

Photo by Ivan Bandura

Harmful Algal Blooms in the Chesapeake Bay

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Objective

Students will study water quality before and after algal blooms, using data from continuous monitoring stations on the Chesapeake Bay.

Standards Met: NGSS

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Should introduce students to/revise knowledge about water quality parameters such as pH, turbidity, salinity and dissolved oxygen.

Background

Harmful algal blooms occur when algae produce harmful or toxic effects on people and marine animals. They may result in large numbers of dead fish, and beaches being closed due to water discoloration. These algal blooms have been increasing in frequency, and have been reported in nearly every coastal U.S. state. These events endanger human health, coastal ecosystems, and regional economies. Algal blooms can suffocate coral reefs and other marine organisms, hurt the economies of coastal communities that rely on the water, and raise serious human health concerns. If people consume contaminated seafood or water, it can cause serious sickness or even death. Algae, being plants, need excess nutrients, and sunlight to thrive but also high temperature. This table summarizes different types of algae and their potential health effects.



Organism	Water Type	Color	Toxin	Target tissue	Health effects
<i>Alexandrium sp.</i>	Salt	Red or brown	Saxitoxins	Nerves and muscles	Paralytic shellfish poisoning, paralysis, death
<i>Karenia brevis</i>	Salt	Red	Brevetoxins	1. Nervous system 2. Respiratory system	1. Gastrointestinal illness, muscle cramps, seizures, paralysis 2. Respiratory problems, especially for asthmatics
<i>Pseudo-nitzschia</i>	Salt	Red or brown	Domoic acid	Nervous system	Amnesiac shellfish poisoning, vomiting, diarrhea, confusion, seizures, permanent short term memory loss, or death
<i>Microcystis</i>	Fresh	Blue-green	Microcystin	Liver	Gastrointestinal illness, liver damage

Source: <https://www.niehs.nih.gov/health/topics/agents/algal-blooms/index.cfm>

The Maryland Department of Natural Resources has a series of stations for continuously monitoring water quality data, including dissolved oxygen (DO), salinity, pH, temperature, turbidity, and total chlorophyll (see table at the end of the lab for details). In this lab, you will explore the relationship between different water quality variables, and how they can be used to analyze harmful algal blooms.

Experimental Part

Materials

- Computer with internet access
- Printer

Procedure

1. Explore the Maryland's Department of Natural Resources (MDNR) home website <http://eyesonthebay.dnr.maryland.gov/> and their Continuous Monitoring Data website <http://eyesonthebay.dnr.maryland.gov/contmon/ContMon.cfm>. These pages contain background about how MDNR monitors water quality in the

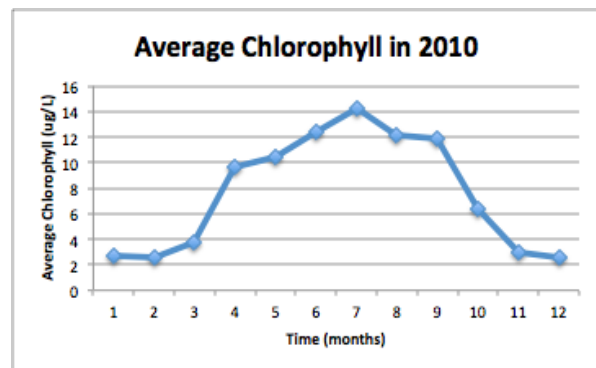
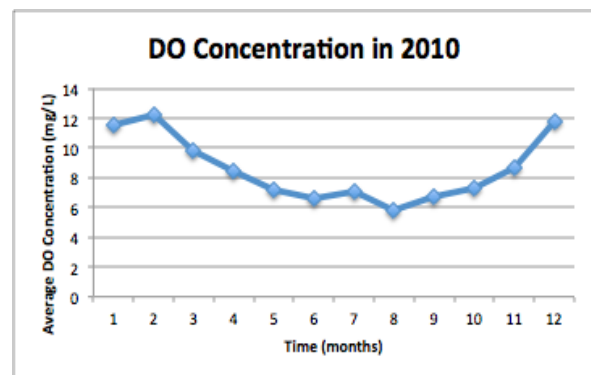


Chesapeake Bay. You may want to look around a bit before moving on to the next step.

1. Open the second link. First, select the station from which you want to see data. Using the drop-down list, choose the "Patuxent River - Jug Bay" location. Select to receive data for Dissolved Oxygen (DO) and the Chlorophyll. Why do we choose these two parameters? Why might chlorophyll and dissolved oxygen levels be indicators of algal blooms?

Hint for Teacher! Chlorophyll will increase in an algal bloom, because algae contain high amount of chlorophyll. The algal decay process is assisted by bacteria, and can deplete the oxygen in water which lead to the death of oxygen-dependent creatures.

2. Select the time range you like to study. As an example, you could ask the data collected between 01/01/2010 and 12/31/2010. Select the resolution you'd like to obtain: choose the summary per month. Click submit, and download the data as a .csv file.
3. Open the CSV to begin creating a graph. You will want to create a scatterplot of average DO and average chlorophyll over time. Do this by first selecting the entire column of average DO and selecting scatter plot in the charts menu. Then select the column of average chlorophyll and create a second scatterplot.



4. Go back to the website and change the water variables to look at the others for the same time range. Download these data as well, and create scatterplots of





each. Compare the patterns of each of the water quality variables over the same time period. Create a chart to help you keep track of patterns you see.

	DO Concentration (mg/L)	DO Saturation (%)	Salinity	Temp.	pH	Turbidity
Total Chlorophyll change (increase, decrease, no change)						
Hypothesis/Rationale						

1. What similarities do you find between patterns of water quality variables?
What differences do you see?



Take Home Messages

Harmful algal blooms change the balance of coastal ecosystems, by altering many of the variables that go into measuring water quality. These changes upset the health of the environment and the organisms that depend on it.

Lesson Adopted From

- <http://stem-works.com/external/activity/484>
- https://www.sciencebuddies.org/science-fair-projects/project-ideas/OceanSci_p001/ocean-sciences/algal-blooms#procedure
- <https://cees.iupui.edu/research/algal-toxicology/bloomfactors>
- <https://www.niehs.nih.gov/health/topics/agents/algal-blooms/index.cfm>