

9. Responding to the PFAS Crisis

Overview and Purpose

To develop student understanding of an important chemical threat to the Great Lakes—per- and poly-fluoroalkyl substances (PFAS)—and to apply learning by generating questions and answers about PFAS problems and potential solutions.

Lesson Summary

Students will learn about per- and poly-fluoroalkyl substances (PFAS) and synthesize their learning into curious questions, as well as evidence-based responses, about the chemical that is threatening the Great Lakes.

This lesson can build on prior knowledge, if you have already completed the lesson [Contemporary Issues Facing the Great Lakes](#), or can be an introduction to PFAS for students.

The required background context for students to have prior is of the interconnectedness of the Great Lakes. This lesson has students utilize a claim-evidence-reasoning framework for their position when they respond to questions or even generate questions.

ESSENTIAL THEMES	<ul style="list-style-type: none">● per- and poly-fluoroalkyl substances (PFAS)● Chemical threats to freshwater of the Great Lakes
NEXT GENERATION SCIENCE STANDARDS	<ul style="list-style-type: none">→ 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.→ MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
OBJECTIVES	<ul style="list-style-type: none"><input type="checkbox"/> Understand the environmental threat posed by chemicals such as PFAS<input type="checkbox"/> Generate scientific questions and answers based on evidence and reasoning
ESTIMATED TIME	❖ 2 class periods

Materials Needed

- Video projection monitor or screen/speakers
- Internet browser
- Student computers, laptops, or tablets
- Notebooks and pencils
- 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: What Are PFAS Anyway?

First, inform students that they are going to be viewing a video documentary about per- and poly-fluoroalkyl substances (PFAS). Explain to them that PFAS is an acronym for a class of industrial chemicals, which have been linked to certain cancers, thyroid and liver disorders, birth defects and high cholesterol.

These chemicals are contaminating drinking water and showing up in people's blood. That's because they are in most homes and are now being detected in an increasing number of people's water systems in Michigan and other states and provinces.

Let them know that 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 class the video “[The Forever Chemicals](#)” a 30-minute documentary 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.

**Note: if you have already completed the previous Great Lakes Now lesson on the Forever Chemicals, entitled [Contemporary Issues Facing the Great Lakes](#), you can show the class the [Forever Chemicals trailer](#) and [the 1-minute explainer on PFAS](#) (bottom of page) to remind them of the documentary they watched and then give them access to the documentary to view parts of it on their own, as needed for the second activity.*

ACTIVITY 2: PFAS in Ann Arbor

First, inform students that they are going to be viewing a video showing how PFAS is affecting one particular city—Ann Arbor. Explain to them that Ann Arbor is one of many places reporting an issue with PFAS. Show [the map of PFAS reports in the U.S.](#) to the class and ask them which area of the country currently seems most affected.

Next, have a volunteer read the introductory paragraphs about [when industrial chemicals get in a city’s water supply](#) from Great Lakes Now.

Then, show the video segment from Great Lakes Now on [PFAS in Ann Arbor drinking water](#).

Last, ask students to turn and talk with a classmate about one thing they learned from the video. Have a few student volunteers share their responses aloud with the whole class.

ACTIVITY 3: PFAS AMA (Ask Me Anything)

First, inform students that they will be doing an Ask Me Anything (AMA) about the PFAS chemicals that they learned about in the [Forever Chemicals](#) documentary. They will be working with their group from the conversation roundtable to create their questions, and then the class will share questions with each other in an effort to get responses to them. Each group should work to generate 8-10 questions. Explain to students that they should be able to support the questions that they create using a claim-evidence-reasoning framework to explain why they asked their question, and later in how they respond to questions to provide answers.

Next, give students a chance to generate the questions that they have about PFAS. They can research online or reference the [Forever Chemicals](#) documentary, as needed, to help them formulate their questions. Once they have 8-10 questions, they should make a poster of their questions, either using chart paper or dry erase boards, so that everyone in the class can see each other's questions. Encourage them to be specific and clear with their wording when they generate their questions. Give students some examples of what they can focus their questions about PFAS on such as, but not limited to, the following:

- health risks
- safety concerns
- effects on the water supply
- ways people can protect themselves and their families
- the cost of PFAS contamination

Then, have students do a gallery walk to give groups a chance to read the other question posters and discuss as a group which questions they would like answered off of other groups' posters. They should choose 2 questions from each poster (including their own) and should put a checkmark next to their chosen questions on each poster. At the end of the gallery walk, students return to their seats and the teacher compiles a single list of the most upvoted questions from each poster for the whole class to see. Remember to list any similar questions only once, so as to avoid duplicates.

Last, go through the combined questions list and have the class vote on the top 3 questions, which they all would like to get an answer on, and [send those questions to Great Lakes Now](#). To help them deliberate, you may ask them to consider which questions on the list could students in the class answer. After the class has selected the questions to send in and you have submitted them to Great Lakes Now, go through the remaining questions on the list and ask for responses to them from students in the class. Use this as an opportunity to facilitate class discussion and link back to their original KNOW and WONDER responses when possible.

**Note: You should check out a few of the questions that have already been submitted to Great Lakes Now and answered [in short explainer videos here](#) and compare those questions to the*

ones that students wanted to know. This could be done before you submit questions to Great Lakes Now or at the end of the activity.

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 question surprised them most of all the questions that they saw on all the posters, and explain why it surprised them.

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

With a [monthly magazine-style television program](#) and daily online reports at [GreatLakesNow.org](#), the **Great Lakes Now** initiative offers in-depth coverage of news, issues, events and developments affecting the lakes and the communities that depend on them, while capturing the character and culture of the region.