Harmful Algae Bloom and Water Quality

TEACHER

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SUBJECT/GRADE LEVEL

Subject

Biology

Environmental Science

Grade:

Middle School

Materials

- Included worksheets (in Appendices)
- Laptops or computer access
- Beaker or aquarium with algae

Next Generation Science Standards

- MS ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- MS ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

LESSON OBJECTIVE(S)

Students distinguish between casual and correlational relationships between human activity and the negative environmental impact of harmful algae blooms and use this data to monitor the human impact on water quality.

CAREER CONNECTION(S)

Mentor Background: Victor Medina: Research Environmental Engineer at Army Engineer Research & Development Center: My career has been primarily in environmental research. My work is largely applied, on the edge of research and full-scale application. I have had the opportunity to work on a wide range of problems, and because of this, I have developed a broad perspective that has allowed me to better develop my work to actual usable solutions.

STEM Careers: Environmental Scientist, Chemist , Chemical engineer, Environmental engineer

ENGAGEMENT

Share one or both video clips to introduce the problem of red tides (harmful algal blooms).

https://www.youtube.com/watch?v=PaV0XV-DDcs

https://www.youtube.com/watch?v=kNL99XVJjQo

Visit the site http://myfwc.com/research/redtide/statewide/ for current data and maps of Florida's Gulf Coast and the extent of red tide. Discuss with students the locations and effects of HABs.

If possible, set up a clear container with algae present. Sources may include pond water, stream water, or water from a fish tank. Allow several days or a few weeks for the algae to become easily visible. Keep the source covered to prevent the algae from becoming airborne. Ask if any students have experience with cleaning fish tanks, and how the growth of algae is prevented. Ask students what the impact on other organisms living in the fish tank might be.

Through discussion identify student knowledge regarding HABs, such as where HABs might occur (in addition to the examples in the video clips). Ask students to pose questions about HABs. Use a card-sort or similar activity to group student questions. Guide students to identify questions related to water quality and pollution, effects of pollution and HABs on living organisms, algae as a living organism, impacts on people (both physical and economic) and solutions or prevention. The exploration phase will allow students to develop an understanding of water quality though data collection and the explain phase will provide students with an opportunity to research answers to other questions.

Possible misconceptions could include the idea that all algae is harmful, all algae is toxic, and algae is a product of pollution. Also, most "algae" is actually cyanobacteria. If appropriate, review the role of cyanobacteria in Earth's history.

EXPLORATION

As students began to learn about the effects of "harmful algal blooms," you may want to begin the discussion about water quality and how not every water source is safe to drink. One of the ways to bring this home would be to have the students collect water samples from around school; inside including but not limited to the bathroom, kitchen, and water fountain. Outside could include a water puddle and even from other schools or buildings that may be near. Allow them to label each sample and record the pH for each. Having the students research the best pH for drinking water would then lead to an extension where the students research the breakout of Algal Blooms in Lake Erie and how the water wasn't fit to drink. Also, research the situation in Florida and how the breakouts are affecting the water supply. You could then show them one of the many videos of individuals taking the pH of different brands of drinking water and asking why they think companies falsify information and what would be some of the possible effects of water that have been consumed that has an unfavorable pH. If possible find the pH of water with "safe" algae and the pH of contaminated water.

Students should be able to answer the following questions:

What is pH?

Why is pH important?

What happened in Lake Erie?

Is there a difference in the pH of the different water samples?

What is considered a safe pH for drinking water?

See Appendix A for a coinciding worksheet.

EXPLANATION

Students will conduct research using the internet or print resources obtained by the educator in order to answer their questions and develop a deeper understanding of HABs, either locally or in other locations. Students will select, either individually or in pairs, one of the questions refined from the original engagement activities or a new question that has been formulated during the exploration activities, as determined by the educator.

See Appendix B for Coinciding Worksheet (or Google Doc Link)

See Appendix C (link) for a list of helpful links. Some of these sites are more suitable for student use while others are intended for educator use. Any could be used for student research, however; The video clips listed for the engagement activity could also be used for student research. This list is as comprehensive as possible, to support a variety of student questions.

ELABORATION

The National Centers for Coastal Ocean Science (NOAA) has identified seven regions where HABs are a critical problem to federal, state, and local managers. From the list below, select one region and complete the Harmful Algal Bloom (HAB) Forecasting activity.

Florida and eastern Gulf of Mexico (Karenia brevis)

Western Gulf of Mexico (Karenia brevis)

Lake Erie (cyanobacteria)

Gulf of Maine (Alexandrium fundyense)

Washington Coast (Pseudo-nitzschia)

California Coast (multiple species)

Chesapeake Bay (multiple species)

Suggested Sources:

Harmful Algal Bloom (HAB) Forecasting

Contributors and Data Providers

HAB Forecast Research

See Appendix D for the Forecasting Activity

EVALUATION

Harmful Algae Blooms Rubric

Criteria				
	3	2	1	Points
HAB Impact	I've listed 2 impacts the HAB has on the region and explain how it affects the population	I did not address 2 impacts the HAB has on the region or did not explain how it affects the population	I did not address 2 impacts the HAB has on the region and did not explain how it affects the population	
Citation	I've correctly cited all of my sources used to research the region	I've partially cited all of my sources used to research the region	I did not correctly site all of my sources used to research the region	
PH Chart	I've presented three affected populations and indicated the level of respiratory irritation impact in the chart	I've presented two affected populations and indicated the level of respiratory irritation impact in the chart	I did not present three affected populations and indicated the level of respiratory irritation impact in the chart	
Total				

This rubric is provided to evaluate each student's or team's HAB Forecasting Activity.

APPENDIX A

Background: Lake Erie was heavily affected by "**Harmful Algal Blooms**." If an area is affected by these organisms the water can be deemed unsafe to drink, which is what happened to those who relied on Lake Erie for water. When algae grows on water, the water becomes more acidic because it lowers the pH. If the water then becomes contaminated with Harmful Algal Blooms, the pH rises to more of a base and can reach as high as 10 or 11.

Keywords:

Harmful Algal Blooms-"Harmful Algal Blooms are organisms that can lower the oxygen in the water and potentially kill marine life.

pH-pH is the term used to measure the amount of hydrogen in an liquid. The numbers range from 0-14. 0-6 is considered acidic; an example would be Coca-Cola. 7 is neutral; an example would be tap water. 8-14 is considered a base, or alkaline; and example would be baking soda.

Directions: In this activity you will be looking at the pH of different liquids using a pH meter or
After collecting the pH of at least 3-4 different liquids; soda, soapy water, orange juice, etc, and compare which liquids have pH close to water that has Harmful Algal Blooms and record the pH in the space provided in the space below.

Name of Substance	pH	Close to water at Lake Erie? Yes or No

APPENDIX B

Harmful Algal Blooms Research

Name _____

My focus question is:

What I learned:

Is this information specific to a location? If so, explain where.

The most important idea I learned is:

Where I found this information:

APPENDIX C

Video clips:

https://www.youtube.com/watch?v=LqXKWT9cyOk Across US, Toxic Blooms Pollute Lakes

https://www.youtube.com/watch?v=gMwQaHtK904 Battling the Bloom: Lake Erie

https://www.youtube.com/watch?v=AvigoZgYbT4 Predicting Harmful Algal Blooms

https://www.youtube.com/watch?v=1ohQ5RhGtPc Battle of the Blooms (Clean Up)

https://www.youtube.com/watch?v=8K_rN-_NDmI What Causes Killer Algae?

https://www.youtube.com/watch?v=MoI7WaGWqiY What are Harmful Algal Blooms?

https://www.youtube.com/watch?v=18wFyybikIY Safeguarding Drinking Water

https://www.youtube.com/watch?v=nQPMIQuYY2k HABs, Red Tide, Green Tide

https://www.youtube.com/watch?v=kxLc5AgT0qk HABs Utah

https://www.youtube.com/watch?v=NBhcrryEA4c HABs Idaho

https://www.youtube.com/watch?v=hlD2qxIr0WI HABs and Wildlife

https://www.youtube.com/watch?v=-qoc3TlkAWU HABs Montana

https://www.youtube.com/watch?v=d3aWkhNIKYI Engineering Solutions

https://www.youtube.com/watch?v=w2JtXVLZcs0 HABs

https://www.youtube.com/watch?v=z99hXQJkc6k HAB FAQs

Resource articles and lessons

http://cees.iupui.edu/research/algal-toxicology/bloomfactors

http://www.coseeflorida.org/uploads/2/8/3/4/28342871/harmful-algal-blooms-bad-algae-lesson-plan.pdf

http://www.seaturtleinc.org/effect-of-red-tide-on-sea-turtles/

https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/ecosystems-branch/algal-blooms

https://knpr.org/npr/2018-08/helping-clean-floridas-red-tide

https://oceanservice.noaa.gov/education/kits/estuaries/media/supp_estuar10f_ph.html

https://oceanservice.noaa.gov/news/redtide-florida/

https://pets.thenest.com/algae-affect-aquarium-water-chemistry-12324.html

https://serc.carleton.edu/microbelife/topics/redtide/education.html

https://start1.org/red-tide/effects/

https://water.usgs.gov/edu/ph.html

https://www.e-education.psu.edu/earth540/content/c7_p4.html

https://www.npr.org/2018/08/23/641279819/scientists-battle-red-tide-that-turned-florida-coast-into-wildlife-killing-field

https://www.grc.nasa.gov/www/k-12/fenlewis/Waterquality.html

https://www.nationalgeographic.com/environment/2018/08/news-longest-red-tide-wildlife-deaths-marine-life-toxins/

https://www.npr.org/2018/08/14/638616228/floridas-gulf-coast-battles-deadly-and-smelly-red-tide

https://www.npr.org/templates/story/story.php?storyId=5716718

https://www.sciencedaily.com/releases/2012/12/121220161753.htm

https://www.sciencedaily.com/terms/red_tide.htm

APPENDIX D

Selected Region: _____

List two impacts HAB had or currently has on your selected region:
Cite your source(s):
Record the affected population and the level of respiratory irritation impact below:

Affected Population	Respiratory Irritation Levels

Explain why people should be concerned about HABs.

Considering what you have learned during this lesson on HABs and pH, what role does pH play in the effects of HAB on aquatic life? Is this problem the same for people as it is for wildlife?

What suggestions can you make about the problems created by HABs? What should we do if an HAB strikes our area?