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## Flint, Michigan: Lethal Water

2017

Between December 2011 and April 2015, the city of Flint, Michigan, was in legal “receivership,” a state of financial emergency that is usually a last-ditch attempt to avoid total bankruptcy. Over approximately 65 years, Flint had gone from automotive manufacturing powerhouse second only to Detroit in the 1950s,<sup>1</sup> to a city with high levels of poverty and unemployment. Starting in the 1960s, Flint began losing residents to better opportunities elsewhere. Over the period of 55 years, 100,000 citizens fled. By 2015, only 99,000 citizens were still living in Flint.<sup>2</sup> Like its neighbor, Detroit, located about 70 miles to the southeast, Flint’s fortunes had dwindled with the decline of the American automobile industry. By 2015, approximately 57 percent of Flint citizens were Black or African American; 41 percent lived in poverty, and the median household Flint income was \$24,000; nearly one in five of citizens had a disability, and as of 2014, 14 percent had no health insurance.<sup>3</sup> In 2015, Flint was rated the third most dangerous city in the United States for violent crime and sexual assault.<sup>4</sup> By some estimates, the city’s unemployment rate in 2016 was more than twice the national average.<sup>5</sup>

### Dollars, Cents, and Water

During Flint’s 2011-2015 fiscal crisis, the city’s finances were directed by Emergency Managers (EMs) appointed by Michigan Governor, Rick Snyder, who took office on January 1, 2011. Under the interim governance of these EMs, Flint city officials decided to slash costs by changing the source of the city’s municipal water. For decades, Flint’s water had been piped from Lake Huron through the Detroit Water and Sewerage Department. The Karegnondi Water Authority (KWA) of Genesee County, where Flint is located, was in the process of planning a new water system separate from the Detroit system. In March 2013, Ed Kurtz, one of the four EMs to serve between 2011 and 2015, signed an agreement for Flint to switch over to the KWA system when it was ready. Construction on the new water system, however, would not be complete until 2016 at the earliest. Meanwhile, the Detroit water department raised Flint’s water payment rates to a level that would cost the city an additional \$10 million over the interim two years—funds not readily available in the near-bankrupt city budget. In June, Kurtz—in an unprecedented move for Flint’s local water supply—signed an order for an engineering contract that would return to operation Flint’s own water treatment plant—not used since 1967,<sup>6</sup> using water from the Flint River “as a primary drinking source for approximately two years and then converting to KWA delivered lake water when available.”<sup>7</sup>

This decision was made despite the known fact that, for decades, the Flint River had served “as the local industry’s sewage collection system.”<sup>8</sup> Early in the fiscal crisis—in 2012—officials went on record to recommend against using the Flint River for city water.<sup>9</sup> In September 2013, a new Emergency Manager—Michael Brown—approved an order for a contract between Flint, Genesee County, and the KWA. In October

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2013, Brown was replaced by yet another Emergency Manager, a longtime state employee, Darnell Earley. Earley had served Flint in the early 2000s as both city administrator and interim mayor. During this time Earley was not a local resident, living almost 90 miles away in Lansing, yet he still earned \$180,000 annually as Flint’s city manager.<sup>10</sup>

The city of Flint continued to use the Detroit water system until April 25, 2014. On that day, city officials—including Earley and then-Mayor, Dayne Walling, celebrated a public switch of the valve that controlled the city’s water source, switching it from Lake Huron water, treated through Detroit, to water from the Flint River.

## No Cause for Celebration

Immediately residents complained. Complainants noted changes in water’s color, smell, and taste. In August 2014, the water tested positive for *E. coli*, a bacterium commonly associated with food poisoning; *E. coli* causes serious debilitating intestinal illness and can also cause kidney disease. Officials told citizens to boil water; complaints about the odor and discoloration continued.<sup>11</sup>

To try and address these concerns, the city added chlorine treatment, at levels so high that residents complained of not only worse odor but also burning symptoms in any contact with the water. Soon officials noted that high chlorine levels were causing unsafe production of a chlorine byproduct, trihalomethane; another warning was issued.<sup>12</sup>

Meanwhile, in Flint’s General Motors plant—historically one of Flint’s largest employers—workers alerted the company that the water was also corroding engine parts. Once this complaint reached Governor Snyder’s office, the governor, it was said, “quietly spent \$440,000 to hook GM back up to the Lake Huron water”<sup>13</sup> through connections in Flint Township, an adjacent municipality that had not gone with the city of Flint in the switch.

## “There is No Need to Worry”

By January 2015 the city’s mayor, Dayne Walling, was continuing to insist that Flint’s water was safe,<sup>14</sup> despite increasingly vocal complaints from residents. The concern was so great that officials in the Detroit water treatment system offered to reconnect Flint to its water at no cost. Earley turned down this offer for reasons that remain unclear.<sup>15</sup> A few weeks later, Snyder re-appointed Earley to a new position, as Emergency Manager for the Detroit Public Schools; Gerald Ambrose took Earley’s place in Flint. Ambrose, determined to balance the books and fix Flint’s finances, also rejected an attempt to switch back to Lake Huron water, calling a city council vote for this change in March 2015 “incomprehensible.”<sup>16</sup>

Throughout these months, Flint’s concerned citizens began to flock to city hall and city council meetings in repeated but futile attempts to persuade the city governance to recognize and admit that a problem existed with the water that needed urgent attention and action.

One of these citizens was LeeAnn Walters. Walters had moved to Flint in June 2011 with her husband, a Navy Reserve officer, and their four children. When they bought their house, it was missing all of its interior plumbing; the Walters had the plumbing restored with a renovation that used safety-compliant PVC plastic pipes and filters. Soon after the city switched to the Flint River water, Walters and her children began to suffer from inexplicable skin rashes and hair loss even before December 2014, when the water coming out of their faucets turned consistently brown. In February 2015, Flint’s Utilities Administrator, Mike Glasgow, visited Walters’ home in response to her complaints about the discolored water. It was Glasgow who first

identified elevated lead levels in her water and immediately warned the family to stop using it.<sup>17</sup> Periodic retesting confirmed increasingly elevated lead levels.

Lead ingestion of any kind and at any level poses a health risk; the ideal lead level in water is zero parts per billion (ppb). In the United States today, any level over 15 ppb is considered a serious problem. Walters' water measured 104 ppb on Glasgow's first visit. It eventually skyrocketed on subsequent testing to over 13,000 ppb, nearly three times the level considered to be toxic waste. Lead itself is invisible in water; the discoloration was caused by other substances such as iron and copper that were leaching into the water due to corrosion of the old pipes throughout the city's water system.

## Demanding to be Heard

Walters immediately took action to learn exactly what her family was experiencing and what all the measurements meant for Flint's water and public health. She contacted the U.S. Environmental Protection Agency (EPA) and spoke with Miguel Del Toral, the Regulations Manager for the ground water and drinking water branch. With Walters' information, Del Toral soon identified that the Flint River water plant failed to include corrosion control treatment. Corrosion control is a standard part of water treatment, and helps to coat water pipes with substances that prevent old lead, iron, and copper pipes from leaching their metals into the water; corrosion control was standard protocol in the Detroit water treatment system. The corrosive (and untreated) nature of the Flint River water had stripped the pipes of its protective coatings and pulled toxins into the water that the city's citizens were using for drinking and bathing.

Del Toral—who one EPA official would later call a “hero”<sup>18</sup>—chose to go public with the information. He wrote an interim report citing Walters' data and test results, and allowed it to “leak” to the press when it became obvious that top officials at Michigan's Department of Environmental Quality (MDEQ) were failing to take citizens' concerns seriously. “Where these problems exist, I will not ignore them,” he would write later.<sup>19</sup> “I understand that this is not a comfortable situation, but the State is complicit in this and the public has a right to know what they are doing because it is their children that are being harmed,” Del Toral wrote. “At a MINIMUM [emphasis in original text], the city should be warning residents about the high lead, not hiding it telling them there is no lead in the water.”<sup>20</sup> While Del Toral's superiors attempted to “silence” him, calling him a “rogue employee,”<sup>21</sup> the publicity of his report continued to advance public concerns in Flint. Even so, top officials persisted in their claims that the water was safe, and Flint citizens felt they were still not taken seriously in concerns they expressed with officials at a meeting in August 2015.

It was immediately following this meeting that LeeAnn Walters decided to get in touch with Marc Edwards, a water supply safety and engineering professor at Virginia Tech. Edwards was considered a world expert on water corrosion and water safety. He had been awarded a MacArthur “genius” grant in 2007 for his research and work that forced national attention on elevated lead levels in the Washington, D.C., municipal water supply, attention that resulted in intervention to fix the problems.<sup>22</sup> After talking with Walters on the phone, Edwards took immediate action. On his own time and at his own expense, he and four graduate students, armed with a large supply of lead test kits, drove to Flint and began asking residents for water samples. Forty percent of the first 252 kits they got back (out of 300 initially distributed; the numbers tested would eventually total more than 800) came back with lead levels over 5 ppb; while the EPA allows 15 ppb in high-risk homes, any level of lead in water is considered a health risk, and many samples were far above this threshold.<sup>23</sup> Edwards' team concurred that “Flint has a very serious lead in water problem.”<sup>24</sup> Edwards also became a public spokesperson to both citizens and public officials in Flint, adding his voice to those who warned the city to do something quickly, and not drink or use the Flint River water. Edwards and his researchers would later charge that the MDEQ had even gone so far as to fail to test the “worst case scenario” homes as federal law mandated. The result, it was charged, “skewed the outcome of its tests to produce favorable results.”<sup>25</sup>

## Effects of Lead Poisoning: Long-lasting and Irreversible

The most serious risk of lead poisoning is its effect on children. Lead poisoning affects behavioral, growth, and learning abilities, and its effects on young children are lifelong and irreversible. While nothing can remove lead from the body once it is present, healthy fresh foods rich in calcium, iron, and vitamin C are believed to play a limited but positive role in reducing the body's absorption of lead.<sup>26</sup> But for many of Flint's children even this protection was missing due to poverty and lack of accessible grocery stores stocked with fresh fruits and vegetables.<sup>3</sup> LeeAnn Walters knew that it was not just her own two youngest children who faced lifelong consequences after they tested positive for high lead levels. The crisis meant that every child in Flint was now at risk.

Despite the public outcry, some low-income Flint residents remained unaware of the risks. Among them were members of the city's small Latino community, many of whom were undocumented immigrants and unable to read English. According to one civic activist for this community, "relatives of these families from Mexico and other countries were calling asking what was going on, and in some cases that's how people found out about it." After many Latinos shied away from the free bottled water distributions across the city—fearful staff at such distributions would ask for identification—local religious groups began an effort to distribute free water to all, without requiring identification or proof of Flint residency.<sup>27</sup>

To understand the effects, one local pediatrician, Dr. Mona Hanna-Attisha, head of the Pediatric Residency Program at Hurley Medical Center in Flint, decided to measure blood lead levels in Children's Clinic patients and compare them to available Flint records prior to the Flint River water transition. Results demonstrated that the percentage of children with high lead levels had nearly doubled since the switch. In September 2015, Hanna-Attisha and other worried medical colleagues held a press conference to announce their findings and concerns, demanding that the city return to Lake Huron water in order to protect public health. While city officials initially dismissed her comments, calling them "unfortunate,"<sup>28</sup> this press conference marked a point of transition. On October 16, 2015, Flint's city officials made the switch back to the Detroit water treatment system.

## A Return to Lake Huron's Water, and Yet...

While Flint residents once again had access to a safe and properly treated water supply, the return to Lake Huron did not solve many of the problems that contributed to Flint's water crisis. The switch did not reverse the effects of lead poisoning and other related toxicities that residents suffered as a result of their exposure to Flint River water. It did not fix urban violence inherent in the dominant poverty or improve home property values. It did not address the widespread lack of public confidence in the governance system nor lingering distrust about any water flowing from their pipes, nor did it fill the health insurance gap that prevented many of Flint's families and young children from easy access to necessary medical care.

One of the many challenges Flint still faced at the end of 2015 was the city's utilities infrastructure. There remained, for example, the simple structural question of how to remove and replace the affected pipes.

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<sup>3</sup> Flint was a "food desert," a community that lacks access to a full-scale, reasonably priced, well-stocked grocery store. Instead Flint residents—like many others who live in poor communities—had to rely for food on local corner stores, which were often expensive and lacked fresh vegetables and fruits. For more on food deserts, see R. Walker et al. *Disparities and Access to Healthy Food in the United States: A Review of Food Deserts Literature*. *Health and Place* 2010; 16:876-884. DOI: 10.1016/j.healthplace.2010.04.013. <http://www.sciencedirect.com/science/article/pii/S1353829210000584>.

Many of Flint's water pipes were more than a hundred years old. To remove ancient iron and lead-lined pipes, city workers first needed to know where they were and how to access them. The city's government records of water pipes was stored in the form of disorganized card files and fraying paper records.<sup>29</sup> Moreover, Flint's dwindling population left the city with an insufficient tax base to maintain the system, let alone upgrade it.

During the late fall and winter of 2015-2016, many officials implicated in the crisis stepped down or were fired, but Governor Rick Snyder stayed in office and remained actively engaged in addressing the storm of media controversy. As part of Snyder's efforts to address public perception and action on the problems, he appointed a Flint Water Interagency Coordinating Committee.<sup>30</sup> Among those he appointed as committee members, Snyder included both Edwards and Hanna-Attisha as "subject matter experts," in addition to the new Flint Mayor, Karen Weaver, and other county and city representatives. Snyder's office also commissioned a Flint Water Advisory Task Force report, released in March 2016.<sup>31</sup> The report admitted that the crisis was due to "government failure, intransigency, unpreparedness, delay, inaction, and environmental injustice."<sup>32</sup> It lay the blame, however, on the Michigan Department of Environmental Quality (MDEQ), together with the Michigan Department of Health and Human Services, and not on the governor himself. The report admitted inaction by the governor's office, explaining that this inaction was due to the "continued reassurances from MDEQ that the water was safe."<sup>33</sup> As part of Snyder's responses in the face of widespread lack of confidence for his decisions during the crisis, he announced in mid-April 2016 that he would drink Flint water for 30 days, in an effort to "alleviate some of the skepticism and mistrust."<sup>34</sup> His staff collected a few gallons of water from a nearby home in Flint for Snyder to carry and drink at work and home even as he also warned pregnant women and children ages 5 and under to continue to drink bottled water.<sup>35</sup>

Snyder's response illustrates the local nature of both environmental problems as well as efforts at resolution in such crises. While the federal Environmental Protection Agency can act based on legislation mandating safe water (the Safe Drinking Water Act), it is the responsibility of individual states to enforce the Act and make decisions based on any evidence of its violation.<sup>36</sup>

Snyder's efforts at swaying public opinion to his favor were not entirely successful. On November 16, 2015, lawyers announced a class action suit on behalf of Flint residents against the city and state officials, including both Snyder and the MDEQ Director, Dan Wymont. A federal judge in Detroit dismissed the suit in April 2016.<sup>37</sup>

Legal wrangles continued. In April 2016, many Flint citizens expressed satisfaction at the Michigan Attorney General's announcement of felony charges against three government officials involved in the crisis: Flint's laboratory and water quality supervisor, Mike Glasgow; Michigan Department of Environmental Quality official Mike Prysby, and Lansing district coordinator for the MDEQ's Office of Drinking Water and Municipal Assistance, Stephen Busch.<sup>38</sup> Reflecting on the news, one Flint citizen, retired Flint school teacher Nadine Roberts, noted, "Clean water is a human right that definitely a lot of people violated in Flint, for greed."<sup>39</sup> In mid-June 2016, Michigan's Attorney General announced a lawsuit against two private-sector companies, one based in Houston, Texas, the other a subsidiary of an international corporation based in France. Hired to ensure Flint's water safety, the failure of both consultant reports to identify obvious problems made them, the attorney general charged, "complicit in the series of events that caused lead to leach from pipes and poison children."<sup>40</sup>

Meanwhile, citizen action groups in Flint continue to band together to provide emergency resources to their neighbors, including faith groups such as the Michigan Muslim Community Council<sup>41</sup> and the Flint Grassroots Initiative,<sup>42</sup> supporting residents who remain in the community with donated time, money, goods, information, and even a few new grocery stores.<sup>43</sup>

## What is the Next Chapter in Flint's Story?

The Walters family moved to Virginia in October 2015. It was “to get us out of Flint,” says LeeAnn Walters, of her husband’s choice to return to active duty with the United States Navy, “Because of what it was doing and the health concerns and the fact that we weren’t being listened to with our child being poisoned.”<sup>44</sup> Yet Walters remained part of citizen action group efforts to address the long-term consequences of the water crisis in Flint. She was among the cofounders of the Community Development Organization of Flint (“C Do”<sup>45</sup>), which “addresses the city of Flint, Michigan’s infrastructure, healthcare, educational, family assistance, and economic development needs that have resulted from the Flint Water Crisis and the long-term economic and civic challenges.”<sup>46</sup> Many residents who left Flint remain suspicious of the water supplies in other cities. Indeed, Flint’s lead crisis has resulted in heightened attention to both safe water and the risks of lead pipes in urban infrastructure across the country.<sup>47</sup>

On June 23, 2016, the U.S. Environmental Protection Agency (EPA) announced that filtered water in Flint was now officially safe to drink, even for pregnant women, nursing mothers, and children. But Mayor Karen Weaver readily admits that the situation is far from solved. “While it’s good to know we can safely drink filtered water,” she added, “this is not the ultimate solution to the problem in Flint. We still need new infrastructure, replacing the lead-tainted pipes in the city remains my top priority.”<sup>48</sup>

Flint eventually received \$27 million to replace thousands of corroded water pipes, but as of November 2016 fewer than 200 pipes had been fixed.<sup>49</sup> Laura Sullivan, a professor at Kettering University who has worked on clean water projects around the world, expressed frustration with Flint’s lack of progress. During a previous interview with National Public Radio (NPR) in January 2016, Sullivan had optimistically thought that the spotlight on Flint would cause the situation to improve rapidly. However in a follow-up interview ten months later in September 2016 she ruefully noted,

“It [Flint] ought to be just a one-time, oh, my gosh, people weren’t paying attention and they were reckless, and now we figured it out and now we fixed it. But unfortunately, it feels more and more like a system in parts of the world where the government is corrupt, and there are too many hands that are involved that don’t involve the people who are actually living in poverty. And the people who are living in poverty aren’t empowered to be part of the solution.”<sup>50</sup>

Indeed in November 2016, two years after the city’s water switch, residents without properly working filters still did not have access to safe water in their homes. A federal district court judge ruled that the city had to begin to provide and deliver at least 96 half-liter bottles weekly to each Flint resident until the city found a permanent solution. Flint fought against the suit, maintaining that city water distribution centers provided clean water to residents in need. However the judge found otherwise, citing obstacles such as language, old age, cognitive barriers, a lack of necessary tools, and challenges transporting water from the distribution centers to their homes. The ruling was effective immediately.<sup>51</sup>

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This website was created and maintained by the research team from Virginia Tech. It includes relevant data and information about: fundraising and grants; stories from Flint residents; Flint River corrosivity experiments, citizen testing, and resources on lead in water/blood lead; opportunistic pathogens, including Legionella, bacteria, chlorine, and TTHMs; FOIA emails, investigations, reports, and the Water Study Analyses (MDEQ, EPA, MDHHS, City of Flint, and Michigan Governor’s Office); information on the study group’s Flint trips and work with school kids; data, talks, podcasts, LCR analyses, and presentations; stories about goodwill efforts on behalf of Flint; and lawsuits, petitions, letters, press releases, and other announcements. The Flint Water Study team also maintains a Facebook page, and has posted nearly 3000 tweets to date on their Twitter site, <https://twitter.com/flintwaterstudy>. A transparent summary of the estimated costs involved in this largely-volunteer effort is listed at <https://www.gofundme.com/flintstudyvt>.

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## Instructor's Note

# Flint, Michigan: Lethal Water

2017

### Overview

The 2014-2015 toxic water crisis in Flint, Michigan, was a disaster with profound health implications. A complex network of interrelated factors contributed to the disaster: culture, ethics, society, environment, politics, urban design, economic justice, and governance—both the governance of health as well as non-health-sector governance issues (such as political decision making about finances) that affect health. The accompanying materials and associated links and educational tools aim to help users understand these multiple contributing factors and think about how governance and global health connect.

The Flint crisis is not a simple problem; its causes cannot be blamed on just one or another individual. And it does not have a simple solution. Certain corrective and preventive actions are absolutely essential, and yet many of its consequences—especially for children affected by lead poisoning—are irreversible. The opportunity to think through this complex situation can help students better understand health challenges globally—both within the United States and around the world.

This Instructor's Note is designed to accompany the following related tools:

#### Preparation Materials:

- Case study: “Flint, Michigan: Lethal Water”
- “Flint Water Crisis Wheel” graphic

#### Classroom Activities

- Discussion questions
- Suggested Role Play Exercise

#### Additional Flint Resources

- Links to external sources (embedded in the Case and its concluding Bibliography)
- Links to related materials on the Flint crisis created by the Global Health Education and Learning Incubator (GHELI) at Harvard University and links to external materials in the GHELI Repository.

### Learning Objectives

- Understand how and why there is a complex network of factors that led to the Flint water crisis;

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- Understand that health issues may be caused by events beyond the traditional health sector, and that solutions for these issues must also be found outside of the health sector;
- Understand that seeking a solution to Flint's water crisis requires coordinated collaboration across diverse sectors of society as well as governments;
- Understand that the issue of lead-poisoned water is a concern that extends beyond the community of Flint, is an issue for many US communities, and is relevant to other water crises across national boundaries;
- Consider multiple issues of water, including: human rights; the role of governments on ecological resources and utilities/infrastructure; citizen action; and health related to economic development.

## Discussion Guide

# Flint, Michigan: Lethal Water

2017

### Assignment

1. Read the case “Flint, Michigan: Lethal Water.”
2. Look at the associated graphic, “Flint, Michigan: Lethal Water: Understanding the Connections.”
3. Reflecting on the wheel graphic as you consider what you read in the case, select from the following collection of discussion questions to help your class or group explore the interconnections on the wheel.

### Discussion Questions: Understanding the Connections

The graphic contains a photograph of the inside of one of the city water pipes in Flint, Michigan, that was affected by the contaminated water discussed in the case. The wheel of words around the pipe identify 15 different themes or connecting factors (circles of influence) related to the community that played a role in the water/lead crisis in Flint, Michigan, and responses to it. The 15 “circles of influence” each overlap, a reminder that the crisis had many causes and requires interconnected responses. Encourage students to consider each of the 15 themes individually and in relation to the others, across and among different groups of themes and factors.

Below are sample discussion questions organized by each of the 15 themes and how they might be interrelated. Teachers might divide the class into small groups around the room, with each group discussing among themselves one of the following areas and series of questions. Each group might then represent that perspective in a class-wide discussion of the whole. Alternatively, choose several themes most relevant to the class you are teaching and focus classroom discussion on those themes, pointing to the other (also related) themes as they come up, to emphasize the connection between the many different parts of community governance and its effect on global health.

#### Science

- How did science play a role in diagnosing the problem?
- Did outdated standards contribute to the crisis?
- Science is data – numbers. Where in the story were people trying to argue their case using data? Whose data was believed? Whose data was questioned? Why?
- As you consider the other themes/factors of the crisis (below), think about how science is connected with them in creating (or solving) health problems.

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## Local Industry, Economics, Employment

- What local industry is Flint, Michigan, best known for?
- Who was the leading employer, and how did changes in industry and employment affect the economic security and prosperity of Flint residents and the city? Did these economic changes play any role in the original plan to find a cheaper water source?
- How does the current employment situation in Flint affect those who live there after the water crisis?
- Think about how jobs and industry affect: loss of industry, abandoned homes, lower tax income to pay for city utilities, and the efforts to maintain a survival infrastructure (water, electricity, schools, jobs, security, food, governance).

## Civil Rights

- Why are civil rights especially important for Flint residents?
- How do you think racial discrimination in civil rights in America might play a role in the Flint crisis? (hint:<sup>a</sup>)
- Some critics of the Flint crisis called the Emergency Managers “dictators” because of the decision-making power they had due to the city’s impending risk of bankruptcy. Do you think this comment is justified? Do you think Flint citizens’ civil rights were shortchanged due to the appointment of “emergency managers”?
- How might a focus on civil rights help address attempts at urban renewal in Flint?

## Poverty

- How does the poverty rate in Flint compare to poverty rates elsewhere in the United States?
- Discussions about poverty often use the words inequity and inequality as if they mean the same thing, but they do not; *Inequity* is a lack of fairness or injustice while *inequality* is a disparity or difference in size or circumstances. How would you use these two words in relation to those affected by the Flint crisis?
- How did poverty increase Flint children’s risk of exposure to lead in the water? How did poverty affect families’ access to healthy foods and the ability to find and purchase safe water alternatives?
- What is the connection between poverty and health care access in the United States? Consider the stressors of poverty and how they increase poor health.

## National Risks

- Discuss the role of national safety in this local crisis. For example: The Flint crisis illustrates the failure of an American governance at the city, state, and federal levels, despite political systems designed to create national norms of health for all who live in the U.S. What happened in Flint alarms experts because it is a symptom of a crisis that could happen elsewhere. For example, Professor Marc Edwards’ interest in the Flint story arose from his discovery of similar issues in Washington, D.C. The crisis in Flint concerns many because it was so easy for incompetence and poor governmental choices to result in the violation of national standards designed to keep people safe and healthy in their homes.
- Many who moved away from Flint said they will never quite trust the water, no matter where they live. Do you agree? Why or why not?

## Politics

- Political factors play a big role in the Flint water crisis. How did politics affect health in this story? Consider the distinct effects of local city government in Michigan with that of national organizations such as the Environmental Protection Agency (EPA).

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<sup>a</sup> Barret J. “Environmental Justice in Maryland” Environmental Law Clinic, University of Maryland September 2015, [https://www.law.umaryland.edu/programs/environment/documents/Envtl\\_Justice\\_in\\_Md\\_0915.pdf](https://www.law.umaryland.edu/programs/environment/documents/Envtl_Justice_in_Md_0915.pdf). Accessed June 23, 2016.

- How influential in decisions about safe water were: Political budgetary concerns? The Receivership (near-bankruptcy) status of the city? The EPA? The literal cost of raising water prices? What were the negative political consequences of the crisis?
- How do you think political factors might play a positive role in cleaning up water and healthy access to water in Flint?

## Health

- In Flint, a non-health-related series of crisis situations led to a health crisis. Consider how health often depends on social factors much more than it depends on good medicine. What social factors in Flint are not directly about health that nonetheless harmed children's health?
- Are Flint's children at special risk because they are poor and may have substandard access to proper medical care? Why?
- Discuss the consequences of lead exposure. What is the short-term vs. long-term impact? What amount of lead is a healthy dose?
- Discuss the consequences and potential health costs to Flint citizens of other contaminants that were discussed in this story (e.g. *E. coli*; trihalomethane).

## Policy

- What policies did state government workers pay attention to in deciding to switch Flint's water source?
- What is the role of government policy in the legal debates over costs and consequences? Does this change depending on what level of government (federal, state and local) is acting? What policies were ignored?
- How are legal policy, environmental policy, and health policy all part of the debates and factors in this narrative?

## Parents' and Citizen Advocacy

- What parent voices did you hear and which did you most identify with? Do you think racial bias played a role in the crisis, since the most vocal parent covered in the news—and the researcher and physician who championed the need for change—were not members of the African American community in Flint?
- How important were the voices of parents in identifying the Flint water crisis and pushing for national attention and change?
- Discuss the importance of citizen action in local environmental crises.

## Environment

- The Flint water crisis was caused by human action that led to environmental contamination. Environment includes not only the natural environment (water, soil, air), but also the social environment of urbanization. How did the crisis affect Flint's environment?
- Do you know what happens to contaminated pipes when they are replaced or upgraded? How does such "waste disposal" affect the broader environment?
- What environmental effect do you think followed from Flint residents new need to depend entirely on safe water from other sources (e.g., plastic bottles that need proper recycling)?

## Legal Action

- Who blamed who in the Flint water crisis? Who had power to push for legal action? What positive role does legal action play in a crisis like Flint's?
- Debate the issue of liability in a situation where government workers were expected to comply with their supervisors and act on decisions they did not always understand.
- What legal action might have the greatest power to improve the lives of those children whose learning potential is permanently affected by lead poisoning as a result of the crisis?

## Public Health Campaigns

- How did public awareness of health issues influence this story? What form did public information about health and health risk in Flint take?
- Usually public health campaigns are driven by citizens in collaboration with local public health organizations, including local government. Discuss the role of the public health organizations in the Flint crisis in communicating effective timely information about the risks in the water.

## Governance

- International, national, state, and local government organizations are responsible for governance decisions that make it possible for ordinary people to live well, affecting both economics and health. Yet often those responsible for economic governance (the budgets) compete with those responsible for health governance (health systems and health care access). Discuss these competing governance tensions as they played a role in the Flint water crisis. How can those who govern budgets increase their focus on the importance of health?
- How can those who govern health effectively communicate with politicians who care primarily about balancing the books?
- Why is health important for economic flourishing and development around the world?

## Public Safety Regulation

- Public safety is regulated by policies, by laws, by citizen action, and by national influence. How was public safety compromised in the Flint water crisis?
- What regulations played a role in the debates? Think about how public safety regulations relate to the other connecting influences and related factors in the “Flint Water Crisis Wheel.”

## Natural Resource Management

- Do you agree that water is a human right? What should the role of government be in ensuring essential water is safe? Affordable?
- Do some research to find the international documents online that spell out exactly what global leaders have agreed upon related to the human right to water. Look at the language in these documents that describe issues of: affordability, access, safety, and health. Think about similar issues related to debates over access and ownership to natural resources such as clean air, adequate food supply, and fossil fuels.



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## Suggested Role-Play Exercise

# Flint, Michigan: Lethal Water

2017

Read the case “Flint, Michigan: Lethal Water” carefully, trying to understand the perspective and decision making of each person who played a role in the events it discusses. In class, break up into small groups of four or five students per group. Each member of the group then chooses to assume the role of one of the individuals listed below who had some influence in the Flint water crisis. Take time to think about how you would defend that individual’s position; refer to the information in the case. The teacher should decide whether students might also take the opportunity to re-read the case and/or do further research on their “persona.” With each student assuming their “role,” groups take about 20-30 minutes together to debate on finding a solution that will (a) improve children’s health potential, (b) support citizens who wish to remain in Flint, and (c) guarantee safe housing and water access in equitable measure. If the class is large enough, some students may play the role of “ordinary Flint citizens.”

### State Government

- Governor Rick Snyder
- Emergency Manager Darnell Earley

### Government Agencies

- Brad Wurfel, Former Communication Director of the Michigan Dept. of Environmental Quality
- A representative of the U.S. Environmental Protection Agency (based in Chicago)

### Activists

- Leanne Walters, Flint mother

### Researcher

- Marc Edwards, Professor, Virginia Tech

### Physician

- Mona Hanna-Attisha, Pediatrician who studied rising blood levels in infants and children in Flint

### Local Government

- Karen Weaver, Mayor of Flint

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## Annotated Bibliography

# Flint Water Crisis

2017

This bibliography was curated by the Global Health Education and Learning Incubator at Harvard University to supplement the case study, “Flint, Michigan: Lethal Water.” Selected publications and teaching resources in this collection focus on lead and water safety, children’s health, and health governance as they relate to the events of the toxic water crisis in Flint, Michigan; the bibliography also includes materials which relate to these issues more broadly at the national and global levels. The wide range of materials highlighted here may add value to teaching and classroom discussion about these issues.

These multidisciplinary resources may be suitable for students at the high school and undergraduate college levels. This collection may also be useful graduate school pedagogy on public health, health policy, maternal and child health, water and sanitation, and global governance. Learning objectives and supporting materials will vary depending on how the material is used in a course or class discussion. Brief annotations provide a cursory summary of resources, and within each subgroup, the most general or pertinent source is listed first.

- [The Flint Water Crisis](#)
  - [Flint: What Happened and Why Is It Important?](#)
  - [Flint: A Focus on Lead](#)
  - [Flint: A Focus on Water Safety](#)
  - [Flint: A Focus on Environmental Science and Governance](#)
- [Global: Lead as an Environment Risk](#)
  - [Lead Toxicity in Children](#)
  - [Prevention and Regulation](#)
- [Global: Water Safety and Regulation](#)
- [Global: Health Governance and Environmental Risks](#)

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## Selected Resources – At a Glance

### The Flint Water Crisis

#### Flint: What Happened and Why Is It Important?

TEACHING RESOURCES	
	<b>Teaching Pack.</b> Teaching Pack: Flint, Michigan: Lethal Water. Global Health Education and Learning Incubator at Harvard University 2017. <a href="http://repository.gheli.harvard.edu/repository/collection/teaching-pack-flint-michigan-and-lethal-water">http://repository.gheli.harvard.edu/repository/collection/teaching-pack-flint-michigan-and-lethal-water</a> .
	<b>Teaching Case.</b> Gordon R, Holman S. Flint, Michigan: Lethal Water – Case Study. Global Health Education and Learning Incubator at Harvard University 2017. <a href="http://repository.gheli.harvard.edu/repository/11515">http://repository.gheli.harvard.edu/repository/11515</a> .
	<b>Instructor's Note.</b> Flint, Michigan: Lethal Water – Instructor's Note Global Health Education and Learning Incubator at Harvard University 2017. <a href="http://repository.gheli.harvard.edu/repository/11516">http://repository.gheli.harvard.edu/repository/11516</a> .
	<b>Discussion Guide.</b> Flint, Michigan: Lethal Water – Discussion Guide. Global Health Education and Learning Incubator at Harvard University 2017. <a href="http://repository.gheli.harvard.edu/repository/11517">http://repository.gheli.harvard.edu/repository/11517</a> .
	<b>Teaching Graphic.</b> Flint, Michigan: Lethal Water – Teaching Graphic. Global Health Education and Learning Incubator at Harvard University 2017. <a href="http://repository.gheli.harvard.edu/repository/11518">http://repository.gheli.harvard.edu/repository/11518</a> .
	<b>Course.</b> Flint Water Crisis: An Online Course. University of Michigan-Flint 2016. <a href="https://www.youtube.com/playlist?list=PLXTcWgqRYb15MwCzeQhFK1ASsx0l416u">https://www.youtube.com/playlist?list=PLXTcWgqRYb15MwCzeQhFK1ASsx0l416u</a> .
MULTIMEDIA AND NEWS	
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<b>Lesson.</b> The Habitable Planet, Course Unit 8. Water Resources. Annenberg Foundation 2017. <a href="http://www.learner.org/courses/envsci/unit/text.php?unit=8&amp;secNum=0">http://www.learner.org/courses/envsci/unit/text.php?unit=8&amp;secNum=0</a> .
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<b>Educator Portal.</b> WaterAid Teaching. WaterAid. <a href="https://www.wateraid.org/uk/get-involved/teaching">https://www.wateraid.org/uk/get-involved/teaching</a> .
<b>Lessons.</b> Global Water Supply Elementary Curriculum. Water.org. <a href="http://static.water.org/docs/curriculums/WaterOrg%20ElemCurricFULL.pdf">http://static.water.org/docs/curriculums/WaterOrg%20ElemCurricFULL.pdf</a> .
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<b>Lessons.</b> Global Water Supply High School Curriculum. Water.org. <a href="http://static.water.org/docs/curriculums/WaterOrg%20HighCurricFULL.pdf">http://static.water.org/docs/curriculums/WaterOrg%20HighCurricFULL.pdf</a> .
<b>Teaching Case.</b> Pellecchia A et al. Knowledge Dissemination and Private Well Water Testing in Middlesex County, Ontario. Western Public Health Casebook. Public Health Casebook Publishing 2015. <a href="https://www.schulich.uwo.ca/publichealth/cases/Western%20MPH%20Casebook%202015.html">https://www.schulich.uwo.ca/publichealth/cases/Western%20MPH%20Casebook%202015.html</a> .

## Global: Health Governance and Environmental Risks

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<b>Organization.</b> The United Nations Environment Programme. <a href="http://www.unep.org">http://www.unep.org</a> .	
<b>Video.</b> Voices in Leadership: Gina McCarthy. Harvard Kennedy School of Government 2016. <a href="https://www.hsph.harvard.edu/voices/events/mccarthy">https://www.hsph.harvard.edu/voices/events/mccarthy</a> .	
<b>Report.</b> The UN World Water Development Report 2015: Water for a Sustainable World. United Nations World Water Assessment Programme, United Nations Educational, Scientific and Cultural Organization 2015. <a href="http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/wwdr/2015-water-for-a-sustainable-world">http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/wwdr/2015-water-for-a-sustainable-world</a> .	
<b>Organization.</b> International Water Association. <a href="http://www.iwa-network.org">http://www.iwa-network.org</a> .	
<b>Report.</b> Bol R. Manual of the Human Rights to Safe Drinking Water and Sanitation for Practitioners. International Water Association 2016. <a href="http://www.iwa-network.org/publications/manual-on-the-human-rights-to-safe-drinking-water-and-sanitation-for-practitioners">http://www.iwa-network.org/publications/manual-on-the-human-rights-to-safe-drinking-water-and-sanitation-for-practitioners</a> .	
<b>Topic Portal.</b> Public Health, Environmental, and Social Determinants of Health. World Health Organization. <a href="http://www.who.int/phe/en">http://www.who.int/phe/en</a> .	
<b>Report.</b> Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and Sustainable Development Goal Baselines. United Nations Children’s Fund, World Health Organization 2017. <a href="https://data.unicef.org/progress-drinking-water-sanitation-hygiene-2017-update-sdg-baselines">https://data.unicef.org/progress-drinking-water-sanitation-hygiene-2017-update-sdg-baselines</a> .	
<b>Topic Portal.</b> Global Water Forum. UNESCO Chair in Water Economics and Transboundary Water Governance at the Australian National University. <a href="http://www.globalwaterforum.org">http://www.globalwaterforum.org</a> .	
<b>Report.</b> Towards a Worldwide Assessment of Freshwater Quality. UN-Water 2016. <a href="http://www.unwater.org/publications/towards-worldwide-assessment-freshwater-quality">http://www.unwater.org/publications/towards-worldwide-assessment-freshwater-quality</a> .	
<b>Report.</b> UN-Water GLAAS 2017: Financing Universal Water, Sanitation, and Hygiene Under the Sustainable Development Goals. UN-Water, World Health Organization 2017. <a href="http://www.unwater.org/publications/un-water-glaas-2017-financing-universal-water-sanitation-hygiene-sustainable-development-goals">http://www.unwater.org/publications/un-water-glaas-2017-financing-universal-water-sanitation-hygiene-sustainable-development-goals</a> .	

## Annotated Bibliography

### The Flint Water Crisis

#### Flint: What Happened and Why Is It Important?

##### TEACHING RESOURCES

###### **Flint, Michigan: Lethal Water – Teaching Pack**

Teaching Pack. Teaching Pack: Flint, Michigan: Lethal Water. Global Health Education and Learning Incubator at Harvard University 2017. <http://repository.gheli.harvard.edu/repository/collection/teaching-pack-flint-michigan-and-lethal-water>. GHELI repository link: <http://repository.gheli.harvard.edu/repository/collection/teaching-pack-flint-michigan-and-lethal-water>

This teaching pack is focused on the toxic water crisis in Flint, Michigan between 2011 and 2016. The teaching pack is centered on a case study, which outlines the social, economic, health, and policy consequences faced by Flint in the aftermath of a governmental decision to switch the city's public water supply from Lake Huron to the more corrosive Flint River. The case highlights the role of citizens, scientists, and activists in raising public awareness of the crisis and the toxic long-term effects of lead poisoning on affected children. It also illustrates the challenges and questions such a crisis poses for other communities in the United States and globally. The teaching pack also includes an instructor's note, role play exercise, and discussion guide with an accompanying teaching graphic, all designed to help students understand the interconnected nature of a complex health issue like Flint's poisoned water, and the complexity of addressing it.

###### **Flint Water Crisis: An Online Course**

Course. Flint Water Crisis: An Online Course. University of Michigan-Flint 2016. <https://www.youtube.com/playlist?list=PLXTcWgqRYbl15MwCzeQhFK1ASsxol416u>.

This a series of 12 approximately 30-minute videos about the Flint water crisis and related issues produced by the University of Michigan. Each video includes a panel addressing a specific issue.

##### MULTIMEDIA AND NEWS

###### **The Controversial Case Over Dangerous Lead in Water in a Michigan City**

Photo Essay. The Controversial Case Over Dangerous Lead in Water in a Michigan City. The Washington Post 2016. [https://www.washingtonpost.com/national/health-science/the-controversial-case-over-dangerous-lead-in-water-in-michigan-city/2015/12/15/54286250-a355-11e5-9c4e-be37f66848bb\\_gallery.html](https://www.washingtonpost.com/national/health-science/the-controversial-case-over-dangerous-lead-in-water-in-michigan-city/2015/12/15/54286250-a355-11e5-9c4e-be37f66848bb_gallery.html).

This photo essay documents moments in the Flint, Michigan water crisis, such as community rallies, water distribution points, community blood testing, and government press conferences.

###### **Poisoned Water**

Film. Poisoned Water. NOVA 2017. <http://www.pbs.org/wgbh/nova/body/poisoned-water.html>.

This documentary, approximately one hour in length, investigates the science behind the Flint water crisis, and examines the similar contexts of water system vulnerability across the country.

###### **Good People, Bad Water, The Flint Water Crisis – A Short Documentary**

Video. Good People, Bad Water, The Flint Water Crisis – A Short Documentary. Roscoe Van Zandt Films 2015. <https://youtu.be/HAC73JRTm8>.

This 5-minute documentary video features short soundbites from several Flint residents who tell how the Flint water crisis was affecting their lives as of December, 2015.

## Flint Water Crisis

News Series. Flint Water Crisis. NBC News 2017. <http://www.nbcnews.com/storyline/flint-water-crisis>.

This news series documents NBC News' ongoing coverage of the Flint water crisis, including recent developments regarding prosecution and controversial legal costs in the aftermath of the crisis.

## Flint Water Crisis: Timeline of Communication

Video. Flint Water Crisis: Timeline of Communication. MLive 2016. <https://www.youtube.com/watch?v=yoXdTL90024>.

This 6-minute video provides a visual timeline of communication through officials in relation to the Flint water crisis, between October 1, 2014 and January 15, 2016.

## Articles on Flint Water Crisis

News. Articles on Flint Water Crisis. The Conversation. <https://theconversation.com/us/topics/flint-water-crisis-24224>.

This news portal highlights news stories—national and international—related to safe water, including stories about the Flint water crisis between January 2016 and the present. The Conversation is an independent news source from the academic and research community written for the general public.

## OTHER SELECTED RESOURCES

### *Focused on Key People*

#### **Meet the Mom who Helped Expose Flint's Toxic Water Nightmare**

News. Lurie J. Meet the Mom who Helped Expose Flint's Toxic Water Nightmare. Mother Jones 2016; Jan 21.

<http://www.motherjones.com/politics/2016/01/mother-exposed-flint-lead-contamination-water-crisis>.

This news article tells the story of LeeAnne Walters, the Flint citizen and mother who led public awareness efforts to alert citizens and identify experts who would measure and begin to address the city's water crisis.

#### **The Mom and the EPA 'Rogue Employee' Who Exposed Flint's Water Crisis**

News. Smith L. The Mom and the EPA 'Rogue Employee' Who Exposed Flint's Water Crisis. Michigan Radio, Public Radio International 2016; Jan 23. <http://www.pri.org/stories/2016-01-23/after-blowing-whistle-flints-water-epa-rogue-employee-has-been-silent-until-now>.

This news story produced for Michigan Public Radio tells the story of Lee Anne Walters, the Flint mom and citizen, and Environmental Protection Agency employee Miguel Del Toral who launched public national awareness about lead in Flint's water. The news story is accompanied by an audio podcast.

#### **Memo on High Lead Levels in Flint, Michigan – Interim Report**

Brief. Del Toral MA. Memo on High Lead Levels in Flint, Michigan – Interim Report. United States Environmental Protection Agency 2015; Jun 24. <http://flintwaterstudy.org/wp-content/uploads/2015/11/Miguels-Memo.pdf>.

This memo was a key early document in the Flint water crisis, which alerted the Chief of the EPA Ground Water and Drinking Water Branch of water quality contamination in the City of Flint following a change in the water source. The memo's "leaked" release to others outside EPA contributed to widespread public awareness of the crisis.

#### **The Heroic Professor Who Helped Uncover the Flint Lead Water Crisis Has Been Asked to Fix It**

News. Itkowitz C. The Heroic Professor Who Helped Uncover the Flint Lead Water Crisis Has Been Asked to Fix It. The Washington Post 2016; Jan 27. <https://www.washingtonpost.com/news/inspired-life/wp/2016/01/26/meet-the-heroic-professor-who-helped-uncover-the-flint-lead-water-crisis>.

This article profiles Mark Edwards, the engineering professor at Virginia Tech whose research investigation into the Flint water crisis mobilized national attention and much of the legal response.

#### **Q&A: What Really Happened to the Water in Flint Michigan?**

News. Lovell J. Q&A: What Really Happened to the Water in Flint Michigan? Scientific American 2016; Mar 2.

<https://www.scientificamerican.com/article/q-a-what-really-happened-to-the-water-in-flint-michigan>.

This article interviews Marc Edwards, the water treatment expert who, with his team of students, was the first group to

test water in Flint. Edwards and his students established the Flint Water Study (<http://flintwaterstudy.org>), to provide public information on their findings and follow-up action on the crisis.

### **Flint Water Crisis Caused by Interrupted Corrosion Control: Investigating ‘Ground Zero’ Home**

Article. Pieper KJ et al. Flint Water Crisis Caused by Interrupted Corrosion Control: Investigating ‘Ground Zero’ Home. *Environmental Science & Technology* 2017; 51: 2007-2014. DOI: 10.1021/acs.est.6b04034.

<http://pubs.acs.org/doi/abs/10.1021/acs.est.6b04034>.

This article summarizes what the environmental scientists at Virginia Tech found when they first investigated water samples and water pipes in the home of Leanne Walters and her family in 2015.

### **Pediatrician Sees Long Road Ahead for Flint After Lead Poisoning Crisis**

Article. Kuehn, BM. Pediatrician Sees Long Road Ahead for Flint After Lead Poisoning Crisis. *Journal of the American Medical Association* 2016; 315(10): 967-969. DOI: 10.1001/jama.2016.1034.

<http://jamanetwork.com/journals/jama/fullarticle/2495224>.

This article profiles Dr. Mona Hanna-Attisha, the pediatrician who documented elevated lead levels in children’s blood in Flint, Michigan following the water supply switch to the Flint River. It outlines her activities in mobilizing public awareness of lead contamination in Flint’s water supply.

### **Flint's Water Crisis and the Unique Role of the Reporter Who Helped Uncover It**

Podcast. Flint's Water Crisis and the Unique Role of the Reporter Who Helped Uncover It. ProPublica 2016.

<https://soundcloud.com/propublica/the-flint-water-crisis-and-the-unique-role-of-the-reporter-who-helped-uncover-it>.

This interview with American Civil Liberties Union (ACLU) investigative journalist, Curt Guyette, highlights the intersection of journalism and public health. Guyette initially planned to investigate and write about the state's emergency management law, but instead uncovered the Flint water crisis.

### **Flint Water Crisis: Key Figures**

Infographic. Stone C. Flint Water Crisis: Key Figures. MLive 2016.

<https://www.thinglink.com/scene/715623865249693698>.

This one-page pictorial graphic shows the key players in the Flint water crisis. Rollover links provide short bios and summaries of each individual’s role and activities.

## **General – Learn More**

### **Flint Water Study Updates**

Organization. Flint Water Study Updates. <http://flintwaterstudy.org>.

The Flint Water Study, maintained by the research team of Professor Marc Edwards at Virginia Tech, offers the latest data and development regarding the Flint water crisis. This includes stories from Flint residents; findings from Flint River corrosivity experiments and citizen testing; resources on lead in water/blood lead and opportunistic pathogens such as Legionella, bacteria, chlorine, and TTHMs; FOIA emails; documents and reports from formal investigations and the Water Study Analyses (MDEQ, EPA, MDHHS, City of Flint, and Michigan Governor’s Office); information on the study group’s Flint trips and work with school kids; data, talks, podcasts, LCR analyses, and presentations; stories about goodwill efforts on behalf of Flint; and lawsuits, petitions, letters, press releases, and other announcements.

### **FlintWaterStudy.org Guide**

Topic Portal. FlintWaterStudy.org Guide. <http://flintwaterstudy.org/guide-to-flintwaterstudy.org>.

This topic portal provides a guide to the key data about the Flint water crisis, including lead resources, investigative reports, data, lectures, and lawsuits. The site was last updated in June 2016, and includes excellent resources for background on creating lessons and other teaching materials about the Flint water crisis.

## **What Went Wrong in Flint**

News. Barry-Jester AM. What Went Wrong in Flint. FiveThirtyEight.com 2016; Jan 26.

<http://fivethirtyeight.com/features/what-went-wrong-in-flint-water-crisis-michigan>.

This article describes the factors that led to Flint's water crisis, including the omission of key data points when the city's water supply was tested. The article includes graphics and neighborhood maps illustrating the data collection process and rise in percentage of children with elevated blood lead levels.

## **I'm in Flint. I See the Pallets of Free Water. It's Not Enough.**

News. Pierce CP. I'm in Flint. I See the Pallets of Free Water. It's Not Enough. Esquire Magazine 2016; Mar 27.

<http://www.esquire.com/news-politics/politics/news/a42791/flint-water-crisis-imam>.

This article describes effect of the Flint water crisis on free donations of bottled water and the role of religious communities in the citizen response. The article features an interview with Imam Hanafi Abdul-Malik and members of his congregation as they coordinate donated water distributions and reflect on their experiences as Flint residents.

## **The Flint Water Crisis, Explained**

News. Nelson L. The Flint Water Crisis, Explained. Vox 2016; Feb 15. <http://www.vox.com/2016/2/15/10991626/flint-water-crisis>.

This article summarizes the many different issues that are part of the Flint water crisis. It provides a helpful introductory overview of the situation and the context in which it emerged. A bar chart compares elevated blood lead levels in Flint with those identified in 20 cities in Pennsylvania.

## **10 Things They Won't Tell You About the Flint Water Tragedy. But I Will.**

Opinion. Moore M. 10 Things They Won't Tell You About the Flint Water Tragedy. But I Will. MichaelMoore.com 2016.

<http://michaelmoore.com/10FactsOnFlint>.

This opinion article, by filmmaker Michael Moore, summarizes 10 factual aspects of the Flint water crisis, focusing on the effect of cost-cutting decisions on children's health.

## **A Toxic Timeline of Flint's Water Fiasco**

News. Lurie J. A Toxic Timeline of Flint's Water Fiasco. Mother Jones 2016; Jan 26.

<http://www.motherjones.com/environment/2016/01/flint-lead-water-crisis-timeline>.

This article summarizes key events in the Flint water crisis between April 25, 2014—the date of the municipal water switch over to the Flint River—and January 27, 2016, the date of a coalition lawsuit requesting federal court intervention to provide Flint with clean drinking water.

## **America is Flint**

Opinion. Kristof N. America is Flint. The New York Times 2016; Feb 6.

<https://www.nytimes.com/2016/02/07/opinion/sunday/america-is-flint.html>

This editorial, by Pulitzer Prize-winning journalist Nicholas Kristof, looks beyond the Flint water crisis to other communities across the United States where children suffer from lead poisoning.

## **Analysis: How Michigan and National Reporters Covered the Flint Water Crisis**

News. Robbins D. Analysis: How Michigan and National Reporters Covered the Flint Water Crisis. Media Matters 2016;

Feb 2. <http://mediamatters.org/research/2016/02/02/analysis-how-michigan-and-national-reporters-co/208290>.

This article analyzes news coverage of the Flint water crisis between the spring of 2014 and January 2016. The article includes a graphic timeline image useful in classroom or group discussion about health issues and the public media.

## **Documents Show Flint Filed False Reports About Testing for Lead in Water**

News. Fonger R. Documents Show Flint Filed False Reports About Testing for Lead in Water. MLive 2015; Nov 12.

<http://s.mlive.com/KrfHmlO>.

This article summarizes the investigation into what caused the Flint water crisis up to November 2015. It includes a 92-image photo gallery illustrating the crisis.

## Flint: A Focus on Lead

### SELECTED RESOURCES

#### **Lead in the Water -- The Flint Water Crisis**

Infographic. Lead in the Water -- The Flint Water Crisis. Compound Interest 2016.

<http://www.compoundchem.com/2016/01/25/flint-water>.

This graphic summary and accompanying explanation illustrates the chemistry behind the Flint water crisis. Includes a downloadable graphic and links to additional background information about the Flint water crisis.

#### **University of Michigan GIS Center – Flint**

Organization. University of Michigan – Flint Geographic Information Systems Center (GISC).

<https://www.umflint.edu/gis>.

This web portal of the University of Michigan (UM) Geographic Information Systems Center highlights data from UM's project to map the lead water pipes in Flint, Michigan, in response to the Flint water crisis. Maps identify the city's water service lines and provide information that can be used help identify which pipes the city needs to remove and replace.

#### **Elevated Blood Lead Levels in Children Associated With the Flint Drinking Water Crisis: A Spatial Analysis of Risk and Public Health Response**

Article. Hanna-Attisha M et al. Elevated Blood Lead Levels in Children Associated With the Flint Drinking Water Crisis: A Spatial Analysis of Risk and Public Health Response. American Journal of Public Health 2016; 106: 283-290.

<http://ajph.aphapublications.org/doi/abs/10.2105/AJPH.2015.303003>.

This article, written by the leading pediatrician involved in studying and combatting the Flint water crisis, summarizes the analysis of elevated blood lead level incidence in children before and after Flint's switch of its municipal water source to the Flint River. The study found that the percentage of children with elevated blood levels increased after the water source change, especially in children that lived in socioeconomically disadvantaged neighborhoods.

#### **Blood Lead Levels Among Children Aged <6 Years—Flint, Michigan, 2013-2016**

Article. Kennedy C et al. Blood Lead Levels Among Children Aged <6 Years—Flint, Michigan, 2013-2016. Morbidity and Mortality Weekly Report; 65(25): 650-654. Centers for Disease Control and Prevention 2016.

<https://www.cdc.gov/mmwr/volumes/65/wr/mm6525e1.htm>.

This article summarizes data on 7,306 children living in the area served by the Flint Water System (FWS) between 2013 and 2016. It indicates a significantly higher proportion of elevated blood levels during the early period of the switch from the Detroit Water Authority (DWA) to the FWS.

#### **Lead Contamination in Flint -- An Abject Failure to Protect Public Health**

Article. Bellinger DC. Lead Contamination in Flint -- An Abject Failure to Protect Public Health. The New England Journal of Medicine 2016; 374: 1101-1103. <http://www.nejm.org/doi/full/10.1056/NEJMp1601013>.

This op-ed article criticizes the failure of government agencies and officials to protect the health of Flint's residents. The online article includes a link to an audio interview with the author, Professor of Environmental Health at the Harvard T.H. Chan School of Public Health, on lead contamination in Flint and the lack of political will to protect public health.

## Flint: A Focus on Water Safety

### SELECTED RESOURCES

#### **Flint Water Advisory Task Force Final Report**

Report. Flint Water Advisory Task Force Final Report. Office of Governor Rick Snyder, State of Michigan 2016.

[https://www.michigan.gov/documents/snyder/FWATF\\_FINAL\\_REPORT\\_21March2016\\_517805\\_7.pdf](https://www.michigan.gov/documents/snyder/FWATF_FINAL_REPORT_21March2016_517805_7.pdf).

This report summarizes findings of the Flint water crisis by Michigan Governor Rick Snyder's appointed Flint Water Advisory Task Force. It was based on interviews and public documents and aimed to clarify who did what and determine accountability; highlight causes of the crisis and suggest preventive measures; and make recommendations to better safeguard Michigan residents and the Flint community. The 63 interviewees included three Flint citizens.

#### **Dangerous Disregard for the Right to Water**

Opinion. Dangerous Disregard for the Right to Water. Editorial. The Lancet 2016; 388(10062): 2838.

[http://dx.doi.org/10.1016/S0140-6736\(16\)32511-9](http://dx.doi.org/10.1016/S0140-6736(16)32511-9).

This editorial summarizes the failure of the American legal system—at the local, state, and national levels—to recognize the human right to water. The editorial was published as part of an issue celebrating Human Rights Day, and invites readers to think of water issues broadly, including the debates over privatizing water supplies and the effects of oil pipeline spillages on impoverished populations at risk in the U.S.

#### **This Is How Toxic Flint's Water Really Is**

Infographic. Ingraham C. This Is How Toxic Flint's Water Really Is. The Washington Post 2016; Jan 15.

<https://www.washingtonpost.com/news/wonk/wp/2016/01/15/this-is-how-toxic-flints-water-really-is>.

This infographic visualizes the toxicity of Flint's water supply, and explains the difference between health and legal regulations in their understanding of “acceptable” lead limits.

#### **Michigan's Medicaid Section 1115 Waiver to Address Effects of Lead Exposure in Flint**

Brief. Michigan's Medicaid Section 1115 Waiver to Address Effects of Lead Exposure in Flint. Kaiser Family Foundation

2016. <http://files.kff.org/attachment/fact-sheet-michigans-medicaid-section-1115-waiver-to-address-effects-of-lead-exposure-in-flint>.

This brief describes Michigan's efforts to address the health-related effects of the Flint water crisis on Medicaid-eligible children and pregnant women served by the Flint water system. The Medicaid waiver submitted by the State of Michigan and approved by the Centers for Medicare and Medicaid Services (CMS) expands health care coverage to children and pregnant women with incomes up to 400% of the federal poverty line. Under the waiver, an estimated 15,000 people would be newly eligible for coverage.

#### **The Flint Water Crisis and Beyond**

Webinars. The Flint Water Crisis and Beyond. American Public Health Association 2016. <https://www.apha.org/events-and-meetings/webinars/lead-and-public-health>.

This series of webinars examines the Flint water crisis from multiple public health lenses: community solutions to lead exposure in homes, the connections between drinking water chemistry and long-term health, and the implications of water quality regulation for health equity.

## Flint: A Focus on Environmental Science and Governance

### SELECTED RESOURCES

#### **EPA Official Letter to Michigan DEQ Regarding Flint**

Article. Beauvais J. Correspondence: EPA Official Letter to Michigan DEQ Regarding Flint. United States Environmental Protection Agency 2016; Feb 29. <https://www.epa.gov/sites/production/files/2016-03/documents/flint-epa-letter-to-mdeq-director-creagh-20160229-3pp.pdf>.

This letter from the United States Environmental Protection Agency (EPA) Office of Water to the Michigan Department

of Environmental Quality (DEQ) ordered specific actions to improve the quality of Flint's drinking water within 30 days. It represents one example of the many available primary documents in the legal battle of the Flint water crisis.

### **Social and Built Environmental Correlates of Predicted Blood Levels in the Flint Water Crisis**

Article. Sadler RC et al. Social and Built Environmental Correlates of Predicted Blood Levels in the Flint Water Crisis. *American Journal of Public Health* 2017; 107(5): 763-769. <http://ajph.aphapublications.org/doi/10.2105/AJPH.2017.303692>. This article combines geocoding with blood lead level results to identify the neighborhoods where residents were at greatest risk in the Flint water crisis. The paper illustrates how a methodology common in emergency response could be useful for addressing health issues in an urban environment.

### **Remember Flint**

Opinion. Markel H. Remember Flint. Editorial. *The Milbank Quarterly* 2016; 94(2): 229-236. DOI: 10.1111/1468-0009.12188. <https://www.milbank.org/quarterly/articles/remember-flint>.

This opinion piece, by a pediatrician and Michigan native, summarizes the place of lead in American public health concerns, highlights the economic and racial inequities that put poor African American children at greatest risk, and discusses key events in the water crisis.

### **Flint, Michigan: A Century of Environmental Injustice**

Opinion. Rosner D. Flint, Michigan: A Century of Environmental Injustice. Editorial. *American Journal of Public Health* 2016; 106(2): 200-201. DOI: 10.2105/AJPH.2015.303011. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4815825>. This editorial reflects on the past century of history in Flint, Michigan, and environmental justice issues related to the rise and fall of its leading employer, General Motors.

### **Politics and Public Health: The Flint Drinking Water Crisis**

Article. Gostin LO. Politics and Public Health: The Flint Drinking Water Crisis. *Hastings Center Report* 2016; 46(4): 5-6. <http://onlinelibrary.wiley.com/doi/10.1002/hast.598/abstract>.

This article by a leading human rights lawyer highlights the legal violations and concerns key in Flint's water crisis, one of the most striking cases of health inequalities in the United States. The article summarizes the role of compensation and justice, legislative action, and how repairing the system will not change the social and economic factors that put Flint citizens at risk in the first place.

### **What the Flint Crisis Reveals About Inequality in the U.S.**

News. Talbot-Zorn J, Shank M. What the Flint Crisis Reveals About Inequality in the U.S. *TIME Magazine* 2016; Feb 9. <http://time.com/4212941/flint-and-inequality>.

This article considers the Flint water crisis within the larger context of inequality in America. It highlights how disparities in wealth too often mean disparities in basic health, nutrition, and cognitive functioning.

### **Flint Water Class Action**

Topic Portal. Flint Water Class Action. <http://www.flintwaterclassaction.com>.

This web portal is the homepage of the class action lawsuit filed by residents of Flint, Michigan affected by the Flint water crisis. The site includes basic information about the crisis, the effects of lead poisoning on children, and recent news updates on Flint's water and the lawsuit.

### **The Flint Water Crisis: Using Systems Thinking to Understand Critical Failures**

Article. Sokolow J. The Flint Water Crisis: Using Systems Thinking to Understand Critical Failures. *Cornell Policy Review* 2017. [http://www.cornellpolicyreview.com/flint\\_water\\_crisis](http://www.cornellpolicyreview.com/flint_water_crisis).

This article considers what went wrong in Flint as a model for thinking through critical system failures more broadly. Graphics illustrate the intersecting systems, what went wrong, and how to shape better preventive policy.

## Global: Lead as an Environmental Risk

### Lead Toxicity in Children

#### SELECTED RESOURCES

##### **Lead Poisoning and Health Fact Sheet**

Fact Sheet. Lead Poisoning and Health. World Health Organization 2016.

<http://www.who.int/mediacentre/factsheets/fs379/en>.

This fact sheet summarizes key facts about lead poisoning and its effects on the health of young children, as well as the response of the World Health Organization.

##### **Economic Costs of Childhood Lead Exposure in Low- and Middle-Income Countries**

Article. Attina TM, Trasande L. Economic Costs of Childhood Lead Exposure in Low- and Middle-Income Countries.

Environmental Health Perspectives 2013; 121: 1097-1102. <http://dx.doi.org/10.1289/ehp.1206424>.

<https://ehp.niehs.nih.gov/wp-content/uploads/121/9/ehp.1206424.pdf>.

This research article estimates the economic costs of childhood exposure to lead in low- and middle-income countries. It suggests a total economic loss due to elevated lead exposure of between \$728.6 and \$1162.5 billion, even though children's blood lead levels have declined worldwide.

##### **Issue Brief: Childhood Lead Exposure and Educational Outcomes**

Brief. Issue Brief: Childhood Lead Exposure and Educational Outcomes. National Center for Healthy Housing 2013.

[http://www.nchh.org/Portals/o/Contents/Childhood\\_Lead\\_Exposure.pdf](http://www.nchh.org/Portals/o/Contents/Childhood_Lead_Exposure.pdf).

This short policy brief describes the negative impact that even low levels of lead exposure can have on children's health and educational outcomes. It also notes that lead exposure occurs more frequently in low-income children and children of color.

##### **Here's How One of the World's Most Common Toxins is Poisoning American Children**

Infographic. Calderone J, Gould S. Here's How One of the World's Most Common Toxins is Poisoning American Children.

Business Insider 2016. <http://www.businessinsider.com/lead-health-child-flint-michigan-body-pollution-water-2016-1>.

This infographic illustrates the physical effects of lead ingestion on children's health and development.

##### **Preventing Lead Poisoning in Young Children: A Statement by the Centers for Disease Control**

Report. Roper WL et al. Preventing Lead Poisoning in Young Children: A Statement by the Centers for Disease Control.

Centers for Disease Control and Prevention 1991.

<https://www.cdc.gov/nceh/lead/publications/books/plpyc/contents.htm>.

This seminal report details how to prevent lead poisoning in young children. The report, most recently revised in 1991, outlines the scientific data showing the adverse effects of lead in young children even at low blood lead levels, and makes recommendations based on practical considerations and essential preventive follow up. Unlike previous versions, this document emphasizes the need for primary care prevention and the importance of coordination between pediatric health-care providers and public agencies.

##### **How Lead Can Get Into the Water Supply, Explained in 5 Charts**

News. Zarracina J. How Lead Can Get Into the Water Supply, Explained in 5 Charts. Vox 2016; Feb 19.

<https://www.vox.com/2016/2/19/10972256/the-visual-guide-to-lead-poisoning>.

This online media article features five graphic images to illustrate and briefly explain how lead can have a harmful effect on health, and how it can enter the drinking supply through old service lines.

##### **Don't Pollute My Future! The Impact of the Environment on Children's Health**

Report. Don't Pollute My Future! The Impact of the Environment on Children's Health. World Health Organization 2017.

<http://www.who.int/ceh/publications/don-t-pollute-my-future/en>.

GHELI repository link: <http://repository.gheli.harvard.edu/repository/11698>

This report synthesizes evidence about the impact of environment risks on children’s health. Fetuses and young children are particularly vulnerable to environmental threats due to their developing organs and immune systems, and it is estimated that approximately a quarter of both childhood deaths and the total disease burden in children under five could be prevented through the reduction of environmental risks such as air pollution, unsafe water, sanitation and inadequate hygiene, or chemicals. The report describes children’s specific vulnerability to such environmental threats during development, and offers selected interventions and economic evaluations by disease group.

## **Lead Contamination Beyond Flint: Drinking Water and Children’s Health**

Video. Lead Contamination Beyond Flint: Drinking Water and Children’s Health. The Forum, Harvard T.H. Chan School of Public Health 2017. <https://theforum.sph.harvard.edu/events/lead-contamination-beyond-flint>.

This one-hour panel discussion discusses cities outside of Flint that are also grappling with the effects of toxic drinking water on population health. The panelists explore potential responses to safekeeping American drinking water, the role of regulation and funding in averting crises, and essential information for the public.

## **Chemical Exposures and the Brain: The Flint Water Crisis and More**

Video. Chemical Exposures and the Brain: The Flint Water Crisis and More. The Forum, Harvard T.H. Chan School of Public Health 2016. <https://theforum.sph.harvard.edu/events/chemical-exposures-and-the-brain>.

This one-hour panel discussion describes the toxic impacts of chemicals on the brain, outside of lead. In particular, the discussion looks at links between certain pesticides, mercury, and flame retardants and children’s cognitive development. The conversation also explored public policy success and failures in safeguarding the public health from neurotoxicants.

## **Why Lead?**

Infographic. Why Lead? United Nations Environmental Programme. <http://www.unep.org/chemicalsandwaste/what-we-do/technology-and-metals/lead/lead-paint-alliance/resources/why-lead-infographic>.

This infographic describes the health effects of lead exposure, common sources of exposure, morbidity and mortality estimates associated with lead exposure, economic costs, and potential avenues for response.

## **Lead**

Topic Portal. Lead. Centers for Disease Control and Prevention. <https://www.cdc.gov/nceh/lead/default.htm>.

This topic portal provides recent resources, news, funding, and data about lead exposure in the United States.

## **Childhood Lead Poisoning Data, Statistics, and Surveillance**

Data Portal. Childhood Lead Poisoning Data, Statistics, and Surveillance. Centers for Disease Control and Prevention 2015. <https://www.cdc.gov/nceh/lead/data/index.htm>.

This data portal compiles state surveillance data for children under 72 months who were tested for lead at least once since January 1, 1997. The data portal includes information by county and state, and also standard lead surveillance definitions and classifications. Although data are not generalizable—only funded health departments are required to provide data to the CDC—the portal provides an important snapshot of lead exposure in the United States.

## **Educational Interventions for Children Affected by Lead**

Report. Educational Interventions for Children Affected by Lead. Centers for Disease Control and Prevention 2015. [https://www.cdc.gov/nceh/lead/publications/Educational\\_Interventions\\_Children\\_Affected\\_by\\_Lead.pdf](https://www.cdc.gov/nceh/lead/publications/Educational_Interventions_Children_Affected_by_Lead.pdf).

This report summarizes the consequences of lead on learning and educational attainment, and outlines available services and successful early childhood education programs to respond to potential cognitive impacts.

## **The Poisoned Generation**

News. Newkirk II VR. The Poisoned Generation. The Atlantic 2017.

<https://www.theatlantic.com/politics/archive/2017/05/the-poisoned-generation/527229>.

This essay from The Atlantic describes a decades-long lead-poisoning lawsuit in New Orleans, which illustrates how lead exposure disproportionately impacts the health and well-being of black families and communities. An audio version is also available.

## Assessing Child Lead Poisoning Case Ascertainment in the US, 1999–2010

Article. Roberts EM et al. Assessing Child Lead Poisoning Case Ascertainment in the US, 1999–2010. *Pediatrics* 2017; 139(5): e20164266. <http://pediatrics.aappublications.org/content/early/2017/04/25/peds.2016-4266.full>.

This research article indicates that under-testing of blood level by pediatric care providers is pervasive in many U.S. states. The authors compare prevalence estimates for elevated blood lead levels with data reported to the Centers for Disease Control and Prevention (CDC) for children 12 months to 5 years of age on a state-by-state basis. During the 1999-2010 study period, the greatest number of children with blood lead levels greater than 10.0 ug/dL lived in the South.

## Prevention and Regulation

### SELECTED RESOURCES

#### Global Report on the Status of Legal Limits on Lead in Paint

Report. Global Report on the Status of Legal Limits on Lead in Paint. United Nations Environmental Programme 2016. <https://www.unep.org/chemicalsandwaste/sites/unep.org.chemicalsandwaste/files/Status%20of%20Limits-Lead-Paint-2016%20Report-Final.pdf>.

This report provides an overview of the progress made towards the global target of all countries having lead paint controls by 2020. Only 36 percent of nations had legally binding limits on lead paint as of 2016, indicating a significant gap still needs to be filled if the 2020 target is to be met successfully.

#### Operational Framework Global Alliance to Eliminate Lead Paint

Report. Operational Framework Global Alliance to Eliminate Lead Paint. World Health Organization, United Nations Environmental Programme 2011. [http://www.who.int/ipcs/assessment/public\\_health/gaelp/en](http://www.who.int/ipcs/assessment/public_health/gaelp/en).

This document outlines a framework to prevent children's exposure to lead from paint and to minimize occupational exposure. It was developed by the Global Alliance to Eliminate Lead Paint, a collaborative initiative between the World Health Organization and the United Nations Environmental Programme, with the ultimate goal of phasing out the manufacture and sale of lead paints. The framework (pp. 1-5) is followed by three Annex documents: the text of international declarations concerning lead in paint; Global Alliance participation information; and group terms of reference.

#### Lead Paint Alliance Regulatory Toolkit

Toolkit. Lead Paint Alliance Regulatory Toolkit. United Nations Environmental Programme, World Health Organization 2016. <https://wedocs.unep.org/bitstream/handle/20.500.11822/17421/brochure%2003.pdf>.

This toolkit provides government officials with information on how to establish legal limits for lead poisoning in their countries. The materials would also be relevant to other interested stakeholders working to prevent lead poisoning. The toolkit includes select references as well as 10 downloadable modules on understanding the problem, identifying the market, and taking action.

#### International Lead Poisoning Prevention Week of Action

Topic Portal. International Lead Poisoning Prevention Week of Action. World Health Organization 2017. [http://www.who.int/ipcs/lead\\_campaign/en](http://www.who.int/ipcs/lead_campaign/en).

This topic portal includes resources from the International Lead Poisoning Week of Action (October 22-27, 2017). Available tools include information and resources, infographics, flyers, and posters.

#### Countries With Legally-Binding Controls on Lead Paint

Data Visualization. Countries With Legally-Binding Controls on Lead Paint. World Health Organization 2017. [http://www.who.int/gho/phe/chemical\\_safety/lead\\_paint\\_regulations/en](http://www.who.int/gho/phe/chemical_safety/lead_paint_regulations/en).

This data visualization describes which countries do and do not have legally binding controls on lead paint. Using data from the World Health Organization and the United Nations Environment Programme, the visualization illustrates that more than one-third of countries do not yet have legally binding controls on the production, import, export, and use of lead paint, which has had demonstrable negative effects on human health.

## TEACHING RESOURCES

### **Establishing Legal Limits on Lead in Paint: Four Country Case Studies**

Teaching Cases. Establishing Legal Limits On Lead in Paint: Four Country Case Studies. Global Alliance to Eliminate Lead Paint 2015. <http://web.unep.org/chemicalsandwastes/noleadinpaint/toolkit>.

These four case studies explain existing lead paint laws and demonstrate various perspectives from a country that has worked to prevent exposure to lead from paint.

### **Middle School Lesson Plans – Environmental Chemistry of Lead Lesson Plan. The Lead Placemat: Understanding Lead Exposure**

Lesson. Middle School Lesson Plans – Environmental Chemistry of Lead Lesson Plan. The Lead Placemat: Understanding Lead Exposure. Centers for Disease Control and Prevention 2007.

<https://www.cdc.gov/careerpaths/scienceambassador/documents/environment-lead-placemat.pdf>.

This lesson introduces middle-school students to the history of lead, its use in society and industry, and its adverse public health effects. Additionally students learn how to identify lead's chemical and physical properties. The lesson plan is part of the CDC's Science Ambassador series to help introduce middle- and high-school students to public health topics and to apply mathematical and scientific thinking to these issues.

### **High School Lesson Plans – Environmental Chemistry of Lead Lesson Plan. Take the Lead – Get the Lead Out**

Lesson. High School Lesson Plans – Environmental Chemistry of Lead Lesson Plan. Take the Lead – Get the Lead Out. Centers for Disease Control and Prevention 2007.

<https://www.cdc.gov/careerpaths/scienceambassador/documents/lead-take-the-lead.pdf>.

This lesson plan focuses on how lead leaches into inorganic compounds such as soil, paint, and water, and describes the adverse health effects of elevated lead levels in the body. The lesson plan is part of the CDC's Science Ambassador series to help introduce middle- and high-school students to public health topics and to apply mathematical and scientific thinking to these issues.

### **How to Reduce Lead Exposure**

Discussion Guide. How to Reduce Lead Exposure. PBS Learning Media 2011.

<http://mass.pbslearningmedia.org/resource/envh10.sci.phys.matter.reducelead/how-to-reduce-lead-exposure>.

This discussion guide includes a short video, background essay, and discussion questions that describe the potential effects of lead exposure and how to reduce its impacts. A doctor discusses frequent ways children become exposed to lead and how high blood lead levels can affect their health. The materials are designed for grades 6-12.

### **The Effects of Childhood Lead Poisoning: A Video**

Discussion Guide. The Effects of Childhood Lead Poisoning. PBS Learning Media 2011.

<http://mass.pbslearningmedia.org/resource/envh10.health.leadpoison/the-effects-of-childhood-lead-poisoning>.

This discussion guide includes a short video, background essay, and discussion questions describing the impact of lead poisoning on children through two families' experiences. The materials are designed for grades 6-12.

## Global: Water Safety and Regulation

### SELECTED RESOURCES

#### **Water Safety Portal**

Topic Portal. Water Safety Portal. World Health Organization, The International Water Association.

<http://www.wsportal.org>.

This topic portal shares recent resources, toolkits, auditing and risk-assessment tools, training materials, and news to support communities that are developing water safety plans. Water safety plans are a comprehensive risk assessment

and risk management approach to ensuring the safety of a community's drinking water supply.

## **Water, Sanitation, Hygiene**

Topic Portal. Water, Sanitation, Hygiene. World Health Organization. [http://www.who.int/water\\_sanitation\\_health/en](http://www.who.int/water_sanitation_health/en). This topic portal links to recent World Health Organization news, reports, and media on water, sanitation, and hygiene (WASH).

## **Recognition of the Human Rights to Water and Sanitation by UN Member States at the International Level**

Report. Recognition of the Human Rights to Water and Sanitation by UN Member States at the International Level. Amnesty International and WASH United 2015. <https://www.amnesty.org/en/documents/ior40/1380/2015/en>. This report is an overview of resolutions and declarations that recognize human rights to water and sanitation. It is based on United Nations documents and information from 77 countries.

## **Drinking Water Requirements for States and Public Water Systems**

Topic Portal. Drinking Water Requirements for States and Public Water Systems. United States Environmental Protection Agency. <https://www.epa.gov/dwreginfo>.

This topic portal provides extensive details on water regulations in the United States, including drinking water [rules on more than 90 contaminants](#), [quick reference guides](#), [state resources for implementing drinking water regulations](#), and information about [drinking water in school and child care facilities](#), including an [educational toolkit](#) to help schools prevent lead in their water sources.

## **Detroit Water and Sewage Department: The First 300 Years**

Report. Daisy M, ed. Detroit Water and Sewage Department: The First 300 Years. Detroit Water and Sewage Department 2002. [http://dwsd.org/downloads\\_n/about\\_dwsd/history/complete\\_history.pdf](http://dwsd.org/downloads_n/about_dwsd/history/complete_history.pdf).

This report is a history of water and sewage in the city of Detroit since its foundation in 1701. The report was produced as part of the Detroit Water and Sewage Department's celebration of the city's 300<sup>th</sup> anniversary. It includes historical images and narrative, affirming Detroit's ongoing commitment to safe water for its citizens.

## **Mortality Due to Unintentional Poisoning Fact Sheet**

Fact Sheet. Mortality Due to Unintentional Poisoning Fact Sheet. Annex A: Summaries of the SDG Health and Health-Related Targets. World Health Statistics 2017: Monitoring Health for the SDGs. World Health Organization 2017. [http://www.who.int/gho/publications/world\\_health\\_statistics/2017/EN\\_WHS2017\\_AnnexA.pdf](http://www.who.int/gho/publications/world_health_statistics/2017/EN_WHS2017_AnnexA.pdf).

GHELI repository link: <http://repository.gheli.harvard.edu/repository/11208>

This fact sheet focuses on reducing mortality from unintentional poisoning, a target of the Sustainable Development Goals (SDGs). Although mortality has declined between 2000 and 2012, there is still a substantial burden of disease attributable to hazardous chemicals and air, water and soil pollution and contamination.

## **Global Strategy for Women's, Children's and Adolescents' Health (2016-2030): Data Portal**

Data Portal. Global Strategy for Women's, Children's and Adolescents' Health (2016-2030): Data Portal. World Health Organization 2016. <http://apps.who.int/gho/data/node.gswcah>.

GHELI repository link: <http://repository.gheli.harvard.edu/repository/11676>

This data portal shares reliable and open data about the health of women, children, and adolescents worldwide. The portal selects 16 key indicators from the United Nations Sustainable Development Goals (SDGs) and other global monitoring initiatives that provide a snapshot of global progress on ending preventable deaths, ensuring health and well-being, expanding enabling environments, and improving equity and human rights. It accompanies [The Global Strategy for Women's, Children's, and Adolescents' Health \(2016-2030\)](#) report, a collaborative effort led by the World Health Organization to position adolescents, in addition to women and children, at the heart of the SDGs for the first time.

## Water Safety Planning Resources

Topic Portal. Water Safety Planning Resources. World Health Organization 2017.

[http://www.who.int/water\\_sanitation\\_health/water-quality/safety-planning/wsp-publications/en](http://www.who.int/water_sanitation_health/water-quality/safety-planning/wsp-publications/en).

This topic portal summarizes the World Health Organization’s tools and resources for managing and assessing global water safety. Water safety plans are an effective way to ensure safe drinking water supply across diverse communities and contexts. The plans require a risk assessment at all steps of the water supply chain, as well as the implementation and monitoring of risk management control measures.

## Drinking Water

Fact Sheet. Drinking Water. World Health Organization 2017. <http://www.who.int/mediacentre/factsheets/fs391/en>.

This fact sheet summarizes key information about the access to and impact of safe drinking water. In 2015, 71 percent of the global population used a safely managed drinking water service—one that was located close by, available when needed, and free of contamination.

## Toxin Alert

Organization. Toxin Alert. <https://www.toxinalert.org>.

Toxin Alert—founded by students at the Harvard T.H. Chan School of Public Health—is a clean water supply and combined public water alert system, with the goal of empowering citizens and communities to prevent toxic drinking water epidemics like the Flint water crisis. Toxin Alert combines mapping and analysis from national and state governments; certified laboratory testing of drinking water; and critical alerts of new toxin water data based on geolocation. Their recent “Safe Water for Schools” campaign encourages citizens to petition and crowdfund the testing of drinking water quality of their local schools.

## Drinking Water

Topic Portal. Drinking Water. Centers for Disease Control and Prevention.

<https://www.cdc.gov/healthywater/drinking/index.html>.

This topic portal shares recent news, research, fast facts, policies, and public health recommendations related to safe drinking water. Resources in the portal also include data and statistics, as well as best practices for testing water quality.

## A Snapshot of the World’s Water Quality: Towards a Global Assessment

Report. A Snapshot of the World’s Water Quality: Towards a Global Assessment. United Nations Environment

Programme 2016. <http://www.wvqa-documentation.info/unep-report.html>.

This report assesses the quality of global water systems, with particular focus on water quality and how it relates to development objectives such as health, food security, and water security. The most common water quality problems in surface waters like rivers and lakes include pathogen pollution, organic pollution, salinity pollution, and eutrophication. The analysis focuses on Latin America, Africa, and Asia, and indicates water pollution has worsened since the 1990s in a majority of rivers in these regions.

## TEACHING MATERIAL

### Poisoned Waters: The Startling New Contaminants

Discussion Guide. Poisoned Waters: The Startling New Contaminants. PBS Learning Media 2009.

<http://mass.pbslearningmedia.org/resource/frntc10.guide.water/poisoned-waters-the-startling-new-contaminants>.

This 8-minute video discusses the new level of contaminants found in U.S. drinking water. Produced as an educational tool for grades 6-13+, the video is accompanied by student questions and a teacher discussion guide. Associated interviews and related materials are also available.

## **Poison in the Rockies**

Film. Poison in the Rockies. NOVA/PBS 1990. <http://sacredland.org/poison-in-the-rockies>.

This hour-long film describes the 100-year legacy of pollution left behind by mining that has polluted the American West's limited water supply. Other factors that impact the water supply are urbanization and acid rain.

## **The Water Crisis - Lesson Plans for All Grades**

Lessons. The Water Crisis - Lesson Plans for All Grades. The Water Project 2012.

<https://thewaterproject.org/resources/lesson-plans>.

This educational portal features water-related lessons that can be used across a variety of subjects, such as social studies, earth sciences, and writing. Interactive activities, worksheets, research ideas, and resource lists are available for both teachers and students. Each of the five lessons is organized into three main sections—"the problem," "the solution," and "additional resources"—with background information, classroom activities, and a reading list.

## **Got Water? 2010 Science Ambassador Workshop Lesson Plan**

Lesson. Got Water? 2010 Science Ambassador Workshop Lesson Plan. Centers for Disease Control and Prevention 2010.

<https://www.cdc.gov/careerpaths/scienceambassador/resources/lesson-plans/lp-index.html>.

This lesson plan looks at how natural disasters may affect water quality and in turn a community's health. The lesson plan is part of the CDC's Science Ambassador series, to help introduce middle- and high-school students to public health topics and to apply mathematical and scientific thinking to these issues.

## **The Habitable Planet, Course Unit 8. Water Resources**

Lesson. The Habitable Planet, Course Unit 8. Water Resources. Annenberg Foundation 2017.

<http://www.learner.org/courses/envsci/unit/text.php?unit=8&secNum=0>.

This lesson unit offers a systems approach to environmental science, with a focus on water: how it is distributed around the globe; how it cycles among the oceans, atmosphere, and land; and how human activities are affecting the earth's finite supply of usable water. The lesson is one of 13 units in The Habitable Planet, an online multimedia course for high school teachers and adult learners interested in environmental science. Supplemental materials for each lesson unit include a video, interactive labs, visuals, a glossary, and a professional development guide.

## **Water Management: Explore Water Management Concepts and Technologies**

Course. Water Management: Explore Water Management Concepts and Technologies. edX 2017.

<https://www.edx.org/xseries/water-management#courses>.

This series of three online water management courses examine drinking water treatment, urban sewage treatment, and introduction to water and climate. They are offered by Delft University of Technology in the Netherlands.

## **WaterAid Teaching Portal**

Educator Portal. WaterAid Teaching. WaterAid. <https://www.wateraid.org/uk/get-involved/teaching>.

This collection for elementary educators includes downloadable lesson plans and free videos on topics such as toilets and hygiene, saving water, finding out where water really goes when it drains or flushes, and more.

## **Global Water Supply Elementary Curriculum**

Lessons. Global Water Supply Elementary Curriculum. Water.org.

<http://static.water.org/docs/curriculums/WaterOrg%20ElemCurricFULL.pdf>.

These elementary school lessons explore the global water supply through lessons relevant to multiple subjects, from science and math to global studies, language arts, and poetry.

## **Global Water Supply Middle School Curriculum**

Lessons. Global Water Supply Middle School Curriculum. Water.org.

<http://static.water.org/docs/curriculums/WaterOrg%20MidCurricFULL.pdf>.

These middle school lessons explore the global water supply through lessons relevant to multiple subjects, from science and math to global studies, language arts, and poetry.

## Global Water Supply High School Curriculum

Lessons. Global Water Supply High School Curriculum. Water.org.

<http://static.water.org/docs/curriculums/WaterOrg%20HighCurricFULL.pdf>.

These high school lessons explore the global water supply through lessons relevant to multiple subjects, from science and math to global studies, language arts, and poetry.

## Knowledge Dissemination and Private Well Water Testing in Middlesex County, Ontario

Teaching Case. Pellecchia A et al. Knowledge Dissemination and Private Well Water Testing in Middlesex County, Ontario. Western Public Health Casebook. Public Health Casebook Publishing 2015.

<https://www.schulich.uwo.ca/publichealth/cases/Western%20MPH%20Casebook%202015.html>.

GHELI repository link: <http://repository.gheli.harvard.edu/repository/10754>

This case study introduces the steps taken by the Environmental Health Department at the Middlesex-London Health Unit in Ontario, Canada to determine the knowledge level of well water testing information, attitudes towards the program, and needs of local community members around this issue. It is estimated that more than four million Canadians receive drinking water from private wells, which is subject to bacterial and chemical contamination, and these risks are particularly prevalent in rural farming communities. The responsibility and maintenance of private wells resides with their respective owners, and although free water testing is provided by the government, compliance to testing recommendations is extremely low due. The case, part of a 13-case collection, includes guidance for instructors, including learning objectives and discussion questions.

## Global: Health Governance and Environmental Risks

### SELECTED RESOURCES

#### Environmental Awareness - Think Global, Act Local

Lesson. Environmental Awareness - Think Global, Act Local. Centers for Disease Control and Prevention 2010.

<https://www.cdc.gov/careerpaths/scienceambassador/documents/envt-health-think.pdf>.

This lesson plan explores the nature of hazardous materials at the local, state, and national levels and associated health issues with these substances. It also introduces students to the federal agencies in charge of hazardous substances. The lesson plan is part of the CDC's Science Ambassador series, to help introduce middle- and high-school students to public health topics and to apply mathematical and scientific thinking to these issues.

#### The United Nations Environment Programme (UNEP)

Organization. The United Nations Environment Programme. <http://www.unep.org>.

GHELI repository link: <http://repository.gheli.harvard.edu/repository/11304>

The United Nations Environment Programme (UNEP) is the leading global environmental authority that sets the global environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations system, and serves as an authoritative advocate for the global environment. UNEP's website offers resources—such as news, multimedia, and the UNEP Knowledge Repository—on related topics including climate change, disasters and conflicts, ecosystem management, environmental governance, chemicals and waste, and resource efficiency.

#### Voices in Leadership: Gina McCarthy

Video. Voices in Leadership: Gina McCarthy. Harvard Kennedy School of Government 2016.

<https://www.hsph.harvard.edu/voices/events/mccarthy>.

This half-hour video is part of the Harvard University Kennedy School's "Voices in Leadership" series and shows a discussion between Harvard T.H. Chan School of Public Health Professor Howard Koh, former U.S. Assistant Secretary for Health for the U.S. Department of Health and Human Services, and Gina McCarthy, Chief of the U.S. Environmental Protection Agency. The conversation, from February 2016, focuses on a wide variety of challenges McCarthy has faced over her 30-year career, including the Flint water crisis, the Clean Power Plan, and the Gold King Mine accident on the Colorado River, as well as her vision for improving environmental protection in the United States. The video is

accompanied by a written transcript.

## **The UN World Water Development Report 2015: Water for a Sustainable World**

Report. The UN World Water Development Report 2015: Water for a Sustainable World. United Nations World Water Assessment Programme, United Nations Educational, Scientific and Cultural Organization 2015.

<http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/wwdr/2015-water-for-a-sustainable-world>.

GHELI repository link: <http://repository.gheli.harvard.edu/repository/10942>

This report on global water and development demonstrates how water resources are essential to global sustainability. Taking into account economic growth, social equity, and environmental sustainability, it presents a forward-looking narrative about how major challenges in the modern world will affect—and can be affected by—water resources, services, and related benefits. The report provides a comprehensive overview of major and emerging trends from around the world, with examples of how some of the trend-related challenges have been addressed, their implications for policy-makers, and further actions that can be taken by stakeholders and the international community. Additional resources include an executive summary, facts and figures, a video entitled “The Future of Water: A Vision for 2050,” and a set of seven country case studies, “Facing the Challenges.”

## **International Water Association**

Organization. International Water Association. <http://www.iwa-network.org>.

The International Water Association focuses on issues related to water management worldwide. With presence in 130 countries, the International Water Association shares resources and news on thematic areas such as agriculture, climate change, energy, environment, health, industry, society, and urbanization.

## **Manual of the Human Rights to Safe Drinking Water and Sanitation for Practitioners**

Report. Bol R. Manual of the Human Rights to Safe Drinking Water and Sanitation for Practitioners. International Water Association 2016. <http://www.iwa-network.org/publications/manual-on-the-human-rights-to-safe-drinking-water-and-sanitation-for-practitioners>.

This report explores the human rights principles related to drinking water and sanitation, and the policies and practices that will support the realization of universal access worldwide. In particular, the report looks at the role of legal and regulatory frameworks in this process, and thinks through institutional implications for water supply and sanitation companies.

## **Public Health, Environmental and Social Determinants of Health**

Topic Portal. Public Health, Environmental, and Social Determinants of Health. World Health Organization.

<http://www.who.int/phe/en>.

This topic portal shares recent news, publications, infographics, and information focused on the intersection of public health and environmental and social determinants of health. The World Health Organization estimates that 12.6 million deaths each year are attributable to unhealthy environments, which are influenced by risk factors such as air, water, and soil pollution, chemical exposures, and climate change. This collection of resources focuses on reducing environmental and social risk factors.

## **Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and Sustainable Development Goal Baselines**

Report. Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and Sustainable Development Goal Baselines.

United Nations Children’s Fund, World Health Organization 2017. <https://data.unicef.org/progress-drinking-water-sanitation-hygiene-2017-update-sdg-baselines>.

GHELI repository link: <http://repository.gheli.harvard.edu/repository/11628>

This report provides a comprehensive global assessment of progress on water, sanitation, and hygiene monitoring, or WASH. It establishes country, regional, and global baseline estimates for the new Sustainable Development Goal targets and indicators relating to WASH. The latest data show that 30 percent of people worldwide, or 2.1 billion individuals, lack access to safe, readily available water at home, and 60 percent, or 4.5 billion, lack safely managed sanitation. This report also presents the first-ever estimates of the population using “safely managed” drinking water and sanitation services—meaning drinking water at home that is free from contamination, and toilets where excreta are safely treated and disposed. The report is accompanied by an [interactive website](#) that allows users to explore the most recent data by country, socioeconomic status, service level, and much more. This update draws on data from the

WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, which has reported country, regional and global estimates of WASH progress since 1990.

## **Global Water Forum**

Topic Portal. Global Water Forum. UNESCO Chair in Water Economics and Transboundary Water Governance at the Australian National University. <http://www.globalwaterforum.org>.

This topic portal brings together recent news and research on water governance, policy, and science. The portal also includes open access courses and tools to help understand new as well as ongoing water challenges.

## **Towards a Worldwide Assessment of Freshwater Quality**

Report. Towards a Worldwide Assessment of Freshwater Quality. UN-Water 2016.

<http://www.unwater.org/publications/towards-worldwide-assessment-freshwater-quality>.

This report outlines linkages between water quality and the Sustainable Development Goals. At present, the global community is facing a water quality challenge wherein increasing pollution of freshwater resources in developing and developed countries threatens public health, food security, and biodiversity. The report indicates that better monitoring and surveillance is needed to quantify the magnitude of these challenges to appropriately and effectively protect and improve water quality over the coming years.

## **UN-Water GLAAS 2017: Financing Universal Water, Sanitation, and Hygiene Under the Sustainable Development Goals**

Report. UN-Water GLAAS 2017: Financing Universal Water, Sanitation, and Hygiene Under the Sustainable Development Goals. UN-Water, World Health Organization 2017. <http://www.unwater.org/publications/un-water-glaas-2017-financing-universal-water-sanitation-hygiene-sustainable-development-goals>.

This report analyzes and discusses how to finance universal access to water and sanitation under the Sustainable Development Goals. The report aims to provide policy- and decision-makers at all levels reliable and comprehensive information about investments to ensure drinking water safety and appropriate sanitation. This assessment indicates that 700 million people worldwide still do not receive drinking water from improved water sources, and further outlines previous challenges and successes in reducing the proportion of individuals without access to safe drinking water.