

OVERVIEW

Students will build a model landscape to investigate how water flows through and connects to watersheds. There are numerous curriculum materials on watersheds and wetlands (e.g., Project Wet, Project Wonders of Wetlands, Wet in the City, Keystone Aquatic Resource Education, Project Wild Aquatic, Pennsylvania State Parks Water Quality Program). For this reason this particular curriculum kit has not duplicated their efforts.

BACKGROUND**Watershed & Water Quality Protection**

Clean water is one of the most important benefits of a forest. Nationwide, more than sixty percent of the water found in streams, ponds and lakes originates in forested watersheds.

Forests make excellent watersheds for a variety of reasons. Let's begin with a rain shower. When it rains, the leaves and branches of trees break the force of raindrops as they fall to the ground. Then as rainwater moves across the forest floor, fallen trees and branches slow the water giving it more time to be absorbed into the ground. Forest soils are capable of absorbing large amounts of water. The forest acts as a natural sponge to intercept, store and slowly release the water into streams and underground aquifers, thereby recharging the water table. Rainstorms and melting snow in forests produce very little surface runoff eliminating many of the problems of soil erosion and sedimentation. Also during this process, the trees' hair-like root fibers help filter the water, trapping many chemical contaminants and transforming them into nontoxic forms through microbial decomposition.

Pennsylvania has approximately 50,000 miles of rivers and streams. Forests protect more than half of these, particularly headwater mountain springs and streams. These rivers and streams then provide clean water for domestic and recreational use.

Riparian forests and other forested wetlands are also critical habitats for a large number of wildlife species. The variety and abundance of vegetation makes them among the most productive and important of all forestlands.

Forested Wetlands and Stream Buffers

Wetlands are junctions on the landscape where the terrain meets water. This meeting may occur along the edges of

lakes, streams, etc., or where water seeps from the earth or where water simply collects on the earth's surface.

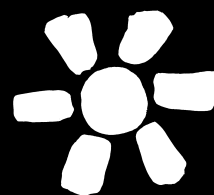
Forested areas can contain wetlands that are very noticeable (swampy areas) and which seem to remain constant. Forests can also contain wetlands that are not as noticeable. This latter type of wetland might be associated with small ponds in the forest that disappear in the warmth of the summer or with "spring seeps." Spring seeps can occur anywhere that the groundwater level meets the surface level, including on the sides of hills. Low areas may collect precipitation run-off, creating additional wet areas on the forest landscape.

Even though these temporary ponds and spring seeps are small, they are very important in the ecology of the forest. The temporary ponds can provide habitat for such creatures as frogs and salamanders that will be ready to head to the drier parts of the forest when they are a little older and the ponds begin to dry.

Spring seeps may be the only areas in a forest that are not snow covered and frozen, allowing animals to visit, finding both food and water.

Wetlands serve many functions for the environment and are protected by law. To learn more, visit the Pennsylvania Department of Environmental Protection's website at www.dep.state.pa.us. Choose "Subjects," then "W," then "Wetlands."

There is a movement in Pennsylvania and elsewhere to plant trees and restore forested areas along streamsides. Forested areas along streams protect the water in the stream from nonpoint pollution. Nonpoint pollution is general run-off from roads, lawns, farm fields, etc. Forested areas help to slow the movement of these pollutants as well as eroded soil into the stream water. It can be said that such forested areas "buffer" the stream. To learn more, visit the Pennsylvania Department of Environmental Protection's website at

**GRADE LEVELS:**

Grades 6–9

OBJECTIVES: Students will (1) predict where water will flow in watersheds and (2) describe drainage patterns in watersheds.

PENNSYLVANIA PROPOSED ENVIRONMENT & ECOLOGY STANDARDS ADDRESSED:**4.1.7**

- A. Explain the role of the water cycle within a watershed.
- B. Understand the role of the watershed.
- C. Explain the effects of water on the life of organisms in a watershed.

4.1.10

- A. Describe changes that occur from a stream's origin to its final outflow.
- B. Explain the relationship among landforms, vegetation and the amount and speed of water.
- C. Describe the physical characteristics of a stream and determine the types of organisms found in aquatic environments.

ESTIMATED DURATION:

Preparation time: 50 minutes. Activity time: Two 50-minute periods

MATERIALS NEEDED: Overhead transparency or copies of Branching Patterns, blue-colored water, spray bottles or sprinkling cans, drawing paper and pencil, blue pencils, tracing paper or blank transparency sheets and copies of a local map showing rivers.

NOTE: In this activity students build a model of a watershed. This is presented as a class activity, but smaller groups of students can construct their own models. Students can build a simple, temporary model or a more durable version that can be used in subsequent activities. The materials for both are listed below.

Temporary Model: white scrap paper, newsprint or butcher paper

Permanent Model: papier-mâché materials (strips of newsprint dipped in a thick mixture of flour and water), water resistant sealer and white paint (or water-proof paint)

Both models require 5–10 rocks ranging from two to six inches (5cm to 15 cm) in height. (If groups of students are making their own models, each group will need its own rocks.), square or aluminum tray large enough to hold rocks, and plastic wrap (thick plastic wrap from a grocery or butcher shop works well).

www.dep.state.pa.us. Choose “Subjects,” “S,” and then “Stream ReLeaf.”

Soil Protection & Nutrient Recycling

Tree root systems hold soil in place that otherwise would be washed away by heavy rains. Through growth, transpiration and death, trees tie up minerals and nutrients from the air, water and soil. Decaying dead tree parts, and ultimately the dead tree itself, decompose and eventually return these nutrients to the soil.

Climate Control

During photosynthesis, young and growing trees use the sun’s energy to convert carbon dioxide and water into carbohydrates and oxygen. For every ton of wood that grows, about 1.47 tons of carbon dioxide are removed from the air and 1.07 tons of life-giving oxygen are produced. It is estimated that one acre of trees provides oxygen for 18 people. Through the absorption of carbon dioxide and the release of oxygen, forests have a major affect on the stability of the world’s climate. As trees reach maturity, this process is dramatically reduced.

Trees also work as natural barriers to wind, snow, rain and solar rays. In doing so, they also control climate in micro-areas.

PROCEDURES

Warm Up

Show students copies of an overhead of Branching Patterns (the outlines of a watershed’s drainage pattern, a tree in winter, the human nervous system and a road map). Ask students what all the pictures have in common.

The Activity

1. Depending on whether a temporary model or a more permanent model is being built, have students do the following:

◆ **Temporary Model**

Instruct students to wrap rocks with white scrap paper and lay them in a square or rectangular aluminum tray. Place larger rocks near one end of the tray. Cover the rocks snugly with plastic wrap.

◆ **Permanent Model**

Have students lay rocks in a square or rectangular aluminum tray with the larger rocks near one end of the tray. Snugly cover the rocks

and exposed areas to the tray with plastic wrap. Apply strips of papier-mâché to cover the rocks. For a sturdier model, apply several layers of papier-mâché. When the papier-mâché has dried, coat the model with waterproof sealant and white paint or waterproof white paint.

2. Have students sketch a bird’s eye view of the model. They should mark points of higher elevation with “H”s and low spots with “L”s. To identify possible ridgelines, connect the “H”s.
3. Explain to students that the model will be experiencing a rainstorm. Ask students where they think water will flow and collect in the model. Have students sketch predictions of their drawings. Show them crevices in the model and possible locations of watersheds.
4. Spray blue-colored water over the model and note where it flows. Water may need to be sprayed for several minutes to cause a continual flow. Assist students in identifying branching patterns as water from smaller channels merges into larger streams.
5. Have students use blue pencil to mark on their drawings the actual branching patterns of the water. Some imagination and logic may be required. Ask them to confirm the locations of watersheds by noting where water has collected in the model.
6. Have students determine if smaller watersheds overflow into larger ones. Does all the water in the model eventually drain into one collection site (open watershed system)? Does the model contain several closed watersheds (collection sites that lack an outlet)?

EXTENSION

- Have students place tracing paper or an overhead transparency over their drawings and draw the drainage pattern. Compare the traced lines to the branching patterns presented during the warm up and compare them with drawings of other students. Discuss how all the networks involve smaller channels merging together and becoming larger.
- Provide each student with a copy of a local map. Have students lo-

cate streams and rivers and note where smaller rivers flow together or merge into larger ones. Ask students to circle land areas they think drain into rivers.

- Have students select one river on the map and follow its path in two directions. If the entire river is pictured, one direction should lead to the headwaters or sources (where the line tapers off). In the opposite direction, the river will merge with another river or empty into a body of water.
- Have students write a story or draw a picture featuring a local river. Ask them to describe in their story how water moves to the river from surrounding land areas or tributaries and then flows to a larger body of water.
- Students may want to finish their models by painting landscapes and constructing scale models of trees, wetlands and riparian areas. They can also include human in-

fluences such as towns and roads. Natural and human-made environmental problems, such as landslides and erosion could be incorporated into the design.

ASSESSMENT

Have students:

- ◆ Predict where water will flow and collect in their watershed model (Step 3).
- ◆ Test their predictions and use the results to confirm or modify their projected drainage patterns (Steps 4 and 5).
- ◆ Compare the drainage pattern of watersheds to other branching networks, such as roadmaps, trees or the human nervous system.
- ◆ Write a story about or draw a map of drainage patterns in their watershed.

Adapted from Project Wet, The Watercourse, 1996, "Branching Out," p.129.