Drinking Water Mystery: A Simple Test

Grade level: 4-12

# of Participants: 1 class of approx. 20-25 students

Subject areas:, Environmental science, math, chemistry

Duration: 1 hour

Setting: Lab

Skills: understanding scientific method, recording and analyzing test results

Charting the course: This activity introduces students to the process of scientific experimentation and testing parameters to determine water quality

Vocabulary: alkalinity; chlorine; pH; parameter;

Different bodies of water have different chemical signatures. In Philadelphia the following parameters: alkalinity, calcium, chloride, conductivity, nitrate, potassium, silica, sodium, total solids and sulfate, are ususally different for the Schuylkill and Delaware waters. Labs analyze many aspects of the water to ensure good clean drinking water quality is maintained, some analysis is required by law, or for public health and/or for aesthetics.

Summary

Using prepared sample solutions and test strips, students will measure the sample's pH, alkalinity and chlorine to determine which one is safe enough to drink.

Students will discover that through a series of simple tests, they can determine which water sample is safe to drink. They will discover that the Philadelphia Water Department also runs a series of scientific tests on a regular basis to ensure good quality drinking water.

Objectives:

The student will:

- Determine which of four solutions in normal drinking water based on water chemistry

Materials:

- 5-in-1 test strips with color key
- 4 samples of liquids in plastic cups marked sample 1-4
- Mason jar samples as follows:
  - drinking water from tap;
  - acidic solution using tap water diluted with vinegar
  - high chlorine solution using tap water diluted with chlorox (household bleach)
  - hardness/alkalinity solution using tap water with dissolved Tums or other antacid tablet

Procedure:

Allow students to work in groups or pairs. They can take turns being "analysts" and "data recorders."

Each student group will have four unknown solutions (normal drinking water, acidic solution, high chlorine solution, hardness/alkalinity solution) that they will test using the test strips. The cups can be labeled 1,2,3,4 to correspond to the data sheet.

Listed on the students' data sheets are the data values for normal drinking water. They will test each solution and record the data values on the sheet. Once all the solutions have been tested and recorded they will make a determination as to which unknown solution (1, 2, 3, or 4) is actually normal drinking water by matching the known values with the values they received by testing.

Background Information

Drinking Water Quality

Philadelphia's drinking water is drawn from our two rivers, the Delaware and Schuylkill. From fighting fires, to cooking, to watering lawns, the Philadelphia Water Department is responsible for delivering reliable and safe water to more than 1.6 million people in Philadelphia and Lower Bucks County. Our three modern water treatment plants -- Baxter, Belmont and Queen Lane -- have a combined, design-rated capacity to treat 540 million gallons of water per day.

Throughout the water treatment process, our plant technicians analyze the water, monitoring its quality. Supported by the very latest in advanced chemical analysis equipment, our environmental laboratories examine over 12,000 samples of water each year collected from our reservoirs and more than 65 locations across the City. Each sample undergoes an average of five (5) tests to ensure that our customers enjoy safe water, free from contamination.

The Philadelphia Water Department has three drinking water treatment plants.

The Baxter Water Treatment Plant treats an average of 200 million gallons a day--enough water to fill almost one-third of the Spectrum. When the Baxter Plant was opened in 1909 it was called the Torresdale Plant. It was renamed in 1982 for Samuel S. Baxter, the first Philadelphia Water Commissioner. The Baxter Plant treats water from the Delaware River. Baxter provides water to almost 60% of the City's population. It also serves some parts of Lower Bucks County.

The Belmont Water Treatment Plant treats an average of 40 million gallons a day. At that rate, treated water from the Belmont Plant would fill the Spectrum in ten days. The plant uses water from the Schuylkill, which has a higher mineral content and is slightly harder than water from the Delaware River. The Belmont Plant was opened in 1904 on the site where a pumping station had once stood in the late 1860s.

The Queen Lane Water Treatment Plant treats an average of 70 million gallons a day. Water treated by Queen Lane would fill the Spectrum in six and one-half days. This plant also uses water from the Schuylkill River.

The Belmont and Queen Lane Plants provide about 40% of the City's population with water.

Testing Your Drinking Water

The treatment of drinking water is an exacting process and Philadelphia's treatment plants take a number of precautions to make sure it is done right. Each plant has its own system of testing. All three of our drinking water treatment plants operate 24 hours a day. Every three hours, they test the water at each stage of treatment at each plant. These tests allow the plant operators, on staff 24 hours a day, to adjust their treatment to varying conditions (weather and upstream treatment can affect the quality of the water before we get it). Chemists at our water treatment plants perform more than 350,000 tests annually to ensure process control. If there is a chemical spill upstream, the intake pipe can be closed until the spill passes. Some testing may also be performed by digital analyzers working continuously. All three plants have about a day's storage capacity without pumping from the rivers. Plant supervisors are on call 24 hours a day to deal with any kind of problem that may arise.

In addition to the testing performed by our plants, the drinking water supplied to the city is also tested by the Department's Bureau of Laboratory Services. A team of chemists, engineers, aquatic biologists and other lab specialists monitor the water on a daily basis. They test water in different stages of treatment from the city's drinking water plants to make sure that treatment is proceeding properly. The Bureau of Laboratory Services also collects drinking water at more than 65 locations around the city to make sure it is clean, not only when it leaves our plants, but also at the tap when it gets to our customers. They perform over 100,000 water quality tests annually.

Resources

http://www.phila.gov/water/index.html
Philadelphia Water Department: Urban Water Cycle; Our Commitment to Protecting our Water Resources; The Bureau of Laboratory Services; Watershed Partnerships
http://www.epa.goc
United States Environmental Protection Agency
http://www.depweb.state.pa.us/dep/site/default.asp
Pennsylvania Department of Environmental Protection
http://www.usgs.gov/
United States Geological Survey
http://water.usgs.gov/nawqa/
United States Geological Survey
National Water Quality Assessment (NAWQA) Program
http://wmc.ar.nrcs.usda.gov/
United States Department of Agriculture; National Water Management Center

PA Academic Standards:

Grades 4, 7 10 and 12

Academic Standards for Environment and Ecology
4.3 Environmental Health
4.8 Humans and the Environment
4.9 Environmental Laws and Regulations

Academic Standards for Science and Technology
3.2 Inquiry and Design
3.4 Physical Science, Chemistry and Physics

National Science Standards:

Grades K – 12

. NS.K-4.1, NS.5-8.1, NS.9-12.1 – Science as Inquiry
NS.K-4.7, NS.5-8.7, NS.9-12.7 – History of Nature and Science