

A Lot of Pooping, Blooming, and Dying

Effects of Disturbance on Ecosystems

Heather Shaffery, Teresa Christensen
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Grade Level	7th Grade	**Time Frame**	4-5 class period(s)
Subject	Science	**Duration**	200 minutes

Essential Question

How do disruptions to a physical component of an ecosystem lead to shifts in all its populations? Specifically, how do increases in nutrient levels change aquatic ecosystems?

Summary

Students will explore the effects of an increase in nitrogen and phosphorus in aquatic ecosystems. They will collect data from an algae growth investigation and complete a reading about human-produced nutrient inputs. Using these sources of evidence, students will develop a causal explanation of the relationship between human activity, nutrient cycles, and changes to organisms' population sizes during eutrophication of aquatic ecosystems. Throughout the lesson they will create and revise a Claim-Evidence-Reasoning statement that explains the phenomenon of algae blooms. Note: The investigation in this lesson has students collecting data for 14 school days. See teacher's note in Engage for more details.

Snapshot

Engage

Students complete an I Notice, I Wonder activity and write an initial Claim-Evidence-Reasoning (CER) explanation for the algal bloom phenomenon they observe.

Explore

Students conduct an algae growth investigation.

Explain

Students identify the steps that occur during the process of eutrophication, learn about nutrient cycles, and identify where in nutrient cycles humans add excess nutrients to systems. They also revise their CER.

Extend

Students read an article about specific kinds of human nutrient inputs and create Cognitive Comics illustrating how excess nutrients cause changes in population sizes during an algal bloom.

Evaluate

Students synthesize the data they collected and scientific concepts to make a final revision to the CER that explains the phenomenon they observed in the Engage section.

Standards

ACT College and Career Readiness Standards - Science (6-12)

IOD302: Understand basic scientific terminology
SIN301: Understand the methods used in a simple experiment
SIN302: Understand the tools and functions of tools used in a complex experiment
EMI401: Determine which simple hypothesis, prediction, or conclusion is, or is not, consistent with a data presentation, model, or piece of information in text

Next Generation Science Standards (Grades 6, 7, 8)

MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Oklahoma Academic Standards (7th Grade)

7.LS2.4 : Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Attachments

- CER Rubric—A Lot of Pooping, Blooming, and Dying.docx
- CER Rubric—A Lot of Pooping, Blooming, and Dying.pdf
- CER Scaffolds—A Lot of Pooping, Blooming, and Dying.docx
- CER Scaffolds—A Lot of Pooping, Blooming, and Dying.pdf
- Data Sheet—A Lot of Pooping, Blooming, and Dying - Spanish.docx
- Data Sheet—A Lot of Pooping, Blooming, and Dying - Spanish.pdf
- Data Sheet—A Lot of Pooping, Blooming, and Dying.docx
- Data Sheet—A Lot of Pooping, Blooming, and Dying.pdf
- Eutrophication Reading Short Version—A Lot of Pooping, Blooming, and Dying - Spanish.docx
- Eutrophication Reading Short Version—A Lot of Pooping, Blooming, and Dying - Spanish.pdf
- Eutrophication Reading Short Version—A Lot of Pooping, Blooming, and Dying.docx
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- Eutrophication Reading—A Lot of Pooping, Blooming, and Dying - Spanish.docx
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- Eutrophication Reading—A Lot of Pooping, Blooming, and Dying.docx
- Eutrophication Reading—A Lot of Pooping, Blooming, and Dying.pdf
- Investigating What's Blooming Teacher Guide—A Lot of Pooping, Blooming, and Dying.docx
- Investigating What's Blooming Teacher Guide—A Lot of Pooping, Blooming, and Dying.pdf
- Investigating What's Blooming—A Lot of Pooping, Blooming, and Dying.docx
- Investigating What's Blooming—A Lot of Pooping, Blooming, and Dying.pdf
- Lesson Slides—A Lot of Pooping, Blooming, and Dying.pptx

Materials

- Lesson Slides (attached)
- CER Scaffolds (attached; optional; one per student)
- Investigating What's Blooming? handout (attached; one per student; two-sided)
- Data Sheet handout (attached; one per student; two-sided)
- Investigating What's Blooming? Teacher Guide (attached; one per teacher)
- Eutrophication Reading (attached; one per student)
- Eutrophication Reading Short Version (attached; optional; one per student)
- CER Rubric (attached; one per teacher)

  Lab investigation material (see Teacher Guide for more details):
  - Mason jars
  - Cheesecloth or coffee filters

- Rubber bands
- Masking tape
- Pond/lake water (or commercial algae culture)
- Bottled spring water
- Graduated cylinders
- Nutrient kits (from aquarium shop or pet store)
- Fertilizer (powdered or granulated)
- Powder detergent containing phosphates
- Nitrile or latex gloves
- Safety goggles
- Digital scale or balance
- Camera (optional)

Engage

Teacher's Note: Investigation Timing

Plan for students to collect their algal bloom investigation data over the course of 14 school days (approximately 3 weeks). It is recommended that you either have students collect data for 3 weeks prior to beginning the lesson, or set the rest of the lesson aside to teach a complementary standard until students have completed their data collection. Consider Wolves of Yellowstone which covers MS-LS2-3 (OASS 7.LS2.3).

Daily qualitative observations (visual descriptions) should only take a few minutes but plan for extra time on days 1, 7, and 14 for students to collect quantitative nutrient measurement data. See the attached **Investigating What's Blooming? Teacher Guide** for more details.

Use the attached **Lesson Slides** to guide the lesson. Show **slide 2** to introduce the lesson. Move to **slides 3-4** to discuss the essential question and lesson objectives. Show the image of a fish in an eutrophied pond on **slide 5**. Use the I Notice, I Wonder strategy to have students make observations and ask questions about the picture they see. Take a few minutes for students to share with the class what they noticed and wondered about the picture. Record their responses on the board or on chart paper. Do not tell the students that what they see is eutrophication or explain the concept at this time. They will develop the concept and vocabulary later in the lesson.

Go to **slide 6** and ask students to make a claim about what caused the phenomenon they observe in the picture. Students should try to explain the cause of the phenomenon they see (as best as they can at this point in the lesson) using the CER strategy. They can use their observations about the picture as evidence to support their claims of what they think happened.

Teacher's Note: Claim, Evidence, Reasoning (CER)

Since this is an initial explanation that they will revise later, it's okay if students' answers are incorrect. Just make sure they are using the correct format to help them practice constructing high-quality explanations. If students have limited experience developing evidence-based explanations, consider using some of the sentence stems in the **CER Scaffolds** handout. Read more about the strategy in this Claim-Evidence-Reasoning (CER) article if you are unfamiliar with it.

Explore

Go to **slide 7**. Put students into lab groups (2-4 students) as you see fit and provide each student with a copy of the **Investigating What's Blooming?** handout and **Data Sheet** handout.

Give students instructions to obtain materials for the investigation. Give students specific guidance for how to complete the nutrient measurements since the procedures will vary depending on your testing kits.

At the end of the 14-day investigation, have each lab group analyze their data. Show **slide 8** of the lesson slides. Ask students to describe what happened to the jars based on their visual observations and how the nutrient levels changed over time. Based on their analysis, students should draw a conclusion about the relationship between nutrients and the water conditions. The last page of the Data Sheet includes space for students to record their ideas in a way that will support their ongoing CER revisions.

Optional Activity

It may be helpful for students to create charts and graphs with data they collected of nutrient level changes and the water conditions to help them visualize what the numbers mean.

Pair up students from different lab groups so that they can discuss their findings. Go to **slide 9**. In these pairs, students should explain to each other, one at a time, their group's conclusions for the Investigating What's Blooming? They will determine if there are any differences between their conclusions, why their conclusions are different, and which conclusions are supported by their data. They should record any new conclusions they agree upon on their Data Sheets.

Explain

Ask students to return to their original lab groups and pick a speaker. Have each group's speaker share their conclusions with the class. Next, move to **slide 10** and formally introduce the terms *eutrophication* and *algal bloom* to describe the phenomenon they investigated. Help students explain what happens in the aquatic ecosystem when an algal bloom occurs. Asking students to walk through what occurs in a sequential order will help them develop an understanding of the impacts of eutrophication for themselves. Move to **slide 11** after students have attempted to explain it themselves.

Teacher's Note

1. An algal bloom occurs, and some plants underwater also grow quickly.
2. Sunlight is blocked from reaching deep into the water.
3. A lack of sunlight kills some underwater plants. Algae also dies quickly.
4. Dead plants and algae create a perfect environment for decomposers.
5. As decomposer activity increases, the amount of oxygen in the water decreases quickly.
6. Organisms in the water that need oxygen die.

Go to **slide 12** and ask the students if they have enough information to explain how the nutrients contributed to the algal bloom. (They don't yet!)

Introduce students to the nitrogen and phosphorus cycles using **slides 13** and **14.** Move to **slide 15** and instruct students to draw one model that illustrates how both phosphorous and nitrogen enter aquatic ecosystems. These cycles usually produce normal amounts of nutrients, but severe algal blooms come from excess nutrient input. Ask students the questions listed on slide 15:

- Where in the cycles are extra nutrients most likely to enter the aquatic ecosystem?
- Why are these parts of the cycle more likely to produce extra nutrients?

Sample Student Answers

Where in the cycles are extra nutrients most likely to enter the aquatic ecosystem?

- via fertilizer, human impact

Why are these parts of the cycle more likely to produce extra nutrients?

- Humans do things (e.g., adding fertilizer to lawns and crops) and cause things to happen (e.g., air pollution) that are not part of natural processes. Therefore, anything humans do that adds nutrients to the environment is considered "extra."

Go to **slide 16.** At the end of note-taking and discussion, each student should revise their initial CER to reflect the data they collected in the investigation. Using new vocabulary they learned, they should include details about the nutrient cycles.

Extend

Next, students will read about two of the major human inputs of excess nutrients specific to algal blooms. Go to **slide 17** and give students a copy of the **Eutrophication Reading** (or the smaller **Eutrophication Reading Short Version**). Using the reading, as well as the resources and notes they have gathered so far, ask students to create a Cognitive Comic that describes how nutrient inputs change population sizes of organisms during an algal bloom. These can be done individually, in pairs, or in their previous lab groups, at your discretion. To help students provide specifics in their comics, consider discussing what organisms are found in aquatic ecosystems (other than fish!) to give them a range of organisms to choose from.

You can choose for students to follow the format of a six-panel comic or allow students to change the number of panels on their Cognitive Comics. Consider offering comic strip layouts to help them format their drawings. Have students present their comics to the class. At the end, highlight the steps of the process and give students time to make notes about anything they missed in their drawings.

Teacher's Note: Tech-Integrated Strategy

Consider using technology as a way for students to draw their comics. Cognitive Comics with Canva is a great way to have students illustrate their understanding without them being concerned with their artistic ability.

Evaluate

To wrap up the lesson, review the phenomenon discussed during the Engage section by moving to **slide 18.** Have students create a final CER that explains what caused the phenomenon. Students should address both the green color of the water and the dead fish as part of their CER.

The **CER Rubric** attachment is a generic rubric for instructors' use that you can modify to include the specifics of this lesson. Students' claims should reference increased nutrient input and evidence should come from their investigation data. Encourage them to reference their notes, the reading, and class discussions when explaining their reasoning.

Sample Student Answer: Evidence and Reasoning

Increased nutrient levels and visual observations of algae growth in students' investigations would be appropriate evidence to support the formation of algal blooms. Observations of decreased dissolved oxygen in their investigations would support the fish's death due to reduced oxygen in the water. Their reasoning might include mentions of nutrient cycles, fertilizer and sewage input sources, and details about the process of eutrophication. These examples are not the only acceptable answers, but they should help guide your assessment of student understanding.

Alternative Assessment: Argumentative Essay

Rather than writing a brief CER, you might consider asking students to expand on their ideas and write an argumentative essay on the effects that large agricultural farms have on local aquatic ecosystems. In their essays, students would explain that the large agricultural farms' fertilizer and sewage cause eutrophication, which causes a change in the aquatic populations. Students can present both an oral and written argument using data. You can view some examples of argumentative essays on MyPerfectWords.

If you opt to go this route, you might give students an opportunity for additional research in the Extend section to gather more external sources of evidence and support.

Resources

Gioffre, D. (n.d.). Eutrophication Reading. Hillsborough; Hillsborough Middle School. Funded by the National Science Foundation, Biocomplexity in the Environment Program, Award #0120453.

Graham, J.L. (2018). *Cyanobacterial accumulation at Binder Lake, Iowa* [Photograph]. US Geological Survey. https://toxics.usgs.gov/photo_gallery/photos/emer_cont/cyanobac/dead_fish_binder_lake_iowa_7_l.jpg

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MyPerfectWords. (n.d.). Argumentative Essay Examples: Samples & Tips. https://www.myperfectwords.com/blog/argumentative-essay-guide/argumentative-essay-examples