

due: 2/23

Activity 4.1.3 Testing the Waters

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2/13/11

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Introduction

Many chemicals dissolve in water because it is an excellent solvent. Once dissolved, these chemicals are not visible to the human eye. Therefore, many chemicals might be present in water without providing any visible evidence. Additionally, some substances can be present in very low concentrations and still cause health concerns. For these reasons, drinking water needs to be tested for contamination. A variety of chemical tests are used to detect water contamination. Most of the tests are specific for a particular contaminant. The test reagents react with the specific contaminant to cause a color change. The color change indicates that a particular contaminant is present in sufficient quantities for the reaction to occur.

Discovering that their well water is contaminated with *C. jejuni* made the Williams family curious as to what else is present in their water. In this activity, you will investigate various drinking water contaminants and their effect on human health. You will perform a series of tests to determine what contaminants, if any, are present in the Williams' well water as well as in the local water sample that you collected.

Equipment

- Computer with Internet access
- Laboratory journal
- Activity 4.1.3 Student Resource Sheet
- Lab-Aids Qualitative Introduction to Water Pollution Kit 19
- Local water sample
- Williams' well water sample
- Safety glasses
- Lab apron
- Latex or nitrile gloves

Procedure

1. Take notes in your laboratory journal as your teacher presents the Water Contamination presentation. Alternatively, your teacher may have you go through the presentation independently.
2. Make the following data table in your laboratory journal. Leave plenty of writing space in the *Effects on Human Health* columns.

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| | Short Tem Effects on Human Health | Long Term Effects on Human Health | Contaminant Present in Local Water Sample (Present or Not Present) | Contaminant Present in Williams' Water Sample (Present or Not Present) |
|-------------------|--|--|--|--|
| Mercury | shortness of breath, chest pain, headache | anorexia, tremors, memory loss, anxiety | Not Present | XXXX |
| Lead | loss of appetite, pale skin, stomach cramps | anemia, kidney problems, miscarriage | Not Present | XXXX |
| Radon | shortness of breath, coughing, headaches, fever | lung cancer, respiratory tract infection | Present | XXXX |
| Chlorine | nose irritation, chest pain, vomiting | pulmonary edema, lung injury, death | present | NA |
| Chromium | asthma, cough, shortness of breath, sneezing | sperm damage, cancer | not present | not present |
| Copper | nausea, vomiting, abdominal pain | destruction of red blood cells, anemia | not present | NA |
| Cyanide | rapid breathing/ heart rate, restlessness, dizziness, weakness, headache | loss of consciousness, lung injury, slow heart rate | not present | not present |
| Nitrates | none | diuretics, increased starch deposits, hemorrhaging | not present | not present |
| Phosphates | XXXX | kidney disease or cardiovascular disease | present | present |
| Silica | XXXX | silicosis, lung cancer, pulmonary tuberculosis, death | present | NA |
| Sulfide | XXXX | chronic cough, olfactory paralysis, severe respiratory tract infection | not present | not present |
| Ammonium Nitrogen | XXXX | fatality | not present | present |
| pH | XXXX | irritation neurological & reproductive problems | 10 | 4 |
| Iron | XXXX | anemia, colon cancer, GERD, hematocrit | not present | not present |

- Research the health effects of each of the contaminants listed in the data table (the exception being those contaminants with an ~~XXXX~~). Use the following websites to guide your research:
 - CDC's Alphabetical Index of Water-related Diseases, Contaminants, and Injuries - <http://www.cdc.gov/healthywater/disease/az.html#c>
 - EPA's basic Information about Regulated Drinking Water Contaminants and Indicators - <http://water.epa.gov/drink/contaminants/basicinformation/index.cfm#mlink>
 - WHO's Water Sanitation and Health: Chemical Hazards in Drinking Water - http://www.who.int/water_sanitation_health/dwq/chemicals/en/index.html
- Add your research information to your data table in your laboratory journal. Compare your findings with a classmate.
- Obtain a Student Resource Sheet from your teacher or your Mission File.

6. Obtain a Williams' well water sample from your teacher as well as the local water sample you collected.
7. Wear safety glasses, lab apron, and gloves when performing the chemical tests. Many of the chemicals you will be working with are harmful and can damage your skin. Be careful not to spill the reagents on the table or to splash them on your skin.
8. Quickly read through the procedure found on the Student Resource Sheet to familiarize yourself with what you will be doing and the contaminants you will be trying to detect in the water samples.
9. Read the instructions carefully and use the exact amounts of each reagent specified in the instructions. Do not mix the chemicals or combine them in any way other than as directed in the directions.
10. Ensure that all test tubes and Chemplates™ are clean and dry before beginning any of the tests.
11. Measure drops of each solution by holding each bottle upside down and slowly squeezing until single drops are released. Do not hold the bottles at an angle because the size of the drops will vary with the angle. Likewise, do not squeeze the bottles too quickly or too hard, or the amount of solution added will be immeasurable.
12. Follow the directions on your Resource Sheet to complete all 11 tests on both the Williams' well water sample and your local water sample. The tests for the contaminants can be completed in any order. Notice that some of the reactions require a longer incubation time than others.
13. Follow your teacher's instructions regarding how to complete the various tests within the class period and how to dispose of the completed test samples.
14. Stop a test when color appears indicating the presence of the contaminant. The listed times are maximum incubation times. If no color appears by the end of the incubation time, the contaminant was not detected.
15. Record the test results and your observations for each water sample.
16. Use the Internet to research possible ways the Williams' well water contamination occurred. Record your ideas in your laboratory journal.
17. Brainstorm ideas about how to remediate any contaminants found in both water samples. Make sure to include contaminants found in both this lab as well as the labs performed in Activity 4.1.2. Record your ideas in your laboratory journal.
18. Wash your hands and clean your work station.
19. Answer the Conclusion questions.

Conclusion

1. What contaminants, if any, were present in the Williams' well water sample and your local water sample?

Williams: phosphates, ammonium nitrogen

Local: phosphates, chlorine, silica

2. Aside from the microbial contamination, was the Williams' well water safe to drink? Explain your reasoning.

No, their water is extremely basic with a pH of 4, which can lead to neurological problems.

3. Based on the coliform test done in Activity 4.1.2 and the tests done in this activity, is your local water sample safe to drink? Explain your reasoning.

Yes because no E. Coli is present or any dangerous antigens, only filtering compounds to make the water safe to drink.

4. What actions can you personally take to protect your local water sources or waterways?

By not flushing any harmful or harsh contaminants down the toilet or sink. This includes prescription medication, Clorox, chlorine, bleach, tobacco products, etc.

5. A two-month old baby died twelve hours after being admitted to the hospital. The baby had been lethargic and vomiting. She was rushed to the hospital when her breathing became extremely labored and her skin turned a blue-gray color. The hospital staff determined the baby had "blue-baby syndrome," or methemoglobinemia. Unfortunately they were unable to save her. The parents are devastated and want to know what caused their baby to develop this rare disorder. Based on what you learned about water contaminants and their effect on human health, what contaminant is responsible for this baby's death? Explain how the contaminant caused the baby's illness.

Nitrate is the contaminant, and since the baby is less than 6 months of age, she was sensitive to nitrate, which is then converted into nitrite, killing the baby.