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

Experience 4: Coding for a Better Future

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 the final step, students will explore how science can help make water more accessible and will familiarize themselves with the wastewater treatment process. They will then go on to program, using Scratch (or another program of the teacher's choice), an animation that will enable them

experiences – why these activities	to simulate a step or more in the process of waster water treatment, to mimic a situation of oil spill in Lake Superior or to raise awareness about an issue related to water quality of their choice based on what they would like to emphasize (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 be exploring 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:** Understanding the issues. Students will use their scientific research skills to explore and understand how scientists use various techniques to clean and recycle water in a wastewater facility. **A2: Coding and Emerging Technologies:** Students will use coding in order to raise awareness or simulate processes related to water pollution or cleanup based on their interests and skill level.
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 will develop their social and presentation skills as they learn about those.

	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 indigenous people and treaty laws and UNDRIP are being violated. Students will finally use the engineering design process (see this presentation on 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 FOR and OF learning:** In this part, the students can decide together by dividing the class into groups and letting each one work on one specific criterion (Knowledge, Critical Thinking, Communication, Application). The teacher can hand out post-its and set up a corner in the class for each of the criteria. The students can write each success criterion for each of Knowledge, Critical Thinking, Communication, and Application on their post-it and place it in the appropriate corner. The teacher can gather all this information to align it with a coding rubric (see Appendix B: Coding Rubric). **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) **A1.1** **A.2**	**CODING FOR A BETTER FUTURE** **A. What can science do to help**: (See Appendix A: Student Activity Guide for student handout.) Before programming with Scratch, students can virtually visit a wastewater management facility. The teacher starts by asking the question: How can science help ensure the availability of water? How do innovative technologies lessen the environmental impact of development? ● Individually, the students are to explore this document summarizing the wastewater treatment process from a facility in Ottawa ● Students will conduct a virtual visit provided by CFORP of the Robert-O-Pickard environmental center ○ This is a virtual 360 visit to the Ottawa Wastewater Treatment Plant (built in 1962). Once treated at the Robert O. Pickard Environmental Centre (CEROP), the water is diverted back into the Ottawa River. ○ The teacher can ask the students to write down two or three interesting things that they have discovered about the factory and share them on the board in class. **B. Let's code for a better future!** Giving the students a choice is a great way to engage them and ensure their success.

	The teacher can start by showing the 'What is Scratch' video introducing Scratch. The students will familiarize themselves with Scratch for block coding, and will use it to program an animation that will enable them to ● Option 1: Simulate a step or more in the process of wastewater treatment ● Option 2: Simulate an oil spill in a lake of their choice (students may also animate its cleanup using an existing technique). ● Option 3: Create an animation that serves as a commercial to raise awareness about water quality issues and/or a message of what we can do to lessen the environmental impact on watersheds that are caused by new developments
Science and Technology Expectations	**Overall & Specific Expectations from the Science and Technology curriculum** **E: Earth and Space Systems** E2.7 explain how municipalities process water and manage water usage
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 the Internet (for the resources) ● Post-its ● The Scratch application (or another application available at the school that the teacher would be comfortable with)

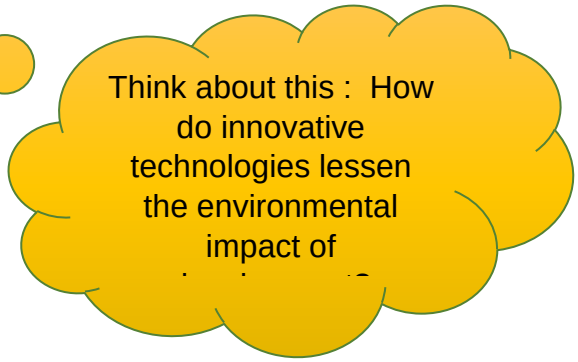
Timeline and Preparation	**Preparation time:** 20 minutes **Time for learning experience:** 2 periods of 75 minutes each
Safety Considerations	Refer to these safety resources: • Safety in Elementary Science and Technology (STAO) • Safe Activity Foundations in Education Document (SAFEdoc) Science and Technology, Grades 1-8 (OCTE) • Ontario Curriculum Program Planning – Health and Safety
Opportunities For Assessment	**Assessment FOR and OF learning:** In this part, the students can decide together by dividing the class into groups and letting each one work on one specific criteria (Knowledge, Critical Thinking, Communication, Application). The teacher can hand out post-its and set up a corner in the class for each of the criteria. The students can write each success criterion for each of Knowledge, Critical Thinking, Communication, and Application on their post-it and place it in the appropriate corner. The teacher can gather all this information to align it with the provided Coding rubric.
Instructional Strategies and Adaptability	21st century learning strategies UDL Differentiation Transferable Skills UDL is encouraged particularly in this part and students are given various options to meet the same expectations. For example, they can choose the coding program that they are most comfortable using and they can choose between various objectives (simulating a situation or raising awareness). These choices motivate them and increase engagement by making them feel more comfortable with the project. 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	**PART A: What can science do to help** **Wastewater treatment process:** (PDF downloaded): Documents.ottawa.ca. 2022. [online] Available at: URL: https://documents.ottawa.ca/sites/documents/files/wastewater_treatment_en.pdf [Accessed 8 September 2022]. **Virtual visit (360) of the Robert-O-Pickard environmental center provided by CFORP:** "Centre Environnemental Robert-O.-Pickard (CEROP)." URL: https://cavlfo.apprentissageelectroniqueontario.ca/shared/CEL/SCH3U-08-19/Module2/visiteVirtuelle/index.htm Accessed 8 Sept. 2022. **PART B: Let's code for a better future!** **Video introduction to Scratch:** undefined [Scratch Team]. (2017, June 20). What is Scratch? YouTube. https://www.youtube.com/watch?v=jXUZaf5D12A **Scratch.** "Scratch - Imagine, Program, Share." Mit.edu, 2018, scratch.mit.edu/. **Interesting resource.** Using micro:bit - coding that aligns with UN's Global Goals
Cross-Curricular Opportunities	**Art:** Building a model or using coding to create a program and represent esthetically beautiful products requires artistic talents.

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 - Coding for a Better Future

Coding for a better future



In this activity, you will demonstrate how science can help make water more accessible. To start, you will familiarize yourselves with the wastewater treatment process. You will then go on to program an animation that will enable you to simulate a step or more in the process of wastewater treatment, to mimic a situation of an oil spill in a lake of your choice, or raise awareness about an issue related to the water quality of your choosing based on what you would like to emphasize (using Scratch or another program of your choice).

What can science do to help?

- Your first task is to familiarize yourselves with the Wastewater Treatment Process at an Ontarian facility:
    - Start by exploring this handout summarizing the Wastewater treatment process from a facility in Ottawa
- Once you have reviewed the process with your peers, you will conduct a virtual visit provided by CFORP of the Robert-O-Pickard environmental center
    - This is virtual 360 visit to the Ottawa Wastewater Treatment Plant
- Write down three interesting things that they have discovered and share them on the board in class.

1. _____

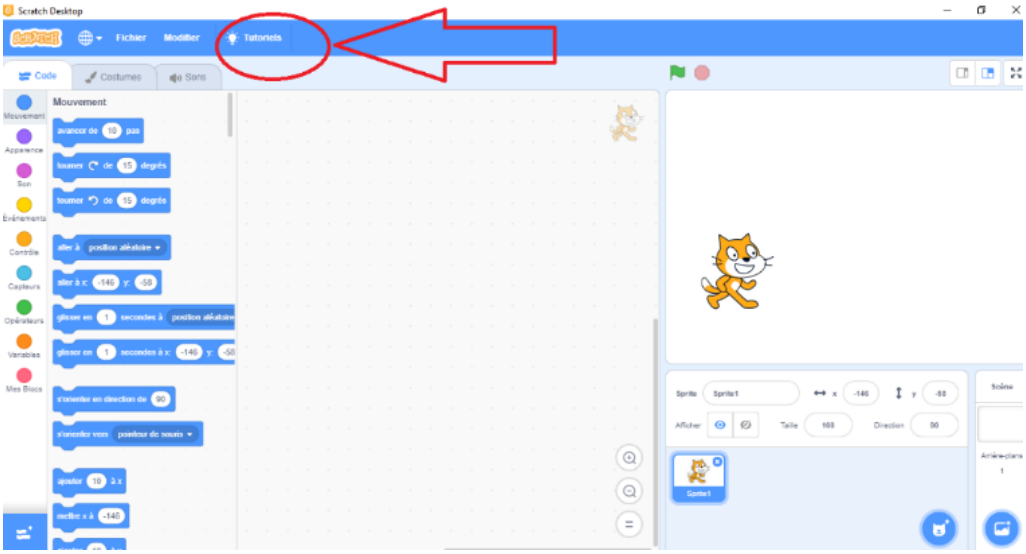
2. _____

3. _____

Let's code for a better future!

How familiar are you with Scratch? Take a few minutes to explore it…

- Watch this video explaining what Scratch is.
- Visit Scratch (https://scratch.mit.edu/).



Your task consists of the following:

- Option 1: Simulate a step or more in the process of waster water treatment
- Option 2: Simulate an oil spill in a lake of your choice (you may also animate its cleanup using an existing technique).
- Option 3: create an animation that serves as a commercial to raise awareness about water quality issues and/or a message of what we can do to lessen the environmental impact on watersheds that are caused by new developments.

My notes/brainstorming/questions:

Appendix B: Coding Rubric

	Beginner	Nearing Proficient	Proficient	Expert
Function **"What" you code!**	Program does not work or errors prevent the intended result.	Program output sometimes works with minor functionality errors.	Program output mostly works the way it was intended.	Program output matched the intended result and there are no issues with program functionality.
	Student applies simple procedures and does not use basic coding skills/ control structures from recent lessons	Student uses very few control structures from recent lessons.	Code is beginning to use control structures learned in recent lessons.	Code is well written and demonstrates a strong understanding and application of control structures.
Style **"How" you code!**	Code is disorganized and difficult to read. Code contains lines that are out of order or will not run or are illogical.	Code shows some organization. Code can be read and logically flows with some misused operators (>,<,=, and/or)	Program is well organized and program logic is mostly correct. Program might have occasional and/or minor event errors.	Program is well thought out and organized and easy to read. Program logic is efficient with no known errors and no errors in conditions.
Concepts	Student cannot describe how their code works and/or are not aware of the goal of the program to demonstrate intended concepts.	Student is aware of the goal or the program and can somewhat describe how their code works. Student has some ideas/solutions when prompted.	Student understand the goal of the program and can describe how their code works and make necessary changes to modify their program with ease.	Student can clearly describe and modify their code with no prompting. Student clearly understands the goal of the program and incorporates new ideas and multiple solutions.

Comments	