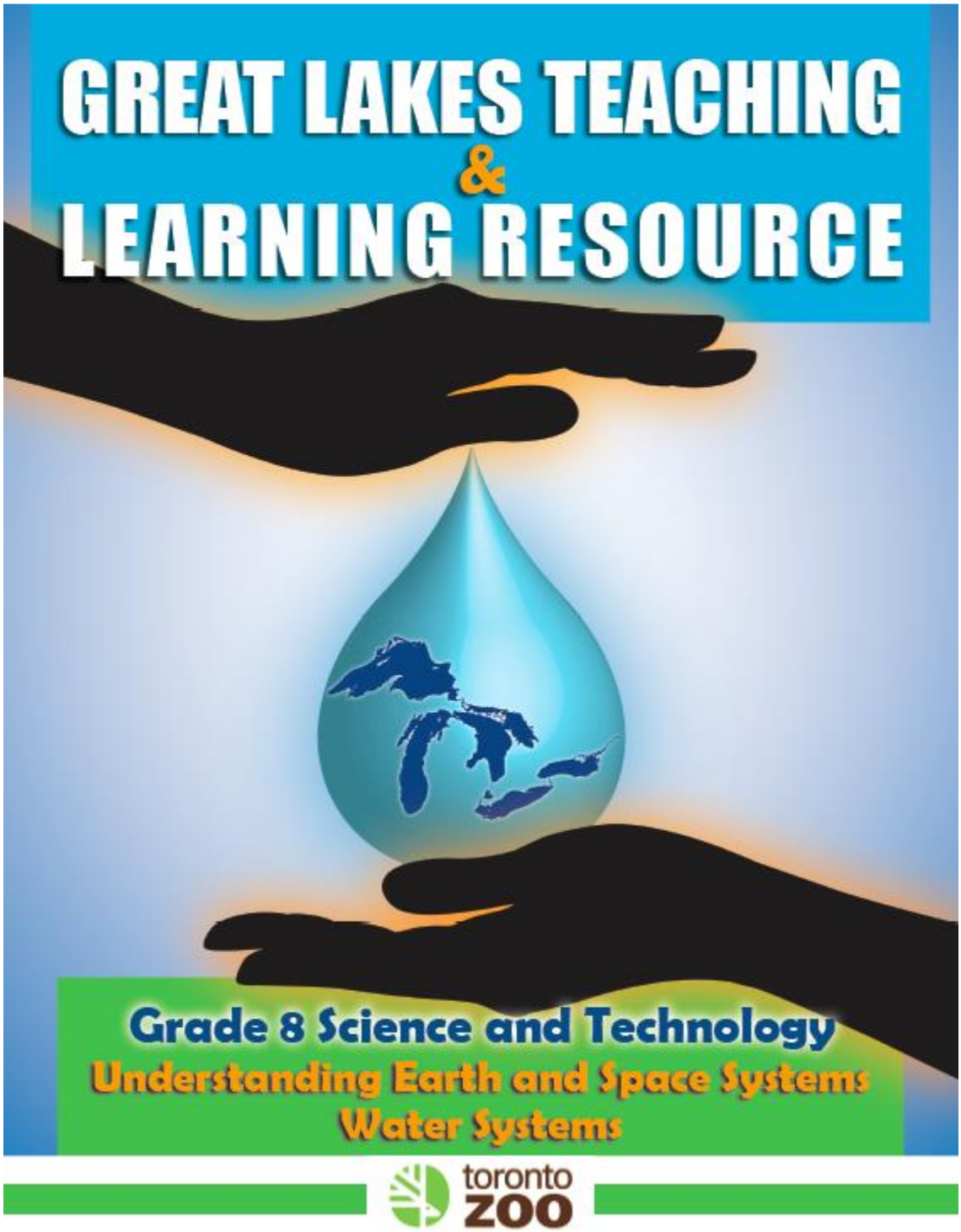

TEACHER'S RESOURCE GUIDE

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Preface

The Toronto Zoo is committed to the conservation of wildlife through the exhibition of animals, plants and ecological habitats and through conservation, preservation, research and educational programs. The Zoo also has a strong mandate to improve public awareness with the goal of species and habitat conservation, which involves the local delivery of curriculum-based education programs. Located adjacent to the largest freshwater source on the planet, it seemed only natural for the Zoo to help foster an appreciation of the North American Great Lakes. This interest and passion led to the creation of the Zoo's highly successful, bilingual Great Lakes Program. Core to this conservation program is classroom outreach, which combines lessons about water as well as the species and processes associated with this amazing ecosystem.

The creation of The Great Lakes Teaching & Learning Resource has been developed as two case studies to provide Ontario educators with classroom materials directly applicable to the Ontario Science and Technology Curriculum objectives and using the North American Great Lakes as the context for teaching and learning. Applying an Inquiry Based Learning (IBL) approach, the resource objective is to acquaint students with the North American Great Lakes and to foster a better understanding of their own role as stewards for its preservation. The second case study presents the material as a more fundamental Inquiry Based Learning (IBL) format and encourages the use of Internet-based resources.

Further Comments and suggestions for future editions are welcomed and encouraged.

Curriculum Connections

This case study makes direct links to the ***Grade 8 Science & Technology Curriculum (2007)***, with a specific focus on the *Earth and Space* strand and the topic of *Water Systems*. Teachers may use this resource from start to finish in order to fulfill these curriculum expectations. Alternatively, teachers may also use this case study in a modular format, selecting one or more scenarios to complement an existing Science & Technology program.

The Big Ideas

1. Sustainability & Stewardship – Water is crucial to life on Earth

2. Systems & Interactions – Water systems influence climate and weather patterns

3. Change & Continuity – Water is an important resource that needs to be managed sustainably

Overall Expectations for Students

- Assess the impact of human activities and technologies on the sustainability of water resources
- Investigate factors that affect local water quality
- Demonstrate an understanding of the characteristics of the earth's water systems and the influence of water systems on a specific region

Specific Expectations for Students

Scenario	Title	Big Idea	Specific Expectations
1	*The North American Great Lakes* *Where is your Watershed?*	**2**	➢ 3.2 - Demonstrate an understanding of the watershed as a fundamental geographic unit, and explain how it relates to water management and planning
2	*How much do you know about our H_2O?*	**1, 3**	➢ 1.1 - Evaluate personal water consumption, compare it with personal water consumption in other countries, and propose a plan of action to reduce personal water consumption to help address water sustainability issues ➢ 3.3 - Explain how human and natural factors cause changes in the water table (lawn watering, inefficient showers and toilets, drought, floods, overuse of wells, extraction by bottled water industry)
3	*Blueprints for Sustainability*	**3**	➢ 1.3 - Assess the impact on ***local*** and global water systems of a scientific discovery or technological innovation ➢ 2.2 - Investigate how municipalities process water and manage water ➢ 2.7 - Use a variety of forms to communicate with different audiences and for a variety of purposes ➢ 3.2 - Demonstrate an understanding of the watershed as a fundamental geographic unit, and explain how it relates to water management and planning
4	*Frozen Over*	**2**	➢ 3.1 - Identify the various states of water on the earth's surface, their distribution, relative amounts and circulation, and the conditions under which they exist ➢ 3.4 - Identify factors that affect the size of glaciers and polar ice-caps, and describe the effects of these changes on local and global water systems ➢ 3.5 - Explain changes in atmospheric conditions caused by the presence of bodies of water
5	*Taking Charge of the Great Lakes*	**1, 2, 3**	➢ 1.2 - Assess how various media sources address issues related to the impact of human activities on the long-term sustainability of local, national, or international water systems ➢ 2.1 - Follow established safety procedures for the use of apparatus and chemicals ➢ 2.3 - Test water samples for a variety of chemical

			characteristics ➢ 2.4 - Use scientific inquiry/research skills to investigate local water issues ➢ 2.5 - Use technological problem-solving skills to design, build, and test a water system device that performs a practical function or meets a need ➢ 2.6 - Use appropriate science and technology vocabulary, including water table, aquifer, polar ice-cap, and salinity in oral and written communication ➢ 2.7 Use a variety of forms to communicate with different audiences and for a variety of purposes

Use as a Cross-Curricular Resource or in an Integrated Learning Environment

Opportunities exist for teachers to apply this case study to:

- Other Science & Technology strands (e.g. Life Systems, Matter and Energy)
- Language
- Mathematics
- Social Studies

To facilitate an integrated learning environment, teachers may wish to create a daily theme on water, where all of the subject areas being taught utilize water and the Great Lakes as a focal point for discussion and activities.

Program Planning and Considerations

The Case Study #1 Package is designed to be flexible and modular, allowing teachers to provide accommodations and/or modifications to support student learning. For example, each case scenario permits differentiated instruction through both the process and product. The use of technology, graphic organizers, oral discussions, kinesthetic experimentation and the opportunities for guided writing help support all students in their academic achievement.

In addition, teachers may wish to provide further supports for students with exceptionalities and English Language Learners by:

- Increasing the use of audio, video and visuals
- Providing access to dictionaries and assistive technology
- Granting extra time for the completion of tasks
- Gathering supplementary and supporting learning resources

The Inquiry-based Learning Approach

Case Study #1 is a collection of five scenarios that help students understand the importance of the Great Lakes and the many interdependent systems that affect and rely on this natural resource. The scenarios, which are to be **conducted in groups**, are designed to inspire students to inquire about their personal connection to the Great Lakes and take concrete steps to protect them.

In a pedagogical context, inquiry-based learning encourages students to take responsibility for their own learning and to discover the facts for themselves while continuing ongoing dialogue and conferencing with the teacher (Ontario School Library Association, 2010).

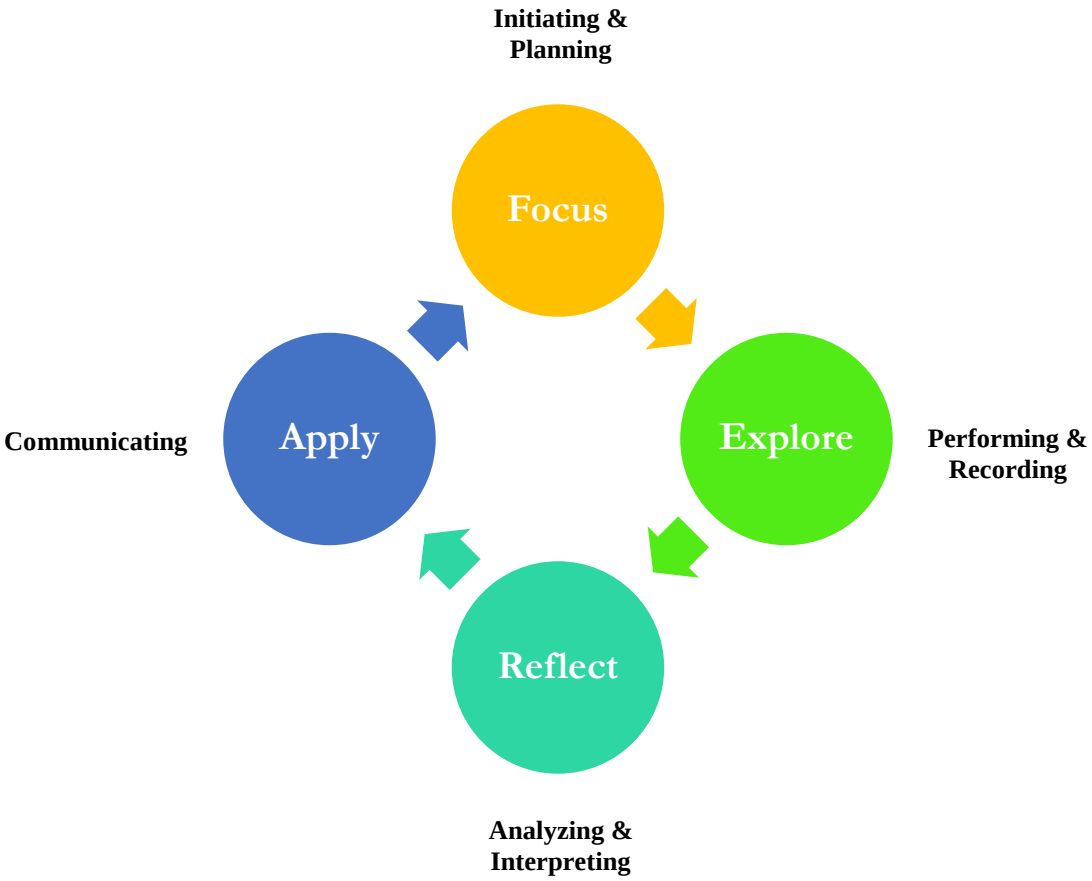
Inquiry-based learning offers many advantages including, but not limited to:

- Engaging students to solve real-world problems that are of interest to them
- Encouraging student collaboration and cooperation
- Developing students' critical thinking and transfer of knowledge to new contexts
- Supporting teacher assessment of both process and product
- Strengthening digital literacy skills to prepare students for the 21st-century

The FERA Learning Cycle

Utilizing the Smithsonian Education Center's FERA Learning Cycle approach to inquiry-based learning, each scenario is accompanied by a series of tasks that enable students to ***focus*** on a specific issue, ***explore*** that issue through further research and experimentation, ***reflect*** on any findings with theirs peers and ***apply*** what they have learned to produce a product or to a new situation (Smithsonian Science Education Center, 2014).

The FERA Learning Cycle was specifically designed for use in STEM subjects, i.e. science, technology, engineering and mathematics. It provides a simple pneumonic for both students and teachers to utilize an inquiry-based approach in the classroom. Furthermore, the FERA Learning Cycle is aligned with the Scientific Inquiry/Experimentation Skill Continuum specified in the in the Ontario Science & Technology Curriculum. Each FERA stage supports the development of at least one of these skills.


Initiating & Planning
Focus
Explore
Performing & Recording
Reflect
Analyzing & Interpreting
Apply
Communicating

The Objectives and Possible Questions in each FERA Stage

STAGE	OBJECTIVES & POSSIBLE QUESTIONS
1. FOCUS	• Using guiding questions, the "Focus" stage help students establish personal connections to the topic (e.g. activate prior knowledge via everyday observations and experiences) to establish a mental anchor. • Students may be encouraged to ask one or more of the following questions while making a personal connection to the topic: o What did you observe when…? o Have you seen…? o Did you ever notice…? o I wonder…?
2. EXPLORE	• Students choose the questions to test via a hypothesis, which may include one or more of the following: o What do you predict might happen when…? o What past experiences can you draw upon to support your hypothesis? o How do you think you can find the answer to your question with the current resources that you have at your disposal? • Students conduct research and/or experimentation to answer one or more of the following questions: o What did you notice happening when…? o Can you describe…? o What happens if…? o Does it matter if I try…? o Can you describe/find a way to…? o How many ways could you…?
3. REFLECT	• Students reflect on their experiences by sharing their discoveries, main ideas, challenges, new questions, problem-solving strategies etc. with their peers. Reflection questions may include one or more the following: o What surprises did you find…? o What was happening when…? o What do you think about…? o Why do you think that…? o How is ….. the same? How is it different? o Does the data you've collected support any particular ideas you have? o What did you see/notice that gave you that idea?
4. APPLY	• Students extend and apply their findings to a new situation or to produce a final product by asking one or more of the following questions: o Where does this happen in the real world…? o How can you use these ideas every day…? o How might this experiment be different if…? o What would happen if…? o Could you design another test to try…? o What ideas do you want to try next…?

Opportunities for Assessment and Evaluation

Each scenario provides multiple opportunities for assessment and evaluation, coinciding with the stages of the FERA Learning Cycle.

- **FOCUS Tasks:** All "focus" tasks present opportunities for the recall of prior knowledge and the use of that knowledge to brainstorm new ideas and concepts. This enables the teacher to ***assess for learning***, assisting with the lesson planning process.

- **EXPLORE Tasks:** All "explore" tasks allow teachers to use the performing and recording process as an ***assessment as learning*** opportunity. Through the use of KWL charts, students can determine what they know, what they would like to know and what they have learned to guide them in their own research on a specific topic.

- **REFLECT Tasks:** Reflection tasks often take place in groups where students discuss their exploration findings with one another and compare these findings to earlier assumptions. These discussions are good opportunities for students to peer assess each other's discovery process which is an example of ***assessment as learning.***

- **APPLY Tasks:** All "apply" tasks enable the student to create a product that communicates what they have learned from the case scenario. Teachers may treat these final tasks as ***assessment for learning*** opportunities or as ***assessment as learning*** opportunities if peer evaluation is desired. A combination of the two could also be considered.

In all instances, teachers have the discretion to apply some or all of the assessments. Universal rubrics, which can be found in the appendices, have been provided to facilitate this process.

Lesson Starters

Lesson starters are provided in this Teacher's Guide to assist with program planning. Teachers may wish to use these lesson starters as an initial starting point for preparing comprehensive lesson plans that are specific to their school schedules and to their students' learning needs.

Each case scenario will contain one or more of the following student prompts:

- **Before you Begin:** These tasks are introductory tasks that will aid students in rapidly recalling the prior knowledge that they need to activate in order to complete upcoming inquiry-based activities in the scenario.

- **Figure It Out:** These are considered "optional" extension tasks that provide students with the opportunity to "think outside the box" and engage in an activity that connects with another curriculum subject area (e.g. Mathematics) or to a specific real-world issue. These tasks usually appear within the scenarios and exist to help establish important connections between theory and practice.

- **Your Turn:** All of the inquiry-based tasks and activities will be presented after a "Your Turn" prompt. Students will go through all four stages of the FERA Learning Cycle and complete the essential activities that will lead them towards the creation of a final product.

In the appendices section of this guide, teachers can find blackline masters of graphic organizers that should be available to students in the classroom environment. The nature of inquiry-based learning allows students to choose the best tool(s) to organize their thinking, research, planning and final product. Some suggestions are provided in the lesson starters but teachers may find it beneficial to make all of them universally available in the classroom.

Where technology permits, teachers may consider using digital tools in lieu of paper-based graphic organizers.

Scenario / Topic	Scenario 1 – The North American Great Lakes 1.1 – Introduction to the Great Lakes
Suggested Timing	1x 40 minutes

OBJECTIVES:

Specific Expectations:

- 3.2 - Demonstrate an understanding of the watershed as a fundamental geographic unit, and explain how it relates to water management and planning

MATERIALS/RESOURCES:

- Case #1 Student Booklet: Scenario 1, Topic 1.1
- Appendix 1 - KWL Chart
- Appendix 2 – Mind Map Template
- Web access (computer, laptop, mobile device etc.)

MINDS ON (FOCUS) - Introduce the concept of "The Great Lakes" as a topic and hold a brief class discussion on what immediately comes to students' minds - Provide students with the KWL Chart - In their groups, have students brainstorm three things that they know about the Great Lakes. They will record this in the appropriate column of their KWL chart - Then have students brainstorm three things that they would like to learn. They will record this in the appropriate column of their KWL Chart	**10 minutes**
INPUT (EXPLORE) - Provide students with a mind map template - Using the silhouettes of the Great Lakes in Topic 1.1, randomly assign one of the Great Lakes to each group - Each group will now use the web to research the name of the assigned lake.. Each group member will record three new findings on their individual KWL chart	**10 minutes**
CONSOLIDATION (REFLECT) - In their groups, prompt students to discuss how accurate their initial assumptions were about the Great Lakes and whether they discovered any new or surprising findings	**5 minutes**
`PRACTICE (APPLY) - Have each group present their mind map to the class; encourage Q&A where applicable - After all of the groups have presented, they may add to their KWL Charts	**15 minutes**

Scenario / Topic	Scenario 1 (Continued) 1.2 – The North American Great Lakes (Map Infographic) 1.3 – Where is your Watershed?
Suggested Timing	3x 40 minutes

OBJECTIVES:

Specific Expectations:

- 3.2 - Demonstrate an understanding of the watershed as a fundamental geographic unit, and explain how it relates to water management and planning

MATERIALS/RESOURCES:

- Case #1 Student Booklet: Scenario 1, Topic 1.2 and Topic 1.3
- Appendix 1 - KWL Chart
- Appendix 2 - Mind Map
- Appendix 3 - Note-taking Chart
- Appendix 4 - Map of Ontario
- Duo-tang, folder, binder for students to organize their notes and handouts for this entire unit
- Web access (computer, laptop, mobile device etc)

MINDS ON (FOCUS) - Recall students' prior knowledge about the Great Lakes by recapping what was learned in the previous lesson - To supplement their recall, have students look at 1.2 – The North American Great Lakes (map infographic) and as a class, go through some of the key facts presented. Encourage any discussions or questions that would enhance their thinking/inquiry - Continuing with the whole class format, have students read **1.3 – Where is Your Watershed?** - Have students brainstorm which of the primary watersheds they reside in. They are to provide reasons to support their assumption. They can utilize a mind map to assist with this process.	**15 minutes**
INPUT (EXPLORE) - Provide students with a KWL Chart. Have them complete the column on what they already know about watersheds. - Provide students with the note-taking chart. Have students explore Ontario's watersheds in greater detail: - Using the Ministry of Natural Resources watershed map in Topic 1.3, students will determine whether they selected the correct primary watershed and explain their reasoning. - Next, students will use the Conservation Ontario website to find their local Conservation Authority's website. See: http://goo.gl/EUWnyQ. - Using the resources available from the local Conservation Authority, students will determine which subwatershed they reside in and describe the specific roles they play for the local ecosystem. E.g. location of the drainage basins, the water pathways, the wetland, lake, river or groundwater where this water ultimately empties.	**40 minutes**

CONSOLIDATION (REFLECT) - In their groups, students will discuss findings. Students will individually include three things that they have learned and three questions that they still have about their community's subwatershed. This information is to be added to their KWL charts for further inquiry - Teachers may consider having some groups share their findings with the whole class, to determine if all students grasp the concept of the watersheds.	**10 minutes**
`PRACTICE (APPLY) - In their groups, students will create a map using the Appendix 4 template to show where their subwatershed is located. They will share their map and reflection findings with the rest of the class. As an extension, conduct additional research to see if they can find answers to the three questions that they still have about their community's subwatershed. They may also wish to contact their local Conservation Authority to get more information. - Remind students that maps should have: o Map Title o Legend o North Arrow o Colour o Major towns/cities/rivers/lakes	**Map: 35 minutes** **Presentation: 20 minutes**

Scenario / Topic	**Scenario 2 – Understanding our Water** 2.1 – How Much do you Know About our H_2O?
Suggested Timing	4x 40 minutes

OBJECTIVES:

Specific Expectations:

- 1.1 - Evaluate personal water consumption, compare it with personal water consumption in other countries, and propose a plan of action to reduce personal water consumption to help address water sustainability issues
- 3.3 - Explain how human and natural factors cause changes in the water table (lawn watering, inefficient showers and toilets, drought, floods, overuse of wells, extraction by bottled water industry)

MATERIALS/RESOURCES:

- Case #1 Student Booklet: Scenario 2, Topic 2.1
- Appendix 1 - KWL Chart
- Appendix 2 - Mind Map
- Appendix 3 - Note-taking Chart
- Appendix 5 – Action Plan Template
- Duo-tang, folder, binder for students to organize their notes and handouts for this entire unit
- Web access (computer, laptop, mobile device etc)

MINDS ON (FOCUS) — **60 minutes**

- Recall students' prior knowledge about the Great Lakes and the watersheds that feed them.
- Display the word "Footprint" and have students brainstorm what comes to mind. Then add the word "Water" before it and have students come up with the meaning of the combined term.
- As a class, have students read **2.1 – How much do you know about our H_2O?** Encourage class Q&A by helping students think about their own personal water usage throughout the read.
- Teachers may wish to have measuring cups, water, fruits, vegetables etc. in the classroom with a scale so students could continue to be self-sufficient, and could make educated guesses about their consumption.
- ***OPTIONAL* Figure It Out Activity:** This is an optional activity that connects with the Mathematics curriculum and can be conducted in class. Students will:
  - Describe the mathematical steps that they will take to convert cubic metres to litres
  - For each of the countries shown on the Global Water Footprint graph, students will use the steps that they have created to convert the figures from cubic metres to litres
  - Finally, students will now describe the steps needed to convert litres back into cubic metres. They will demonstrate their accuracy by performing this conversion with at least one example. **(NOTE: 1 cubic metre = 1000 litres)**
- Provide each student with a mind map
- Students will now work individually to discover their personal water footprint. They will take a look at how much water they use at home on an average day, week, month and year. With examples, they will describe what, where, when and how this water is being used. They may

use the Water Footprint calculator to help them with their calculations. Students must visit "National Water Footprints", "Case Studies" and select a country from this tool. The QR code is provided.	
INPUT (EXPLORE) - Students will now select a country of their choice and research how much water the average individual or household in that country uses in a day, week, month and year. With examples, students will describe what, where, when and how this water is being used. They may use the Water Footprint database to help them with this task.	**25 minutes**
CONSOLIDATION (REFLECT) - In their groups, students will compare and contrast their water footprint with their selected country's water footprint and the global average. Identify and discuss any specific similarities and differences that they have noticed. They should also compare their water footprint with one another's.	**15 minutes**
`PRACTICE (APPLY) - In a medium of their choice, create a well-defined action plan to reduce their own water footprint. They will present their footprint, their selected country's footprint and their action plan to the class for further discussion. You may provide the Action Plan Template as a reference.	**60 minutes**

Scenario / Topic	Scenario 3 – Managing our Water 3.1 – Blueprints for Sustainability
Suggested Timing	4x 40 minutes

OBJECTIVES:

Specific Expectations:

- 1.3 - Assess the impact on ***local*** and global water systems of a scientific discovery or technological innovation
- 2.2 - Investigate how municipalities process water and manage water
- 2.7 - Use a variety of forms to communicate with different audiences and for a variety of purposes
- 3.2 - Demonstrate an understanding of the watershed as a fundamental geographic unit, and explain how it relates to water management and planning

MATERIALS/RESOURCES:

- Case #1 Student Booklet: Scenario 3, Topic 3.1
- Appendix 1 - KWL Chart
- Appendix 2 – Mind Map
- Appendix 6 - Graphic Organizer for Brainstorming
- Duo-tang, folder, binder for students to organize their notes and handouts for this entire unit
- Web access (computer, laptop, mobile device etc)

MINDS ON (FOCUS) — **20 minutes**

- Recall students' prior knowledge about the Great Lakes, watersheds, and the water footprint. To switch things up, teachers may wish to use a game as the hook. E.g. a Q&A game, hangman with water terminology etc.
- Display the word "Sustainability" and as a class, have students brainstorm what they think it means.
- As a class, have students read **3.1 – Blueprints for Sustainability.** Encourage class Q&A by helping students think about their own communities throughout the read.
- Students will now work in their groups to *brainstorm* where they think their water comes from and where it might be going when it leaves their house. They will also do the same for how they think stormwater is managed. Students will record their assumptions in a chart or mind map and briefly explain why they have made those assumptions.

INPUT (EXPLORE) — **20 minutes**

- Using the web, students will determine whether their water comes from a surface water source or a ground water source. They will compare and contrast their assumptions for how water arrives at their homes, where it goes when it leaves their home and how stormwater is managed. Students will note the similarities and differences between their assumptions and their research. They will need to visit their community's website or the Ministry of Environment website to gather some of these facts.
- Key Search Terms:
    - [town/city/municipality name], [drinking water], [public works], [where does our

water come from] Note that: some smaller municipalities will not have this information available online. In this case, have students look at a larger town or city that is close by.	
CONSOLIDATION (REFLECT) - In their groups, students will discuss their findings. For example, were all, some or none of their initial assumptions correct? If so, which ones and why? What surprised them the most? Why?	**15 minutes**

`PRACTICE (APPLY)
 	
- Students will now take control of the flow. They have the option of designing and presenting, in a medium of their own choice, **ONE (1) of the following:**
 	
  - A community in Ontario (real or fictitious) that is built (or modified) to utilize and manage water in a sustainable way. Students must describe the flow of water into and out of buildings and how they plan on managing stormwater and runoff. They must also explain why they decided on this design and clearly state the features that enable water to be used and managed in a sustainable way. Here are some examples:
 	
  o City of Guelph: http://goo.gl/wz6CzB
  o City of Ottawa: http://goo.gl/QEb1r9
  o City of Toronto: http://goo.gl/tMnRmz
 	
  - A device or system that addresses a specific water management issue – e.g. water filtration, bioremediation of wastewater, a state-of-the-art septic or wastewater treatment system, drip irrigation system, deep lake cooling, water recycling system, etc. Some examples:
 	
  o Water Filtration: http://goo.gl/cxeaeH
  o Bioremediation: http://goo.gl/lSnqb6
  o Wastewater Treatment: http://goo.gl/kkVc44
  o Drip Irrigation: http://www.dripirrigation.ca/
  o Deep Lake Cooling: http://www.enwave.com/district_cooling_system.html
  o Water Recycling (Reclamation): http://goo.gl/jTZXlM
 	
- A new and effective flood protection plan that can be adopted by a specific city, town, or village in Ontario. See example: http://goo.gl/JW9s7t
	105 minutes

OPTIONAL – FIGURE IT OUT ACTIVITY
 	
- Teachers who feel that their students would benefit from studying recent Ontario floods may wish to assign the optional "Figure It Out" activity to students as an exit card / out-of-class assignment.
 	
- Students would conduct a web search on floods that have occurred in Ontario within the last five years. If students are stuck, try these examples:
  o Belleville Flood (April 2014)
  o Huntsville, Bracebridge and Bancroft Floods (April 2013)
  o Ottawa (July 2009)
  o Sault Ste. Marie (September 2013)
  o Toronto Floods (July 15, 2012 / July 8, 2013)
  o Thunder Bay (May 2012)
 	
- They would then select one of these flood events and explain why the flood occurred and what measures have been implemented to prevent future floods.	

Scenario / Topic	Scenario 4 – Weather, Climate & the Great Lakes 4.1 – The Water Cycle 4.2 – Frozen Over
Suggested Timing	4x 40 minutes

OBJECTIVES:

Specific Expectations:

- 3.1 - Identify the various states of water on the earth's surface, their distribution, relative amounts and circulation, and the conditions under which they exist
- 3.4 - Identify factors that affect the size of glaciers and polar ice-caps, and describe the effects of these changes on local and global water systems
- 3.5 - Explain changes in atmospheric conditions caused by the presence of bodies of water

MATERIALS/RESOURCES:

- Case #1 Student Booklet: Scenario 4, Topic 4.1 and Topic 4.2
- Appendix 1 - KWL Chart
- Appendix 6 - Graphic Organizer for Brainstorming
- Appendix 7 – Water Cycle Diagram
- Duo-tang, folder, binder for students to organize their notes and handouts for this entire unit
- Web access (computer, laptop, mobile device etc)

MINDS ON (FOCUS) — **25 minutes**

- Recall students' prior knowledge about what they learned about sustainability.
- Display the term "Water Cycle" and have students recall what they remember about the steps in the cycle
- **BEFORE YOU BEGIN:** Have students complete the Water Cycle diagram in groups. Take up these answers as a class and prompt students to think about how the Water Cycle may affect the Great Lakes region.
- As a class, have students read **4.2 – Frozen Over.** As students are reading, take the opportunity to encourage Q&A about weather in the Great Lakes Basin
- Have students return to their case group:
    - In their groups and without conducting any research, have students think back to the last three years.
    - Students are to discuss and record what they remember about the winter weather conditions in their community over these three years.
    - For example, students should remember whether it was warm or cold, whether there was significant precipitation etc. They are then to do the same for the summer weather conditions. Have students take note of whether any patterns exist and prepare a conclusion that they will share with the class.

INPUT (EXPLORE) — **40 minutes**

- Students will now conduct a weather experiment. This is a group activity.

  - Students will review the National Oceanic and Atmospheric Administration's (NOAA) publication on Great Lakes ice cover. Record the maximum ice coverage for a 10-year period.

  - Students will then select a community in Ontario other than their own. They will make a prediction about whether they think there is a relationship between the amount of Great Lakes ice cover and the average spring and summer weather conditions (e.g. temperature and precipitation).

  - Once they have a hypothesis, students are to visit Environment Canada's Climate Data website to retrieve the weather data for the spring and summer months in their chosen community for the same 10-year period selected previously.

  - For each of the years shown in the NOAA publication, students will calculate the **average** spring and summer temperatures combined (April-September).

  - Students will then calculate the **average** precipitation in the spring and summer for those same years.

  - Students will then describe whether any patterns exist between winter ice cover and the average spring and summer temperatures, followed by whether any patterns exist between winter ice cover and average precipitation for those spring and summer months.

  - **Supporting Teacher Notes:**

    - Specify that the spring and summer months are April – September
    - When visiting Environment Canada's Climate data website, students must use the advanced search option and will have to select a weather monitoring station near their location.
    - Environment Canada climate website: http://climate.weather.gc.ca/index_e.html
    - Click on the "Data" drop down menu at the top right
    - Choose "Advanced Search" and "Search by Proximity"
    - Have student select a city near a Great Lake in Ontario
    - Enter a date range that corresponds to the data that they found for the Great Lakes ice cover data (1975-2014)
    - Search
    - Select the Data Interval (Hourly, Monthly, Daily). Choose Monthly.
    - Note: not all weather stations will have monthly data. Students will have to choose a weather station near the city of their choice that does.
    - Note: not all weather stations will have data for the years of your choice. Students will have to choose a weather station near the city of their choice that does.
    - Once students have selected a weather station, they should press "Go"
    - Students will have to calculate the average temperature for the spring and summer months (April – September) using the Mean Temperature data

    - Example:
      - Average temperature = (April's mean temperature + …) / number of months

      - Average temperature = (2.8 + 15.5 + 18.1 + 21.6 + 19.9 + 13.1) / 6 = 14.8

      - Students will calculate the average precipitation for the spring and summer

months (April – September) using the Total Precipitation data ▪ Remind students that they will be calculating the averages for the chosen year. ▪ Students should know how to calculate averages, and should have an understanding of how to round numbers to 1 decimal place (required / expected pre-knowledge). Students should know what an independent and dependent variable is -	
CONSOLIDATION (REFLECT) - In their groups, students will discuss their findings. For example, were all, some or none of their initial assumptions correct? If so, which ones and why? What surprised them the most? Why?	**15 minutes**
`PRACTICE (APPLY) - Each group will now present this data and findings to the class. - Using a table of values (which can also be created in a spreadsheet), students are to create a well-labelled scatterplot with the ice cover data as the *independent variable* and temperature as their *dependent variable.* - Students will now create a second well-labelled scatterplot with ice cover data as the *independent variable* and precipitation as their *dependent variable*. - Develop a conclusion about whether there is any relationship between winter ice cover on the Great Lakes and the spring/summer weather conditions for their chosen community. Students will support their conclusion with an explanation and come together for a class discussion after this task. - **EXTENSION:** If students have discovered a relationship between winter ice cover and the weather conditions, encourage them to test it to see if it holds true by monitoring the upcoming spring and summer season. - If no relationship exists, have students think about another community in Ontario that they would like to try this experiment on. Have them think about whether the results will be the same or different? They will need to explain and support their hypothesis.	**80 minutes**

Scenario / Topic	Scenario 5 – Great Lakes Stewardship 5.1 – Taking Charge of the Great Lakes
Suggested Timing	5x 40 minutes

OBJECTIVES:

Specific Expectations:

- 1.2 - Assess how various media sources address issues related to the impact of human activities on the long-term sustainability of local, national, or international water systems
- 2.1 - Follow established safety procedures for the use of apparatus and chemicals
- 2.3 - Test water samples for a variety of chemical characteristics
- 2.4 - Use scientific inquiry/research skills to investigate local water issues
- 2.5 - Use technological problem-solving skills to design, build, and test a water system device that performs a practical function or meets a need
- 2.6 - Use appropriate science and technology vocabulary, including water table, aquifer, polar ice-cap, and salinity in oral and written communication
- 2.7 Use a variety of forms to communicate with different audiences and for a variety of purposes

MATERIALS/RESOURCES:

- Case #1 Student Booklet: Scenario 5, Topic 5.1
- Appendix 6 - Brainstorming Blackline Master
- Appendix 8 – Habitat Assessment Template
- Appendix 9 – Generic Action Plan Template
- Duo-tang, folder, binder for students to organize their notes and handouts for this entire unit
- Web access (computer, laptop, mobile device etc)

MINDS ON (FOCUS)	**20 minutes**
- Recall students' prior knowledge about what they learned about weather and climate in the Great Lakes Basin - As a class, start by having students brainstorm a list of organizations and government agencies that currently exist to protect bodies of water or help to increase awareness about managing and utilizing water effectively.. - Continuing with the whole class discussion, have students read **5.1 – Taking Charge of the Great Lakes.** As students are reading, take the opportunity to encourage Q&A about what actions individual students can take to protect the Great Lakes.	

INPUT (EXPLORE)	**40 minutes**
- In groups students will select one of the organizations listed in the scenario and conduct a web search to determine: - Organization vision, - Organization mission - Organization values - Students will outline existing initiatives or their chosen organization and determine how successful they have been in achieving their objectives. (note: have students think about the	

word "success" and its underlying meaning	
CONSOLIDATION (REFLECT) - Students will discuss their findings with their groups and then follow up in a class discussion. For example, students will explain why they thought the organization was successful or unsuccessful at achieving their stated objectives. Would they consider participating or supporting the organization's initiatives? Why or why not? If the students were a member of this organization, what would be the next initiative that they would recommend? Why?	**20 minutes**
`PRACTICE (APPLY) - Students will now assume the role of *Great Lakes Steward* and take charge of the Great Lakes. Each group will now choose **one (1)** of the following activities for their cumulative assessment: i. Visit a body of water connected to the Great Lakes, or the Great Lakes themselves, and conduct a habitat assessment. **Remember to follow the safety rules that are posted in their science classroom!** Students will evaluate the water's ability to support life (e.g. fish, mussels and other lake species). Form conclusions about the health of that water body by discussing the chemical, physical and biological characteristics of the water body. Provide recommendations on how students may solve any issues that students have discovered. ii. Select a local water issue of their choice and have it approved. This issue could be a current issue or a hypothetical issue. For example, an oil spill, decreasing water levels, managing runoff etc. Students are encouraged to be creative, yet scientific. Students are to use the scientific method to accomplish this task. iii. Conduct a simplified environmental assessment of the proposed Island Airport expansion in Toronto. Students will provide pros and cons about the expansion and make final recommendations. Students will justify their recommendations with specific examples. See http://goo.gl/afOTi6 for the format of an environmental assessment. At the Grade 8 level, the simplified environmental assessment should be around 8-10 pages, double spaced (including title, table of contents and references). iv. Create an action plan to address nutrient loading and its contributions to algal blooms in our Great Lakes **v.** Explore the three different types of water well systems that are used in Ontario. Compare and contrast each type, select one that students would recommend to a new home/cottage owner in the Community of _____, explain why and construct a digital or physical model. Encourage groups to present their final product in a medium of their choice (e.g. a report, poster, video, social media campaign etc).	**120 minutes**

Appendices

Teachers will find the following customizable templates on the accompanying USB drive:

1. KWL Chart
2. Mind Mapping Templates
3. Note Taking Charts
4. Map of Ontario
5. Action Plan Template for Reducing Water Footprint
6. Brainstorming Templates
7. The Water Cycle
8. Habitat Assessment Template
9. Generic Action Plan Template
10. Rubric for Assessment and Evaluation
11. Key Terminology (Word Wall)

Open Inquiry Opportunity: Case Study #2

For teachers and students who are comfortable with inquiry-based learning in their classrooms, Case Study #2 provides a unique opportunity for students to learn about five real-world issues that are currently affecting the North American Great Lakes.

Through a digital format, students will discover issues such as:

1. Declining water levels in parts of the Great Lakes Basin
2. The "Dead Zone" in Lake Erie (impact of nutrient loading and algal blooms)
3. The impacts of oil spills on the Great Lakes
4. Road salt application and their effects on the Great Lakes
5. How flooding affects Ontario communities

Using the FERA Learning Cycle, students take on the role of *Great Lakes Stewards* to investigate one of these real-world issues and their political, economic, social, and technological impacts. Students will then use this information to create a final product that represents a possible solution to the problem.

Throughout the learning journey, students will:

- Conduct investigations using primary and secondary data
- Come up with a hypothesis and experiment (i.e. proposed solution / predicted effects)
- Maintain an up-to-date glossary of scientific terminology related to their issue
- Brainstorm and contribute ideas (e.g. think, pair, share)
- Create and present the final solution using multimedia and social media tools

Case Study #2 is available at http://www.greatlakesresource.ca. It can be accessed on any web-enabled device including smart phones, tablets, and desktop and notebook computers.


Great Lakes Teaching
& Learning Resource
Case Study #2