

## LEARNING SET 3 INTRODUCTION

### Learning Set 3

# How Can Changes in Water Quality Affect the Living Things in an Ecosystem?

†  $8\frac{1}{2}$  class periods\*

*Throughout Learning Sets 1 and 2, students concentrated on the abiotic features of watersheds. Learning Set 3 introduces the role and importance of the biotic portion of these ecosystems. Students classify organisms and learn that living things can serve as an indicator of water quality. They investigate the affects of photosynthesis on water quality. They are introduced to and model feeding relationships in food webs.*

### Overview

In *Learning Set 3*, students learn that water quality can affect the number and variety of organisms that live in and around it. In doing so, students' understanding of the importance of changes to water in a watershed expands from merely looking at changes in the water to how these changes affect living things trying to survive there. With the use of dichotomous keys, students classify common aquatic macroinvertebrates based on their physical characteristics. Through a case study investigation, students also learn that some species of aquatic organisms can be monitored and therefore act as biotic indicators of water quality. Using elodea, students learn the rudiments of photosynthesis and observe that some organisms are more tolerant of polluted water conditions than others. Students learn about food chains. This leads them to study the characteristics of populations and communities. Using the computer program NetLogo, students simulate population changes in a model community. NetLogo can be used with MAC, Windows, Linus, and Unix. The Unit culminates with students preparing a presentation to the Wamego town council that explains scientifically, the ecological impacts that are likely to occur if the town takes on a new industry.

### Looking Ahead

In *Section 3.4*, students will use elodea, a live aquatic plant, for an investigation. Order the materials either Monday or Tuesday for delivery on Wednesday or Thursday. Elodea is relatively easy to care for but is sensitive to low temperatures, so avoid cold. *Section 3.6* requires access to a computer lab for the NetLogo program or simulations can be used in a classroom with a single computer and an LCD projector.

\*A class period is considered to be one 40 to 50 minute class.

Targeted Concepts, Skills, and Nature of Science	Section
Human activity may affect the ecology of a community.	3.3
Scientists classify organisms based on patterns of physical characteristics.	3.2
The growth and survival of organisms depends on the physical conditions of its environment ( <i>ecosystem</i> ).	3.3, 3.4
Scientists use tools such as dichotomous keys to classify and identify different organisms.	3.2
Biotic and abiotic components of an ecosystem interconnect with each other.	3.1, 3.3, 3.4
Scientists can use biotic indicators to determine water quality.	3.3
Living organisms are made of cells, get energy from the environment, grow and develop, reproduce, and respond to changes in their environment.	3.2
Organisms may interact in several ways as producer and consumer, predator and prey.	3.2, 3.4, 3.5, 3.6, 3.7
Herbivores feed on plants; carnivores consume herbivores; other carnivores or omnivores consume carnivores.	3.5, 3.6, 3.7
Bacteria act as decomposers.	3.7

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### Students' Initial Conceptions and Capabilities

- Tracing food chains in various environments helps students gain a deeper understanding of how interdependent organisms are on each other and their ecosystems. By middle school, students have some understanding of this interdependence. However, this understanding is limited to relationships between two different organisms. Often students think animals are dependent on humans for food and shelter. Some students have misconceptions about adaptations. They may think that all animals can change their food preference according to what is available when their normal food source disappears. They also may think that animals can change their body structure to accommodate changes in the environment. (Jungwirth, 1975; Clough and Wood-Robinson, 1985a.)
- Aquatic macroinvertebrates are common in river systems. They are linked to each other and to the abiotic features of their environment. When students make food webs, they begin to understand the complexity of life in an ecosystem. Many students may think that only vertebrates are animals (Mintzes et al., 1991). Some students have difficulty understanding hierarchical classification schemes and may not, for example, think of birds as animals (Bell, 1981). Some students may not understand that grass, vegetables, and some trees are plants. (Osbourne & Freyberg, 1985.)
- Many students think that plants get food from outside of themselves, rather than making their own food during photosynthesis. (Anderson et al., 1990.)
- Computer-based technology can extend learning by helping students perform cognitive tasks they might otherwise not be able to do in the classroom. (Salmon and Perkins, 1991.) Using software helps students to make predictions and explanations. (Linn and His, 2000.) Using technology in the classroom enables the teacher to become more of a guide and collaborator rather than the expert resource of all information. (Dwyer, 1994.)

## Understanding for Teachers

Concepts in this *Learning Set* bring students closer to understanding the complex relationships that exist in an ecosystem. Students learn about some real organisms that might be present in the Crystal River near the fictional town of Wamego. This gives them a context for seeing the effects of human intervention in the case study of the Marry Martans River Mystery. Students also begin to understand that in any ecosystem, matter and energy are being transferred as one organism feeds on another. Through the use of the NetLogo software, they also begin to appreciate that when a food chain or web is interrupted because a specific organism has not survived, the ecosystem becomes unbalanced.

8½ class periods\* u

## LEARNING SET 3 IMPLEMENTATION

## Learning Set 3

## How Can Changes in Water Quality Affect the Living Things in an Ecosystem?

10 min.

*Students begin to think more specifically about what interacts within an ecosystem. They focus more on the role and importance of living things within a watershed.*



## Learning Set 3

### How Can Changes in Water Quality Affect the Living Things in an Ecosystem?

You have studied watersheds and water quality. You modeled how water can affect the land over which it flows. You also modeled how a river is affected by changes in land use. Changes in land use affect how water flows in the watershed. They also affect the quality of the water.

Factories might use water from a river. They may return it to the river at a higher temperature. Runoff from farms and lawns can increase the amount of phosphates and nitrates in the river. You learned about how this affects the quality of the water. The quality of water, in turn, can affect the organisms that live in and around it.

A watershed, the land, the water flowing through it, and the plants and animals living in it are all part of what scientists call an **ecosystem**. An ecosystem is made up of both nonliving and living components. In an ecosystem, the living things have **interactions** with one another and with the nonliving things.

Human activities, water quality, and the types of organisms that live in the watershed are all connected. When you understand the interactions among living and nonliving things in an ecosystem, you can better measure the effects your actions might have on the **ecology** of the community.

In the first two Learning Sets, you investigated the nonliving parts of an ecosystem—watersheds and how they change. In this Learning Set, you will look more closely at the living things in an ecosystem. You will answer the question *How can changes in water quality affect the living things in an ecosystem?*

**ecosystem:** all the living things in a given place, along with the nonliving environment.

**interaction:** a kind of action in which two or more organisms have an effect on each other.

**ecology:** the study of the relationships between organisms and their environment.

*What do you think this otter depends on to live?*



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LIVING TOGETHER

### Engage

To begin to build a more complete picture of the concept of an ecosystem, ask students to tell you what they have interacted with thus far today. Record their ideas. Then, ask students to classify each of the listed items as living (L) or nonliving (NL). At the end, explain that everyone exists within a system made up of living and nonliving things. Explain that this system is called an *ecosystem*. Make sure students understand that ecosystems are not limited to an idyllic woods or a local stream. Get students to identify themselves as part of many different ecosystems.

**TEACHER TALK**

“Each day, no matter where you are or what you are doing, you are an active and important part of many ecosystems. Ecology isn’t just about being out in the woods or at a lake. What are some of the settings you find yourself in each day? (*Whether you are riding on the school bus, walking down the street, sitting in a classroom, or sleeping in your bed, you are a part of an ecosystem.*) What are some of the living and non-living parts of each of these settings?”

**△ Guide and Assess**

As students describe various possible ecosystems, ask them why their example qualifies as an ecosystem. Make sure you hear them include both living and non-living parts. If they mention only animals, ask them what forms of plant life there might be for the non-living parts. At first, students often forget that air and soil are important nonliving parts of ecosystems. A few students may mention bacteria and fungi, which are important living parts of almost every ecosystem, but not always easily recognized.

**△ Guide**

Introduce students to the driving question for this *Learning Set: How can changes in water quality affect the living things in an ecosystem?* Refocus students’ attention to water as an important non-living factor in ecosystems and listen for them to connect what they have learned in *Learning Sets 1* and *2* with this discussion on interactions between living and non-living things.

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