

When Water is Dangerous

Unit: Strand BIO.1: Interactions with Organisms and the Environment	Utah SEEd Standard / NGSS Performance Expectation: (Core Guides) Standard BIO.1.5 Design a solution that reduces the impact caused by human activities on the environment and biodiversity. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize a solution. Examples of human activities could include building dams, pollution, deforestation, or introduction of invasive species.	Time: 75 minutes
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Access to all materials for this lesson: <https://byu.box.com/s/mqe4bqlinzkfqmy7thyygahu23zgee4>

Anchor Phenomenon	Picture of lake closed because of algal bloom in Teacher Slides
Driving Question(s)	What human activities contribute to algal blooms?
Performance Task	Students will develop a solution to a local water quality concern.



Lesson Summary:			
	Time	Guiding Question / Learning Objective	How are students answering the guiding question or meeting the learning objective? (Note the SEPs, DCIs, and CCCs in the corresponding color.)
 Engage	5 min	What might cause access to a lake to be restricted? Students will ask questions using the picture as the frame of reference.	Brainstorm discussion at tables, have students come up with ideas about why the lake has been closed, and then ask questions about what students notice or wonder.
 Explore	15-20 min	Students learn the human impact causing fluctuations in the ecosystems through the lens of local algal blooms causing water quality issues.	Show a short video showing an example of an algal bloom caused by cyanobacteria. Students read and annotate the “Student Handout” instructing them about • HABs (harmful algal bloom) • Harmful versus nonharmful algae • Causes of cyanobacteria blooms • Human causes of the algal blooms
 Explain	20-30 min	What is contributing to the algal bloom?	Students are given a case study about a local algal bloom. They will use the information to determine the human activities that may be contributing to the HAB in that particular location.
 Elaborate	10-20 min	Students design a solution to address a local water quality issue caused by a harmful algal bloom. It could be preventative or restorative.	Students will use an exit ticket with their explanations of human impacts on water quality as well as their solution explanations.
 Evaluate		The teacher will use the students' presentations of their solutions as the lesson's assessment tool.	

Three Dimensions Focused on in This Lesson		
Disciplinary Core Idea: NGSS Appendix E Utah SEEd Bio1.5 Fluctuations in conditions caused by human activity (anthropogenic) can affect the function of ecosystems.	Science and Engineering Practices: NGSS Appendix F Constructing Explanations and Designing Solutions Students will design a solution to a local water quality concern.	Crosscutting Concept: NGSS Appendix G Cause and Effect Solutions can be designed to cause a desired effect and reduce unintended impacts caused by human activity on ecosystems.
Learning Objectives 1. Students will identify specific human activities that cause fluctuations in aquatic ecosystems. 2. Students will design a solution to address a local water quality concern.		
Related Knowledge and Skills from Prior Grades		
Disciplinary Core Idea: NGSS Appendix E Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. Students will learn to identify human activities as disruptions to ecosystems.	Science and Engineering Practices: NGSS Appendix F Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing. Students will determine human activities that cause fluctuations in an aquatic ecosystem and then will design solutions to those causes. Solutions can be preventative or restorative.	Crosscutting Concept: NGSS Appendix G Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. Students will learn how to use cause and effect relationships in an aquatic ecosystem to decide on a solution to those causes or effects.

Connections to Mathematics and ELA/Literacy Standards

ELA/Literacy Standards:

English Language Arts:

- **RST.9-10.8:** Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
 - **RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
 - **RST.11-12.8:** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
 - **RST.11-12.9:** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
 - **WHST.9-12.5:** Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- WHST.9-12.7:** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Mathematics Standards:

- **MP.2:** Reason abstractly and quantitatively.
- **MP.4:** Model with mathematics.
- **HSN.Q.A.1:** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- **HSN.Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling.

HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.



Materials		
Handouts	Lab Supplies	Other Resources
Student Handout Student Info Sheet Case Studies Folder Exit Ticket	Sticky notes	Teacher Power Point Algal blooms: • Current state of state algal blooms Utah Department of Environmental Quality • Utah Lake: https://www.fox13now.com/news/local-news/harmful-algal-bloom-warnings-issued-for-portions-of-utah-lake • Zion NP: Zion National Park Algal Blooms • Panguitch Lake: https://www.kuer.org/energy-environment/2018-09-25/toxic-algae-closes-panguitch-lake-warnings-remain-at-seven-other-utah-sites • Mantua Reservoir: https://www.hjnews.com/tremonton/toxic-algal-blooms-return-to-mantua-reservoir/article_6c79b454-ebf6-5509-97e8-107824abecaf.html • Mill Meadow Reservoir (Wayne County) Cyanobacteria Bloom Utah Lake Time Lapse Utah Lake News Story CDC Cyanobacteria Deseret News Algal Bloom article Extention and Intervention Materials

ENGAGE

What might **cause** access to a lake to be restricted?

Brainstorm discussion at tables: ideas about why the lake has been closed. Students will **ask questions** about what they notice or wonder.

Teacher:

- Using the attached [Teacher Power Point](#), the teacher will show the class a picture of a lake with warning/closure signs. **(Slides 1-2)**
- The teacher will give students 30 seconds to identify things they notice and wonder about the picture. After 30 seconds, the teacher will allow students to turn and tell a classmate what they notice or wonder about the picture. The teacher will allow the class a chance to share out their notices or wonders.
- The teacher then poses the following questions to students and asks students to reply with a thumbs up or thumbs down. **(Slide 3)**
 - Have you ever seen a body of water closed to recreation or fishing?
 - Have you ever had a boil order?
 - Have you ever seen water that looked, smelled, or tasted unsafe?

Student:

- Students will signal thumbs up or thumbs down to a series of questions about past experiences with unsafe water posed by the teacher.

Teacher:

- The teacher will explain to students that one reason that lakes and streams may close is due to harmful algal blooms. **(Slides 4-5)**
- The teacher will explain the various ways of describing these blooms (Harmful algal blooms, blue-green algae, Cyanobacteria). **(Slide 5)**

Teacher Tips

This activity should help students connect to prior ecosystem knowledge and/or to circumstances they have experienced in their local environment, city, and home.

The teacher should move around watching and listening for student ideas. Making a comment about how they are thinking can validate student thinking.

These questions may be used, but, more importantly, watch for questions students may pose that would be great to use for the thumbs-up/down activity.

EXPLORE

Students use the class video and handout to explore information

- The teacher will explain that the following video is made by the Department of recreation in California about the dangers of Cyanobacteria blooms. The teacher will ensure that students understand that even though the video was created for the residents of California, the content is still relevant to residents of Utah. **(Slide 6)**
 - The teacher will hand out a sticky note to each student in the class and instruct them to write down at least three things about harmful algal blooms that stick out to them while watching the video. The teacher will also instruct students to write down at least one question that they have about HABs. **(Slide 6)**
 - The teacher will show the video to the whole class: [Understanding the Dangers of Cyanobacteria](#) **(Slide 6)**
 - After the video, the teacher will allow students to share the contents of their sticky notes with a classmate and will solicit a few responses for whole class sharing. The teacher will then ask students to stick their notes at the top of their desks/tables.
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- The teacher will advance the slideshow to the Utah Map screenshot from the Utah Department of Environmental Quality. Explain to the students that just like they do in California, scientists in Utah actively monitor bodies of water for Cyanobacteria. **(Slide 7)**
 - The teacher will then click the link on **slide 7** to navigate to the state of Utah's HAB real time tracking website. The teacher will ask the students which lakes, reservoirs, and rivers they frequent and will look up the current conditions at a few local waterways.
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- The teacher will give students the online Student Information handout. Ask them to highlight the **causes of algal blooms**. **(Slide 8)**

Student:

Teacher Tips

The sticky note should provide learners at all levels a chance to write anything that sticks out to them. Look for chances to recognize student ideas especially in ELL and struggling learners.

Tip: Be sure to emphasize the **Cause and Effect** CCC here.

- Based on the time of year, there may NOT be active algal blooms in the state. We recommend the teacher look ahead of time to know whether to visit the site with students.

Differentiation:

One idea for helping all learners in your classroom is to provide longer, more detailed articles or shorter, more direct articles for students to read and annotate.

Teachers may want to create case studies for a particular body of water that is more applicable to the students. An alternate activity could be to use a news article discussing a local HAB.



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- Students will highlight the causes of algal blooms on Student Handout. - Once causes have been highlighted, students will return to the info sheet and highlight the human-activity that contributes to those causes. This can be done in a different color or underlined. Teacher: - The teacher will give students a minute to turn and talk with a neighbor about what they highlighted. If time permits, groups can share the causes and human activities discussed with their groups to the class. - The teacher will distribute the “Student Assignment” to the class (digital or printed). Students complete the first portion of the assignment. Provide each group a case study discussing a local HAB. Teacher should move around the class during this time. Student Do: (5 min)	
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EXPLAIN	
What might cause access to a lake to be restricted?	
- The teacher will put students in groups of 3-4 and will provide each group with a digital case study that covers a local HAB along with a student assignment sheet to guide the groups in their learning. (Slide 10) - Before exploring their assigned case studies, groups should answer question 1 on the assignment sheet that asks students to identify “Of the causes of harmful algal blooms, which are influenced by human activity?” - Students will then use the information in their case studies to determine the potential causes of these specific, local algal blooms. Specifically, students will identify what human activities may be contributing to the issue.	Teacher tips

ELABORATE

Students design a solution to address a local harmful algal bloom. It could be a current problem or a prevention solution for the future.

- The teacher will explain to the class that now that they have researched the human influenced causes of the HABs in their local case study, each group will elaborate on their learning by designing a solution to reduce or eliminate the HAB. The focus will be on mitigating the human activities that can cause the blooms.
- The teacher will provide students with a rubric to guide their solutions.
- Before getting started as a group, the teacher will time the class for 3 minutes while they brainstorm individually. There is space provided on the student assignment page for individual brainstorming. **(Slide 11)**
- The teacher will get the groups back together and have them share their individual brainstorms; the groups will produce a plan together and begin to refine their idea, using the student assignment sheet and rubric to guide them. The teacher will sign off on groups work once they are finished filling out the student assignment sheet.
- As the culminating activity for this lesson, the teacher will instruct students to create a piece of visual media that they will present to their classmates about their solution. Possibilities for media include a poster, a brochure (paper or digital), a billboard, etc. The teacher will explain that students' solutions can be preventative or restorative, they can be mechanical, social, or educational. The teacher may need to spend some time discussing what each of those things mean.

Teacher Tips

Differentiation:

Students are provided with time to brainstorm their own ideas before working as a group.

Students also have access to additional resources on their "Student Handout." These are meant to help explain the phenomenon further if needed, but also to look further into the phenomenon.

Possible extensions are found at the end of the lesson.

Rubric provided for students' [Exit Ticket](#)



EVALUATE

- The teacher will use the student presentations of their solutions as the lesson's assessment tool. Students should score 10/12 on the rubric to be considered proficient. Teachers should adjust the point scale accordingly to fit individual classroom needs.

Assessment rubric: [Exit Ticket](#)

(This is the same as the student exit ticket)

POSSIBLE EXTENSION / ALTERNATIVE ADAPTATIONS

Students can explore the resources found on the "Student Handout."

As an extension, the teacher can have students refer to their post-it notes, read their question, and determine whether it was answered. If it was, have them write the answer to their question.

Students will place their post-it note on the back of their assignment.

In "Elaborate"

The Student Handout includes additional resources that can be used to help understand the problem better and/or explore the phenomenon further.

For further extensions and interventions see articles in the "Student Materials" folder:

<https://byu.box.com/s/j2alaeo0hzbqp6dkwd23hfnfzrzcmyu>



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ASSESSMENT MATRIX

This matrix supports three-dimensional assessment across this 5E instructional sequence. For each E phase, list the artifacts/strategies that provide evidence of what students know and can do as they work towards proficiency. These formative assessment opportunities should be used to track student progress. The dimensions that are reflected in the Evaluate are the ones that can be assessed summatively at the end of this 5E plan. Make sure these Make sure to call out these connections in the lesson above so they are explicitly addressed.

	Engage	Explore/Explain 1	Explore/Explain 2	Elaborate	Evaluate
Design a solution	n/a	n/a	n/a	Students design a solution to address a local water quality issue	n/a
Human Impact on Ecosystems	n/a	Students list human activities that contribute to HABs	Using a case study from a local HAB, students determine human impacts that contribute to problem	Students design a solution to address a human-caused water quality issue.	n/a
Cause and Effect	n/a	Students highlight causes of HABs	Determine which activities specifically cause HABs	Students design a solution addressing specific causes of HABs	n/a

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