

Lake Waterford Fish Kill

Grade Level: Upper Elementary, Middle School

Subject Areas: Life science, physical science

Duration: 45 minutes

Next Generation Science Standards:

- 3-LS4-3 – Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
- 3-LS4-4 – Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change
- 5-ESS3-1 – Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.
- 3-5- ETS1-2 – Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- MS-ESS3-3 – Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment
 - Practices of science
 - Asking questions
 - Planning and carrying out investigations
 - Analyzing and interpreting data
 - Constructing explanations
 - Obtaining, evaluating, and communicating information
 - Cross cutting concepts
 - Cause and effect
 - Stability and change

Common Core State Standards – ELA/Literacy

- SL.4-5.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade appropriate topics and texts, building on others’ ideas and expressing their own clearly.
- SL.6-8.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade appropriate topics, texts, and issues, building on others’ ideas and expressing their own clearly.

Environmental Literacy:

- 1.A.1 – Identify an environmental issue
- 4.B.1 – Analyze the growth or decline of populations and identify a variety of responsible factors
- 5.A.2 – Analyze the effects of human activities that deliberately or inadvertently alter the equilibrium of natural processes.
- 7.A.1 – Investigate factors that influence environmental quality



Objectives:

- Students will make use of authentic water quality data tables from the Eyes on the Bay website.
- Students will understand the importance of water quality monitoring stations in helping scientists determine the causes for changes in fish populations.

Teacher Background:

This activity is based on an event that occurred in Lake Waterford in Anne Arundel County. Lake Waterford is a 12 acre, man-made lake, created by a dam near the headwaters of the Magothy River. The area around the lake is surrounded by development, mostly suburban homes, with a lot of impervious surfaces. On March 23, 2010, approximately 500 dead fish, including bluegill, gizzard shad and stocked trout were found floating in the lake.

Scientists from the Maryland Department of the Environment were called in to investigate. They discovered that the dissolved oxygen level in the lake was less than 1 mg/L. Most fish, including bluegills, cannot survive levels this low for more than a few hours. On March 25, water quality data from DNR's Monthly Monitoring Station downstream in the Magothy river showed that the dissolved oxygen level in the river was still very low (0.80 mg/L).

The scientists concluded that the immediate cause of death was low dissolved oxygen in the lake, which may have lasted for several days. The low oxygen level was probably triggered by an algae bloom fueled by nutrients washed off the land by the earlier heavy rains (over 3 inches of rain across much of Maryland). When the algae ran out of nutrients, they died and the process of decomposition used up the oxygen.

Materials:

- Student worksheet

Activity:

- Engage
 - Ask students whether any of them watch crime shows on TV, like CSI. How do the detectives or forensic experts solve a case? What sorts of things do they look for? *Answers may include physical clues like fingerprint or blood stains, autopsy results, toxicology studies, etc.*
 - Suppose the "victims" were fish; why might scientists be concerned about a large number of dead fish? *Because whatever was causing the fish to die might cause serious damage to the environment, affect the commercial and recreational fisheries, or be dangerous to humans.*
 - In the case of a fish kill, what sorts of things might scientists do to determine the cause? *Look at water quality, do necropsies and toxicology studies on the fish, test the water for the presence of toxic chemicals, etc.*
- Explore
 - Tell the students that there has been a fish kill in Lake Waterford in Anne Arundel County. This fish kill is an actual event that occurred in March



2010. Since they can't necropsy the fish, they are going to have to use water quality data to try to determine the cause.
- Give the students a copy of the Student Worksheet. Tell them that the information they need will be found on the worksheet.
 - Explain that they are to try to determine not only the direct cause, but also the indirect cause or causes.
 - Explain (Class discussion)
 - What caused the fish kill? *The answer is low dissolved oxygen.*
 - *Students might say that it was higher temperature (Average temperature in March 2010 was almost 10° warmer than the mean).*
 - Tell them to check temperature requirements for bluegills
 - What might cause a sudden severe drop in dissolved oxygen? *An algal bloom probably occurred. When the algae died, the process of decomposition used up the oxygen.*
 - What usually triggers an algal bloom? *Excess nutrients.* Where might these nutrients have come from in Lake Waterford? *The area around the lake is very developed with a lot of impervious surface. There had been heavy rains earlier in the month which would have washed pet waste, excess lawn fertilize, etc. off the roads and into the lake.*
 - What impact might climate change have on an event such as this? Go to
 - <https://www.nwf.org/Wildlife/Threats-to-Wildlife/Pollutants/Algal-Blooms.aspx>
 - <https://www.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms>
 - *Low oxygen levels could become more frequent, resulting in more fish kills. Warmer temperatures and more nutrient runoff due to increased precipitation could increase the frequency of algae blooms.*
 - Extend
 - Have students research, design, and implement an action project to reduce nutrient runoff from their schoolyard.

Lake Waterford Fish Kill – Student Worksheet

You work for the Maryland Department of the Environment and one of your duties is to investigate fish kills.

On March 23, 2010, 500 dead fish, including bluegills, were found in Lake Waterford in Anne Arundel County. Lake Waterford is formed by a dam near the headwaters of the Magothy River and is a popular fishing lake. Your job is to try and figure out what caused the fish to die, since you obviously do not want people fishing there if there is a problem.



You know that the area around the lake is surrounded by development, mostly suburban homes, with a lot of impervious surfaces (roads, driveways, rooftops, and parking lots). You also read the following article:

The heavy rainstorms of mid-March 2010 resulted in over 3 inches of rain across much of Maryland. In addition to the heavy rains, rapidly melting snow cover in western Maryland and Pennsylvania, and saturated soils caused the rain and snowmelt to run off streets, parking lots, buildings, residential yards and farm fields, filling neighborhood stormwater facilities and downstream culverts, small creeks and wetlands. This surge of water carrying excessive nutrients, sediments and other pollutants continued downstream to rivers, and then eventually down to the Chesapeake Bay. Continued wet spring weather could extend these high freshwater flows that might result in less underwater grasses, an increase in algal blooms and an early onset of Bay “dead-zones.”

<http://mddnr.chesapeakebay.net/eyesonthebay/documents/March2010RunoffEvent.pdf>

The water in the lake has already been tested for toxic chemicals and the results came back negative. There are no water quality monitors in Lake Waterford, but there is a monthly monitoring station downstream in the Magothy River. Maybe the information from the downstream station will give you a clue, so you pull up the data on dissolved oxygen, water temperature, and turbidity.

You know that bluegills require the following water quality parameters:

- Dissolved oxygen – greater than 5.0 mg/L
- Water temperature – can survive in water ranging from 32° F to 95° F
- pH – 6.5-8.5

The data tables include the “Mean” or average data for each month. You want to compare the March 2010 data with the Mean data for March.

Magothy River - Dissolved Oxygen (mg/L)				
Month	Minimum	Mean	Maximum	2010
January	4.10	8.91	14.00	8.10
February	1.70	9.34	13.60	7.20
March	4.90	10.06	13.00	0.80
April	2.30	7.48	10.80	
May	0.08	5.14	11.00	
June	0.00	1.97	6.70	
July	0.00	0.92	3.50	
August	0.00	1.54	6.10	
September	0.00	3.11	8.70	
October	0.70	5.96	11.60	
November	0.02	7.40	12.20	
December	1.60	8.49	13.30	

Magothy River - Water Temperature (Degrees F)				
Month	Minimum	Mean	Maximum	2010
January	32.90	37.58	45.50	36.86
February	33.98	38.65	41.90	37.40
March	38.84	45.01	52.52	54.68
April	45.32	54.61	64.94	
May	60.62	66.33	76.64	
June	71.24	77.01	83.48	
July	77.72	81.21	86.72	
August	76.28	81.10	86.72	
September	67.64	75.03	80.42	
October	57.20	63.80	70.16	
November	43.16	51.51	60.80	
December	35.24	42.60	50.36	



Magothy River - Surface Water pH				
Month	Minimum	Mean	Maximum	2010
January	7.60	8.26	8.70	8.00
February	7.40	8.03	8.60	8.10
March	7.20	8.03	8.90	8.30
April	7.40	8.13	9.00	
May	7.90	8.71	9.60	
June	7.60	8.21	9.20	
July	7.20	8.05	8.90	
August	7.20	8.13	8.90	
September	7.40	8.08	9.50	
October	7.40	8.02	9.00	
November	7.50	8.41	10.00	
December	7.60	8.35	9.20	

Do you see something in the data that might explain why the fish died?

What might have caused this to happen?

What impact might climate change have on an event such as this? Go to

- <https://www.nwf.org/Wildlife/Threats-to-Wildlife/Pollutants/Algal-Blooms.aspx>
- <https://www.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms>

