

6. The Bloomin’ Algae Harming Lake Erie

Overview and Purpose

To understand the relationship between nutrient cycles and Great Lakes ecosystems, with special consideration given to the algal blooms caused by runoff pollution in western Lake Erie.

Lesson Summary

Students will learn about the nitrogen and phosphorus cycles and investigate how these nutrients are cycled through the ecosystem near Toledo, OH, eventually causing significant algal blooms that threaten the water supply along the western coastline of Lake Erie.

Students will complete activities that will help them to visualize the problem behind the harmful algal blooms (HABs) in western Lake Erie as an instance of a nutrient cycle within an ecosystem. Their understanding of nutrient cycles will help them to identify potentially-effective solutions to the problem.

The background context that is needed for this lesson is for students to know that phosphorus and nitrogen are naturally-occurring elements contained within an ecosystem and necessary for plants and animals to live, which is why they are used in crop fertilizers. Students should also be familiar with food chains (e.g., how cyanobacteria play a role in the ecosystem) and the basic geography of the Lake Erie-Maumee River area near Toledo, OH.

ESSENTIAL THEMES	<ul style="list-style-type: none">● Nutrient cycles (e.g., Nitrogen and Phosphorus) within an ecosystem● The threat posed by cyanobacteria in the Great Lakes
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.→ 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.→ MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

	<p>→ HS-LS2.B.2: Plants or algae form the lowest level of the food web. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways.</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>
OBJECTIVES	<p><input type="checkbox"/> Analyze the flow of nutrients through the water in areas of the Great Lakes, including streams, rivers, wetlands, or groundwater</p> <p><input type="checkbox"/> Understand the problem with harmful algal blooms facing the western region of Lake Erie and possible solutions to it</p>
ESTIMATED TIME	❖ 2 class periods

Materials Needed

- Video projection monitor or screen/speakers
- 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 1: How Nutrients Cycle Through an Ecosystem

First, explain to students that they are going to be viewing an informational video explaining how certain nutrients cycle through an ecosystem. 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 from PBS about the [Nitrogen and Phosphorus Cycles](#) 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. After students have shared takeaways from their 4 Notes Summaries, work with the whole class to try and collectively create a diagram mapping out the nutrient cycles for Phosphorus and Nitrogen based on what they learned in the video. Allow students to volunteer information while the teacher records what they say on the board, clarifying their ideas and prompting them along until a basic nutrient cycle is completed. Once the nutrient cycles are drawn on the board, have students copy them into their notebooks. (*Alternatively, depending on time, teacher can show a graphic of the Nitrogen and/or Phosphorus Cycle to students and have them sketch these into their notebooks prior to the rest of the activities in this lesson.)

ACTIVITY 2: Algae in the Black Swamp

First, have a volunteer read the overview information about the Great Black Swamp from Great Lakes Now in [this article](#).

Next, show the [video segment](#) (starting at 17:16) from Great Lakes Now on the harmful algal blooms (HABs) in Lake Erie to the whole class.

Then, ask students to partner up and discuss how the harmful algal blooms would relate to the nutrient cycles they drew in their notebooks. Have them create a new diagram showing how the

nutrient cycles affect the cyanobacteria in Lake Erie based on the information they learned in the video.

Finally, have students volunteer to explain what they discussed and sketched with their partners. The teacher should work to sketch out on the board a representation of what the students are saying (e.g., facilitate a consensus among all the ideas) such that a diagram is created showing the nutrient cycles and how they lead to harmful algal blooms. Have partners turn and talk to summarize the class consensus with each other.

ACTIVITY 3: Why Are Microcystis a Concern?

First, show the video [on Harmful Algal Blooms \(HABs\)](#) from the Ohio DNR to the class.

Next either distribute copies of, or direct students to view the following documents online from Ohio DNR: [HABs Fact Sheet](#), [Recognizing HABs](#), and [Lake Erie Harmful Algal Bloom Health Information](#). Have students work in groups of three to review the information provided in these two Fact Sheets about HABs and jot down 3-5 key ideas that they learned from them. They can review the information in any way they choose (e.g., jigsaw, one leader reads to the group, everyone reads all three).

Then, have students write down three questions they have about microcystis after reading these articles.

Last, have students review the [Frequently Asked Questions](#) about HABs from NOAA and try to come up with answers to the questions they had.

ACTIVITY 4: Using Data to Evaluate Solutions

First, remind students that, as they learned from earlier video activities, several factors can affect the HABs including:

- amount of fertilizer runoff into the water system
- where fertilizer runoff from farmland goes, and
- the amount of rain in the region.

Inform them that in this activity they will be analyzing historical data from the NOAA Algae Bulletins over a three-year period to see how some of the responses to HABs have made a difference. Assign them bulletins from the same week of the year from three different years (e.g., the last week in August from [2017](#), [2018](#), and [2019](#)) in Lake Erie using [the drop-down menu](#) provided by NOAA. **Note: do not have two groups look at the same week of the year as each other.*

Next, have students summarize their findings and observations from the bulletins by describing the changes in HABs from year to year. For each year, have students claim whether the HABs increased or decreased as a threat, allow them to hypothesize what might have caused the change, and have them provide a written explanation providing evidence and reasoning from the data.

Then, have students draw a diagram to show how changing the factors, which they learned about in the videos (e.g., amount of fertilizer runoff, destination of fertilizer runoff, and amount of rain,) could affect the HABs through the nutrient cycles.

Last, have students make a claim, backed by evidence and reasoning, as to which solution they think would be most effective at controlling the HABs.

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 explain why they think it has been so difficult to control the HABs in Lake Erie over the years.

About the Author

Gary is an educational consultant, award-winning science educator and the author of [Science With Scarlett](#). He is also a 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. Contact him via his consulting firm, [Saga Educators](#), or connect with him on [Twitter](#).

About Great Lakes Now

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