

GREAT LAKES LEARNING

LESSONS & ACTIVITIES BASED ON THE
MONTHLY GREAT LAKES NOW PROGRAM

EPISODE 1028 | SUPERIOR BLOOMS

ALGAL BLOOMS ON LAKE SUPERIOR



Image Credit: Great Lakes Now

OVERVIEW

This lesson will introduce students to the phenomenon of **eutrophication** by helping them understand the reasons behind the novel algal blooms observed in Lake Superior, the impact that climate change has on algal blooms, and how toxic algal blooms affect the Great Lakes.

LESSON OBJECTIVES

- **Know** how the watershed concept can help explain and predict the locations of algal blooms
- **Understand** the problem with harmful algal blooms, and the specific algal blooms facing the western region of Lake Superior
- **Be able to** explain the process of eutrophication and what factors can magnify or mitigate it

WHAT YOU'LL NEED

- Computer or mobile device with Internet access to view video and online resources
- Notebooks and pencils
- Chart paper
- Sticky notes
- Markers
- The Great Lakes Watershed Map (link provided)
- Copies of the Student Handouts

INTRODUCTION

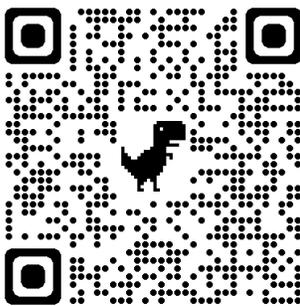
In this lesson, students are introduced to the phenomenon of eutrophication through the harmful algal blooms (HABs) happening in Lake Superior, how they occur, and get an understanding of what contributes to them.

They will learn what eutrophication is, understand how human activities can contribute to it, and explore a specific instance of it happening in Lake Superior.

This lesson can span the course of several class periods, as it includes multiple activities.

Some prior knowledge* with which students should be familiar includes:

- The water cycle
- The watershed concept
- Nutrient cycles
- Food chains/webs



[Follow this hyperlink or QR Code to the episode page!](#)

**Check out our [online collection of lessons](#) for more activities related to these topics.*

***The sequence of these activities is flexible, and can be rearranged to fit your teaching needs.*

NGSS CONNECTIONS

Phenomenon: Eutrophication

- MS-LS2-2
- MS-ESS3-3
- MS-ESS3.A.1
- HS-LS2.B.2
- MS-ESS3-2
- SEP2
- SEP8

During the course of the lesson, students will progress through the following sequence** of activities:

- Class discussion to elicit or activate prior knowledge
- Teacher notes on eutrophication
- Close reading a photo
- Watch a *Great Lakes Now* segment on algal blooms in Lake Superior
- Class discussion to debrief video
- Create a model of eutrophication
- Read about Harmful Algal Blooms

The lesson progresses through three major sections: **launch, activities, and closure**. After the launch of the lesson sequence, you are ready to begin the lesson activities. Once finished with the activities, students will synthesize their learning in the closure section.

If you use this lesson or any of its activities with your learners, we'd love to hear about it!

Contact us with any feedback or questions at:
GreatLakesNow@dptv.org

BACKGROUND INFORMATION

by Great Lakes Now Contributor, Gary G. Abud, Jr.

**This information can be presented by the teacher as notes to students at the teacher's discretion.*

Eutrophication is based on a Greek root word, *trophe*, which means "nourishment or food."

In the study of food chains, you may have explored the term "trophic level" to refer to primary producers, primary consumers, etc. Eutrophication, which comes directly from the Greek *eutrophos*, means "well-nourished" and it describes the process by which certain algae or other plants get nourishment from excess nutrients—like phosphates or nitrates—in the waters and start growing out of control to the point where they can take over a body of water.

Through eutrophication, the aquatic ecosystem becomes overly enriched with nutrients, increasing the amount of producers, e.g., algae and other plant growth, in the waters which compete with other native plants for sunlight and nutrient resources, thus causing a disruption to the natural order of the food chain in the ecosystem.

Nitrates and phosphates from cow manure coming out of Concentrated Animal Feeding Operations (CAFOs), as well as agricultural and residential fertilizers, household detergents, and human waste can all run off the land into rivers, or enter the waterways through the sewer system, ending up in a body of water—such as Lake Superior.

This promotes the growth of algae and other plant life. Typically, flora, or plant life, like this occurs naturally in a water ecosystem; however, when algae overgrows a body of water, it can cause the depletion of oxygen in the water, causing the death of aquatic animals.

Algal blooms on their own are not generally harmful to animals directly, unless they involve certain kinds of algae that produce harmful toxins, but can have a negative impact on an entire ecosystem, thus having an indirect impact on animals and human activity.

It has become a major environmental problem in other regions of the Great Lakes, most notably in Lake Erie, largely because of the frequency and magnitude of its impact. However, until recently, colder more-northern bodies of water like Lake Superior had not shown the algal blooms prior.

Now that Lake Superior has demonstrated a capacity for algal blooms, eutrophication is a threat to its ecosystem as well.

LESSON LAUNCH

A. Warm Up

The warm up is intended to be structured as teacher-facilitated, whole-group student discussion activities.

1. Begin by asking students to call to mind a time when they saw an area of land flooded after a heavy rain storm or lots of snow melt.
2. Have students describe what they noticed while you list ideas on the board as they share aloud.
3. If it doesn't come up, prompt students to consider the flow of water in a flooded area by asking where the water went or if it moved at all to lead into a connection to the watershed concept.
4. If you live in a particularly flat region, the most movement students may describe will be down driveways or down streets into drains. If that is the case, you can ask students to consider how things would be different if they lived at a higher elevation, such as in a hilly or mountainous area.
5. Show students this [PBS watershed animation](#) to introduce the concept.
6. Show, or distribute copies of, the Nature Conservancy's [Great Lakes Watershed Map](#) from the Erb Foundation to students.
7. Explain how to interpret the map, comparing it to their examples of flooded areas and water movement.
8. Direct their attention to the western region of Lake Superior and have students trace the paths water would take into the lake.

B. Bridge to Learning

After the warm up activity has concluded, help students prepare for the learning that is about to come.

1. Ask them to discuss with a partner what would happen to a lake if the watershed nearby it got polluted.
2. Ask them to draw a picture in their notebooks to make their thinking visible to each other.
3. Have a few student pairs share out.
4. Tell them that in this lesson they will be learning about what happened to an area of Lake Superior where something like this took place and the phenomenon of **eutrophication** that resulted.

C. Close Reading a Photo

Provide students a copy of [this photo of Lake Erie](#) from *Great Lakes Now* and have them write out 4 sticky notes to answer the following questions with their partner:

1. What do you notice in this image?
2. What do you wonder?
3. What does this remind you of?
4. Would you swim in this water? Drink this water? Fish in this water?

Then, collect and display the stickies for all to see and discuss as a class.

D. Background Information Notes

Explain this photo is of a harmful algal bloom in 2011 on Lake Erie, and provide students notes about **eutrophication**, from the Background Information section connecting it to the photo.

ACTIVITY 1: WATCH A GREAT LAKES NOW SEGMENT

This activity is a video discussion of a *Great Lakes Now* episode segment.

First, inform students that they will be watching a video from *Great Lakes Now* that discusses the problem that came up earlier in the discussion: **what can happen to a lake if its watershed gets polluted?** During the video they need to jot down four things they took away from watching using the **4 Notes Summary Protocol**.

Then, if students are not already familiar, introduce them to the 4 Notes Summary Protocol, which they will use after they finish watching the video, where they write down one of each of the following notes:

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

Next, have students watch this segment from episode 1028 of *Great Lakes Now* called, [Superior Blooms](#)

Last, have students complete their individual 4 Notes Summary and then discuss those in groups of 3-4 students.

Teaching Tip: Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.

Post-Video Discussion

After the groups have had time to go over their 4 Notes Summaries, invite a handful of students to share out some of their notes, eliciting at least 1-2 of each of the 4 Notes and listing those on the board for the group to see.

Ask students to turn back and talk with their groups to make connections to what they did in the warm up activity with the discussion of the watershed and the photo of Lake Erie, asking them: how is what we saw in the video the same as what we learned earlier in this lesson? How is it different?

After giving the groups some time to talk, bring the whole group back together for a shareout and discussion of ideas.

In this culminating discussion, the goals are to help students make connections between the process of eutrophication, the watershed concept, the harmful algal blooms in Lake Erie and the emerging algal blooms in Lake Superior.

Once the discussion finishes, have each student write a "**Sum It Up**" statement in their notebooks. This is a single sentence that captures the big idea of what was just learned.

Have 2-3 students share out their **Sum It Up** statements before concluding this activity.

ACTIVITY 2: READ ABOUT HARMFUL ALGAL BLOOMS

This activity aims to provide students a better understanding of harmful algal blooms and the effect that they can have on aquatic ecosystems. Moreover, it will provide students with additional information about the Algal Blooms happening in Lake Superior, which they learned about in the video. The purpose of this reading is to help students understand why the emergence of any algal bloom activity in Lake Superior is cause for concern.

In this activity, students will use a **Think Pair Square Protocol** for discussing the article that they will read individually.

First, distribute the article entitled "[Lake Superior Summer](#)" by Sharon Oosthoek from *Great Lakes Now*, giving students time individually to read the article, and ask them to jot down 3 things they learned in the article.

Then, have students pair up with a partner to discuss the article and which 3 points they noted from it.

Next, have two student pairs join up, standing near each other to form the four corners of a square, to discuss the article and what they talked about in their pairs.

Last, have each group come up with a summary statement about the most important point from their discussion and ask for a volunteer in each group to share that most important point with the whole group.

As student groups share out their most important point, record their ideas on the board and have students copy the list of student ideas down into their notebooks.

Inform them that they will be using some of the information from this article and discussion in a later activity about algal blooms.

After the shareout is complete, ask students to return to their groups and discuss one last question:

Which of the possible solutions proposed in the article to address the algal blooms problem do you think would be most workable?

After giving the groups some time to discuss this question, open up the conversation to the entire class to discuss the merits of different possible solutions for the problem of algal blooms and harmful algal blooms.

Further Reading on the Subject:

*An additional article further discussing the science of these Harmful Algal Blooms is included in this lesson as an optional extension activity to for students to read and discuss with one another, again, using the **Think Pair Square Protocol**.*

Teaching Tip: Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.

ACTIVITY 3: CREATE A EUTROPHICATION MODEL

The purpose of this activity is for students to create a model that will communicate how algal blooms (and harmful algal blooms) happen in a lake.

First, inform students that they will be working with their groups to create a eutrophication model that explains how algal blooms and harmful algal blooms occur. Elicit student suggestions about what makes for a good model (e.g., a visual representation that explains how something works) and what sorts of aspects of eutrophication should be included in the model.

Then, provide students with chart paper and markers, or large dry-erase boards and whiteboard markers, to construct their models with their groups. Monitor group activity as students work.

Next, have students display all of their models next to each other along a wall space so that everyone can see all of the models. Provide students time to do a gallery walk and examine each group's model.

Last, engage students in a whole-group discussion about the models, getting them to compare, and make connections between, all of the models and decide if the model would adequately explain Lake Superior.

Try to arrive at what an ideal eutrophication model of algal blooms would look like based on the best features of all the boards. When finished, have students sketch the ideal model in their notebooks.

Figure 1: an example model of eutrophication

How Do We Get Harmful Algal Blooms (HABs)?

Harmful algal blooms are the results of a process called eutrophication — which occurs when the environment becomes enriched with nutrients, increasing the amount of plant and algae growth to lake waters.



Image Credit: Gary Abud, Jr.

LESSON CLOSURE

After the conclusion of all the activities, help students to make connections* between everything they did in the lesson and what they learned overall by:

A. Compare and Connect

Initiate a discussion with students where you ask them to identify ways in which each activity corresponded to the other activities. This could be in terms of what was done, what was learned, or specific moments of the activities that corresponded with others. Guide students to refer to each other's thinking by asking them to make connections between specific features of the activities and how they all connect to the big ideas of the lesson. Make sure to invite students to connect other students' responses to their own ideas in the discussion.

B. Lesson Synthesis

Give students individual thinking and writing time in their notebooks to synthesize their learning, by jotting down their own reflections using the **Word, Phrase, Sentence Protocol**.

In the Word-Phrase-Sentence Protocol, students write:

- 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

C. Cool Down

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

After sharing their syntheses, have students complete a **3, 2, 1 Review** for the lesson with their partner, recording in their notebooks or, optionally, on exit ticket slips to submit, each of the following:

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

Invite several students to share aloud what they wrote in either the synthesis or 3, 2, 1 Review.

Lastly, ask one student volunteer to summarize what has been heard from the students as a final summary of student learning.

**Optionally here, the teacher can revisit the learning objectives and make connections more explicit for students.*

Teaching Tip: Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.

FURTHER READING: HABs HARMFUL ALGAL BLOOMS

by *Great Lakes Now* Contributor, Gary G. Abud, Jr.

One of the most visible signs of dangerously high levels of nutrients in a body of water is an algal bloom. That is where the amount of algae increases so rapidly that it "blooms," or covers the surface of the water, and the water turns green, much like a swimming pool that hasn't been chemically treated for a long time. Some algae produce a chemical that's toxic to the liver called microcystin, which can be harmful—or even fatal—if ingested by people or animals, resulting in what are called toxic algal blooms or Harmful Algal Blooms (HABs).

The increased number of toxic algal blooms, such as those that have been happening in Lake Erie for a number of years, are a hazard to people, domestic animals and wildlife; and it can even lead to the loss of sensitive plants, native animal species, and their habitat. Oxygen levels are also reduced in water bodies affected by eutrophication, because much of the sunlight shining on the water is absorbed and used by the increased number of algae for photosynthesis.

That means that the other plants in the water beneath won't get as much sunlight, and won't do as much photosynthesis. In turn, those plants won't be able to contribute oxygen—a byproduct of photosynthesis—to the water, and that means that fish and water bugs won't have the oxygen they need available to survive.

Eutrophication not only yields green waters, it results in fewer aquatic insects and fish, because it has a direct impact on primary producers and the consumers that depend on them in the food chain and food web of a lake's ecosystem.

This disruption to aquatic food webs can render a body of water uninhabitable, and can eventually lead to a so-called "dead" lake.

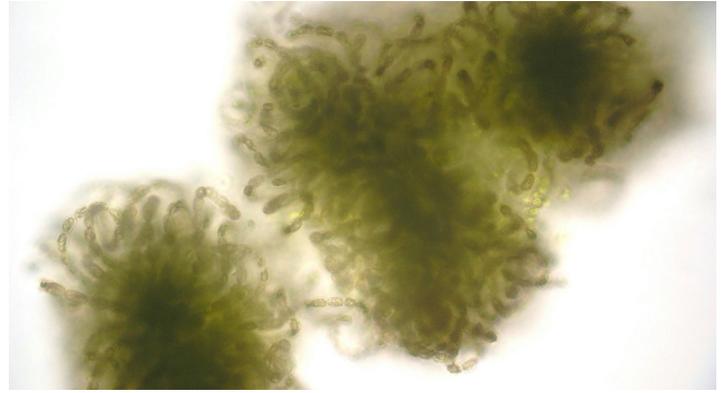


Image Credit: Great Lakes Now

But it can also affect drinking water sources for humans, when people depend on the lake as a freshwater source, as it did several years ago in the western region of Lake Erie when people couldn't drink their tap water for several days due to toxic algae contamination.

Historically, toxic algae has been a problem in Lake Erie for decades. In the 1960s and '70s, the eutrophication of Lake Erie advanced so extremely that it became known as the "dead lake." But now, colder bodies of water, like Lake Superior are starting to get algal blooms, because of pollution and weather events.

When hotter temperatures warm the lake more and cause more storms, pollution from nearby land runs off into the lake, providing necessary nutrients for the growth of algae. Given just the right conditions and the algae will bloom, causing the potential for harmful impacts on the lake, shoreline, nearby communities, and ecosystem.

To combat this problem, two main categories of solutions exist: proactive approaches, like reducing the amount of nutrients that enter the waters from human activity, and reactive measures: filtering and testing the water once an algal bloom takes place, or temporarily shutting down regions of the waters to commercial and recreational activities.

If we want to preserve the beauty of our lakes, managing algal blooms will be an important step.

NAME: _____

A Word, Phrase, Sentence Protocol

What is a **word** that you thought was most important from this lesson?

What is a **phrase** that you would like to remember from this lesson?

What is a **sentence** that sums up what you learned in this lesson?

3, 2, 1 Review Protocol

What are **3 things that you liked or learned** from this lesson's activities?

-
-
-

What are **2 ideas that make more sense** now to you?

-
-

What is **1 question that you were left with** after this lesson?

-

NAME: _____

4 Notes Summary Protocol

OOOH!

Something that was interesting to you

AAAH!

Something that became clearer; an "ah-ha" moment

HMMM...

Something that left you wanting to learn more

HUH?

Something you questioned or wondered

Sum It Up Statement:

Summarize your group discussion about your 4 Notes Summaries below:

NAME: _____

Think Pair Square Protocol

THINK

Write down your own individual ideas

PAIR

Summarize what you and your partner discussed

SQUARE

Summarize what your group discussed