7. A Freshwater Oil Spill Cleanup Simulation

Overview and Purpose

To learn about the impact oil spills have on ecosystems of the Great Lakes region and explore the nature of the work involved with cleaning up a freshwater oil spill.

Lesson Summary

Students will learn about a remote Canadian research station where scientists are working to understand the effects of oil spill pollution on freshwater and simulate an oil spill cleanup effort in the lab.

Students will first learn about the Kalamazoo River oil spill and why better cleanup efforts are needed to address oil spills in freshwater when they happen. They will do this through a video segment from Great Lakes Now. Then, they will apply their learning through a simulation in which they will create an oil spill and have to figure out a cost-effective way to clean it up.

The background context needed for this lesson is for students to know the properties of solids, liquids and gases, including density and solubility (e.g., water and oil do not mix and the less dense substance floats atop the denser substance.)

ESSENTIAL THEMES	● How oil spills affect ecosystems ● Methods of cleaning up oil spills in large bodies of water
NEXT GENERATION SCIENCE STANDARDS	➔ MS-ESS3.A.1 Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. ➔ MS-ETS2-2. Given a design task, select appropriate materials based on specific properties needed in the construction of a solution ➔ MS-LS2-5. Evaluate competing design solutions for protecting an ecosystem. Discuss benefits and limitations of each design. ➔ MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
OBJECTIVES	❏ Know the threat that oil spills pose to bodies of freshwater

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	❏ Simulate how a cleanup effort for an oil spill might happen ❏ Understand the difficulties associated with cleaning up an oil spill
ESTIMATED TIME	❖ **2-3 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
- Cotton Balls or Rounds
- Feathers
- Cotton cloth fabric squares (e.g., 12" x 12" rags)
- Q-Tips
- Cardboard Squares (1 sq-ft)
- Paper Towel Pieces (pre-cut)
- Newspaper (full sheet, folded)
- Pipe Cleaners (any size)
- Plastic Pipettes (disposable)
- 100mL Graduated Cylinders
- Liquid Dishwasher Detergent
- Aquarium skimmers (nets)
- Large plastic basins (10-20 qt)
- Motor Oil
- Blue food coloring

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: Polluting With Purpose

First, explain to students that they are going to be viewing an informational video explaining how researchers are purposely creating oil spills on freshwater lakes to study the cleanup of oil in 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, have a volunteer read the introductory overview article Polluting With Purpose from Great Lakes Now to the whole class.

Then, show the Polluting With Purpose video segment from Great Lakes Now to the whole class.

Last, after the video, 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. Record on the board one of each type of note that students share.

ACTIVITY 2: Oil Spill Cleanup Simulation

First, explain to students that they will be learning about methods of cleaning up oil spills and then simulating an oil spill cleanup. Have volunteer students read—a couple of paragraphs at a time—the article Cleaning Up the Oil Spill about how surfactants/dispersants are used to chemically break up oil spills in New Zealand, from the Science Learning Hub at the University of Waikato. After the video get students into groups before providing the next instructions.

Next, explain to students that each group will be given a similar environment (e.g., a "lake") in which to clean up an oil spill: a large plastic basin (size can vary depending on available space) filled with roughly the same amount of blue food-colored water and the same amount of oil (e.g., 30 mL of motor oil.) They will be able to select any materials they want to clean up their oil spill, but materials will have a cost associated with them. Provide students a copy of the materials list below by displaying it on the board in the classroom, sharing it with them as a handout, or having them copy it into their notebooks. Instruct students that the challenge is to clean up as much oil as possible. The success criteria for cleanup is based on how much oil a group recovers and the amount of money they spent to clean it up.

Note: plastic garbage bags or painter's sheet plastic should be used to cover table tops under the "lake" and students should wear latex-free gloves when conducting this lab activity.

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Material	Category of Material	Cost
Cotton Balls or Rounds	Absorber	10 for $1
Feathers	Absorber or skimmer	5 for $1
Cotton cloth fabric squares (e.g., 12" x 12" rags)	Absorber or skimmer	$5 each
Q-Tips	Absorber	25 for $1
Cardboard Squares (1 sq-ft)	Boom	$10 each
Paper Towel Pieces (pre-cut)	Absorber or skimmer	$1 each
Newspaper (full sheet, folded)	Absorber, skimmer, or boom	$1 each
Pipe Cleaners (any size)	Skimmer	$1 for 10
Plastic Pipettes (disposable)	Skimmer	$10 each
100mL Graduated Cylinders	Skimmer	$25 each
Liquid Dishwasher Detergent	Dispersant	$1 per mL
Aquarium skimmers (nets)	Skimmer	$20 each

Then, provide groups time to research the materials and plan for their oil spill cleanup, before distributing the "polluted lakes." Once they have their lakes setup, allow them to purchase materials from the supply station—have the group show you on paper how much of each supply they are taking and the total cost so that you can sign off before they begin the cleanup process.

Last, give groups time to clean up as much of the oil as they can with their supplies. Remind them to record observations and findings as they work (e.g., someone can be the designated recorder of data for the group.) At the end of the time allowed, have students measure and record the volume of oil they recovered from the oil spill and return any unused supplies they purchased. Finally, have them calculate their final cleanup budget after returning unused materials. Once the lab is completed, have students fully clean up their workstations and return all supplies before you debrief the lab activity the next day.

Share what students create with Great Lakes Now by emailing experimental results and photos from students' oil spill cleanup efforts to gln@dptv.org or by posting them on Facebook or Twitter with @GreatLakesNow!

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ACTIVITY 3: Oil Spill Cleanup Debrief

First, have students display, on chart paper or dry-erase boards, a summary of their oil spill cleanup effort (e.g., what materials they purchased, their procedure, amount of oil recovered, notable observations, and the total final cost of cleanup.)

Next, arrange the class in a circle so that all students are facing one another and can all see each other's lab posters. If students have their posters, instruct them to hold those in front of themselves so they face the class. Alternatively, if students used wall space to display their posters, arrange the class in a semi-circle so that they can see all the results next to one another.

Then, have students review the class solutions to the oil spill problem and debrief their solutions with each other. Have the class respond to any of the following prompts on what happened with the oil spill in order to facilitate the discussion and reach consensus about what methods were most effective:

- What happened to the oil after it was added to the water—how do you know?
- What made it most difficult to clean up the water?
- Which materials were most effective and which were least effective at cleaning the oil?
- Did any solution completely recover all of the oil?
- Would you change any of your cleanup decisions if you had this to do over again?
- How would cleanup have been different had there been a limit to how much money you spent?

Last, ask students to turn and talk with their groups about how this oil spill simulation connects to the efforts to clean up oil in the Great Lakes water system—for example, what extra considerations might complicate a real-life oil spill more than the conditions in our simulation? After giving groups some time to discuss the connections and compare the simulation to an oil spill in the Great Lakes, a couple of volunteers should share their ideas.

ACTIVITY 4: Lake Pollution Cleanup Revisited

First, explain to students that after exploring ways to clean an oil spill, they are going to now be viewing a video that explores the cleanup from other pollutants in the Great Lakes. This video will look at the pollution cleanup that arose as a consequence from copper mining near Lake Superior. Instruct students that they will again be using the 4 Notes Summary protocol to debrief what they learned after the video is complete.

Next, have a volunteer read the introductory overview article [Buffalo Reef Restoration](#) from Great Lakes Now to the whole class.

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Then, show the Waters Restored video segment from Great Lakes Now to the whole class.

Last, after the video, 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. Ask students to reflect on how much more the oil spill cleanup lab gives them an appreciation of pollution cleanup efforts in the 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 describe which method of cleanup (e.g., absorbers, booms, skimmers, or dispersants) was most effective and why.

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.

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