

LESSON PLAN

Testing Water: Chemical Properties

Objectives

Students will determine the water's chemical properties by measuring *E. coli* concentrations and nutrient (nitrate or phosphorus) levels.

Prerequisites

Teachers should determine the number of supervisors needed and ensure that those supervisors understand their responsibilities before starting this lesson.

Duration

40 minutes

Materials

Note: If you do not have one of the following test kits, feel free to remove that station from the lesson.

- Student Worksheet
- E. coli (or coliform bacteria) test kit
- Phosphate or nitrate test kit (or both)

Introduction

TEACHER BACKGROUND INFORMATION

The following sections describe several key indicators that scientists use to evaluate aquatic environments in Texas.

Pollution Indicators

High Levels of E. coli Bacteria

Bacteria have long served as indicators for determining if water is safe for drinking and recreational use. Indicator bacteria are not necessarily harmful but may indicate the presence of other harmful bacteria and viruses found in raw sewage. The greater the amount of indicator bacteria found in water, the higher the chance that pathogens are also in the water.

Historically, fecal coliform bacteria (commonly found in the small intestines of humans and other warm-blooded animals) was the most widely used indicator bacteria in surface waters. *Escherichia coli* (more commonly associated with human waste only) has replaced fecal coliform as the indicator bacterium for freshwater bodies



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in Texas.

The presence of fecal coliform or *E. coli* is usually associated with inadequately treated sewage, improperly managed animal waste from livestock and pets, failing septic systems, and wildlife (birds and mammals) living near water (Ex. Birds nesting under a bridge).

The Presence of Sewage Fungus

Sewage fungus is an indicator of organic material pollution (oxygen-demanding substances). Sewage fungus is:

- Found in flowing waters
- White, gray, or brown
- Slimy with a cottony, wood-like plume
- Generally found in massive amounts with long streamers clinging to twigs, leaves, or even the sides and bed of a stream

Changes in Algae Concentration

The presence of little or no algae in a water body indicates a low nutrient content. Water bodies with low nutrient concentrations are known as **oligotrophic**. Besides low nutrient concentrations, oligotrophic water bodies are characterized by clear water capable of only supporting small populations of plants, invertebrates, and fish in contrast, water bodies with high nutrient levels capable of supporting an abundance of living organisms are called **eutrophic**. Eutrophic water bodies are also susceptible to **algal blooms**.

When algal blooms occur, algae floating on the water's surface decrease light penetration for the algae underneath and causes that algae to die off. The decay of the dead algae uses up oxygen, leading to very low dissolved oxygen levels, potential fish kills, and strong odors. The effect is intensified at night when photosynthesis stops but oxygen consumption by aquatic animals and plants including algae continues.

Algae attract attention because of their bright colors and overabundance in nutrient-enriched streams, ponds, and lakes. While the majority of freshwater algae are microscopic, the more obvious forms are often referred to as "pond moss" or "scum." Slick rocks in streams often result from algal growth.

Procedure

- 1. Separate into groups of 2-3 and select a testing station.
- 2. Since you might encounter water and harmful chemicals, remember to:
 - a. Stay in shallow water.
 - b. Wear rubber boots or waders if entering the water.
 - c. Wash your hands at the completion of the lesson.
 - d. Wear safety glasses and gloves when handling any harmful chemicals included with the test kits.
- 3. Remember to enter all test data on the worksheet.

NOTE: Print out the station flyers on the following pages which include student instructions and place at each station.

Glossary

- **Algal Bloom** An event where algae multiply at an accelerated rate and may continue to grow until the limiting nutrient is exhausted
- Escherichia coli (E. coli) A bacteria commonly associated with human waste
- **Eutrophic** Water bodies with high nutrient levels, capable of supporting an abundance of living organisms
- Oligotrophic Water bodies with low nutrient concentrations

Applicable Texas Essential Knowledge and Skills (TEKS) Science TEKS

- 6th Grade 19 TAC 112.26.b. 1A-H; 5A-G; 11A-B
- 7th Grade 19 TAC 112.27.b. 1A-H; 5A-G; 11A-B
- 8th Grade 19 TAC 112.28.b. 1A-H; 5A-G; 11A-B

E. coli Concentrations

DISCUSS:

- 1. Why are *E. coli* considered "indicator bacteria" and not necessarily harmful themselves?
- 2. If E. coli is found in water, what can that tell us about where contamination might have come from?
- 3. Why might scientists or health officials test for *E. coli* instead of testing for every harmful pathogen individually?
- 4. What could be the possible sources of *E. coli* in a rural area vs. an urban area?

TEST:

Follow the directions included with the *E. coli* test kit. This may require a team member to enter the water to collect a sample.

E. coli Concentration: _____ Potential factors affecting the *E. coli* concentration:

REFLECT:

Review the factors that influence *E. coli* concentrations:

- Inadequately treated sewage
- Improperly managed animal waste from livestock or pets
- Failing septic systems
- Wildlife living near water

Write down the factors that you believe are affecting the concentration of *E. coli* in the survey area. (Ex. "If the *E. coli* concentration is low, then the factor affecting this low concentration could be minimal human and animal waste entering the stream.")

Nutrient Levels

DISCUSS:

- 1. How does excessive nutrients in the water lead to algal blooms, and why is this a problem?
- 2. What might happen to an aquatic food web if a large algal bloom occurs?
- 3. Why do algal blooms eventually lead to low levels of dissolved oxygen in the water?
- 4. Why are fish particularly affected by low oxygen levels, while algae seem to thrive at first?

TEST:

Follow the directions included with each test kit. This may require a team member to enter the water to collect a sample.

Phosphorus concentration:

Nitrogen concentration:

Potential factors affecting the phosphorus and nitrogen concentrations:

REFLECT:

Review the factors that influence phosphorus and nitrogen concentrations:

- Runoff containing fertilizer or manure
- Domestic and industrial wastewater effluent

Write down the factors that you believe are affecting the phosphorus and nitrogen concentrations in the survey area. (Ex. "If concentrations are low, then the factors affecting nutrient levels could be minimal runoff containing fertilizers and possibly a release of water with low nutrient concentrations from a wastewater treatment plant upstream.")