history and politics as they see how the treaty laws and UNDRIP are being violated. Students will finally use the engineering design process to represent these developments using models and propose alternatives that align with the UN's Sustainable Development Goals. In the last part, students will code a program to either simulate a situation where a chosen development is impacting a water source or watershed of their choice OR use their programming skills to raise awareness about an issue related to water quality.
Learning Goals / Success Criteria	There are a few assessment opportunities in these lesson parts: **Assessment OF learning;** In this case study lesson, the students will have to create an infographic to present their findings. The teacher should present the rubric and elaborate on it with the students before they start the task so they can make sure all the success criteria are met. Likewise, as the teacher presents to the students the Engineering Design Process and all its steps - they should discuss together the success criteria for this and for Model-Building. The teacher can then present the provided rubric to them before they begin the Engineering Design Process.

	Ministry of Education Key Points 1. **STEM Skills and Connections:** Perspectives and approaches that provide opportunities for students to investigate and apply concepts and skills from all areas of learning. 2. **Research and Experimentation Processes:** Provides students with the scientific literacy skills needed to approach scientific questions that are becoming a part of everyday life. 3. **Engineering Design Process:** Provides students with support to plan and build solutions to problems or address needs that connect to the curriculum and the world around them. 4. **Hands-on, Experiential Learning:** Includes hands-on, experiential learning opportunities to support classroom activities that encourage curiosity 5. **Coding:** Allows students to explore a wide variety of science and technology concepts and contexts through coding, while also learning valuable skills related to the automation and control of systems.
Learning Experience(s) **A1.2**	**GETTING WET** **Preparation for the activity** See Appendix A: Student Activity Guide for a handout for this activity**.** For this activity, the students need to be familiar with the scientific research process. A reminder of the various steps involved should be reviewed prior to the experiment as the students will use their knowledge thereof in order to complete their task. One week prior to the experiment, the teacher divides the students into groups and asks each group to be ready, on the day of the experiment, with a sample of drinking water from their home or a nearby facility such as a community center or school. The students identify the source of this drinking water and explain if this source is part of a watershed or not. They will also need to define what a watershed is.

 **A1.2, A1.4**  **A1.5**	The teacher can also provide water quality testing kits; such kits are readily available at a local hardware store. The teacher can create a shared Google sheets document in which the students can enter the data of their findings. **Group Activity – Wet Lab** ● Students pick three aspects to test for and share their findings. ● Students take all the necessary safety considerations into account and execute the test to evaluate the water quality. ● Students use a shared Google Sheets file to enter their data. **Class discussion and analysis** A representative from each group summarizes their findings and all students compare their results to the Ontario Standards of Water Quality
Science and Technology Expectations	**Overall & Specific Expectations from the Science and Technology Curriculum** **D. Structures and Mechanisms** D1.2 assess the impact on individuals, society, and the environment of alternative ways of meeting needs that are currently met by existing systems, taking different points of view into consideration **E: Earth and Space Systems** E1.3 assess the impact of scientific discoveries and technological innovations on local and global water systems E2.3 explain how human activity and natural phenomena cause changes in the water table E2.6 describe various indicators of water quality, and explain the impact of human activity on those indicators
Science and Technology Vocabulary	Specific vocabulary that will be used and/or covered in this learning experience Engineering Design Process Scientific Process System Sustainability Watershed Development

	Stewardship Model Simulation Block Coding Infographic
Equipment and Materials	**Materials required:** ● Computer with access to Internet (for the shared Google Sheets) ● Projector ● Universal indicator OR digital pH-meter to test for pH ● Water Quality Test Kit ● Beakers (enough for the groups)
Timeline and Preparation	**Preparation time:** 60 minutes **Time for learning experience:** 2 periods of 75 minutes
Safety Considerations	Refer to these safety resources: ● Safety in Elementary Science and Technology (STAO) ● Safe Activity Foundations in Education Document (SAFEdoc) Science and Technology, Grades 1-8 (OCTE) ● Ontario Curriculum Program Planning – Health and Safety
Opportunities For Assessment	Assessment **AS** learning can apply to the scientific process in this section. The teacher can use and elaborate on the provided checklist with the students on some of the most important lab skills so they can be aware of them and develop those skills as they go through the activity. See Appendix B: Self-Assessment of Laboratory Skills.
Instructional Strategies and Adaptability	21st century learning strategies UDL Differentiation Transferable Skills

	Testing water quality is a hands-on activity that engages the students and exposes them to Real-World situations from their neighborhood. Throughout all the activities: We see Key transferable skills throughout all 4 parts. Communication skills are developed by various means. Differentiation is used throughout as the activities in each lesson are tailored toward different types of learners and are designed to be inclusive. A combination of individual and group work, calm activities like reading articles, and activities tailored towards kinesthetic learners like model-building are also applicable throughout the lessons.
Additional Supporting Resources	**Experience 2: Getting wet! Testing drinking water quality** **Peel – resource about water quality:** Peel Water Story: a resource for exploring Peel's water systems - Region of Peel. (n.d.). Retrieved September 12, 2022, from https://www.peelregion.ca/waterstory/ "How to Use Google Sheets - Computer - Google Docs Editors Help." **Class discussion and analysis** The Ontario standards of water quality, **Adaptations:** Alternatively, students who are unable to physically collect the data, may analyze data available online through Public Health Ontario. It is suggested to explore the Raw Waters Chemicals Map UNDRIP Truth and Reconcilliation Commission - Call to Action 1977 Pipeline Treaty
Cross-Curricular Opportunities	**Literacy:** Many of the activities involve reading news articles, presenting and communicating in English or French using the proper terms and vocabulary.

	Math: Students must assess the quality of water using and comparing numerical values, they will present this data in the form of tables to analyze them.
Future Opportunities / Next Steps	After these activities, students are encouraged to explore Sustainable Development Goals that were not explored in these lessons and make links with the other Units. They can study how development (highways, suburban expansion) affect elements of our biosphere (for example, their impact on the accessibility of healthy food choices to Canadians). They can also choose to use coding to promote good choices as responsible Canadian citizens.

Appendix A: Student Activity Guide - Getting Wet! Testing Water Quality

GETTING WET!
TESTING WATER QUALITY

Name:_____ Date:_____

Part A – Let's get ready!

Objectives:

In this activity, you will do a comparative study of water from different sources and determine the relative health of the watercourse in question. You will bring samples of water from watercourses close to your homes and school (be very cautious while doing so, under adult supervision!). You may also choose to evaluate the quality of drinking water in your neighborhood. As a class, we will study specific aspects of the water samples to evaluate the quality of water and gather all the data in ONE shared Spreadsheet (such as GoogleSheets) (teacher can insert link here) table so they can be analyzed.

St Nora Lake, Algonquin Highlands.
Photo credit: Christine Guindy

Introduction:

What is "good" water quality? Does that answer depend on what the water is being used for (e.g. drinking, swimming, bathing, wildlife/fish, etc.)? Which factors affect water quality?

All these are important questions! Let's discuss this as a class before we continue!!

So how do we test and evaluate water quality? Scientists use three main ways:

- Chemical analysis (pH, Oxygen/Carbon Dioxide, lead, Nitrates, Ammonia, Phosphates)
- Biological indicators (living organisms and how they change).
- Physical measurements (colour, conductivity, etc…)

In this activity, we will focus mainly on chemical analysis

My teammates	
Our chosen water source	
Our chosen tests (other than pH which is mandatory for everyone)	

Before beginning the testing, make a list with your class regarding important safety rules:

Important safety rules

Our answers to these important questions

Part B: Group activity – wet lab

Fill in the table on Google sheets
Table 1: _____ (Give a title to the table)

	Drinking water	Water source	pH	Nitrates (mg/L)	Copper (mg/L)	Lead (mg/L)	Chlorate/ Chlorites (mg/L)	E. Coli	Other
Group 1 (Example)	House in brampton	Lake Ontario	7.8						
Group 2									
Group 3									
…									

Part C: Class discussion and analysis

Once all your tests have been completed and your data gathered, you will now compare your findings to the Ontario Standards of Water Quality (pdf downloaded if needed).

A representative from each group summarizes their findings – fill out the following table and answer these questions to help you with this task:

- What **tests** were conducted? What values **aligned** with the Ontario Standards of Water Quality? Which did not?
- What **watershed** or source of water did you gather your sample from?
- Would you say your source contained "good" water quality? Why or why not?
- What **factors and developments** could affect the quality of water from your source?

Table 2: _____ (Give a title to the table)

Test conducted	Accepted value according to Ontario Standards of Water Quality	Our value	Does the value obtained align with the standard? Possible explanation for this.

Appendix B: Self Assessment of Laboratory Skills

Self-assessment of Laboratory Skills

Name: _____ **Date:** _____

Group : _____ **Laboratory:** _____

Laboratory safety:

- ☐ I follow the steps of the protocol while observing its safety and the safety of others.
- ☐ I wear all the necessary safety equipment (glasses, gloves, a lab coat ...)
- ☐ Safety precautions are well observed (hair well tied, no food ...)
- ☐ I demonstrate an understanding of the dangers associated with the chemicals used (corrosive, flammable...) and equipment (never leave a hot plate on unattended...)
- ☐ ALL chemicals and equipment were well picked up at the end of the lab. The chemicals were disposed of safely according to the teacher's instructions.

The student follows the scientific process correctly:

- ☐ I make a hypothesis based on previous knowledge.
- ☐ I select proper data to test the hypothesis by following the accepted protocol.
- ☐ I record data and observations in a clear and well-organized way; as in a well-structured table.
- ☐ I compare the collected data to the accepted values to evaluate them properly.

Teamwork:

- ☐ I demonstrate leadership and team player skills.
- ☐ I demonstrate a thorough understanding of the concepts studied and I share my ideas with my comrades.
- ☐ I discuss results and observations with the other members of the team.
- ☐ I stay with my team.

Completion of the task:

- ☐ I demonstrate organizational skills.
- ☐ I contribute to an equitable division of tasks, and I complete my part to the best of my ability.
- ☐ I respect the deadlines.
- ☐ I show enthusiasm and focus on the task at hand.
- ☐ Group discussions are concerned with experimental procedures only (no outside discussions or distractions)
- ☐ I demonstrate skills by organizing time without compromising the quality of the work.

Other important comments: