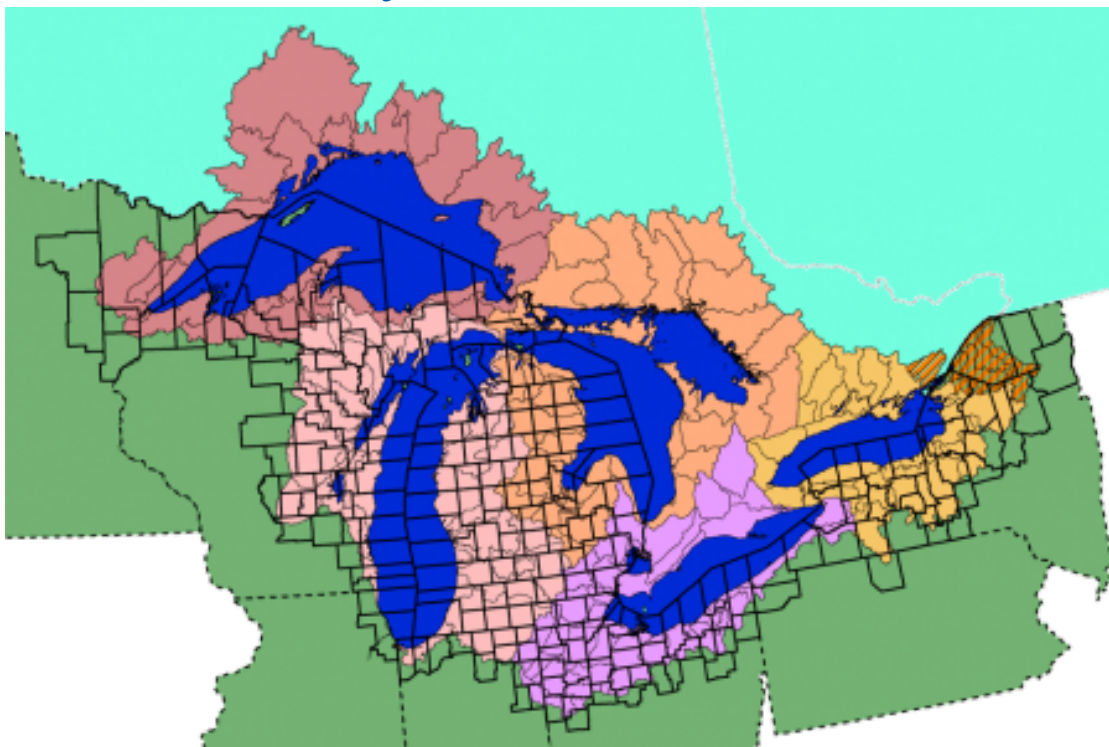


An Exploration of the Great Lakes

*An introductory curriculum to the science and geography
of the Great Lakes*



Gary Abud, Jr.
- Saga Educators, Inc. -

A Curriculum Publication of



Overview of the Collection

Great Lakes Now: An Exploration of the Great Lakes is an introductory curriculum to the science and geography of the Great Lakes. This collection aims to introduce students to basic scientific and geographic concepts about the Great Lakes.

There are 17 lessons in this collection, each aligned to the Next Generation Science Standards and either Common Core standards, Earth Science or SEP standards. The lessons feature a number of interactive or hands-on activities for students to explore such topics as the physical features of the Great Lakes, the interconnectedness of the water system, and the geology and formation of the Great Lakes. Moving away from these majestic lakes themselves, the lessons also explore broader concepts such as watersheds and ancillary bodies of water that are part of the Great Lakes ecosystem, special environments within the Great Lakes region, and examine societal concerns about drinking water quality – both in the lakes and delivered through municipal water systems.

The 17 lessons from this collection can be taught individually or sequenced together as a larger unit on the Great Lakes. Embedded throughout the collection are links to videos produced by Detroit Public Television and Great Lakes Now, as well as a range of other resources that support citizen science and encourage exploration.

1. Meet the Great Lakes

Overview

The purpose of this lesson is to introduce challenges facing the physical and geographic features of the Great Lakes.

Lesson Summary

In this lesson, students will be introduced to physical and geographic features of the Great Lakes, through significant issues facing the Great Lakes, including ecology, water quality and recreation.

By understanding the significance of the issues facing the Great Lakes to many aspects of life for the region in which they are located, students will get a sense of the magnitude of the physical features of the Great Lakes and their importance to the 30 million people in eight U.S. states and two Canadian provinces who live in the Great Lakes region.

The background context that is needed for this lesson is for students to know the basic anatomy of the Great Lakes, including the size, area, amount of water in, and locations of each of the Great Lakes.

This lesson focuses on productive student-to-student discourse and scaffolds students to clarify their own thinking, listen to others, deepen their understanding and think together with classmates. As they do this, they will familiarize themselves with some essential features of the Great Lakes and contemporary issues which will establish a need-to-know basis of importance for learning about the Great Lakes.

ESSENTIAL THEMES	<ul style="list-style-type: none">• Challenges facing the physical and geographic features of the Great Lakes
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS3.A.1: Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.

OBJECTIVES	<input type="checkbox"/> Know key issues facing the Great Lakes and how they relate to physical and geographic features <input type="checkbox"/> Engage in productive academic talk with others
ESTIMATED TIME	❖ 1-2 class periods

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Notebooks and pencils
- Chart paper or a dry erase board and markers

Facilitation Steps

Before starting to facilitate this lesson, create a 4x6 data table to display for the class to see that has the following column labels:

Name of Great Lake	Approximate Size / Surface Area (mi ²)	Approximate Volume of Water (mi ³)	Location (Adjacent States/Provinces)

WARM UP: Begin by asking students to call to mind what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, explaining that they will be filling in the data table together, and make connections to

their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: Data Table: What Do We Know About the Great Lakes?

First, explain to students that they will be making predictions about several features of the Great Lakes and that no one is expected to know these—they are merely predictions. Explain what each category in the data table means and discuss the units for measurement as needed with students.

Next, ask students to work with their partner to see if they can fill in the data table with their predictions, trying to name all five of the Great Lakes and make estimates for each category in the data table for each Great Lake. Give students about five minutes to do this with a partner.

Then, after giving students about five minutes to make their predictions, have volunteers share responses to fill in the data table. Facilitate this part of the discussion by asking the class to use their thumbs to show their level of agreement with each prediction, e.g., “thumbs up” = agree/more; “thumbs down” = disagree/less; “thumbs sideways” = not sure/same amount. Adjust the class predictions to represent the majority before filling in student responses into the data table.

Last, tell students that after the upcoming video, you will reveal the actual values for each category so that they can compare to their predictions. Be sure to make time to come back to this data table at the end of class or as part of the next class period as a warm-up discussion. Information can quickly be found at [the Wikipedia page for the Great Lakes](#).

Optionally, you can assign students the task of looking up the actual values online for each category and extend this activity to the entire class period (and then move Activity 2 to the next class period) or have students look up the values for homework and discuss their responses during the next class period if you wish to do both activities in the same class period.

ACTIVITY 2: Importance of the Great Lakes Video & Discussion

First, explain to students that they are going to be viewing an introductory video about the Great Lakes and some of the important issues facing them. This video will provide some basic information to them and may address some of their KNOWS/WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the [Great Lakes Week video special](#) from Great Lakes Now.

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have students form a group of four to discuss their takeaways from the video using the Conversation Roundtable protocol. In this protocol, students take turns sharing what they wrote for their individual responses to the 4 Notes Summary with their group while each student writes down what they heard the speaker say. Then, each student writes their own “sum it up” statement of their group members’ responses. After the Conversation Roundtable, have a whole-class share out. Choose a few students to each share their summaries from their group discussion aloud with the whole class. After each, ask students to raise hands if what was just shared matches something that came up in their group discussion as well.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write one trivia question about the Great Lakes in multiple choice format.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

2. H.O.M.E.S. For Sale

Overview

The purpose of this lesson is to understand physical and geographic features of the Great Lakes.

Lesson Summary

In this lesson, students deepen their knowledge of physical and geographic features of the Great Lakes by exploring one of the five Great Lakes in depth with a study group and creating a “for sale sign” poster to present to the class for one of the Great Lakes.

They will research features, including the size, area, amount of water, and locations of each, as well as the significance of the Great Lakes to many aspects of life for the region in which they are located. The background context that is needed for this lesson is for students to know the names of the Great Lakes and have been introduced to the Great Lakes basin and basic information about the five Great Lakes and how to make a graphic organizer.

This lesson focuses on students acquiring and synthesizing knowledge that they obtain in their own research and jigsawing their knowledge together with classmates. Expert groups will focus on one of the five Great Lakes, generating a graphic organizer poster about that lake, but all students will gain knowledge of all five lakes through the poster presentations of their classmates.

ESSENTIAL THEMES	<ul style="list-style-type: none">• Physical and geographic features of the Great Lakes
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS3.A.1: Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.→ 5-ESS2-2 Describe and graph the amounts and percentages of water and fresh water in the Great Lakes to provide evidence about the distribution of water on Earth.→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.

OBJECTIVES	<ul style="list-style-type: none"> <input type="checkbox"/> Describe and the essential features about each of the five Great Lakes <input type="checkbox"/> Create a graphic organizer that visually represents the features of one of the five Great Lakes
ESTIMATED TIME	◆ 1 class period

Materials Needed

- Internet access via computers or mobile devices (e.g., tablets, cellphones)
- Notebooks and pencils
- Chart paper or a dry erase board and markers

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY: Create a Graphic Organizer of the Main Features of the Five Great Lakes

First, assign students a number 1-5 to number off into groups until every student has a group number. Inform them that those who are number 1s will explore Lake Huron, number 2s will explore Lake Ontario, number 3s will explore Lake Michigan, number 4s will explore Lake Erie, and number 5s will explore Lake Superior. Have them rearrange themselves to meet with their groups and wait for the next instruction.

Next, inform students that they will be researching their assigned lake and exploring information about the Great Lakes using a variety of online resources. Emphasize to them that the goal of this activity is that they can summarize information about the Great Lakes and represent it visually in a graphic organizer “for sale sign” poster, imagining that they are selling a lake like a home might be listed for sale with information about its main features. The type of graphic organizer (e.g., Venn Diagram, Web Diagram, Matrix, etc.) is up to student choice, but teachers may wish to give

students either examples or templates of graphic organizers to help frame their poster creation. Students will be creating their graphic organizers on a poster to present to the class. All graphic organizers should contain information for the assigned one of the Great Lakes about the following:

- Size/area
- Amount of water, and how this compares to the world's available freshwater
- Location relative to U.S. states and/or Canadian provinces
- Unique geographic features
- Types of representative wildlife found there
- What makes the lake appealing to people

Then, students should be given time to explore and access to the following learning resources to explore as they build their graphic organizers, but may check other sources as needed:

- [Physical Features of the Great Lakes](#)
- [Facts & Figures of the Great Lakes](#)
- [Great Lakes Environmental Atlas](#)
- [Defining the Basin](#)

Last, after the graphic organizers are complete, students should give poster presentations to the whole class, in an effort to “sell” their lake, and share information about their assigned Great Lake to their classmates while students from other groups take notes in their notebooks about all five Great Lakes.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write which lake they would “buy” based on the “for sale sign” posters and explain why.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

3. Lakes Levels Over the Years

Overview

The purpose of this lesson is to understand how the water levels in lakes relate to the water cycle.

Lesson Summary

In this lesson, students will analyze historic lake level patterns of the Great Lakes to learn about one measure of lake health—the level—and how data is monitored over time for a lake.

The background context that is needed for this lesson is for students to know how to interpret and create a data table and graph. They will use that historic data to make a prediction about future lake levels. They should also be familiar with the water cycle and how it relates to the amount of water in bodies of water such as lakes.

This lesson focuses on students collecting data and analyzing trends to make claims based on evidence and reasoning.

ESSENTIAL THEMES	<ul style="list-style-type: none">• Water levels in lakes relate to the water cycle
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS3.A.1: Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.→ SEP7: Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
OBJECTIVES	<ul style="list-style-type: none"><input type="checkbox"/> Identify the water levels in each of the Great Lakes over the past 50 years<input type="checkbox"/> Predict future water levels in the Great Lakes based on historic trends<input type="checkbox"/> Create an argument using a claim, evidence, reasoning framework
ESTIMATED TIME	◆ 1 class period

Materials Needed

- Internet access via computers or mobile devices (e.g., tablets, cellphones)
- Notebooks and pencils
- Chart paper or a dry erase board and markers

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY: Explore Lake Levels

First have students number off 1-5 until all students have a number. Those who are number 1s will explore Lake Huron, number 2s will explore Lake Ontario, number 3s will explore Lake Michigan, number 4s will explore Lake Erie, and number 5s will explore Lake Superior.

Next, explain to students that they will be creating a data table and graph to show historic lake level data for their assigned one of the Great Lakes and use that data to make a prediction about future lake levels. Go over with them the framework for the argument that they will make in claim-evidence-reasoning format. Inform them that they will be creating a poster with their claim, showing their evidence, and providing reasoning behind what they think future lake levels will be.

Then, give students group time to explore historic data of lake levels, and create a summary table or graph for their assigned lake to use in constructing their prediction about future levels. Have students work with their groups to use the [Lake Level Viewer](#) website and create a data table that reports the current level, as well as average levels for 1 year, 5 years, 10 years, and 50 years.

Last, give students time to create a claim-evidence-reasoning poster where they make predictions about future lake levels based on the data. Groups should present their posters to the

class and the teacher should facilitate a discussion within the class during each poster session to ensure that everyone has adequately supported their claims with evidence and reasoning.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write which of the Great Lakes they think has the most concerning lake levels and explain why.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

4. The Great Lakes Watershed

Overview

The purpose of this lesson is to understand what a watershed is and how it relates to the Great Lakes basin.

Lesson Summary

In this lesson, students will model how a watershed works to understand how the Great Lakes basin is a large watershed region.

The background context that is needed for this lesson is for students to know the water cycle and how it relates to precipitation and water accumulation at ground level in water bodies such as lakes and rivers.

This lesson focuses on developing and using models to explain or predict phenomena that may be difficult to directly observe.

Variations of this lesson include individual students building their own model watershed, small groups building a model watershed, or an entire class constructing a larger-scale model watershed as a class investigation.

ESSENTIAL THEMES	<ul style="list-style-type: none">• The Great Lakes basin• What is a watershed and how it works
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS3.A.1: Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.→ SEP3: Develop and/or use a model to predict and/or describe phenomena.→ 5-ESS2-2MI Describe and graph the amounts and percentages of water and fresh water in the Great Lakes to provide evidence about the distribution of water on Earth.→ 2-ESS2-2 MI Develop a model to represent the state of Michigan and the Great Lakes, or a more local land area and water body.

	→ MS-ESS2-4 Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity.
OBJECTIVES	<input type="checkbox"/> Define the basin of the Great Lakes region <input type="checkbox"/> Develop a model to show how a watershed works <input type="checkbox"/> Use a model watershed to explain water distribution in the Great Lakes basin
ESTIMATED TIME	❖ 2 class periods

Materials Needed

- Computers, laptops, or tablets
- Internet access
- 8.5” x 11” cardstock or printer paper
- Markers
- Spray bottles filled with water
- Notebooks and pencils
- Chart paper or a dry erase board and markers
- *Optional: a large plastic trash bag or tarp

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: Learn About the Great Lakes Watershed

First, either distribute copies of, or direct students to view online, the article [Watershed Facts](#)—read the article as a whole class. Have volunteers take turns reading paragraphs of the article aloud and stop after each paragraph to briefly write a sum-it-up statement of what that

paragraph was about. At the end of the article, have the students write a one-sentence recap of the main idea of the article.

Next, explain to students that they are going to be exploring some learning resources with a partner, including animations of watersheds and readings about the Great Lakes watershed. These learning resources will provide some basic information to them and address some of their WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after exploring the learning resources, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Then, have students explore the [Michigan Tech Animation Module on Watersheds](#) with a partner.

Last, students should individually complete a 4 Notes Summary after finishing the module the article and discuss their notes with their partner.

ACTIVITY 2: Build a Model Watershed

First, before beginning this activity, the teacher should decide whether this activity will be done individually, in small groups, or as a whole-class demonstration. The steps are roughly the same for each, but the materials are different. Optionally, the teacher may choose to do a large demonstration of the watershed model first and then have students create their own smaller-scale watershed individually or in groups.

Next, distribute materials students would use to build a model watershed, including paper, markers and spray bottles filled with water. Have students start by taking their piece of paper, crumpling it up, and roughly unfolding it to lay unevenly on their desk top. It should not be flattened or smoothed out. They would then trace the highest points on the paper with marker (as if to illustrate the lines of highest altitude).

Then, students spray water from a spray bottle on the paper to watch the water run off and collect in different areas. They then record and discuss their observations in their notebooks, making a diagram of what is going on in their model watershed.

Last, engage students in a whole-class discussion to go over what they observed, what this means about a watershed, and how this models the Great Lakes basin. Have individual

students/groups share their findings and help students to make connections about the important features of a watershed and how it relates to the Great Lakes watershed.

*Optionally, if doing this activity as a class investigation or demonstration, have students crumble up pieces of paper and put them all on the floor in the middle of the room in a 1-square-meter area. You can add other objects of varying heights in the same area as well. Unfold the trash bag and lay it over the area on top of all the objects. As the bag settles, it will naturally take on a topography with varying altitudes and contours, simulating the geography of a region. Then, have students mark the lines of the bag, which follow paths of high altitude, with markers. Finally, have several student volunteers spray water on the bag to simulate precipitation and observe how the water accumulates, runs off, and collects. Engage students in a whole-class discussion to go over what they observed, what this means about a watershed, and how this models the Great Lakes basin. End by having students write a diagram of the watershed in their notebooks and a summary of how it worked.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write a metaphor to describe what a watershed is and how it works, using a sentence frame such as: “a watershed is like a(n) _____ because _____.”

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his

family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

5. A Digital Expedition Around the Great Lakes

Overview

The purpose of this lesson is to introduce the interconnectedness of the Great Lakes water waterways system.

Lesson Summary

In this lesson, students will act as digital explorers traveling through the Great Lakes using an interactive digital atlas to learn about the interconnectedness of the Great Lakes waterways.

Students will experience the magnitude of the trip that actual explorers once took to enter into the waterway from the Atlantic Ocean and traverse the paths through the five Great Lakes.

Along the way, they will identify different elements of the waterways and appreciate how this expedition relates to travel routes still used to this day. The background context that is needed for this lesson is for students to know how to access and use a digital atlas, such as Google Earth.

This lesson focuses on independent exploration using digital tools. Students will conduct their expedition with a partner and discuss their findings with other classmates. As they do this, they will familiarize themselves with the interconnectedness of the Great Lakes.

ESSENTIAL THEMES	<ul style="list-style-type: none">• Interconnectedness of the Great Lakes waterways
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS3.A.1 Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources.→ 5-ESS2-2. Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.→ SEP2: use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.

OBJECTIVES	<ul style="list-style-type: none"> ❑ Understand the path of waterways that lead from the Atlantic Ocean through the Great Lakes and beyond ❑ Know transportation features of the Great Lakes waterways, including: rivers, canals, locks and bridges. ❑ Use a digital model to simulate travel through the Great Lakes waterways
ESTIMATED TIME	<ul style="list-style-type: none"> ◆ 1 class period

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Student computers, laptops, or tablets
- Google Earth app
- Notebooks and pencils

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY: Exploring the Waterways of the Great Lakes

First, explain to students that they are going to be viewing an introductory video about the waterways of the Great Lakes. This video will provide some basic information to them and address some of their WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)

- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the video [Who Owns the Water of the Great Lakes?](#) to the whole class.

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have students work in partners on Google Earth to map out the path(s) of travel through the Great Lakes waterways on several expeditions. Have them complete at least three expeditions of their choice (e.g., one starting destination and one final destination) from the menu of destinations. They must complete at least one expedition that takes them through all five Great Lakes in a single trip. As they complete each expedition, they should sketch out and label the path they took in their notebook, listing the bodies of water they had to travel through in order to complete the expedition.

Destinations:

- New York City, NY, USA
- Quebec City, QC, Canada
- Detroit, MI, USA
- Green Bay, WI, USA
- Niagara Falls, ON, Canada
- Chicago, IL, USA
- Duluth, MN, USA
- Thunder Bay, ON, Canada
- Cleveland, OH, USA
- *The Great Loop (USA & Canada)

*Bonus: Explore a trip through what is known as the Great Loop, an expedition through the Great Lakes waterways that lead to the gulf of Mexico and incorporates the eastern coastline of the U.S. through the Atlantic ocean. Destinations in this loop might include St. Louis, MO, USA, New Orleans, LA, USA, and Miami, FL, USA. Additional resources to consult, which may be helpful to make this expedition include: [America's Great Loop](#) and [NOAA Facts About the Great Loop](#).

After the activity, have one or two groups share out about one of their expeditions.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students submit one of their expedition map sketches and waterway lists.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

6. Water Beyond the Lakes

Overview

The purpose of this lesson is to understand the interconnectedness of the Great Lakes water waterways system.

Lesson Summary

In this lesson, students will investigate various features of the Great Lakes basin, including an exploration of groundwater, ancillary bodies of water—such as estuaries, rivers, falls and locks—and how ice cover in winter affects the Great Lakes. This lesson sets up several learning stations with a variety of multimedia content for students to read, watch, and explore.

The background context that is needed for this lesson is for students to know that the Great Lakes waterway is one continuously connected system of bodies of water. There are eight station rotation activities for students to explore in groups.

This lesson should be spread out over two class periods. *Complete the WARM UP and LAUNCH steps on the first day only and complete the SYNTHESIS, COOL DOWN, and CLOSURE on day two only. On each day, the same exit ticket should be given to all students.

ESSENTIAL THEMES	<ul style="list-style-type: none">• Interconnectedness of the Great Lakes waterways
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS3.A.1 Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources.→ 5-ESS2-2. Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.
OBJECTIVES	<ul style="list-style-type: none"><input type="checkbox"/> Analyze the flow of water through the Great Lakes, including surface features like lakes, streams, rivers, wetlands, and groundwater<input type="checkbox"/> Use a historic data to predict future levels of ice coverage

	<ul style="list-style-type: none"> <input type="checkbox"/> Understand problems facing the Great Lakes water and possible solutions to them <input type="checkbox"/> Understand the structure and function of locks and waterfalls
ESTIMATED TIME	◆ 2 class periods

Materials Needed

- Internet browser with access to YouTube
- Student computers, laptops, or tablets
- Notebooks and pencils

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY: Exploration Station Rotation

Create seven groups by numbering students off 1 - 8 until all students have a number. The number that they are assigned indicates the station where they will begin exploring. Depending on the length of class periods, the teacher should assign an amount of time for students to complete each station (at least 10 minutes) and divide up the stations over two class periods. Give an overview of what each station is and where it will be located in the classroom. Let students know that after time is called, they will rotate to the next station with their group until they have visited each station. If they do not finish the task at a station, they should be given additional time on day two to revisit that station and complete the task.

Station 1: Investigating Groundwater and Related Issues

Task: Describe what groundwater is and what the biggest threat to it might be in the Great Lakes region?

Learning resources to explore:

- Read the article [Groundwater the 6th Great Lake](#)
-

Station 2: Map Out Water Flow Through the Great Lakes

Task: Create a flowchart showing how water travels through the Great Lakes waterways

Learning resources to explore:

- Use the [US Army Corps of Engineers Great Lakes Pathway Appendix D](#) to examine the diagram of water flow through the Great Lakes on page D-4
 - [Great Lakes Water Flow Animation](#) from Michigan Tech
-

Station 3: Learn About Estuaries

Task: List the regions of the Great Lakes where estuaries are most and least likely to be found and explain the evidence and reasoning behind your claims.

Learning resources to explore:

- Watch this NOAA video: [What is an Estuary?](#)
-

Station 4: Learn About Locks

Task: Create a table that lists the regions of the Great Lakes where locks are located, the name of the locks, and the function they serve at each location.

Learning resources to explore:

- Watch this Destination Michigan Video from PBS on [the Soo Locks](#)
 - U.S. Army Corps of Engineers [Animation](#) of the Soo Locks
-

Station 5: Niagara Falls

Task: Create an annotated map labeling the flow of water through the Great Lakes waterway as it passes through Niagara Falls, and note at least five geographic facts about the falls, using an online tool such as [Scribble Maps](#).

Learning resources to explore:

- [Geological Facts and Figures of Niagara Falls](#) from the Niagara Parks
- Niagara Falls [FAQ](#) from NY Falls

Station 6: Investigate Ice Cover Data for the Great Lakes

Task: Compare ice coverage data over time to determine patterns and predict future coverage. Identify historical data milestones (e.g., highest %, lowest %, long-term average) and predict levels five years and ten years into the future. Write a claim-evidence-reasoning response about your predictions.

Learning resources to explore:

- [Ice Coverage Data Sheet](#) from the Great Lakes Environmental Research Laboratory

Station 7: Breaking Up Ice Coverage on the Great Lakes

Task: Write a one-paragraph summary of how ice breaking works and helps with ice coverage on the Great Lakes.

Learning resources to explore:

- Video on how ice breaking is carried out on the Great Lakes from [PBS NewsHour](#)

Station 8: Dealing With Sewage

Tasks: Create a summary flowchart that explains how wastewater is handled in the Great Lakes and write 1-2 sentences explaining what most surprised you about the interview.

Learning resources to explore:

- Wastewater Management [Animation from Michigan Tech](#)
- Read the Great Lakes Now [interview with Milwaukee's Sewage Executive, Kevin Shafer](#)

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students describe which station rotation activity was the most interesting to them and explain why.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

7. Great Lakes Ecosystems

Overview

The purpose of this lesson is to explore the environments and ecosystems of the Great Lakes region.

Lesson Summary

In this lesson, students will investigate various environments of the Great Lakes, including an exploration of flora and fauna unique to the region.

They will engage in a jigsaw reading to introduce them to some of the regional environments and then work with a partner to further explore some of the most common ecosystems.

An optional extension activity exists for this lesson to help students further learn about the flora and fauna that they encounter in their learning about the various ecosystems.

ESSENTIAL THEMES	<ul style="list-style-type: none">• Environments and Ecosystems of the Great Lakes Region
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS3.A.1 Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources.→ 5-ESS2.C.3 Nearly all of Earth’s available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.→ MS-LS2-1-MI: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.→ MS-LS1-6: Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

	→ MS-LS2-4: Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological components of an ecosystem can lead to shifts in all its populations.
OBJECTIVES	<input type="checkbox"/> Know the coastal habitats of the Great Lakes <input type="checkbox"/> Understand the ways in which ecosystems are important for life in the Great Lakes region <input type="checkbox"/> Know the four types of wetlands <input type="checkbox"/> Understand how streams differ from rivers
ESTIMATED TIME	◆ 1 class period

Materials Needed

- Video projection monitor or screen/speakers
- Internet browser
- Student computers, laptops, or tablets
- Notebooks and pencils

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: Jigsaw the Coastal Habitats of the Great Lakes Basin

In this activity, students will conduct a jigsaw reading of the coastal habitats of the Great Lakes Basin using [an article from Michigan Sea Grant](#). Before beginning, display the following [diagram from Michigan Tech](#) to remind students of the big picture of the region we are talking about when we learn about and discuss the ecosystems of the Great Lakes.

First, have students number off 1-6 until all students are assigned a number. Students should meet with their assigned-numbered classmates in an expert group to read and discuss the information from the [Michigan Sea Grant](#) article. Each group should read, discuss, and craft a written summary of the information in their section to present to their classmates later in jigsaw groups. Students in group number 1 will be assigned beaches, group 2 will have sand dunes, group 3 will have islands, group 4 will have lakeplain prairies, group 5 will have coastal wetlands, and group 6 will have open water.

Next, give expert groups time to familiarize themselves with their topic and create a summary that they each can take back to their jigsaw groups.

Then, have students leave their expert groups and form jigsaw groups (e.g., a group comprised of one member of each expert group). Here, each student from the different expert groups will take turns teaching their jigsaw group about the coastal habitat they learned about in their expert group while their group members take notes and ask questions.

Last, give groups time for each jigsaw member to share about their habitat. Each student should write down one thing they liked/learned from their jigsaw group after everyone has shared.

ACTIVITY 2: Wetlands

First, show the NOAA video about [wetlands](#) to the whole class.

Next, give students time with partners to explore the [Wetland Ecosystems](#) animations to understand further aspects of how these ecosystems function. If students need further resources to explore wetlands, they can also view these short videos from PBS:

1. [A Wetland Science Trek](#)
2. [The Varied Importance of Wetlands](#)
3. [The Value of Wetlands](#)

Then, have students create a summary table of the four types of wetlands, including key features, one type of flora, and one type of fauna supported by each.

Last, have 1 group share out something they wrote for each type of wetland.

ACTIVITY 3: Rivers and Streams

First, view and read aloud the Background Information provided in this [Fish Life Cycle](#) lesson from Michigan Sea Grant to the whole class.

Next, give students time with partners to explore the [River and Stream Ecosystems](#) animations to understand further aspects of how these ecosystems function.

Then, have students create a summary table of these aquatic ecosystems and key differences between rivers and streams.

Last, have 1 group share out something they wrote for each type of wetland.

ACTIVITY 4 (OPTIONAL): Flora and Fauna of the Great Lakes Region

This could be used as an extension activity or opportunity for learning beyond the school day. Students research one type of flora and fauna found in one of the ecosystems that students learned about in the earlier activities using the National Wildlife Federation's [Wildlife Guide](#) and create an infographic about the two species.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students describe which species they learned about was most interesting to them.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to

love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

8. Great Lakes Regional Meteorology

Overview

The purpose of this lesson is to introduce the relationship that the Great Lakes have with the weather and climate of the Great Lakes region.

Lesson Summary

In this lesson, students will become familiar with some of the unique meteorology of the Great Lakes region in terms of weather and climate.

They will investigate the impact that summer precipitation has in the region, with an emphasis on storm water, and conclude by looking at effects and influences of climate change on the region.

The background context that is needed for this lesson is for students to know basic meteorology terminology and concepts.

ESSENTIAL THEMES	<ul style="list-style-type: none">● Climate and Weather in the Region Are Related to the Great Lakes
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.→ MS-LS1-6: Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.→ MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.→ MS-ESS2-5-MI: Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions in Michigan due to the Great Lakes and regional geography.

	<p>→ HS-ESS2-5: Conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</p> <p>→ SEP2: use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.</p>
OBJECTIVES	<ul style="list-style-type: none"> <input type="checkbox"/> Know the difference between weather and climate <input type="checkbox"/> Understand the ways in which Great Lakes influence weather and climate of the region <input type="checkbox"/> Understand the problems that changing climate has on the Great Lakes region <input type="checkbox"/> Know the impact of stormwater runoff
ESTIMATED TIME	<p>◆ 1 class period</p>

Materials Needed

- Video projection monitor or screen/speakers
- Internet browser
- Student computers, laptops, or tablets
- Notebooks and pencils

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: Understanding the Difference Between Weather & Climate

First, show students the animations and satellite images of [Summer & Winter Weather](#) from the University of Wisconsin-Madison and have a volunteer read the text aloud to the class. Ask students what they notice about the satellite images in relation to what the text says.

Next, show students the animations and satellite images of [Spring & Fall Weather](#) from the University of Wisconsin-Madison and have a volunteer read the text aloud to the class. Ask students what they notice about the satellite images in relation to what the text says.

Then, show the video [Weather v. Climate](#) from PBS. Tell students that their goal in watching this video is to learn key differences between weather and climate.

Last, give students time to generate a chart listing the different features of the weather and climate in the Great Lakes region.

ACTIVITY 2: Storm Water Runoff

First, direct students' attention to the significance of precipitation in the Great Lakes region that they just learned about in the first activity. Call their attention specifically to the seasonal weather that would produce high amounts of liquid precipitation accumulation on the ground. Ask them to consider what the impact of large amounts of storm water runoff would have in the region and elicit 1-2 student responses.

Next, introduce students to the 4 Notes Summary protocol that they will use after they read the upcoming article on storm water runoff, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Then, distribute, or direct students to view online, the article [Stormwater Runoff Awareness](#) from Michigan Sea Grant and give them time to read the article individually and annotate the article as they read to take notes about it.

Last, have students create a 4 Notes Summary on the article.

ACTIVITY 3: Confronting Climate Change

First, pair students up and have them share one of their responses to the 4 Notes Summary from the storm water runoff article.

Next, distribute, or direct students to view online, the article [Confronting Climate Change in the Great Lakes Region](#) and give them a chance to read, review, and discuss it with their partners.

Then, have students create a summary of what they think is the most significant influence (e.g., more/less water,) implication, and impact.

Last, ask students to determine which of the factors associated with climate change in the Great Lakes Region they think would be most easily addressable and what a possible solution might be.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students describe a possible solution they generated for confronting climate change.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to

love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

9. [Debate]: Which of the Five Great Lakes Is Best?

Overview

The purpose of this lesson is to synthesize student understanding of important characteristics of the five Great Lakes, and to debate competing ideas based on claims, evidence and reasoning.

Lesson Summary

In this lesson, students will synthesize learning about the five Great Lakes and apply their knowledge to engage in a debate about which of the Great Lakes is the best lake.

This lesson builds on prior knowledge, which is required background context for students to have prior, of the physical and geographic features of the lakes, the interconnectedness of the lakes, and the environments and meteorology of the region. They will conduct further research one particular lake and construct an argument for why their lake is the best of the Great Lakes.

This lesson has students utilize a claim-evidence-reasoning framework for their position. Teachers can choose to run this lesson as a traditional debate with representatives from each of the five great lakes presenting in front of the class, who then vote on a winner, or teachers may have students give individual presentations on their lake and a winner need not be selected.

This lesson would happen over a period of several days with some of the time allotted to research and development of presentations, but then time should also be allocated for presentations. Students should each create a visual aid to support their position when they give their presentations.

ESSENTIAL THEMES	<ul style="list-style-type: none">• Characteristics of the Five Great Lakes• Scientists debate competing ideas based on claims, evidence and reasoning, and present ideas to groups
NEXT GENERATION SCIENCE STANDARDS	→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.

	<p>→ MS-LS1-6: Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</p> <p>→ SEP7: Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.</p>
OBJECTIVES	<ul style="list-style-type: none"> <input type="checkbox"/> Know the similarities and differences between the five Great Lakes <input type="checkbox"/> Integrate knowledge of several features of a lake into a comprehensive profile of it <input type="checkbox"/> Construct an argument in favor of a position and support your claim with evidence and reasoning
ESTIMATED TIME	<p>◆ 2-3 class periods</p>

Materials Needed

- Video projection monitor or screen/speakers
- Internet browser
- Student computers, laptops, or tablets
- Notebooks and pencils

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY: Debating Which Lake is the Best of the Five Great Lakes

Inform students that they will be assigned one of the five Great Lakes on which to research and develop a position and argument in a debate. Further explain that the format of their argument should be structured as a “top 5 reasons why” model, in which they should have five key points to frame their argument and support their position. Each of their claims should be backed by evidence and explained using reasoning.

Next, assign students a number 1-5 to number off until every student has a number. Inform them that those who are number 1s will explore Lake Huron, number 2s will explore Lake Ontario, number 3s will explore Lake Michigan, number 4s will explore Lake Erie, and number 5s will explore Lake Superior. Students may choose to work individually or with a partner of the same number to complete this project.

Then, give students and groups time in class to utilize their existing notes and materials, as well as conduct additional research, on the lake they’re assigned. They should have the opportunity to develop a top 5 reasons list in support of their lake, as well as compiling comparison data to the other lakes, e.g., size of their lake compared to others, in preparation for the debate. Finally, they should prepare a visual aid to support their argument for which lake is best, e.g., presentation slide deck or an infographic.

Learning resources for each lake that students can use in their additional research include:

From Michigan Sea Grant:

- [Superior](#)
- [Michigan](#)
- [Erie](#)
- [Huron](#)
- [Ontario](#)

From the Environmental Protection Agency:

- [Superior](#)
- [Michigan](#)
- [Huron](#)
- [Erie](#)
- [Ontario](#)

Last, students should present their projects to the class according to the debate format the teacher should choose to follow (e.g., traditional head-to-head debate or individual presentations.)

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students describe which lake they now think is the best, whether that is the one they were assigned or not, and give their top reason why.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

10. Loading...4.54 Billion Years

Overview

The purpose of this lesson is to introduce students to traditional geologic timeline, and geologic history of the earth, so that they can contextualize the glacial activity that led to the formation of the Great Lakes within that timeline.

Lesson Summary

In this lesson, students will be introduced to the geologic time scale and a brief history of geologic time.

The purpose of introducing this context is for students to understand the position in the history of the formation of the Great Lakes with respect to geologic time. This lesson sets the stage for learning about the glacial impact on the formation of the Great Lakes region.

Students will learn about the geologic time scale and geologic history together as a whole class during a video and discussion, but then create a model of the geologic time scale using ticker-tape style paper.

ESSENTIAL THEMES	<ul style="list-style-type: none">• The geologic timeline and geologic history of the earth
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.→ HS-ESS2.A.4: The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.→ SEP2: Develop and/or use a model to predict and/or describe phenomena.→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that

	contained in media and visual displays to clarify claims and findings.
OBJECTIVES	<input type="checkbox"/> Know the geologic time scale and major events in geologic history <input type="checkbox"/> Create a model of geologic history using a time scale
ESTIMATED TIME	◆ 1 class period

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Notebooks and pencils
- Scissors
- Rolls of paper that can be cut into 4” wide strips of varying length

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: A Brief History of Geologic Time

First, explain to students that they are going to be viewing an introductory video about the geologic timeline. This video will provide some basic information to them and address some of their WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmmm... (something that left them thinking afterward)

- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the video [Brief History of Geologic Time](#) from PBS to the whole class.

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have students form a group of four to discuss their takeaways from the video using the Conversation Roundtable protocol. In this protocol, students take turns sharing what they wrote for their individual responses to the 4 Notes Summary with their group while each student writes down what they heard the speaker say. Then, each student writes their own “sum it up” statement of their group members’ responses. After the Conversation Roundtable, have a whole-class share out. Choose a few students to each share their summaries from their group discussion aloud with the whole class. After each, ask students to raise hands if what was just shared matches something that came up in their group discussion as well.

ACTIVITY 2: Create a Geologic Timeline

*Note: there are two variations of this activity. One variation is done digitally using a web-based timeline tool. The second variation would be to use strips of paper and to draw out the timeline. Both versions of the activity provide meaningful learning opportunities for students and the steps are essentially the same.

First, students will work with their Conversation Roundtable groups from the previous activity. Have them identify the major events on the geologic timeline and determine how far apart each event is in years.

Next, show students how to scale the years of the geologic timeline to a physical distance, e.g., centimeters, by giving them a conversion factor and doing one example of a unit conversation together.

Then, allow students to determine how far apart in physical distance each of the events would be. Support students as needed with the calculations involved.

Last, give students supplies to make a paper timeline where they label the geologic timeline on the paper according to the scale they determined. Once students have finished their timelines, inform them of the timing of the formation of the Great Lakes, which began approximately 14,000 years ago at the end of the last glacial period, and have them mark that event on their timelines.

*Alternatively, if using the digital version. Students would still do the calculations to convert time to a physical distance, but they would then proceed to create a digital model of the geologic timeline indicating the events using a web-based tool like [Google Sheets](#) (tip: consider using the Gantt chart template).

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write what surprised them most from this lesson.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

11. All About Glaciers

Overview

The purpose of this lesson is to introduce students to how Glacier movement physically affects land, shaping and changing landforms over time.

Lesson Summary

In this lesson, students will become familiar with glaciers, how they form, move, and shape the land.

The purpose of introducing glaciers is to prepare students for an in-depth understanding of the formation of the Great Lakes. This lesson sets the stage for learning about how glaciers carved out the Great Lakes basin and then filled them with ice melt as the glaciers retreated.

The background context needed for this lesson is to understand the geologic timing of the last glacial period. Students will be able to explain what happens to the surface of the Earth when glaciers move or an ice sheet is removed.

ESSENTIAL THEMES	<ul style="list-style-type: none">• Glaciers move and shape the land
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.→ HS-ESS2.A.4: The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun’s energy output or Earth’s orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.→ SEP2: Develop and/or use a model to predict and/or describe phenomena.→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that

	contained in media and visual displays to clarify claims and findings.
OBJECTIVES	<input type="checkbox"/> Know the way in which glaciers move, shape the land, and what happens when they retreat <input type="checkbox"/> Create a model of glacial deposition
ESTIMATED TIME	◆ 1 class period

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Notebooks and pencils
- Ice cubes
- Beakers filled with liquid water
- Plastic or metal specimen trays

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: Where Does Melting Ice Go?

First, explain to students that you will be modeling glacial ice melt during class, but in order for it to have time to proceed, it needs to be set up first, then given some time, and revisited later. So, inform them that you will set up a demonstration in front of the class, watch a couple of videos and discuss them, and then return to the demonstration later.

Next, set up the demonstration by placing a beaker filled with water and ice to the point that it is as full as possible (ideally, ice should be visible above the plane of the rim of the beaker) inside of a tray. Explain to students that you are modeling the melting of ice that would take place in a glacier. Have them draw a diagram of what they observe at the start of this demonstration and make a prediction about what will happen to the water in the beaker system as the ice melts.

— *After the videos are watched and Activity 2 is completed* —

Then, revisit the demonstration and have students make and discuss observations with a partner, diagram what they observe, and comment on whether their prediction is supported or not by the evidence.

Last, have students share and discuss their individual ideas with the entire class and help them make connections between observations and ideas until they understand that the water stays in the beaker system after melting. Have them write a summary statement about what this might imply about glaciers as they melt.

ACTIVITY 2: How Glaciers Move and Shape the Landscape

First, explain to students that they are going to be viewing three videos about glaciers and how glaciers shape the land. These videos will provide some basic information to them and address some of their WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the following videos to the class, asking a couple of students to share their reactions after each video:

1. [How do Glaciers Move](#) from PBS
2. [Mother Nature in Charge](#) from PBS
3. [How The Ohio River Was Formed](#) from PBS

Then, after the videos ask students to describe in their own words how glaciers shape the land. They can turn and talk with a partner to discuss or write individually and discuss ideas as a whole class.

Last, after all videos, have students record in their notebooks a 4 Notes Summary about their combined learning from the videos.

ACTIVITY 3 (OPTIONAL): Digital Lab Experiment — Glacial Erosion

In this extension activity, which can be used as a digital lab experiment in follow up to the lesson activities (possibly on a second day or as learning beyond the school day,) students complete the [PhET Simulation on Glacial Erosion](#) to further explore how glaciers move, change, and shape landforms.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write an “I used to think...” / “Now I think...” protocol about the demonstration experiment they observed.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

12. Formation of the Great Lakes

Overview

The purpose of this lesson is to understand how glacial movement and retreat shaped the Great Lakes landscape.

Lesson Summary

In this lesson, students will understand the particular impact that glaciers had in forming the Great Lakes by carving out the basin and filling the waterways with ice melt as they retreated over 10,000 years ago.

Students will engage with multimedia content, class discussion, and create a storyboard to tell the progression of events in the formation of the lakes based on background context and prior knowledge of how glaciers move and shape the landscape.

ESSENTIAL THEMES	<ul style="list-style-type: none">● Glacier movement and retreat shaped the Great Lakes landscape
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.→ HS-ESS2.A.4: The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun’s energy output or Earth’s orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.→ MS-ESS3.A.1: Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

	<p>→ MS-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distribution of Earth’s mineral, energy, and groundwater resources are the result of past and current geoscience processes.</p> <p>→ SEP4: Analyze and interpret data to provide evidence for phenomena.</p>
OBJECTIVES	<ul style="list-style-type: none"> <input type="checkbox"/> Know the events that led to the formation of the Great Lakes <input type="checkbox"/> Understand the evidence for glacial formation of the Great Lakes <input type="checkbox"/> Create a visual representation of the events in the formation of the Great Lakes
ESTIMATED TIME	<p>❖ 1-2 class periods</p>

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Notebooks and pencils
- Computers, laptops or tablets

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: The Big Picture of Great Lakes Formation

First, explain to students that they are going to be viewing a video about the glacial formation of Lake Erie. This video will help them make connections between their knowledge of glaciers and the formation of the Great Lakes, as well as address some of their WONDERS from the warm up.

Introduce students to the 4 Notes Summary protocol that they will use after the videos are complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the video [Lake Erie: From Glacier to Great Lake](#) PBS to the whole class. After the video ask a couple of students to share reactions to the video.

Then, ask students to turn and talk with a partner in response to the following prompt: “How do you think glacial formation compared when glaciers formed the other four of the Great Lakes?”

Last, after the video and discussion, have students record in their notebooks a 4 Notes Summary about their combined learning from the two activities.

ACTIVITY 2: What Does Bathymetry Data Tell Us About the Formation of the Great Lakes?

First, review with students some background context about glaciation to set the stage for the lesson. This [summary from Michigan Tech](#) provides a good summary of the key highlights. Display the webpage and have a student read the summary aloud to the whole class as everyone reads along and examines the images.

Next, inform students that they are going to analyze lake bed measurements, known as bathymetry data, for each lake and use that to appreciate the exact shapes that glaciers carved out for each of the Great Lakes as they moved.

Then, give students time to review [the bathymetry data for each of the Great Lakes](#).

Last, have them jot down the largest depth of each lake in a summary table from the data.

ACTIVITY 3: Wisconsin Sea Grant Article, Discussion and Storyboard

First, distribute copies of, or direct students to view online, the article [How They Were Made](#) from the Wisconsin Sea Grant and give them time to read the article individually and annotate the article as they read to take notes about it.

Teaching Tip: During this lesson, have students focus only on the first two paragraphs of the article, which directly speak to the formation of the lakes,

and save the rest of the article for a separate lesson about the modern significance of the lakes.

Next, discuss the article with the whole class, beginning by asking them what were some of the annotations they made as they read.

Then, help students to make connections between this article and what they've been learning about glaciation and the formation of the Great Lakes.

Last, ask them how they could use the information in this article to make a storyboard to show the key events and timeline in the formation of the Great Lakes. Give them time to map out the major events of the formation of the Great Lakes in four main process "steps," using a *first-next-then-last framework* to storyboard. Have students share their storyboards with a partner and discuss them, before asking 1-2 students to share their storyboards with the whole class.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students submit their storyboards for the formation of the Great Lakes.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to

love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

13. Historic Significance of the Lakes

Overview

The purpose of this lesson is to understand some of the significant contributions and historical legacies the Great Lakes have been part of over time in North America.

Lesson Summary

In this lesson, students will be introduced to the ways in which people encounter the Great Lakes as they explore some of the history of the Great Lakes, including how local people groups regard the waters, how New World explorers from Europe traveled the Great Lakes waterways, and how the Great Lakes are a source of commercial transport.

While there are numerous historically significant events tied to the Great Lakes waterways, a few representative categories are the focus of this lesson. Students will engage with multimedia content and apply their learning to create infocards about the historical significance of the Great Lakes.

The background context needed for this lesson is the geographic features and the locations of the main waterway elements of the Great Lakes.

This lesson should be spread out over two class periods. *Complete the WARM UP and LAUNCH steps on the first day only and complete the SYNTHESIS, COOL DOWN, and CLOSURE on day two only. On each day, the same exit ticket should be given to all students.

ESSENTIAL THEMES	<ul style="list-style-type: none">• The Great Lakes are a region of historic significance
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.→ MS-ESS3.A.1 Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

	→ SEP4: Analyze and interpret data to provide evidence for phenomena.
OBJECTIVES	<input type="checkbox"/> Know historically significant events associated with the Great Lakes <input type="checkbox"/> Understand the perspective of people groups about the waterways in the Great Lakes as culturally significant <input type="checkbox"/> Summarize key facts about the historical significance of the Great Lakes
ESTIMATED TIME	◆ 2 class periods

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Notebooks and pencils
- Computers, laptops or tablets with access to Quizlet.com or the Quizlet app

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: The Seven Generation River

First, explain to students that they are going to be viewing a documentary about a small band of Native Americans nestled into the southwest corner of the Great Lakes called the Pokagon. This video will provide some basic information to them and address some of their WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the video [7 Generation River](#) Great Lakes Now to the whole class. Pause the video about every 8 minutes, at a natural pausing point, and ask for one or two students to respond to the prompt: “what do we notice is going on here?” Then play the video and continue the next segment.

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have students form a group of four to discuss their takeaways from the video using the Conversation Roundtable protocol. In this protocol, students take turns sharing what they wrote for their individual responses to the 4 Notes Summary with their group while each student writes down what they heard the speaker say. Then, each student writes their own “sum it up” statement of their group members’ responses. After the Conversation Roundtable, have a whole-class share out. Choose a few students to each share their summaries from their group discussion aloud with the whole class. After each, ask students to raise hands if what was just shared matches something that came up in their group discussion as well.

ACTIVITY 2: Learning Station Rotation — Historical Significance

Station 1: Explorers Through the Great Lakes

Task: Describe what each explorer had in common between them in terms of how they encountered Great Lakes.

Learning resources to explore:

- Watch the video about [Samuel de Champlain](#) from PBS
- Watch the video about [Louis Jolliet & Jacques Marquette](#) from PBS
- Watch the video about [René-Robert Cavalier de La Salle](#) from PBS

Station 2: Map Out Water Flow Through the Great Lakes

Task: Explain why the Great Lakes had an important role to play in Midwest fur trading.

Learning resources to explore:

- Investigate how the Great Lakes played a role in [Fur Trading With Midwest Native Americans](#)
-

Station 3: Maritime History

Task: List the regions of the Great Lakes where estuaries are most and least likely to be found and explain the evidence and reasoning behind your claims.

Learning resources to explore:

- Explore the [Maritime History of the Great Lakes](#)
-

ACTIVITY 3: Did You Know? Fact Cards

In this activity, students will integrate learning from the prior activities in this lesson to create a flashcard set on Quizlet of Did You Know? facts about the historical significance of the Great Lakes.

First, have students decide what facts they will make into Did You Know? cards and list them out in their notebooks.

Next, have students create a Quizlet flashcard set of their Did You Know? Cards.

Then, have students share their Quizlet sets with the teacher.

Last, have students test out their Quizlet flashcard sets with a partner, by trading and quizzing themselves on their partner's set of Did You Know? cards.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now

- 1 question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write one thing they were left wondering at the end of class.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

14. How Fresh Are the Great Lakes?

Overview

The purpose of this lesson is to realize the historic significance of the Great Lakes as a major source of freshwater and the importance of maintaining and sustaining the supply of freshwater.

Lesson Summary

In this lesson, students will continue examining the historic significance of the Great Lakes by focusing on one of the key ways that people encounter the Great Lakes—as a source of freshwater.

Students will connect with the importance of freshwater through a hands-on activity and learn about the Great Lakes as a source of freshwater.

This lesson includes a lab experiment and should be spread out over two class periods.

*Complete the WARM UP and LAUNCH steps on the first day only and complete the SYNTHESIS, COOL DOWN, and CLOSURE on day two only. On each day, the same exit ticket should be given to all students.

ESSENTIAL THEMES	<ul style="list-style-type: none">• The Great Lakes are a major source of freshwater
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.→ MS-ESS3.A.1: Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.→ MS-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distribution of Earth’s mineral, energy, and groundwater resources are the result of past and current geoscience processes.→ SEP4: Analyze and interpret data to provide evidence for phenomena.
OBJECTIVES	<ul style="list-style-type: none">☐ Know where freshwater comes from and how it gets there

	<input type="checkbox"/> Understand the importance of protecting freshwater resources <input type="checkbox"/> Identify contemporary issues that threaten freshwater resources
ESTIMATED TIME	◆ 2 class periods

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Notebooks and pencils
- Computers, laptops or tablets
- Chart paper or dry erase boards and markers
- 500mL Beakers
- Glass stirring rods
- Scoopulas
- Filter paper
- Oil (e.g., inedible oil, such as motor oil)
- Small pieces of trash
- Travel size bottles of personal care products (shampoo, conditioner, lotion, etc.)
- Heat source (e.g., hot plate or open-flame burner)
- Iron filings
- Magnets
- Peppercorns or poppy seeds
- Sand
- Funnel
- Filter paper
- Sodium Chloride

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: Freshwater Quality Lab

Pre-Lab: [How Much Do You Know About Freshwater](#)

In this pre-lab task, students will be taking a quiz about freshwater, predicting their score on a percentage scale before taking the quiz, and writing a 1-2 sentence reflection on their actual score after taking the quiz. They should take the [National Geographic quiz](#) individually to see how much they already know. As for a “show of thumbs” about how students did on the quiz compared to how they thought they would do: thumbs up (better); thumbs down (worse); thumbs sideways (as expected.) Once the quiz is completed, proceed to the lab experiment steps

In this lab, students will recognize the impact that pollution has on freshwater resources and realize that what may seem like harmless practices do in fact have harmful effects. They will also generate a system for water treatment to model a solution for the freshwater pollution problem. This lab has two parts, the supplies for which should be set up ahead of time so that after part one is completed as a whole class, part two can be started right away with lab groups.

Lab Part 1) Would You Drink It, Bathe In It, or Swim In It?

First, set up 8 stations in the classroom. At each station place a beaker half-filled with clean water. Beside the beaker, have samples of the personal care products, pieces of trash, oil, etc. (e.g., pollutants) in easy-to-dispense containers. The whole class will be rotating through the stations simultaneously from teacher-directed cues and instructions.

Next, number students off 1-8 into lab groups until every student has a group and have them report with their group to one of the stations. In their lab notebooks, have students record how likely they would be to drink, bathe, or swim in the water in the beaker on a scale of (least) 1 - 5 (most). Ask a show of fingers that represents the number they rated for themselves with the clean water in the beaker. Inform them that this beaker represents the available freshwater that we have in the Great Lakes.

Then, instruct students to add some of one type of “pollutant” to the beaker at their station. After they have done so, a group member should use the stirring rod to mix the solution, and students should record their new self-rating of likelihood to use the water after one pollutant is added.

Last, have students circulate to each station, one at a time on the direction of the teacher, adding another “pollutant” from some of the materials to the beaker each time they rotate. Ask students to record their comfort level rating with drinking, cooking, or bathing using the water after each rotation. This rotation proceeds until all the “pollutants” have been added. Give students a chance to discuss what they observed and experienced in the lab with their group and then have a couple of groups share out their thoughts. Close this part of the experiment by explaining to students that this is no different than the pollution that takes place in the Great Lakes to our freshwater resources. Stress to them that this is why we have to take conservation of freshwater seriously and be mindful of what goes down the drain and overboard into our waters.

Lab Part 2) A Solution to Pollution

First, transition students to the second part of this lab experiment by having them discard the solution in their beakers and getting materials for the next experiment. Prime their thinking by informing them that after they just completed polluting the freshwater, now they will be challenged to clean polluted water.

Next, give students the new beakers of pre-polluted water and various supplies they can use as tools to develop a water filtration/purification system. Inform them that the pollutants in this water include iron filings, peppercorns/poppy seeds, sand, and salt. Let them know that the properties of these pollutants can inform methods for separating them out from the solution, thus treating the water and purifying it. Make sure that every group has for tools a stir rod, magnet, filter paper and funnel, scoopula, beaker, and heat source.

Then, give students time to devise a system for water treatment with their group and challenge them to recover as much of the given amount of water in its purest form as possible. Have them document their treatment process along the way.

Last, have students create posters (e.g., chart paper and markers) that illustrate their water treatment solution for purifying polluted water in the lab and give students an opportunity to do a gallery walk to see all the posters displayed.

ACTIVITY 2: Tapping the Great Lakes

First, explain to students that they are going to be viewing a documentary related to the lab experiment they completed, which is about the importance of freshwater and preserving it. This video will provide some basic information to them and address some of their WONDERS from the warm up and apply their learning from the lab. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the video [Tapping the Great Lakes](#) from Great Lakes Now to the whole class. Pause the video about every 8 minutes, at a natural pausing point, and ask for one or two students to respond to the prompt: “what do we notice is going on here?” Then play the video and continue the next segment.

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have a couple of students share one of the notes they wrote in their summary aloud.

ACTIVITY 3: Treating Drinking Water

First, have students join up with their lab groups from the Water Quality Lab activities and inform them that now that they know about the importance of freshwater and drinking water treatment, they will be investigating where their water comes from.

Next, have them complete the [Drinking Water Treatment](#) module from Michigan Tech.

Then, have individual students write a one-paragraph summary explaining what makes drinking water drinkable, where it comes from and how it gets to people for consumption in the Great Lakes region.

Last, have a couple volunteers share how the module on drinking water treatment connected to the lab experiment that they completed.

ACTIVITY 4 (OPTIONAL): Researching Pollutants

As a possible extension activity, application project, extra credit opportunity, or learning-beyond-the-school-day assignment, students could research one of the several common pollutants in [this water pollution module by Michigan Tech](#) found in the Great Lakes freshwater system and create an infographic to summarize the pollutant and its impact on freshwater.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write one action they plan to take to protect their freshwater resources.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

15. Travel & Leisure on the Great Lakes

Overview

The purpose of this lesson is to explore some of the opportunities for recreational travel and leisure that the Great Lakes provide.

Lesson Summary

In this lesson, students will interact with the ways that people encounter the Great Lakes through travel and leisure activities.

This lesson focuses on recreational encounters with the Great Lakes, because recreation is one of the most common ways that people experience the Great Lakes today, and this aspect of the lakes provides opportunity for studying personal interest topics, as well as a variety of educational opportunities for students, schools, and families to extend learning about the Great Lakes beyond the classroom walls.

The background context required for this lesson is that students would know the geography of the Great Lakes, including some of the ancillary bodies of water that are part of the waterway.

ESSENTIAL THEMES	<ul style="list-style-type: none">• The Great Lakes provide many opportunities for travel and leisure
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.→ MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.→ HS-ESS3.1: Construct an explanation based on evidence for how availability of natural resources, occurrence of natural hazards and changes in climate have influenced human activity.→ 5-ESS2-2 Describe and graph the amounts and percentages of water and fresh water in the Great Lakes to provide evidence about the distribution of water on Earth.

	→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.
OBJECTIVES	<input type="checkbox"/> Know some of the common leisure and travel activities associated with the Great Lakes <input type="checkbox"/> Understand coastal hazards and safety practices <input type="checkbox"/> Identify locations of particular interest for tourism, leisure, or travel
ESTIMATED TIME	❖ 1-2 class periods

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Notebooks and pencils
- Computers, laptops or tablets
- Chart paper or dry erase boards and markers

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: Life on a Great Lakes Island

First, explain to students that they are going to be viewing a documentary related to life on one of the Great Lakes 30,000+ islands. This video will provide some basic information to them and address some of their WONDERS from the warm up and apply their learning from the lab.

Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the video [Island Life in the Great Lakes](#) from Great Lakes Now to the whole class.

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have a couple of students share one of the notes they wrote in their summary aloud.

ACTIVITY 2: Awareness of Coastal Hazards & Safety

First, have the class read the article on [Dangerous Currents](#) from Michigan Sea Grant and discuss it as a whole class. Have a couple of students share a takeaway from the article.

Next, have the class watch the video [Here's How to Avoid Drowning in the Great Lakes](#) from the Center For Michigan. Have a couple of students share a takeaway from the article.

Then, have the class read the article on [Drownings in 2018 in the Great Lakes](#) from Great Lakes Now and discuss it as a whole class. Have a couple of students share a takeaway from the article.

Last, have students summarize in writing the most important point of coastal hazards and safety.

ACTIVITY 3: Travel & Leisure Poster

First, distribute copies of, or direct students to view online, the report [Travel, Sport & Leisure Trends in the St. Lawrence Region](#) from the Council of the Great Lakes Region and have students explore the report with a partner.

Next, have them use the report to create a summary Top 10 List poster, on chart paper or a dry erase board, of Key Facts About Tourism Trends in that region of the Great Lakes.

Then, have partners square up with other partners, to form groups of four, and discuss their posters using a similarities and differences protocol. In this protocol, they discuss connections between their lists, e.g., items that were similar on both lists, and compare novelties between their lists, e.g., facts that were unique to their individual lists.

Last, have the whole class display their posters side-by-side and generate a list consensus list of facts that come from all the lists together. Alternatively, each partnership shares their number one top fact with the class and makes a case for why it is most important.

ACTIVITY 4 (OPTIONAL): Visiting the Sand Dunes of the Great Lakes

This activity can be used as an opportunity for extended learning beyond the school day, or if time permits to take this lesson into more than one day. It could also be used as an extra credit opportunity for students, if desirable.

Students would obtain a copy of [Michigan's Sand Dunes](#) brochure from Michigan Sea Grant. They would work with a partner to explore and understand the brochure. Then, they would adapt the information in the brochure to create a single page infographic about Michigan's Sand Dunes, effectively condensing the information and upgrading the design of the brochure, using an infographic tool such as Canva.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write whether or not they would want to live on a Great Lakes island and explain their position using evidence and reasoning in a one-paragraph summary.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

16. Economic Significance of the Great Lakes

Overview

The purpose of this lesson is to introduce students to the many opportunities for commerce and commercial travel that the Great Lakes provide.

Lesson Summary

In this lesson, students will be introduced to one of the main ways that the Great Lakes impact the economy of the region—shipping.

Countless ships carry myriad cargo throughout the Great Lakes waterways to various destinations, making the transportation of goods accessible, reliable, and effective. Without the Great Lakes to transport various goods, which are typically shipped in the waterways, many commonly accessible materials would not be available in the ways they are today.

Materials like steel, for example, are essential to many commercial industries around the Great Lakes region, and the companies depend on reliable transportation via the waterways to get the supplies they need to do their work—in turn, this fuels economic productivity. But how do ships move around the Great Lakes? Various boats, freighters, and vessels of different sizes and shapes all rely on navigation technology to maneuver through the Great Lakes.

This lesson will afford students the chance to see some of that technology in action, as well as see the direct impact that shipping has on the regional commercial industry.

The background context required for this lesson is that students would know the geography of the Great Lakes, including some of the ancillary bodies of water that are part of the waterway and how vessels move through them.

ESSENTIAL THEMES

- The Great Lakes provide many opportunities for commerce and commercial travel

<p>NEXT GENERATION SCIENCE STANDARDS</p>	<p>→ MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p> <p>→ HS-ESS3.1: Construct an explanation based on evidence for how availability of natural resources, occurrence of natural hazards and changes in climate have influenced human activity.</p> <p>→ SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.</p> <p>→ HS-ESS2.A.4: The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun’s energy output or Earth’s orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.</p>
<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Know some of the common materials that are transported by freighter <input type="checkbox"/> Understand the importance of the Great Lakes in transporting goods and materials for the economy <input type="checkbox"/> Identify ships based on their GPS information and determine the distribution of boat types in a sampling.
<p>ESTIMATED TIME</p>	<p>◆ 1 class period</p>

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Notebooks and pencils
- Computers, laptops or tablets
- Chart paper or dry erase boards and markers

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: Shipping Goods on the Great Lakes

First, explain to students that they are going to be viewing videos about shipping, each from different perspectives. These videos will provide some basic information to them and address some of their WONDERS from the warm up and apply their learning from the lab. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the following videos to the whole class:

1. Video 1 gives an overview of the pros and cons of shipping goods on the Great Lakes, [Shipping on the Great Lakes](#) from PBS
2. Video 2 is from the perspective of how [shipping impacts the region of a major city Chicago, IL](#) from Great Lakes Now
3. Video 3 is from the perspective of the impact climate change has on [Great Lakes Shipping](#) from PBS to the whole class.

Last, after the videos, have students record in their notebooks a 4 Notes Summary, and have a couple of students share one of the notes they wrote in their summary aloud.

ACTIVITY 2: Can You Eat Fish From Commercial Fishing on the Great Lakes?

First, have students partner up and view the video [Lake Superior Whitefish: Carrying on a Family Tradition](#) from PBS, which shares the story of the Petersons, a commercial fishing family in Hancock, Michigan. Alternatively the entire class can view the video before partnering up to complete the activity. After the video, have students discuss with a partner what they think would be the biggest challenge someone would face if they earned their living through commercial fishing on the Great Lakes.

Next, inform students that one of the biggest concerns facing commercial fishing in the Great Lakes region is the safety of consuming fish caught in the Great Lakes. And a key part of this concern is the level of Mercury that could potentially be found in any fish caught in the lakes. In this activity, students will learn about commercial fishing on the Great Lakes and investigate the levels of Mercury over time in one type of fish—Walleye—from recently published reports.

Then, have students and their partners navigate to the webpage of the [Great Lakes Indian Fish & Wildlife Commission](#)—the agency that manages some of the commercial fishing referenced in the video—to research the Mercury levels reported in Walleye.

Last, have students create a data table and chart/graph that shows the Mercury levels over ten years (2004-2014) in Walleye. One partners have finished creating their charts/graphs, have two pairs of partners join together and co-present their findings to each other, addressing the following prompts:

1. Why did you choose to represent the data the way you did?
2. What trend in the data did you find over time?
3. What claim, based on evidence and reasoning, can you make about the safety of eating Walleye?

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write what was the most surprising thing about shipping that they learned.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

17. Contemporary Issues Facing the Great Lakes

Overview

The purpose of this lesson is to explore a number of threats, both natural and related to human activity, that confront the Great Lakes and the implications and challenges for each.

Lesson Summary

In this lesson, students will explore several contemporary issues facing the Great Lakes, including naturally occurring phenomena, such as invasive species, and issues that arise as a result of human activity, such as chemical pollutants.

The background context that is required for this lesson is a rudimentary knowledge of the Great Lakes environments and ecosystems as well as an understanding of the effects of pollution on the Great Lakes freshwater resources. After exploring a variety of issues and learning resources, students will synthesize their knowledge by creating a summary graphic of issues that face the Great Lakes based on geographic location.

This lesson should be spread out over five class periods. The videos are between 26-27 minutes long, which when combined with the other lesson activities would take up one class period. Each day, you would still do the warm up, launch, synthesis, cool down and exit ticket elements of this lesson.

As an extension, though this lesson does not include it, the introduction to contemporary issues here could set the stage for a research project for students to further investigate a specific issue facing the Great Lakes and generate possible solutions.

ESSENTIAL THEMES	<ul style="list-style-type: none">• The Great Lakes face a number of threats both natural and related to human activity
-------------------------	---

<p>NEXT GENERATION SCIENCE STANDARDS</p>	<ul style="list-style-type: none"> → MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. → HS-ESS3.1: Construct an explanation based on evidence for how availability of natural resources, occurrence of natural hazards and changes in climate have influenced human activity. → SEP8: Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. → HS-ESS2.A.4: The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun’s energy output or Earth’s orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. → MS-LS2-1-MI: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. → 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. → SEP1: Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. → SEP6: Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.
<p>OBJECTIVES</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Know some of the major issues facing the Great Lakes <input type="checkbox"/> Understand the impact that human activity has on the sustainability of the Great Lakes as a natural resource <input type="checkbox"/> Summarize and organize information into a graphic organizer to communicate contemporary issues <input type="checkbox"/> Engage in productive discussion and assert claims supported by evidence and reasoning
<p>ESTIMATED TIME</p>	<p>◆ 5 class periods</p>

Materials Needed

- Video projection monitor or screen/speakers
- Internet access
- Notebooks and pencils
- Computers, laptops or tablets

Facilitation Steps

WARM UP: Begin by asking students what they already know about the essential themes of the lesson and what they wonder about it. Have them turn and talk with a shoulder partner. Then, after a minute of conversation, elicit responses from a couple of volunteers and jot down 2-3 ideas on the board under the categories KNOW and WONDER. The teacher should help students clarify their ideas as they are shared by checking for understanding using a talk move such as “so you are saying...” or help students think together by asking for a show of hands of agreement from the class in response to what individual students share.

LAUNCH: Once the warm up has concluded, give a brief overview of the background context to students, making connections to their KNOW and WONDER responses as well as any other relevant prior knowledge they would have from other lessons they have learned. Describe the activities planned for this lesson to students.

ACTIVITY 1: The Forever Chemicals

First, explain to students that they are going to be viewing a video about per- and poly-fluoroalkyl substances (PFAS). This video will provide some basic information to them about the chemicals and address some of their WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the video [The Forever Chemicals](#) from Great Lakes Now to the whole class.

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have students form a group of four to discuss their takeaways from the video using the Conversation Roundtable protocol. In this protocol, students take turns sharing what they wrote for their individual responses to the 4 Notes Summary with their group while each student writes down what they heard the speaker say. Then, each student writes their own “sum it up” statement of their group members’ responses. After the Conversation Roundtable, have a whole-class share out. Choose a few students to each share their summaries from their group discussion aloud with the whole class. After each, ask students to raise hands if what was just shared matches something that came up in their group discussion as well.

ACTIVITY 2: The Line 5 Pipeline

First, explain to students that they are going to be viewing a video about an oil pipeline that lies beneath Michigan’s Straits of Mackinac. This video will provide some basic information to them about the chemicals and address some of their WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the documentary [Beneath the Surface: the Line 5 Pipeline](#) from Great Lakes Now to the whole class.

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have students form a group of four to discuss their takeaways from the video using the Conversation Roundtable protocol. In this protocol, students take turns sharing what they wrote for their individual responses to the 4 Notes Summary with their group while each student writes down what they heard the speaker say. Then, each student writes their own “sum it up” statement of their group members’ responses. After the Conversation Roundtable, have a whole-class share out. Choose a few students to each share their summaries from their group discussion aloud with the whole class. After each, ask students to raise hands if what was just shared matches something that came up in their group discussion as well.

ACTIVITY 3: The Rights of Lake Erie

First, explain to students that they are going to be viewing a video and reading an article about a recent movement to create an identity and rights of one of the Great Lakes: Lake Erie. This video will provide some basic information to them about the chemicals and address some of their WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)
- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, distribute, or direct students to, the article from Great Lakes Now, entitled: [Great Lake Gets Rights](#) and have them read it as a whole class. After the article reading, ask for a few students to share reactions to what they read. Follow the article reading up by showing the video available at the end of the article [Great Lake Gets Rights](#).

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have students form a group of four to discuss their takeaways from the video using the Conversation Roundtable protocol. In this protocol, students take turns sharing what they wrote for their individual responses to the 4 Notes Summary with their group while each student writes down what they heard the speaker say. Then, each student writes their own “sum it up” statement of their group members’ responses. After the Conversation Roundtable, have a whole-class share out. Choose a few students to each share their summaries from their group discussion aloud with the whole class. After each, ask students to raise hands if what was just shared matches something that came up in their group discussion as well.

ACTIVITY 4: Invasive Species

First, explain to students that they are going to be viewing a video about invasive species that are affecting the Great Lakes. This video will provide some basic information to them about the chemicals and address some of their WONDERS from the warm up. Introduce students to the 4 Notes Summary protocol that they will use after the video is complete, where they write one of each of the following:

- Oooh! (something that was interesting)
- Aaah! (something that was an ah-ha moment)

- Hmm... (something that left them thinking afterward)
- Huh? (a question they have afterward)

Ask students to give an example of each type of note that they will be making to check for understanding.

Next, show the video [Addressing the Threat of Aquatic Invasive Species](#) from PBS to the whole class.

Then, after the video, have students record in their notebooks a 4 Notes Summary.

Last, have students form a group of four to discuss their takeaways from the video using the Conversation Roundtable protocol. In this protocol, students take turns sharing what they wrote for their individual responses to the 4 Notes Summary with their group while each student writes down what they heard the speaker say. Then, each student writes their own “sum it up” statement of their group members’ responses. After the Conversation Roundtable, have a whole-class share out. Choose a few students to each share their summaries from their group discussion aloud with the whole class. After each, ask students to raise hands if what was just shared matches something that came up in their group discussion as well.

ACTIVITY 5: Interactive Graphic Organizer

First, explain to students that they are going to be integrating their learning from the earlier activities in this lesson and creating a graphic organizer that represents each of these major contemporary issues facing the Great Lakes. Inform them that their goal is to make an interactive image poster using an image-annotation tool (e.g., [Google Slides](#) with comments tagged on different spots on a slide) that illustrates the issues overlaid on an image of the Great Lakes.

Next, partner students up to work together on the activity and combine their notes from each of the issues activities. They can consult their own notes or do additional research, as needed. Content must include at least 2 links for each issue, and the issues that must be included should be at least those issues studied in earlier activities in this lesson.

Then, give students time to create an annotated image using ThingLink where they will take an image of the Great Lakes and add annotations of multimedia and web-based content, which correspond to the major issues affecting the Great Lakes, to different spots on the image.

Last, have students share their completed graphics with the teacher.

Select one group to volunteer and present their graphic to the class on the classroom display.

SYNTHESIS: Give students individual thinking and writing time in their notebooks to synthesize their learning by jotting down their own reflections using a Word, Phrase, Sentence protocol, with:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

After the individual synthesis is complete, students should share their synthesis with a shoulder partner.

COOL DOWN: Have students complete a 3, 2, 1 Review protocol for the lesson with a partner, recording in their notebooks or, optionally, on exit ticket slips to submit, the following:

- **3** things that they liked or learned
- **2** things that make more sense now
- **1** question that they were left with

CLOSURE: Have one student share a response from each of the categories of the 3, 2, 1 Review. Depending on the available time, the teacher can make connections between the ideas students share and the learning objectives of the lesson, and respond to the question that is shared.

EXIT TICKET: Students write which issue facing the Great Lakes they think is most crucial to address.

About the Author

Gary is an award-winning educator and double cornea transplant recipient who, since having his sight restored, was moved to use his teaching gifts to make science fun for kids. He lives with his family near Detroit and designs learning experiences to inspire children, like his own daughter, to love science. Gary is the 2014 recipient of the Michigan Teacher of the Year honor and author of *Science With Scarlett*.

Enrichment Activities Around the Great Lakes

The enrichment activities provide educational opportunities for schools, community groups, families and individuals to extend learning beyond the setting of the Great Lakes Now: An Exploration of the Great Lakes collection of lessons. Around the Great Lakes, destinations, activities, experiences, and other educational opportunities have been curated by lake region and a description along with a website is provided for each. These enrichment activities can be used independently of the lessons in the collection or paired with one or more lessons at the discretion of the individual to create a multi-dimensional learning experience.

Activity	Location	Description
Isle Royale National Park	Houghton, MI (Lake Superior)	This is the third largest island in the contiguous United States, and features beauty, solitude, and scenic wilderness. Learn about how the water system influences the dynamics of the Moose-wolf population, or get out on a trail to see a cave around Rock Harbor. To see the area in its full charm, you can take a Keweenaw Waterway Cruise.
Pictured Rocks	Minising, MI (Lake Superior)	The first officially designated National Lakeshore, tag along on a shipwreck tour, or take in the beauty of the shoreline on your own by foot or kayak.
Sleeping Bear Dunes	Maple City, MI (Lake Michigan)	Miles of high dunes (upwards of 450ft) afford spectacular views across the lake.
Indiana Dunes National Park	Chesterton, IN (Lake Michigan)	Indiana Dunes National Park hugs 15 miles of the southern shore of Lake Michigan and has much to offer, including 50 miles of trails over rugged dunes, mysterious wetlands, sunny prairies, meandering rivers and peaceful forests.
Shedd Aquarium	Chicago, IL (Lake Michigan)	One of the most impressive aquariums, sparking compassion, curiosity and conservation for the aquatic animal world, Shedd Aquarium is located in a large coastal city along Lake Michigan.
Lakeshore State Park	Milwaukee, WI (Lake Michigan)	Lakeshore State Park is located in a large coastal city along Lake Michigan with a beautiful blend of nature and cityscape. Here you can attend the nature center's What's in the Water? Program , Hike on Lake Michigan , or take in one of their many other events.

Manitoulin Island	Ontario, Canada (Lake Huron)	Known as “the Heart and Spirit of the Great Lakes of Canada,” this is the world’s largest island situated in a freshwater lake.
NOAA’s Thunder Bay National Marine Sanctuary and Great Lakes Maritime Heritage Center	Alpena, MI (Lake Huron)	Explore the many shipwrecks on the lake in a hands-on way, which includes a full-size replica wooden Great Lakes schooner and shipwreck where visitors can walk the decks, feel a Great Lakes storm, and touch the massive timbers of the boat resting on the lake bottom—without getting wet!
Ottawa National Wildlife Refuge	Oak Harbor, OH (Lake Erie)	Visit this preserved habitat for waterfowl and other migratory birds, resident wildlife, and endangered and threatened species, in the Great Black Swamp of Lake Erie in northwest Ohio.
Niagara Falls	Niagara Falls, ON (Lakes Erie and Ontario)	Situated between two of the Great Lakes and spanning the international border between Canada and the United States, the impressive Niagara Falls are a natural wonder of the world, and a source of hydroelectric power. If you get the chance while there, be sure to check out one of the fireworks shows .
Huron Clinton Metroparks	Metro Detroit, MI (Lake Erie, Kent Lake, Stony Creek Lake, & Lake St. Clair)	Experience firsthand the beauty of inland lakes, marshes and rivers, as well as one of the five Great Lakes on a nature trail. Attend a guided field trip with one of the field experts. Take in some history of the Great Lakes at one of their Nature Centers or catch one of their Mobile Learning Centers out and about at a local event—you can inquire about arranging a visit to your school or group event.
DNR Adventure Center	Detroit, MI (Detroit River)	Discover all Michigan's great outdoors has to offer with interactive exhibits, from water protection and conservation to experiencing the flora and fauna of the region.
The Nature Conservancy	Various Locations	Learn about Great Lakes fish at a lunch and learn Conservation Café, take a glass-bottomed boat tour of North Point Peninsula, or get your hands dirty at Ives Road Fen Preserve. Select your location to find events near you or close a destination of your choice.
River and Lake Educational Cruise	Metro Detroit, MI (Lake St. Clair - Clinton River &	Provides an opportunity for hands-on experience: students examine plankton and benthic samples, test water clarity, practice marine knot tying, take air and

	Lake Erie - Detroit River)	water temperature readings, and more. Cruises last between two and two and a half hours.
Holland State Park	Holland, MI (Lake Michigan)	Explore the sugar sand beaches and sand dunes, see the "Big Red" lighthouse, take in a meteor shower in the late summer, attend a weekly nature program, or simply take in one of the gorgeous sunsets over Lake Michigan.
Belle Isle State Park	Detroit, MI (Detroit River)	Rich with history and natural beauty, Belle Isle Park is situated on the Detroit River between the United States and Canada. It is home to a wide assortment of educational and recreational opportunities, including an aquarium, conservatory and the James Scott Memorial Fountain.
Cheboygan State Park	Cheboygan MI (Lake Huron)	With a system of well-marked trails that provide access to scenic Lake Huron vistas and glimpses of rare wildflowers, visitors have access to boating and fishing both on the bay and on Elliot Creek.
Toronto Islands	Toronto, ON (Lake Ontario)	The group of 15 islands are inter-connected by pathways and bridges just off the shore of the city of Toronto. You can walk from one end of the Island to the other. On the mainland, visit the CN Tower to get a perfect view of all the lake has to offer, experience the history of the region at the Royal Ontario Museum, or explore the marine life directly at Ripley's Aquarium of Canada.
Mackinac Island	Mackinac, MI (Lake Huron)	This national landmark nestled in Lake Huron features no cars at all on the island and is considered the Jewel of the Great Lakes. Hike one of the beautiful trails or walk the photo-ready shoreline where you can see an awe-inspiring rock formation. Check out an unforgettable sunset or awe-inspiring sunrise. Visit historic Fort Mackinac and take a step back in time with a horse-drawn carriage ride.
Hamlin Beach State Park	Hamlin, NY (Lake Ontario)	Get in the clear water or play on the sandy beaches before you take a self-guided tour of the Yanty Creek Marsh area. Visitors can launch car-top boats, fish for salmon and trout and enjoy the picnic facilities.

Presqu'ile Provincial Park	Brighton, ON (Lake Ontario)	A migration hotspot in spring and fall, with 338 bird species recorded with 130 breeding species, this park is a birdwatchers dream. The 1km boardwalk trail accesses the largest protected marsh on the north shore of Lake Ontario. Here, you can visit the second oldest lighthouse in Ontario, or participate in one of their daily interpretive programs.
--	--------------------------------	--