LESSON 8

LESSON 8
Survey: Chemical Properties

Applicable TEKS

Science Grade 4	Science Grade 5	Science Grade 6
4.1 A 4.2 A, B, D, F 4.3 A 4.4 A, B	5.1 A 5.2 A, C, D, F 5.3 A 5.4 A, B	6.1 A 6.2 A, E 6.3 A 6.4 A, B

Duration

One 40-minute lesson

Objectives

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

Prerequisites

Students should complete *Lesson 4—Water Pollution* before starting this lesson.

Teachers should determine the number of supervisors needed (example: one per station) and make sure those supervisors understand their responsibilities before starting this lesson.

Materials

- *Handout 8—Survey: Chemical Properties*
- *E. coli* (or coliform bacteria) test kit
- Phosphate or nitrate test kit (or both)

Procedure

1. Discuss the safety procedures. Since students might come in contact with the water and harmful chemicals, remind your students to:
   a. stay only in shallow water,
   b. wear rubber boots or waders if entering the water,
   c. wash their hands at the completion of the lesson, and
   d. wear safety glasses and gloves when handling any harmful chemicals included with the test kits.
2. Have all students open their binders to *Handout 8—Survey: Chemical Properties*. Remind the students to enter test data on the handout.
3. Send student teams to each of the testing stations.

E. coli Concentrations

1. Discuss information in "Pollution Indicators" about *E. coli*, including:
   a. You find *E. coli* in the intestines of humans and animals. They are also found in human and animal feces.
   b. They are not necessarily harmful, but may indicate the presence of pathogens (harmful bacteria and viruses). This is why *E. coli* are called "indicator bacteria."
   c. The higher level of indicator bacteria, the higher chance pathogens are in the water.
2. Follow the directions included with the *E. coli* test kit; this may require a student to enter the water to collect a sample.
3. Discuss factors that influence *E. coli* concentrations—inadequately treated sewage, improperly managed animal waste from livestock or pets, failing septic systems, wildlife living near water, etc. Have students write down the factors they believe are affecting the concentration of *E. coli* in the survey area.
   a. Example: 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

1. Discuss information in "Pollution Indicators" about nutrients, including:
   a. Excessive nutrients can cause an algal bloom.
   b. Algal blooms can eventually cause low dissolved oxygen levels, and this might cause problems to fish populations (stress and even death).
2. Follow the directions included with each test kits; this may require a student to enter the water to collect a sample.
3. Discuss factors that influence phosphorus and nitrogen concentrations—runoff containing fertilizer or manure, domestic and industrial wastewater effluent, etc. Have students write down the factors they believe are affecting the phosphorus and nitrogen concentrations in the survey area.
   a. Example: 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.

Pollution Indicators

High Levels of *E. coli* Bacteria

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

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

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

Changes in the 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, fish, and wildlife. 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, the algae floating on the surface can decrease light penetration to the algae underneath and cause the algae to die off. 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 and oxygen consumption continues by aquatic plants including algae, as well as animals.

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.