



“What’s in the Water, Anyway?”

Submitted by: Christi Ridley

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Target Grade Level: 9-12, Biology 1

Time Required: 90 minutes

Standards:

TN Biology BIO1.LS2.3: Analyze through research the cycling of matter in our biosphere, and explain how biogeochemical cycles are critical for ecosystem function.

TN Biology BIO1.LS4.3: Identify ecosystem services and assess the role of biodiversity in support of these services

TN Biology BIO1.LS4.3: Analyze the role human activities have on these services

Objectives:

Students will demonstrate comprehension of the water cycle, including the processes responsible for changing forms, the different states of water, and how humans may impact the water cycle.

Students will demonstrate understanding during Google Earth Tour (while using Biotic Index of Biological Integrity chart) that cleaner water comes from ecosystems with higher biodiversity.

Students demonstrate through writing that certain conditions in the environment, which were exacerbated by humans, led to unclean water, which made people sick.

Materials:

- Google Earth Tour of local waters sources that were used for samples <https://tourbuilder.withgoogle.com/builder#play/ahJzfm3ZWItdG91cmJ1aWxkZXJyE-QsSBFRvdXIYgICgpsvB4wgM>
- List of organisms contained in each water sample
- Access to Internet for Interactive Water Cycle Activity: (<https://water.usgs.gov/edu/watercycle-kids-adv.html>); use intermediate or advanced level
- Article from NPR Health News: “Algae Toxins in Drinking Water Sickened People in Two Outbreaks” (<https://www.npr.org/sections/health-shots/2017/11/09/563073022/algae-contaminates-drinking-water>)



- “Biotic Index of Water Quality” chart from EPA
- Microscope (optional) for demonstration

Introduction:

Hook for lesson: Youtube video- “When is Water Safe to Drink?” (<https://www.youtube.com/watch?v=G244Q4AGJ7U>)

- Create student discussion on why clean water is such a vital natural resource.
- Ask students how they can know that their water is safe to drink.

Procedure:

- 10 minutes for watching “When is Water Safe to Drink? With Discussion from above (hook).
- 20 minutes for interactive water cycle activity: students work in pairs to find and write down 3 processes in the diagram, along with the water’s location before and after the process; students may write this in a composition type notebook or journal
- 20 minutes for reading NPR Health News article about algae toxins in Ohio water and writing a paragraph in their journal with the prompt, “Which conditions in the environment led to the water quality problem that made people sick and how did humans contribute to those conditions?”
- 30 minutes for Google Earth Tour of the 5 locations from which teacher sampled water; students should have a copy of the “Biotic Index of Water Quality” chart in front of them;
*Before Earth tour, pass out the chart, and discuss why there are three groupings of animals.
*Students will assess the water quality based on the organisms found in the sample.
*As a homework assignment, students can be given a small sealable container to bring in a pond or creek sample for analysis in class (with microscope)
- 10 minutes for lesson closure by taking turns verbally sharing one important fact about water that students learned during the lesson

Assessment:

Formative assessment completed with questioning about why clean water is such a valuable natural resource, while summative assessment will be accomplished with students writing (or drawing) about the conditions in the Ohio lake that made people sick

Closure:

Students in small groups will take turns sharing one important fact they learned during this lesson.

Modifications:

Students may be given copy of Google Earth Tour to aid students with language/hearing challenges, students may draw a diagram/flow chart (as opposed to the writing assignment) of what happens in the Ohio lake to make the water unsafe for drinking (and how humans affected the lake)



Algae Toxins In Drinking Water Sickened People In 2 Outbreaks

November 9, 2017 4:16 PM ET

GRETA JOCHEM



A algae bloom in Lake Erie contaminated the water supply for Toledo, Ohio, in August 2014. About 400,000 people were without useable water.

The Washington Post/Getty Images

The city of Toledo and nearby communities have earned the dubious distinction of being the first to report outbreaks of human illness due to algae toxins in municipal drinking water, according to a report published Thursday by the Centers for Disease Control and Prevention.

Both areas take their drinking water from Lake Erie. Blue-green algae are common there and in many other in freshwater lakes, where they can multiply in the heat of summer and **produce toxins**, according to the Environmental Protection Agency.

Exposure to water contaminated by toxins can cause rashes, respiratory issues and stomach or liver illness, and are an **ongoing issue** in recreational areas around the country.

Not to mention they can cause dead zones in bodies of water, killing marine life. And if you've ever seen one, they don't exactly make for a pleasant day at the beach. The bloom can look like chunks of green, earthy scum floating on the water, or make the water look like it's been dyed green.

In September 2013, microcystin toxin was detected in the water treatment facility for Carroll Township, Ohio, at **3.5 times the safety threshold** for drinking water. The township's 2,000 residents were **told** to



use water only for dishes and "non-drinking uses." Six people suffered gastrointestinal illnesses in the outbreak, [according to the CDC](#).

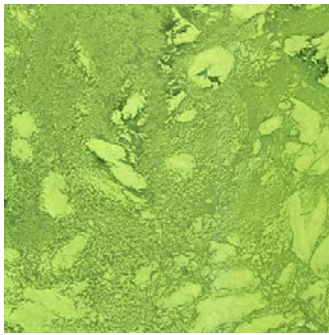
Then in August 2014, the state of Ohio declared a [state of emergency](#) after algal toxin contaminated the city of Toledo's water supply. This time around, 110 people got sick, and almost half a million people had to quit drinking tap water until they got the all clear.

Drawing water from the cold depths of a lake can reduce the risk of contamination, according to the EPA, and [water treatment facilities](#) can filter out or neutralize toxins.

Among the [biggest causes](#) of algae blooms: an excess of nitrogen and phosphorus in warm, unmoving water. Those nutrients [sneak into water](#) predominantly through the use of fertilizer in agriculture.

Warmer summers and higher rainfalls that cause sewer systems to overflow also help algae flourish.

It's too early to know whether drinking water problems due to algae are becoming more common, says Jonathan Yoder, a CDC epidemiologist and one of the report's authors.



ENVIRONMENT

Poisonous Algae Blooms Threaten People, Ecosystems Across U.S.

"The bottom line is that we can't say whether they are increasing or not, we know that the conditions that lead to algal blooms — nutrient pollution and warm water — are present in these freshwater lakes," Yoder says. "I think there's a continual risk in some of these areas for algal blooms and for some of them to be the type that have toxins that cause human illness."

Kathy Benedict, lead author of the paper and an epidemiologist with the CDC's Waterborne Disease Prevention Branch, points out that the cases in Ohio in 2013 and 2014 were not necessarily the first — they were just the first to be reported. The CDC is [tracking harmful algal blooms](#) through One Health Harmful Algal Bloom System (OHHABS) to help prevent illnesses, she says.

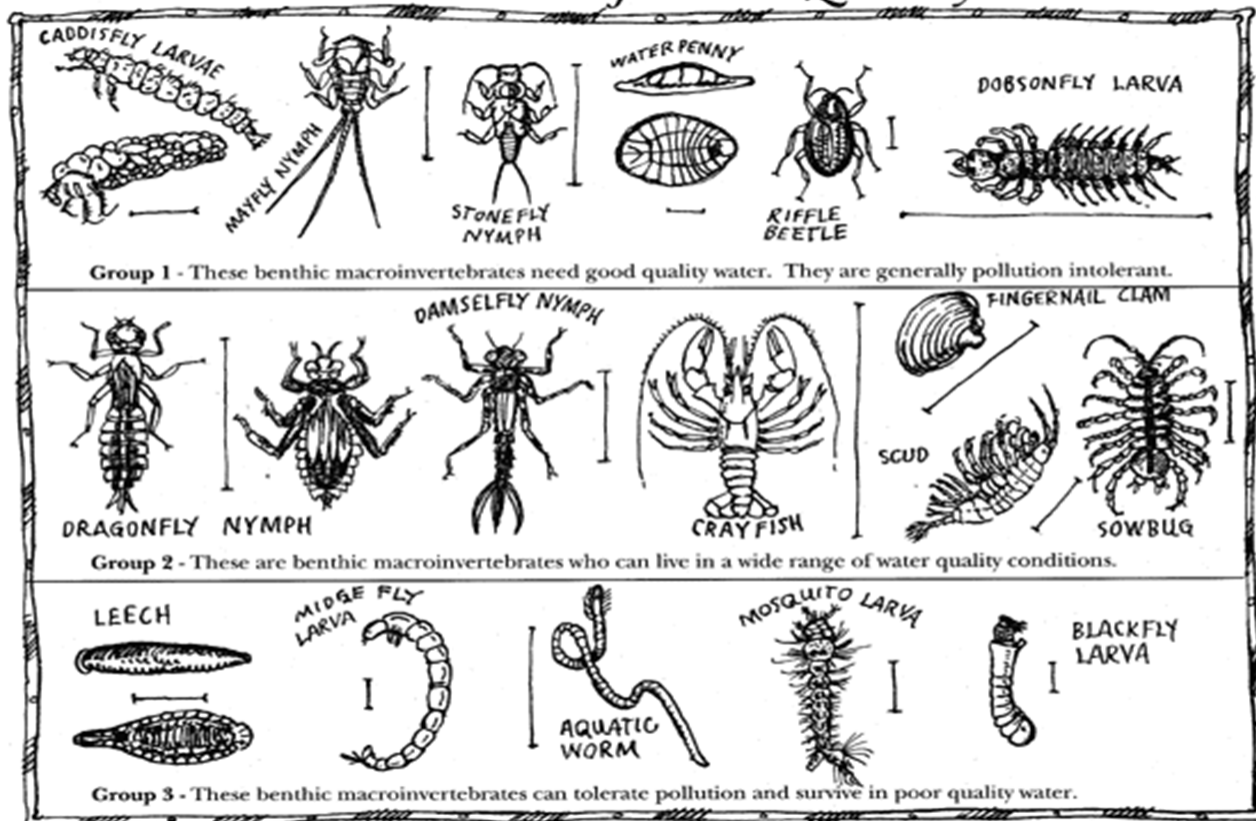
Fortunately, health problems from drinking water remain rare in the U.S. The CDC [report](#), which was published in *Morbidity and Mortality Weekly Report*, found that in 2013-2014, 42 outbreaks were reported in 19 states, resulting in 1,006 illnesses and 13 deaths. Most of the cases and all of the deaths were caused by *Legionella*, the source of Legionnaire's disease.

For Lake Erie, blue-green algae blooms have become an "[annual summer plague](#)," in the words of Cleveland's newspaper, *The Plain Dealer*. And they've just had one of their worst years yet. In the summer of 2017, blooms in the great lake were the [third-largest ever recorded](#). The good news is that this time around, no one got sick.

Greta Jochem is an intern on NPR's Science Desk.



Biotic Index of Water Quality



I - bar line indicates actual size.