



Environmental Stewardship

Lesson 4: Testing and Evaluating Water Quality – Part One

Grade Level: 9-12

Time Required: 50 minutes

Summary

Significant global challenges to water quality exist now and are projected to intensify over the next 30 years. According to some projections, safe water access will face critical shortages in that time frame. Introducing students to water quality testing allows them an opportunity to become familiar with various types of contamination along with the likely origins of the contaminants. Additionally, students will reflect on the human activities that can exacerbate water pollution, as well as the kinds of actions that can prevent and correct the problems.

Objectives

The purpose of this lesson is to help students gain experience in measuring water quality by assessing some typical parameters that reflect the composition of a water source. Students will gain an understanding of how key factors such as dissolved oxygen, pH, conductivity, and BOD are evaluated and used by scientists to determine water quality. Students will form hypotheses regarding the sources of contamination for a body of water.

Engineering Connections: Environmental Engineering, Chemical Engineering, Civil Engineering

Testing of water quality is done in many fields of engineering. When structures such as buildings, bridges, dams and landfills are constructed, there are possible ramifications and detrimental effects that may result. Landfills, as an example, may leak over time and the leachate released can affect the composition of groundwater.

I Can:

- o Define and correctly use functional vocabulary related to water quality, landfills, and contamination of the water supply.
- o Explain how groundwater contamination might occur as a result of leachate leakage from a landfill.
- o Make measurements of mass, volume, and temperature, pH, total solids, and density with appropriate tools and units.
- o Describe how human choices and activities can impact the environment and the quality of our water supply.
- o Identify the chemical and physical characteristics that are used to monitor water quality.
- o Perform basic analytic tests to determine the presence or absence of specific parameters that are used to measure water quality.

Standards

[HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics](#)

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

[HS-ESS3-4 Earth and Human Activity](#)

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

[HS-ETS1-1 Engineering Design](#)

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Keywords

Water quality, water chemistry, pH, Dissolved oxygen, conductivity, Biological Oxygen Demand (BOD)

Part 1 Lab – What’s in that Water?

Time required:

- Time at home for pre-lab homework done the previous day.
- 50 minutes of class time for Part 1 Conducting initial sets of tests.

Pre-lab preparation

Using resources provided, complete the following:

Define: watershed, runoff, groundwater, dissolved oxygen, pH, nitrates, phosphates, chemical oxygen demand, biological oxygen demand

Pre-Lab Thought Questions

1. Why does water quality matter to you? (This is a very broad question. Be thoughtful in your answer. Think of the importance of water to all life on earth)
2. What do the chemical tests for dissolved oxygen, pH, nitrates, phosphate, COD and BOD tell us about the quality of a water source?
3. List all the possible sources of contamination for a body of water.

Safety:

Goggles, gloves, follow correct procedures for handling glassware and chemicals, dispose of waste in waste containers as instructed by teacher.

Materials:

1. Water Samples: Pure Deionized water, River water, Tap Water, “Organic matter” water prepped by teacher, Soapy Water, Protein water. Samples should be prepped by teacher and numbered. Students will not be told the origin of their samples until post-lab discussion.
2. Assorted labware, including test tubes and racks, and pipettes for sampling and conducting tests
3. Universal Indicator, pH test papers
4. Tests kits as are available and affordable at teacher’s discretion. Some possible examples from vendors are as follows:
<https://www.carolina.com/environmental-science-water-quality/carolina-9-factor-classroom-water-quality-test-kit/652747.pr>
<https://www.flinnsci.com/the-tapwater-tour-student-laboratory-kit/fb2126/>
<https://www.flinnsci.com/water-pollution-testing-kit/ap7559/>
[LaMotte® Dissolved Oxygen Water Test Kit | Carolina.com](#)
5. Meters as are available and affordable at teacher’s discretion. Some possible examples from vendors are as follows:
<https://www.flinnsci.com/sper-portable-orp-pen/ap10076/>
<https://www.flinnsci.com/sper-portable-conductivity-pen/ap10073/>
<https://www.flinnsci.com/sper-portable-ph-pen/ap10071/>
6. Parameters to be tested can be adjusted according to availability of materials. If your school budget is a constraint, consider contacting local water treatment facilities or any number of departments at a local university for assistance in securing materials.

Procedure:

1. Students will be placed in assigned lab groups . Groups will be to perform analysis on their sample(s). This can be adjusted according to availability of samples, numbers of students etc. There should be at least 2 sets of data collected for each sample.
2. Remind students of safety and hygiene at all times. The test kits may contain small amounts of reagents considered hazardous, so safe handling is important. Also, some of the water samples used may have biological or chemical contaminants that should not be ingested.
3. Students should first make qualitative observations of their samples. Note clarity, color, odor, and the presence of any suspended solids or surface film.
4. Testing pH can be done in multiple ways depending upon what is available to you. If you are using a pH meter, place the probe into the sample after the probe has been standardized and cleaned and dried. Make certain to clean probe thoroughly between samples. If you are using universal indicator to determine pH, fill the pH test tube with 10 ml of sample. Add 10 drops of universal pH indicator and mix thoroughly. Compare the sample color to color standard and record the pH.
5. Testing for dissolved oxygen should be completed by closely following the detailed instructions for testing that are included with the specific test kit that your class uses.
6. Testing for nitrates should be completed by closely following the detailed instructions for testing that are included with the specific test kit that your class use.

Sample Number	Identity of Water Sample	Appearance	pH	Dissolved Oxygen (ppm)	Nitrates (ppm)	Phosphates (ppm)
1						
2						
3						
4						
5						

6						

Contributors

Kim McVicar, NDSU RET, North Dakota State University, Fargo, ND

Mike Dobberstein, NDSU RET, North Dakota State University, Fargo, ND

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