The Science and Civics of the Flint Water Crisis (Elementary/Middle School Version)

OVERVIEW

ESSENTIAL QUESTION

What is the Flint water crisis, and why did it occur?

Photo: Rebecca Cook

OVERVIEW

For much of the 20th century, Flint, Michigan was a booming automobile manufacturing town, and the headquarters of General Motors. By the 1980s, however, the financial stability of the city began to falter as General Motors began the process of outsourcing, offshoring, and automating autoworker jobs. In 2002, Michigan Governor John Engler declared a financial emergency in Flint, and installed what would be a series of unelected emergency managers who were given authority to oversee the city's finances and cut costs. From 2002 to 2018, these managers began laying off city workers, cutting benefits, eliminating social programs, and raising water bills in an attempt to balance the city's budget.

In 2013, the Flint City Council made the decision to switch the city's water source from Detroit to a yet-to-be-built pipeline that would run from Lake Huron directly to the city, as a way to cut costs. Without City Council approval, Flint's emergency managers additionally decided to end the water contract with Detroit before the completion of the pipeline, and draw water temporarily from the Flint River.

Almost immediately after the city switched its water source, residents began to grow worried about the smell, taste, and appearance of the water. Some started reporting sudden rashes and hair loss. Doctors and scientists began taking notice, and found dangerous levels of lead in the drinking water, among other pollutants. Despite this, state officials continued to claim the water was safe to drink, even after it was revealed that Flint's emergency managers did not add corrosion control to the Flint River water treatment process as a cost-cutting measure—a vital step to insuring lead from plumbing does not filter into tap water. The Michigan Department of Environmental Quality even tampered with research data and dismissed the results of other tests to maintain this stance that Flint's drinking water was safe.

Feeling dismissed by the state government, some Flint Residents took their concerns national. Perhaps most remarkable of these activist was Amariyanna "Mari" Copeny, who at 8 years old wrote a letter that convinced President Barack Obama to meet with activists in Flint (months later, President Obama allocated $100 million to repair Flint's water system). Copeny has continued her activism by helping facilitate a water bottle donation program to the city of Flint.

In October 2015, a year and a half after residents were first exposed to toxic drinking water, Michigan Governor Rick Snyder ordered the city's water supply switched back to Detroit. As of 2019, no governmental officials have been convicted of any crimes related to the Flint water crisis. And while the water in Flint has been tested safe to drink, residents are living with the lifelong effects of lead poisoning, and a skepticism towards authorities brought about after being told for nearly a year that water with high amounts of lead was safe to drink.

In this lesson, students analyze selected lyrics from rapper Vic Mensa's song "Shades of Blue" to better understand the sense of frustration and injustice people living in the city felt during the water crisis. Students then experiment with creating their own water filtration system to better understand the scientific and engineering principles behind water treatment, and consider the biological effects of lead poisoning. Finally, they are introduced to the advocacy work of Mari Copeny, and consider how young people can enact great social change.

MATERIALS REQUIRED:

- 2-liter soda bottles, cut in half horizontally
- Water "Pollutants," which could include dirt or soil, coffee grounds, dish washing liquid, baking soda, vinegar, food coloring, vegetable oil
- Rubber bands
- Cheesecloth
- Measuring cups
- Spoons
- Filter material: cotton balls, small pebbles, sand, coffee filter, active charcoal
- Beakers

OBJECTIVES

Upon completion of this lesson, students will:

1. KNOW (KNOWLEDGE):

- The process of water treatment
- The biological effects of lead poisoning
- The cause of the Flint water crisis
- The artist Vic Mensa and activist Mari Copeny ("Little Miss Flint"), and their role as advocates for the Flint Water Crisis

2. MASTERY OBJECTIVE

- Students will be able to identify the causes of the Flint Water crisis through STEM activities, and evaluate strategies of clean water advocacy by evaluating the work of musical artist Vic Mensa and activist Mari Copeny.

ACTIVITIES

PREPARATION

1. Cut the 2-liter bottles in half horizontally, and place the top half face-down in the bottom half.

MOTIVATIONAL ACTIVITY

1. Play Vic Mensa's song "Shades of Blue" for students at https://www.youtube.com/watch?v=yKIqIcAdNsE. (*Note: after 0:23, strong language is present. Teacher discretion is advised. The link will open to the official song on YouTube, we suggest loading the video before class to avoid showing advertising during class.*)

2. Display **Image 1, "Shades of Blue" Excerpt**. Ask students:

    - What story is Mensa telling in these lyrics? Do you think he is rapping about an actual event? If so, what event might it be?

    - What might Mensa mean when he says "poor people get the shorter end of the stick"? Can you think of an example where this might be the case?

PROCEDURE:

1. Tell students that Mensa is referring to a specific and ongoing event: the contamination of the drinking water in Flint, Michigan, otherwise known as the "Flint Water Crisis." Ask students:

    - How might have the drinking water in Flint gotten contaminated? (*It was not treated properly.*)

    - What is water treatment? (*Water treatment is the process by which water is cleaned and disinfected for healthy consumption.*)

    - Why is water treatment important? What might result from ineffective water treatment?

2. Tell students they will be creating and experimenting with their own water treatment systems. But first, they need to create "dirty water" which will represent water from a natural source that hasn't been treated. As a class, prepare a large container (around 2 liters) of dirty water by mixing tap clean water with various pollutants such as dirt, liquid detergent, vinegar, and/or food coloring.

3. Divide students into groups, and give each group one copy of **Handout 1 - Water Filter Schematic.** Have each student group to go to a station containing:

    - A 2-liter soda bottle, split in half.

    - Cheesecloth, cut into a 3" square

    - Cups full of various filtering components: small pebbles, large pebbles, sand, coffee filters, activated charcoal

    - A rubber band

    - A beaker

4. In their groups, ask students to wrap the cheesecloth around the bottleneck of the 2-liter bottle, and secure it with the rubber band. Then, place the bottleneck face down into the other half of the bottle (a Youtube video of this process can be found at https://youtu.be/1vovK75C4hY. We suggest loading the video before class to avoid showing advertising during class.) Then, decide as a group what filter materials they will use for their water treatment, and what order they will be putting in the materials. After placing their materials in the bottle, have them pour the dirty water through their the filter into a beaker. Make sure the students note what materials they used and the order of materials in their handout.

5. In a central location, have each student group present their sample of filter water alongside their filled-out copy of Handout 1. As a class, observe the results of each filter. Ask students:

    - Which beaker seems to contain the clearest water?
    - What materials did the group who filtered the clearest water use? What order did they place these materials?
    - Which beaker seems to contain the dirtiest water?
    - What materials did the group who filtered the dirtiest water use? What order did they place these materials?
    - Based on the results of the experiments, what was the most effective water to filter water? Why might that be?
    - Would you be comfortable drinking any of the water from these beakers? Why or why not?
    - Based on these experiments, do you think filtering is the only step to treating water? Why or why not?

6. Show **Image 2, Water Treatment Diagram**. Read aloud as a class each step in the water treatment process. Ask students:

    - How many processes in this diagram did the class cover in the experiment? Which process was covered?
    - Why are all these steps required to treat water? What might they each accomplish? What might happen if one of these steps is eliminated?

7. Tell students they will now watch a video about what occurred in Flint, Michigan that led to lead in the water. Play SciShow's clip The Science of Flint's Water Crisis from the beginning to 3:30 at https://youtu.be/BAIXmt58iBU. Ask students:

    - When did the Flint Water Crisis begin? (*If needed, play back the beginning of the clip, which mentions the city began using its own river to supply it water.*)
    - What is "Orthophosphate?" What role does it play in water treatment?
    - Based on the clip, what happens when orthophosphates aren't included in the water?
    - Why did lead end up in Flint's drinking water?

8. Show **Image 2, Water Treatment Diagram** once again. Ask students:

    - What component of the water treatment process keeps lead from entering water? (*Note: teachers may help students by reminding them that orthophosphate is used to stop corrosion.*)

9. Pass out one page of **Handout 2 - Preventing Childhood Lead Poisoning (CDC)** from the Centers for Disease Control to each student group. Have student groups read the document together. Then ask the class:

    - How might led exposure harm your health?
    - What are the long-term effects of lead poisoning?
    - Where might lead be found in the household? How can it get into the body?
    - Is lead exposure still an issue today in the United States? How do you know?
    - What are some of the ways a person can prevent lead poisoning?

10. Show **Image 1, "Shades of Blue" Excerpt** once again. Ask students:

    - According to Mensa, why was Flint's water source switched? (*Note to teacher: Mensa correctly identifies that the water source was changed as a cost-cutting measure.*)
    - Why might have the city chosen not to add Orthophosphates into the water to treat corrosion? (*It was another cost-cutting measure*).
    - Elsewhere in the lyrics, Mensa says "The people with the least always gotta pay the most/We the first to go when they deleting them budgets." How might this sentiment apply to the situation in Flint? Why might people in that city be frustrated?

11. Play "Meet Mari Copeny" at https://www.youtube.com/watch?v=ML2dRP9i3FQ. (*The link will open to YouTube, we suggest loading the video before class to avoid showing advertising during class.*) Ask students:

    - Who is Mari Copeny?
    - Is her account of the Flint Water Crisis similar to what you learned in class?
    - What were some ways Copeny spread awareness of the Flint Water Crisis? Who did she reach out? What other projects did she pursue?
    - Are water bottles a sustainable solution to Flint's water problem, or is something else needed?

SUMMARY ACTIVITY

1. Split students into groups. Ask them:

    - Why did the Flint water crisis occur? Was it a problem that required new scientific research or technological innovation to solve? Or was it something else?

    - Imagine one day you begin to notice a strange look and taste in your drinking water. As a group, brainstorm and action plan of what you would do to make sure the drinking water is tested and safe, and present your plan to the rest of the class.

2. Share student's action plans with info@teachrock.org!

EXTENSION ACTIVITY

1. Research an environmental concern in your city or state. Write a short summary of the problem, and suggest ways the problem might be addressed by governments, businesses, or individual citizens.

2. Choose one of the people profiled in the article "Women of Water" (https://about.google/intl/en-GB/stories/cleanwater/). Read the portion of the article about the figure you chose, and summarize their contribution fighting the Flint Water Crisis. Could their actions be defined as scientific, civic, or something else?

COMMON CORE STATE STANDARDS

College and Career Readiness Anchor Standards for Reading (K-12)

Reading 1: Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

Reading 2: Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

Integration of Knowledge and Ideas 7: Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

Range of Reading and Level of Text Complexity 10: Read and comprehend complex literary and informational texts independently and proficiently.

College and Career Readiness Anchor Standards for Writing (K-12) (Extension Activities only)

Text Types and Purposes 1: Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.

Text Types and Purposes 2: Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

Production and Distribution of Writing 4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Production and Distribution of Writing 6: Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

Research to Build and Present Knowledge 8: Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

Research to Build and Present Knowledge 9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

College and Career Readiness Anchor Standards for Language (K-12)

Language 1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

Vocabulary Acquisition and Use 6: Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing,

speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

College and Career Readiness Anchor Standards for Speaking and Listening (K-12)

Comprehension & Collaboration 1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

Comprehension & Collaboration 2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

Presentation of Knowledge 4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

NEXT GENERATION SCIENCE STANDARDS (NGSS)

K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3: Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

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.

3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identofy aspects of a model or prototype that can be improved.

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, too, or process such that an optimal design can be achieved.

NATIONAL CURRICULUM STANDARDS FOR SOCIAL STUDIES – NATIONAL COUNCIL FOR THE SOCIAL STUDIES (NCSS)

Theme 1: Culture

Theme 3: People, Place, and Environments

Theme 5: Individuals, Groups, and Institutions

Theme 6: Power, Authority, and Governance

Theme 7: Production, Distributions, and Consumption

Theme 8: Science, Technology, and Society

Theme 10: Civic Ideals and Practices

COLLEGE, CAREER & CIVIC LIFE (C3)

Dimension

D4.1.6-8: Construct arguments using claims and evidence from multiple sources, while acknowledging the strengths and limitations of the arguments.

D4.6.6-8: Draw on multiple disciplinary lenses to analyze how a specific problem can manifest itself at local, regional, and global levels over time, identifying its characteristics and causes, and the challenges and opportunities faced by those trying to address the problem.

D4.6.9-12: Use disciplinary and interdisciplinary lenses to understand the characteristics and causes of local, regional, and global problems; instances of such problems in multiple contexts; and challenges and opportunities faced by those trying to address these problems overtime and place.

D4.7.6-8: Assess their individual and collective capacities to take action to address local, regional, and global problems, taking into account a range of possible levers of power, strategies, and potential outcomes.

D4 .7.9-12: Assess options for individual and collective action to address local, regional, and global problems by engaging in self-reflection, strategy identification, and complex causal reasoning.

NATIONAL STANDARDS FOR MUSIC EDUCATION – NATIONAL ASSOCIATION FOR MUSIC EDUCATION (NAFME)

Core Music Standard: Responding

Interpret: Support interpretations of musical works that reflect creators' and/or performers' expressive intent.

Evaluate: Support evaluations of musical works and performances based on analysis, interpretation, and established criteria.

Core Music Standard: Connecting

Connecting 11: Relate musical ideas and works to varied contexts and daily life to deepen understanding.

RESOURCES

HANDOUTS

- Handout 1 - Water Filter Schematic
- Handout 2 - "Preventing Childhood Lead Poisoning" (CDC)