



NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

What's in Your Water?

by

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Stuck in traffic as usual during a long commute home from her office in the DC area, Rose thought about her evening ahead. Hopefully, Ned would have dinner ready when she arrived home, and after eating they would take their active three-year-old to the local playground. Rose turned on her favorite radio program, which not only entertained her during the long commute, but also kept her well enough up to date that she could carry on reasonable conversations with the other adults at the playground.

The radio host was speaking. “Residents were left unaware of the high levels of lead in their drinking water. Now they want answers. Many of the residents fear for the immediate and long term health of their children.”

Rose knew the program was discussing a recent scandal in another state involving the discovery by residents of high levels of lead in their drinking water. What really caught her attention were the next statements she heard. “Many more people were affected by high levels of lead in the drinking water in the DC area several years earlier, and according to a recent publication by the American Water Works Association nearly six million households in the United States have lead service lines.”

Rose was shocked. She had moved to the Washington area for a new job more than three years ago when she was pregnant with her daughter. She hadn't known there had been a problem with lead in the drinking water. Was there still a problem? Did her home have lead service pipes? What were the potential, long-term health effects to her child? How did this happen? Why hadn't the realtor told her about the potential of the drinking water being contaminated by lead? She and Ned didn't have their water tested before moving into their new home. Rose realized that she and Ned had some research to do. Perhaps the neighbors at the playground would be able to alleviate her fears.



Further details of the DC lead contamination issue can be found in the following news reports:

- Augenstein, N. 2016. Before Flint: DC's drinking water crisis was even worse. *Washington's Top News (WTOP)* April 4, 2016. <<https://wtop.com/dc/2016/04/flint-d-c-s-drinking-water-crisis-even-worse/>>.
- Augenstein, N. 2016. After DC's crisis: how to make sure your drinking water is safe. *Washington's Top News (WTOP)* April 6, 2016. <<https://wtop.com/dc/2016/04/d-c-s-crisis-make-sure-drinking-water-safe/>>.
- Shaver, K. and D. Hedgpeth. 2016. DC's decade-old problem of lead in water gets new attention during Flint crisis *Washington Post* March 17, 2016. <https://www.washingtonpost.com/local/dcs-decade-old-problem-of-lead-in-water-gets-new-attention-during-flint-crisis/2016/03/17/79f8d476-ec64-11e5-b0fd-073d5930a7b7_story.html?utm_term=.8d4531133ae0> [Note: may require a subscription to access.]

The following websites from the Environmental Protection Agency (EPA) and the Centers for Disease Control and Prevention (CDC) are useful references for answering the questions below:

- EPA. *n.d.* Basic information about lead in drinking water. <<https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water>>.
- CDC. 2017. FDA warns Americans about risk of inaccurate results from certain lead tests. <https://www.cdc.gov/nceh/lead/about/blood_lead_test_safety_alert.html>.

Questions

Answer the following in your own words. Some questions require longer answers than others. Keep your answers to three sentences or less. Use correct grammar.

1. What are some of the health effects of exposure to lead? What population is especially vulnerable to lead in drinking water?
2. Where does lead in drinking water come from?
3. Why was the agent used to disinfect the DC water supply changed? What disinfecting agent was used prior to 2001, and what was used after 2001?
4. What is meant by a passivation layer in lead pipes? How was the passivation layer affected by the change in disinfectant used in the DC water supply?
5. When a metal, such as lead, is oxidized (loses electrons) to form a positive ion (cation), how does the solubility change? How does the solubility of a metal (ion) like lead affect its toxicity?
6. What federal agency is charged with determining the level of lead in drinking water at which no adverse health effects are likely to occur?
7. Long term exposure may lead to accumulation of lead in the body. In what part of the body does lead accumulate?
8. Later in the evening, Rose finds out from her neighbors that fewer than 10% of the taps tested in their area exceeded the 15 ppb limit. Does this indicate that Rose and her family are safe to drink water from their tap? What are the next step(s) that Rose should take to ensure the safety of her family, especially her young child? What are actions Rose or any other person can take to reduce exposure to lead in drinking water?
9. Rose reviews the EPA website and finds a recommendation to use cold tap water for cooking instead of starting with warm water from the tap. Why does the EPA site suggest using cold tap water for cooking instead of starting with warm tap water?

10. According to the EPA site, if greater than 10% of tap water samples exceed the lead action level of 15 ppb, additional remediation is required. A ppb is parts per billion and is an indication of the mass (grams) of lead per billion grams of water. Convert 15 ppb to g/mL (grams per milliliter, assuming water has a density of 1.0 g/mL). Rose reads in one source that lead concentrations in U.S. drinking water are generally below 5 $\mu\text{g/L}$. How does this value compare to the 15 ppb action level? Show your work!

11. After testing, Rose finds that her drinking water is at the 15 ppb level. If an average person in her household drinks 2.0 L of water in a day, what mass of lead would be consumed? Show your work! One source estimated the daily intake of lead from consumption of food and water as approximately 4 μg for small children. How does the mass in this 2.0 L of water compare with this estimate?

12. Aside from drinking water, what are two other sources of lead exposure for children? How significant are those sources?

13. What value of lead level in blood does the CDC use as a reference level, above which action must be taken? According to the previously referenced news reports, were any of the children in the DC area above that limit?

14. Identify potential ethical issues related to the DC water crisis. Make a list of these and be prepared to discuss them.

15. There have been a number of cities in the United States in addition to DC and Flint that have had an issue with lead in drinking water. Describe one of these in just a few sentences.