

LEARNING SET 2 INTRODUCTION

Learning Set 2

How Do You Determine the Quality of Water in a Community?

8 class periods

Students design investigations to test for the presence of six water quality indicators. Claims and evidence are presented to the class. Conclusions are modified and refined through class discussion in preparation for drafting recommendations for the Wamego town council.

Looking Ahead

In *Section 2.2*, students test the effects of fertilizer on duckweed growth. This experiment must be run over 5 to 10 days. In *Section 2.3*, cabbage juice indicator must be prepared one to two days in advance, refrigerated until the day it is used, and brought to room temperature on the day it is used.

Overview

In *Learning Set 1*, students were introduced to the concept of watersheds. They learned that land use can affect the quality of water that drains into a river and ultimately, into oceans. In *Learning Set 2*, students begin a more concentrated study of the driving question (*How do you determine the quality of water in a community?*) when they learn about specific indicators that can be used to monitor water quality in a community's watershed. Students come to realize that these indicators reflect how land use can affect water quality. They also are introduced to how water quality can affect life forms in a body of water.

Students begin the *Learning Set* by discussing the problem of how to test water quality in a watershed. Initially, in *Section 2.1*, they believe that merely checking the clarity, smell, and condition of organisms tells them the quality of the water. In *Section 2.2*, they move in a more scientific direction when they design and present plans for investigating the effects of fertilizer on plant growth.

In *Section 2.3*, students' knowledge of what and how to test for water quality is expanded. They learn how to test water for pH. They consider whether organisms can continue to survive in a stream when the pH of the stream changes. In *Section 2.4*, students observe how temperature and turbulence affect the amount of dissolved oxygen in a body of water and how this in turn, affects organisms living there. In *Section 2.5*, students read about the effects of changes in temperature, turbidity, and the presence of fecal coliform bacteria on water quality. By the end of the *Learning Set*, students have a better idea of how and why it is important to monitor water quality in a community and can begin drafting recommendations to the town of Wamego.

Targeted Concepts, Skills, and Nature of Science	Section
Scientists often work together and then share their findings. Sharing findings makes new information available and helps scientists refine their ideas and build on other's ideas. When another person's or group's ideas are used, credit needs to be given.	2.1, 2.2
Scientists plan investigative questions and communicate ideas.	2.1, 2.2, 2.3, 2.4
Some common water quality indicators that can be measured are pH, temperature, turbidity, levels of dissolved oxygen, nitrates, phosphates, and fecal coliform bacteria.	2.2, 2.3, 2.4, 2.5
Land use can affect water in a watershed.	2.2, 2.5
The use of fertilizers can affect water quality in a watershed.	2.2
In a scientific investigation, one variable is manipulated and one variable is measured to see what happens as a result of changing the first variable. All other variables are kept constant.	2.2
pH, a measure of the acidity of a liquid, is an indicator of water quality.	2.3
Some aquatic organisms are sensitive to changes in pH.	2.3
Most aquatic organisms use dissolved oxygen for respiration. Dissolved oxygen is an indicator of water quality.	2.4
The amount of dissolved oxygen in water increases with decreased temperature and/or increased turbulence.	2.4
Water temperature is affected by temperature, turbidity, and fecal coliform bacteria.	2.4, 2.5
Thermal pollution causes water temperatures to increase, reduces water quality and can harm organisms in an aquatic ecosystem.	2.4, 2.5
Turbidity is a measure of how opaque water is. Turbidity may increase as a result of disturbances in land structure or changes in a river bed.	2.4, 2.5
Fecal coliform bacteria are found in the digestive tracts of animals.	2.5
Humans use rivers for residential, commercial, industrial, and agricultural purposes. These activities affect water quality along a watershed.	2.1, 2.2, 2.3, 2.4, 2.5

Students' Initial Conceptions and Capabilities	<ul style="list-style-type: none"> • Most students will have an idea of what a scientific investigation is and how it proceeds, but they may not realize that investigations are usually carried out within a group and that results are shared among members of the scientific community. (Mead & Metraux, 1957.) • Students may not understand that scientists do investigations to test ideas, not to produce a desired result. (Carey, et al., 1989; Schauble et al., 1991; Soloman, 1992.) • Students may not understand the need to change only one variable (the independent variable) during an experiment. (Wollman, 1977a, 1977b; Wollman and Lawson, 1977.) • Students often do not grasp that the most important part of an experiment lies in analyzing results, not just collecting
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Understanding for Teachers

Clean water resources are essential for life. It is a worldwide problem. Outside the developed countries of the world, between 2 and 3 billion people are without adequate or any sanitation. Without clean drinking water resources, illness and disease is common. It does not take long for these same problems to appear in developed areas either if the systems that protect drinking water supplies, such as sewage treatment, break down. Breakdown may come in the form of an actual break in sewer lines which usually results in a call to boil water used for drinking until the problem has been solved. Breakdown may also come when someone intentionally or through ignorance, pours harmful or potentially harmful materials into a water resource.

No river or pond is completely free of pollutants. It is nearly impossible to keep pollutants out of air and water. The Environmental Protection Agency (EPA) monitors major watersheds throughout the country and makes this information available online. Individual states must set what are called *total maximum daily loads* for individual pollutants that provides information that shows maximum allowable levels of materials that may exist in specific bodies of water without causing harm.

Sediment, nitrates and phosphates, and harmful organisms (pathogens) from non-point sources are the greatest sources of problems in North America. Seventy-five percent of problems with water pollution come from erosion, materials washed out in rainfall, and runoff from farms and large livestock feeding areas called feed lots. In addition, according to the United States Department of Agriculture, runoff carries away nearly one quarter of all fertilizer applied to cropland.

By the end of *Learning Set 2*, students should understand that it is desirable for communities to monitor the quality of their water supplies and to take steps to correct problems as soon as they are noticed. There are several ways that communities monitor water quality beyond merely checking its appearance. The investigations and demonstrations in *Learning Set 2* enable students to expand their science knowledge about water quality. They also prepare students for *Learning Set 3* in which students will concentrate on the effects that water has on life forms that occupy ecological niches in watersheds.

LEARNING SET 2 IMPLEMENTATION (page 53 goes with this section)

Learning Set 2

How Do You Determine the Quality of Water in a Community?

Engage

Have students recall the kinds of land uses they modeled in *Learning Set 1* or, if the models are still available, assemble them in a place in the room where students can view all of them together. Make sure students recall the terms *residential, commercial, industrial, and agricultural uses*.

Ask students to think about what it would be like if all of the land uses they were introduced to in *Learning Set 1* were brought together in one place. Record the students' suggestions. Some students may quickly realize that many towns and cities are, in fact, made up of many, if not all of the land uses.

Think about what might happen if all the water from each type of land use fed into your community's watershed. At might be in the water from homes, from factories, business, streets, and farms? What might happen to the water in the watershed? Let's record some of the things you think would change in the watershed?

Introduce students to the driving question for this *Learning Set*—*How Do You Determine the Quality of Water in a Community?*

Guide

Have students read the introduction to *Learning Set 2* on page 53 in the student text for the purpose of reviewing concepts learned in *Learning Set 1*. Tell students that recalling this information will give them a setting for studying about water quality.

Emphasize that by the end of *Learning Set 2*, they will be able to answer the driving question and they will be closer to answering the big question for the unit: *How does the quality of water affect the ecology of a community?*