Grade 8 Learning Experiences: Innovative Irrigation: The Value of Water to Food Security

Experience 1: Innovative Irrigation and the Value of Water to Food Security

Experience 1 Explore the value of water regarding food production across cultures and technologies.

Experience 2 Hands-on activities that demonstrate some factors that affect the flow of fluids.

Experience 3 Design Challenge: Build and test a prototype for an irrigation system based on student research from Experiences (Activities) 1 and 2.

Long Range Plan: Grade 8 Model 1 (February/March)

Overview of learning experiences – why these activities	This set of experiences looks at the importance of water use (irrigation) in crop production. Students research the variety of irrigation methods there are in farming around the world. Using a variety of syringes and tubing of various lengths and gauges, they will then explore the properties of fluids. Finally, they will apply that knowledge to create their own irrigation model. Students will be guided by the engineering design process (Strand A: Engineering design), the concepts of water flow (Strand C: Matter and Energy - Fluids), and the value and importance of water in our environment (Strand E: Earth and Space Science – Water systems). Long Range Plan: Grade 8 Model 1 (February/March)
Prior Knowledge / Prior Skill Set(s)	Background Knowledge and Concepts (Teacher) ● Basic understanding of Systems (inputs, outputs, side effects) ● UN Sustainable goals to link these experiences to real world situations Background Knowledge and Skills (Students) ● Strategies for determining area of an odd shape (or simply calculating the area of rectangles) ● Rudimentary experience with coding on a platform such as Scratch or Minecraft Education

Strand A - STEM Investigation and Communication Skills	**A1.1** use a scientific research process and associated skills to conduct investigations (Experience 1) **A1.5** communicate their findings, using science and technology vocabulary and formats that are appropriate for specific audiences and purposes (Experience1, 2, 3) **A2.1** write and execute code in investigations and when modelling concepts, with a focus on automating large systems in action (Experience 1) **A3.1** describe practical applications of science and technology concepts in various occupations, including skilled trades, and how these applications address real-world problem (Experience 1) **A3.3** analyse contributions to science and technology from various communities (Experience 1)
Overview / Big Ideas/Fundamental Concepts	Experience 1 integrates the Fundamental Concept of Sustainability and Stewardship by introducing students to the UN Sustainable Development Goals and how they apply to the irrigation of food crops. It also integrates Systems and Interactions as irrigation methods are systems that have imputs, outputs and side effects that interact with the natural world.
Learning Goals / Success Criteria	During Experience 1, students will be doing the following: • Conducting research online independently and with colleagues • Sharing information with others • Recording information found by themselves and others • Using code to create a working model of and irrigation system The main goal is to support students in completing a full cycle of an engineering design process, with a real-world problem concerning sustainable water use practices as a starting point. This activity integrates several of the ten **Ministry of Education Key Topics** introduced in Science and Technology (2022):

	• **Research and Experimentation Processes:** Provides students with the scientific literacy skills needed to approach scientific questions that are becoming a part of everyday life. • **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. • **Emerging Technology:** Ensures that students are aware of exciting and innovative solutions in science and technology that are being implemented today and that may be introduced in the future. • **Contributions to Science and Technology**: Showcases the important contributions made to science and technology from people with diverse lived experiences. Students also explore real-world issues by connecting scientific and technological knowledge systems and perspectives from various cultures, including connecting Indigenous sciences and technologies and Western science and technology. • **Climate Change:** Students will develop the skills and knowledge needed to understand the causes and potential solutions and mitigation strategies related to climate change and other environmental issues, and how they can make the most environmentally responsible decisions possible, given the choices they have. • **Food Literacy:** Skills and knowledge related to food literacy: from students developing an understanding of where food comes from and how it is grown and prepared, to students investigating the importance of biodiversity in agriculture.
Learning Experience(s)  **A1.1, A1.5**	**Minds On (1class)** • Drought greatly impacts agriculture and food production everywhere in the world. Show your class the short provocation video below to start a discussion about drought, how it will become more prevalent in the future due to climate change, and what possible strategies and tools we might use to combat it. • Drought and Agriculture - Predict, Plan and Prepare: Stop Drought Becoming Famine - YouTube • Brainstorm a list of ideas students might have for combatting agricultural drought. Make a note of the UN sustainable goals that the video references and which ones may apply.

	• One of the mitigation strategies to drought is irrigation. By using waterways, piping, and controlled flooding, growers have been able to give their crops access to water when rainfall is absent. There are a wide variety of strategies and tools that growers around the world have used over time to accomplish this. Each method has pros and cons based on a variety of factors. **Action** • Students will use the Impacts of Irrigation: Minds On table provided (see Appendix A: Impacts of Irrigation) to record points from an opening discussion they will have on how irrigation might impact the environment, social implications, and the economy. Students will add to this table as they conduct their research. • The best media for this research is short videos. Some of these are advertisements for various agricultural products, some are growers showing the set-up in their own fields, some are University research groups, and some are projects from non-governmental organizations that are funding irrigation projects worldwide. In any case, videos show the machinery in action. The visual aspects are very important. Many videos watched by the author have had a wealth of accompanying information. • Students will break into small groups with internet-enabled devices to research and analyze a variety of types of irrigation used around the world. Students can use this table to record their findings (see Appendix B: Investigation Irrigation). • You can assign certain types of irrigation to certain groups or allow them to explore on their own. • Students can record information on the table (see Appendix B: Investigation Irrigation), or create a shared document or slide show with the column headings as guidelines as to the information that is important. Taking screenshots and incorporating photos of a working model will help others to understand how this particular method of irrigation works. • When the research is complete, students re-group with students from another group and share their findings. **Consolidation (1-2 class work periods)**
A2.1	• To consolidate the understanding of the variety of irrigation methods around the world, research pairs will look at their research and

	decide upon one method that they would like to model. Then, using a coding platform (e.g. Scratch, Minecraft Education), they will run their model. ● Students will create a rectangle on the screen that will represent an overhead view of a field. They can insert crop rows and add details if they wish. The goal of this model is for their program to fill in as much of the area of their field with water (represented by the colour blue) as they can. For example, a student could code the movement of an icon of a tractor that leaves a blue trail behind it as it travels around the rectangle while covering as much of the rectangle in blue as possible. Another student could code dots on the field that will create a larger diameter blue circle around them when the model is activated, to show the distance the irrigators can spray. ● As students are creating their programs, you can assess their understanding of the content by asking questions as you circulate through the classroom. ○ What kind of irrigation system are you modeling? ○ Where is a place where you know that system is used? ○ Where in your code are the instructions for where the components of the irrigation system are placed? ○ Explain how your code shows the water spreading across the field ● Students can then submit the code to you and share their model with others in the class.
Science and Technology Expectations	**Overall & Specific Expectations from the Science and Technology curriculum** **Strand C: Matter and Energy (Fluids)** **Overall Expectation** **C1**. Relating Science and Technology to Our Changing World: analyse uses of various technologies that rely on the properties of fluids, and assess the impact of these technologies on society and the environment (Experiences 1,2,3). **Overall expectation** **C2**. Exploring and Understanding Concepts demonstrate an understanding of basic fluid mechanics, including the properties and uses of fluids (Experiences 2, 3) **C2.6** Explain in qualitative terms the relationship between pressure, volume, and temperature when a liquid or a gas is compressed or heated

	(Experience 2 addresses the relationship of pressure and volume of water when it is compressed, Experience 3 applies this concept to the design challenge) **C2.7** describe how forces are transferred in all directions in fluids, including using Pascal's law to quantify the transfer of forces in fluids (Experience 2, 3) **C2.8** describe factors that affect the flow of fluids (Experiences 1, 2, 3) **Strand D: Structures and Mechanisms (Systems in Action)** **Overall Expectation** **D2**. Exploring and Understanding Concepts demonstrate an understanding of different types of systems and the factors that contribute to their safe and efficient operation (Experience 1, 2, 3) **D2.2** describe the purpose, inputs, and outputs of various systems, including systems related to food processing (Experience 1,3) **D2.3** identify the various processes and components of a system that allow it to perform its function efficiently and safely (Experience 3) **D2.7** identify ways in which energy can dissipate from mechanical systems, and describe technological innovations that make these systems more efficient (Experience 3) **D2.9** describe technological innovations involving mechanical systems that have increased productivity in various industries (Experience 1, 3) **D2.10** identify social factors that influence the evolution of a system (Experience 3) **Strand E: Earth and Space Systems (Water Systems)** **Overall Expectation** **E1.** Relating Science and Technology to Our Changing World assess the impact of human activities and technologies on the sustainability of water resources (Experience 1, 3) **E1.1** assess the social and environmental impact of the scarcity of fresh water, and propose a plan of action to help address fresh water sustainability issues (Experience 1, 3) **E1.3** assess the impact of scientific discoveries and technological innovations on local and global water systems (Experience 1, 3)

Science and Technology Vocabulary	Irrigation system – inputs, outputs, side effects. Drought
Equipment and Materials	Appendix A: Impacts of Irrigation table Appendix B: Investigation Irrigation table Internet-enabled device (at least one per pair of students)
Timeline and Preparation	Approximately 3-4 classes ● Introduction and research (1 class) ● Sharing research with others (1 class) ● Coding a model of a selected irrigation system (1-2 classes)
Safety Considerations	There are no additional safety considerations beyond classroom supervision for Experience 1
Opportunities For Assessment	Below are suggestions for opportunities for assessment for Experience 1. Inside the ellipses is the section of the Achievement Chart from Science And Technology (2022) that corresponds. **Assessment FOR learning** See Appendix A: Impacts of Irrigation table ● Briefly look over student tables as they are completing them. How much background knowledge do students have? Is there a representative short video you could play in class and add to the table together? (Knowledge and Understanding) ● Observation of interactions and the completed table (Knowledge and Understanding) **Assessment AS learning** As students are using a table (see Appendix B: Investigation Irrigation) to record their research, circulate around the class as students are selecting resources (Thinking and Investigation). Use a checklist as you ask some questions about one of the irrigation methods students have researched (Conversation) ● Tell me about one of the types of irrigation you've looked at ● Why did you choose this one? ● What might be one advantage of this form of irrigation? ● What might be a deficit for this form of irrigation?

	Assessment OF learning When assessing students' code for the consolidation piece, consider whether the students accurately represented the type of irrigation they were modeling. (Knowledge and Understanding). You can also assess coding expectations from the Grade 8 math curriculum if they have applied that knowledge to their modeling program.
Instructional Strategies and Adaptability	Ways to integrate culturally relevant and responsive pedagogy (CRRP) into these lessons are as follows: ● One way is to model the selection of resources. In Experience 1, students will be searching for short videos depicting a variety of irrigation systems. Find a video that models successful irrigation in a non-North American region. There are a wealth of videos focused on farming success in South American, Asian, and African regions. ● Another way to integrate these teachings is to make connections with families of students at the start of the year. Your welcome package could include a questionnaire that asks parents and extended family members if they have a career or job in a science or tech-based industry. In this case, anyone connected with farming or water resources would be ideal. Organizing a short QA between the professional and the class would help students to see themselves and their families recognized as an asset to education in the school. ● Adaptations for students with an IEP for reading and writing or for ELLs, could include the following: ○ Provide students with a list of irrigation methods for them to search for videos or images (Google Images is very helpful). ○ Instead of written notes on the Appendix B table, these students could create a series of slides (using PowerPoint or Google Slides) with photos and labels of inputs and outputs; crop variety; one pro and one con; and a possible geographic location this method of irrigation is used. ○ These students could orally describe the details of the irrigation methods to you, using the created slides as prompts.
Additional Supporting Resources	● Drought and Agriculture - Predict, Plan and Prepare: Stop Drought Becoming Famine - YouTube

	● Home | Sustainable Development (un.org)
Cross-Curricular Opportunities	Cross-curricular opportunities include the following: **Geography** ● A2 use the geographic inquiry process to investigate issues related to the interrelationship between human settlement and sustainability from a geographic perspective (gathering and organizing data from various sources to investigate the relationship among irrigation, agriculture and sustainability **Mathematics** ● C3 Coding (solve problems and create computational representations of mathematical situations using coding concepts and skills) **Language** ● Oral Communication ○ Listen in order to understand and respond appropriately in a variety of situations and a variety of purposes ○ Use speaking skills and strategies appropriately to communicate with different audiences for a variety of purposes ● Writing ○ Generate, gather, and organize ideas and information to write for an intended purpose and audience (using the provided table)
Future Opportunities / Next Steps	● Students who finish coding their model have the opportunity to consider another method of irrigation to model that is very different from the first one they chose. How could they alter their original code to model this new method? What portions of the code need to be completely different? Why? ● Prompt students to start to think of where we are going in Experience 3? Which of these methods of irrigation would be interesting to build on a smaller scale in the classroom? How might they begin? What materials might they need? Can they source them from home? These might then be integrated into the materials that you make available for Experience 3.

Appendix A: Impacts of Irrigation

Impacts of Irrigation

Irrigation technology around the world allows growers to bring water to their crops at times when natural precipitation is not enough to result in a good harvest.

Discuss some of the possible environmental, social, and economic impacts that result from this technology and add them to the table. Outline negative impacts in red and positive impacts in green. You will find both.

Add ideas to this table as you conduct your on-line research. Remember to include specific real-world examples from your research.

Environmental	Social	Economic

Appendix B: Investigation Irrigation

Investigating Irrigation Research Table

Some methods of irrigation to get you started: Pivot, Linear, Flood, Lateral, Furrow, Surge, Drip

Irrigation Type	Resource links or video title	Ideal crops for this type and where they are found	Sketch or details of function	Pros	Cons