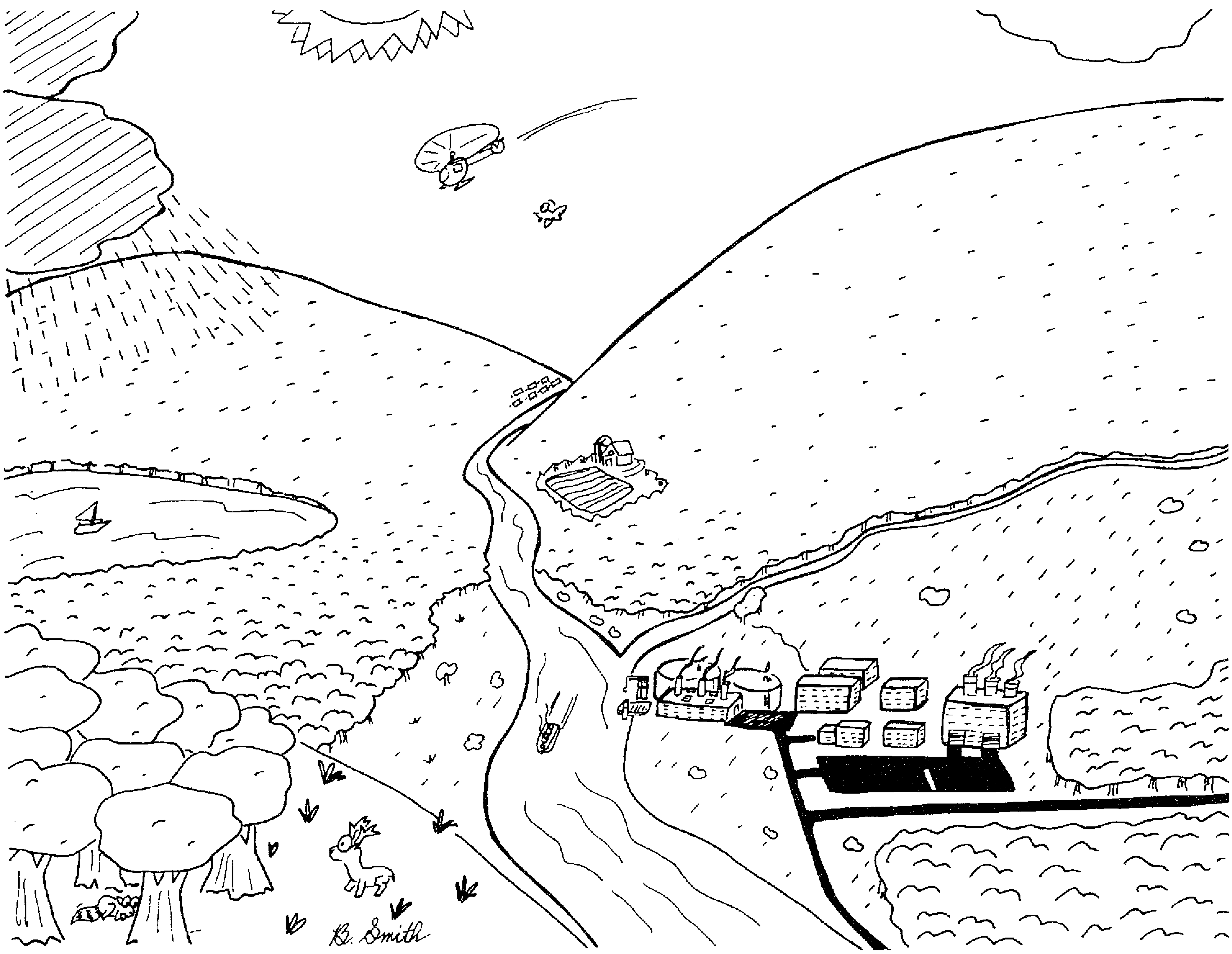
A DYNAMIC WATERSHED



Simply defined, a watershed is an area of land where water drains into an individual stream, lake, or other body of water. It includes all of the land, soil, rocks, plants, and animals as well as people and all of those objects that have been built by people. According to the Center for Watershed Protection, "watersheds" can be separated into various categories based on their sizes. <u>Basins</u> are the largest, draining land areas of over 1,000 square miles, <u>subbasins</u> cover 100 to 1,000 square miles, and a <u>watershed</u> drains from 10 to 100 square miles. A <u>subwatershed</u> covers 1 to 10 square miles, and the smallest drainage unit is the <u>catchment</u> which only covers up to 1 square mile. New Jersey has six drainage basins that are made up of numerous subbasins, watersheds, subwatersheds, and catchments.

Any precipitation that falls onto the land which is not used by plants or animals and does not evaporate, travels within the watershed in a specific manner. Higher points of elevation (e.g., ridges, mountains, hills) determine the direction that water flows once it hits the ground. Rivers, streams, storm drains, channels, lakes, ponds, and wetlands all play parts in defining how the water flows through the watershed.

Water that stays on the surface of the earth is termed surface water. It collects in various types of natural wetlands as well as in human-enhanced or human-created bodies of water. Surface water is used in many ways. It provides habitat for countless plant and animal species, including those that live in the water and those that use the water, but live in

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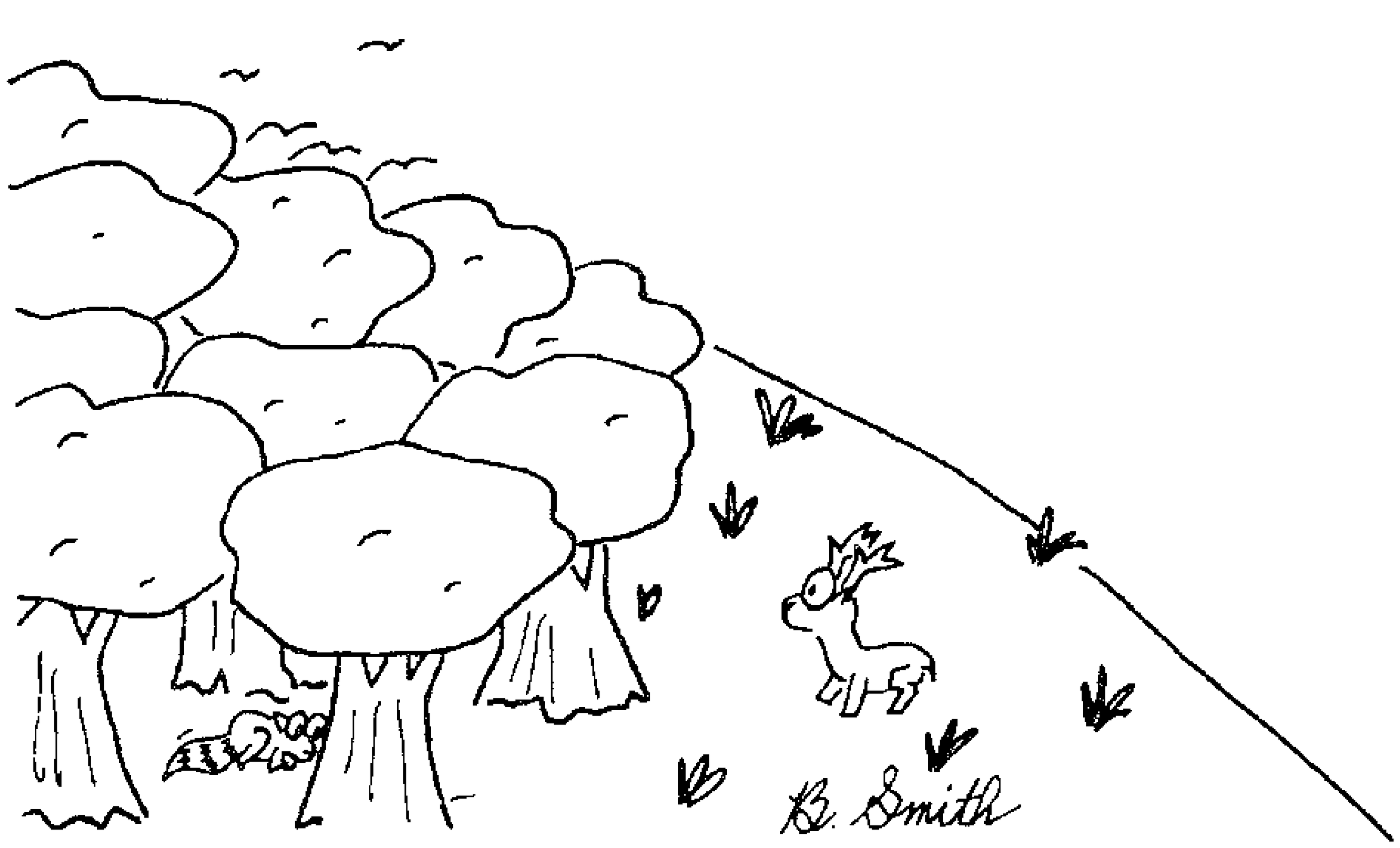
adjacent habitats. Surface water is used for drinking water and for irrigation of agricultural lands. It is used for recreation as well as for industrial and commercial ventures. Each of these uses requires a different degree of water quality and each of these uses affects water quality in different ways.

Some of the precipitation that reaches the earth seeps into the ground. Ground water moves through the soil and through cracks in bedrock. If the water becomes trapped between layers of clay or other impermeable substrate it becomes a subsurface reservoir called an aquifer. Fifty percent of New Jersey citizens receive their potable (drinking) water from ground-water aquifers. Wells can be owned by individual homeowners or a municipality or a water-purveyor can distribute well water to its residents and/or customers.

Both surface water and ground water are subject to various forms of pollution including point source pollution (that which comes from the "end of a pipe") and non-point source pollution (that which comes



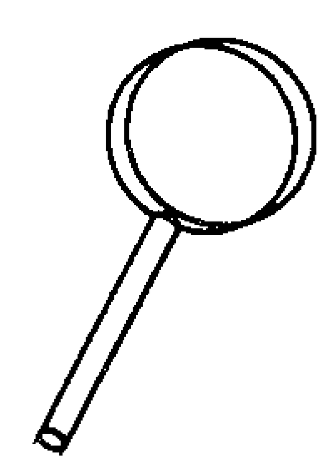
from many sources and is difficult to identify). The quality of drinking water supplies can be protected through various measures, including reducing the aforementioned types of pollution and by preserving undeveloped areas surrounding reservoirs, lakes, rivers, aquifer recharge areas, and wellheads. Most of New Jersey's river systems provide drinking water to various populations throughout the state. The quality of these systems can be protected by preserving the headwaters regions of river systems and by creating "greenways" along the river corridors. Besides buffering the river from terrestrial pollution, greenways provides valuable habitat for New Jersey's wildlife as well as recreation opportunities for our state's citizens. Without the protection of buffers and greenways, water designated for drinking purposes may require additional treatment to remove certain pollutants and chlorine and other chemicals may need to be added to make it "drinkable" according to state and federal standards.

TAKE A LOOK AT YOUR WATERSHED:

Where are the waterways and water bodies in your watershed? Which direction do they flow?

What landforms do you see that help determine the topography of the watershed?

How can you tell when you have crossed over into another watershed?



LESSON 1

A Dynamic Watershed

GOAL To understand the definition of a watershed by looking at its physiographic elements and their functions.

TIME
- (1) 45-minute period

OBJECTIVES Students will:
- ✔ construct a landform model as the foundation for learning about a watershed
- ✔ identify the physiographic aspects of a watershed relating to surface water
- ✔ observe and describe drainage patterns in a watershed

SKILLS observe, identify, organize, analyze, predict, evaluate, justify

VOCABULARY

aquifer	open watershed
basin	pervious surface
bedrock	physiographic
catchment	precipitation
closed watershed	ridgeline
drainage area	subbasin
elevation	subwatershed
ground water	surface water
impervious surface	topography
landform	watershed

PRIOR KNOWLEDGE Students should have background in:
- the water cycle

CORE CURRICULUM CONTENT STANDARDS

- Language Arts 3.1 (14,15) 3.2 (8,11)
- Science 5.1 (4,5,7) 5.2 (10,14) 5.10 (10,14) 5.12 (4,5,6,7,9,10)
- Social Studies 6.6 (10,16) 6.9 (5)

MATERIALS

Model A (Paper Watershed):
- ❑ 2 sheets of paper per student or pair of students
- ❑ Masking tape
- ❑ Blue, water soluble markers
- ❑ Permanent markers

Model B (Watershed in a Basin):
- ❑ Newspaper
- ❑ Plastic basin (at least 16" x 24") one per group of six students
- ❑ Clear or white plastic bag big enough to cover the top of the container
- ❑ Blue food coloring

For both models:
- ❑ Spray bottles with water
- ❑ Paper towels
- ❑ Newspaper

PREPARATION

Select one of the following models for the students to construct.

Model A: "Paper Watershed"
(based on "What is a Watershed?" from Global River's Environmental Education Network)
Give each student (or pair of students) two sheets of paper. Crumple one sheet, open the paper but do not straighten it out completely. Tape the edges of the crumpled paper to the surface of the other paper. The crumpled sheet should resemble a relief map.

Model B: "Watershed in a Basin"
Instruct the students in each small group to crumple up pieces of newspaper and place them in their plastic container. Explain that the newspaper pieces represent bedrock and create topography (changes in elevation). Lay a sheet of plastic over the entire model (represents the earth's surface) and tuck the edges into the plastic container. (Other materials that can be used to create topography include rocks, Styrofoam pieces, or clay.)

PROCEDURE

1. Have the students create their landform / watershed model.
2. Identify the types of "land" that the topography of their model represents [*hills, mountains, valleys, plateaus, etc.*].
3. Using either model, have the students identify ridgelines. (Model A: have the students trace these with blue, water soluble markers.)
4. Write the words surface water and ground water on the chalkboard. Explain the difference between these two types.
5. Tell the students their models will focus on surface water systems. Discuss why this is the case. [*Neither model allows for water to filter below the surface of the model - the paper on Model A and the plastic layer on Model B are impervious surfaces; to discuss ground water, these layers would have to be pervious like soil.*]
6. Ask the students to predict where the major rivers might be and where, on their model, water would collect after a rainfall. (Model A: have the students mark these sites with permanent markers.)
7. Put each model on newspaper or other water-tolerant surface. Provide each group with several spray bottles. Instruct the students to "mist" spray their models. (Model B: add blue food coloring to the water.) Discuss how the water flowed, where it accumulated, and how topography affected the drainage patterns of their model.
8. Introduce the definition of *watershed* as an area of land where water drains into an individual stream, river, lake, or other body of water. Drainage areas vary in size. Discuss the differences between basins, subbasins, watersheds, subwatersheds, and catchments.
9. Explain the difference between closed watersheds (those that lack a visible outlet) and those that are clearly linked by rivers and streams. Have the students discuss and define which of these are represented on their models.

FURTHER DISCUSSION

- List what the watershed's natural elements might be. [*soil, vegetation, animals, people, rocks, etc.*]
- List what the watershed's human-made elements might be. [*buildings, roads, dams, parking lots, fences, airports, train tracks, etc.*]
- Discuss which of these watershed elements would shed water and which would use and/or absorb water. [*Those that shed water would include the human-made elements, rocks, and some compacted soils; those that use and/or absorb water would be most soils, animals, and vegetation.*]

ASSESSMENT

Pose the following scenarios:

- If this was your watershed, where would you like to live? Why?
- The forest that surrounds the town's reservoir is sold and developed. The town builds a water treatment plant to filter and clean the water. What has been gained? What has been lost?

EXTENSION

Repeat the activity, but add the human aspect to the watershed.

1. Assume that this area (model) includes several towns. Where would be the best place to locate housing, the shopping mall, school and municipal buildings, recreation fields and parks, the water treatment plant, roads, the sewage treatment plant, landfills, etc.
2. Place a drop of food coloring or colored powder (Koolaid) at each of the above sites on Model B. Explain that the colored liquid (or powder) represents pollution. Ask the students to predict what will happen to water supplies the next time it rains. Spray mist the entire model and discuss the outcome and the cumulative effect of pollution.

EMPOWERMENT CHALLENGE

Map the schoolyard to show drainage patterns. Have students locate ridgelines and catchment basins. Have the students predict the direction of surface water flow then do follow-up evaluation of their predictions during (or just after) a rain storm.

LESSONS FROM OTHER SOURCES

Beneath the Shell - The Movement of Water

Project WET - Imagine, The Incredible Journey, Branching Out

Hands On Save Our Streams - Watershed Workings

WOW! The Wonders of Wetlands - Over Hill & Dale

REFERENCES

Center for Watershed Protection. 1998. *Rapid Watershed Planning Handbook: A Comprehensive Guide for Managing Urbanizing Watersheds.* Ellicott City, MD.