Is Your Water Clean?

Subject: Science (Chemistry, Environmental Science, Earth Science, Aquatic Science)

Grade level: 6-12

Rationale or Purpose: Over 2 million people rely on groundwater from karst aquifers in central Texas. Due to the high porosity and permeability of karst landscapes, inputs such as rain, streams, and rivers influence groundwater quality. In this lab students will compare the quality of water from different sources. This lesson involves students testing samples of water from different sources for pollutants and discussing the possible sources of these pollutants.

Materials:

- goggles
- waterproof gloves
- phosphate test kit
- coliform test kit
- pH paper
- data sheets
- microscopes
- water samples
- methyl alcohol
- NASA Explores article "Water: It's Not Just for Drinking" (http://media.nasaexplores.com/lessons/02-054/9-12_article.pdf)
- electronic sensor electrodes to test for current conduction
- glass containers to hold water samples

Lesson Duration: 50 minutes

Objectives:

- Science 112.22 (1A), demonstrate safe practices during lab investigations
- Science 112.22 (2B), collect data by observing and measuring
- Science 112.22 (2C), analyze and interpret information to construct reasonable explanations
- Science 112.22 (2D), communicate valid conclusions
- Science 112.22 (4A), collect, analyze, and record information using tools
- Science 112.22 (7B), classify substances by their physical and chemical properties

- Science 112.23 (1A), demonstrate safe practices during lab investigations
- Science 113.23 (2B), collect data by observing and measuring
- Science 112.23 (2C), analyze and interpret information to construct reasonable explanations
- Science 112.23 (2D), communicate valid conclusions
- Science 112.23 (4A), collect, analyze, and record information using tools
- Science 112.23 (7C), recognize that compounds are composed of elements
- Science 112.23 (14C), draw conclusions about effects of human activities on the environment

- Science 112.24 (1A), demonstrate safe practices during lab investigations
- Science 112.24 (2B), collect data by observing and measuring
- Science 112.24 (2C), analyze and interpret information to construct reasonable explanations
- Science 112.24 (2D), communicate valid conclusions
- Science 112.24 (4A), collect, analyze, and record information using tools
- Science 112.24 (12C), predict the results of modifying the Earth's water cycle
- Science 112.24 (14C), draw conclusions about effects of human activities on the environment

- Science 112.44 (1A), demonstrate safe practices during lab investigations
- Science 112.44 (2B), collect data by observing and measuring
- Science 112.44 (2C), analyze and interpret information to construct reasonable explanations
- Science 112.44 (2D), communicate valid conclusions
- Science 112.44 (4C), evaluate the impact of human activity

- Science 112.45 (1A), demonstrate safe practices during lab investigations
- Science 112.45 (2B), collect data and make measurements with precision
- Science 112.45 (2D), organize, analyze, evaluate, make inferences, and predict trends from data
- Science 112.45 (2E), communicate valid conclusions
- Science 112.45 (4A), differentiate between physical and chemical properties of matter
- Science 112.45 (4B), analyze examples of solids, liquids, and gases to determine their composition
- Science 112.45 (12C), evaluate the significance of water as a solvent

- Science 112.46 (1A), demonstrate safe practices during lab investigations
- Science 112.46 (2B), collect data and make measurements with precision
- Science 112.46 (2D), organize, analyze, evaluate, make inferences, and predict trends from data
- Science 112.46 (2E), communicate valid conclusions
- Science 112.46 (4B), research and identify components of an aquatic ecosystem
- Science 112.46 (4C), collect and analyze quantitative data from aquatic environments
- Science 112.46 (6A), identify the role of various cycles in aquatic environments
- Science 112.46 (8B), analyze the impact of humans on aquatic environments
- Science 112.46 (10C), identify water quantity and quality in a local watershed

Activity:

Step 1: Collect four different water samples. Use what is available, including tap water, bottled spring water, parking lot runoff, local stream/lake water, swimming pools, fish tanks, and distilled water.

Step 2: Explore with the students some indicators of water quality, writing their responses on the board. Explain the steps you will take in determining the quality of your water samples.

Step 3: Distribute and read "Water: It's Not Just for Drinking"

Step 4: Discuss what would be important to do if the astronauts needed to recycle water.

Step 5: Distribute the Student Sheets and materials.

Step 6: Go over the instructions for the kits.

Step 7: Stress safety and ensure the students are wearing goggles and gloves. Remind students to wash hands after contact with any unknown water. Spilled water should be cleaned up immediately.

Step 8: Students will test water samples and record data on odor, clarity, phosphates, pH, fecal coliforms bacteria, and total dissolved solids.

Modification: Students with special needs may not be able to do some tests, or may require more time to finish the lab.

Student Product: Students will fill out the Data Table and answer several data analysis questions. The table and questions are weighted out of 100 points to facilitate student evaluation.

Closure: Orally discuss the results and each test might indicate:

- bad odor – pollution, algae, chlorine from treatment plants
- clarity – presence of suspended solids
- phosphates – presence of fertilizers, detergents, sewage, industrial discharges
- pH – strongly acidic (below 5) or alkaline (above 9) pH may kill eggs, larvae, nymphs, and hatchlings; may also leach toxic heavy metals from rock and soils
- fecal coliform – bacteria from human feces
- microscope observations – mainly harmless organizations in most water
- total dissolved solids – more conductive samples have higher amounts of dissolved constituents

Assessment or evaluation: Students should be evaluated on lab safety, data collection procedures, and data analysis. The table and questions on the Student Data Sheet are weighted (100 points) to facilitate student evaluation.

Extension: Have students bring tap water samples from home to test. Find a teacher in another city with whom you can trade water samples. Sample different bottled spring waters to compare quality.

Original source: NASA Explores
Modified by Robin Havens Gary and Dennis Ruez, Jr.
Environmental Science Institute, The University of Texas at Austin

Is Your Water Clean?
Lab Procedure

Materials

- goggles
- rubber gloves
- phosphate test kit and directions
- coliform test kit and directions
- pH paper
- microscopes
- data sheets
- methyl alcohol (for hand cleaning)
- electronic sensor (electrodes to test for current conduction through water)
- gass containers (four per group)

Procedure

1. Choose a water sample to test. Each team member will test two samples.
2. Test the odor of your water sample by smelling it. Record your data on the data sheet. Write any conclusions you can make from the scent of the water in the conclusion section of the data sheet.
3. Test the clarity/color of your water. Record your data and any conclusions you can make. Turbidity refers to the cloudiness of water—the muddier the water, the higher turbidity. Suspended solids in the water create turbidity, which can be measured by how much light is blocked or absorbed.
4. Read the directions for the phosphate test kit. Perform the phosphate test on your water sample. Record your data and any conclusions you can make. Phosphorus, a component of all phosphates, is one of the key elements necessary for growth of plants and animals. Rainfall can cause varying amounts of phosphates to wash from farm soils into nearby waterways. Phosphates stimulate the growth of plankton and aquatic plants that provide food for fish. This increased growth may cause an increase in the fish population and improve the overall water quality. However, if an excess of phosphate enters the water, algae and aquatic plants will grow wildly, choke up the waterway and use up large amounts of oxygen. This condition is known as eutrophication.
5. Using the pH paper, test the acidity of your water sample. Record your data and any conclusions you can make. A pH range of 6.0 to 9.0 appears to provide protection for the life of freshwater fish and bottom-dwelling invertebrates.
6. Carefully read the directions for the coliform test kit. Perform the coliform test on your water sample. Record your data and any conclusions you can make.
7. Look at a drop of your water sample under a microscope. Look for bacteria and other small creatures in your water sample. Record your data and any conclusions you can make.
8. With the assistance of the teacher, check for total dissolved solids, like salt, using a conductivity tester. **Be careful to avoid electric shock!** Record your data and any conclusions you can make.

Name: _____ ***Date:*** _____

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Student Data Sheet

Water Sample: _____		
Test	Results	Conclusions
Odor		
Clarity/Color		
Phosphates		
pH		
Fecal Coliform		
Bacteria		
Conductivity		

Water Sample: _____		
Test	Results	Conclusions
Odor		
Clarity/Color		
Phosphates		
pH		
Fecal Coliform		
Bacteria		
Conductivity		

Data Analysis:

Over 2 million people rely on groundwater from karst aquifers in central Texas. Nearly the entire population of San Antonio gets water solely from underground. Due to the high porosity and permeability of karst landscapes, inputs such as rain, streams, and rivers influence groundwater quality. Use data gathered from this lab and your knowledge of central Texas to answer the following questions.

1. Which water sample was the most polluted? In what way?

2. Which indicator of water quality did you find to be the most useful in determining the level of contamination? Why?

3. Name three major sources of pollution that threaten water quality. Explain how you came to your conclusion.

4. In paragraph form, explain why it is important to frequently test groundwater quality.

Name: _____ ***Date:*** _____

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Evaluation Rubric

Circle the points awarded. The most possible is on the far right.

Data table				
Sample 1	0	8	17	25
Sample 2	0	8	17	25
Data analysis				
1.	0	3	7	10
2.	0	3	7	10
3.	0	5	10	15
4.	0	5	10	15

Total _____