Sum of the Parts

An example lesson from Project WET Water Education for Teachers

Project WET is an environmental education program designed for teachers and other educators working with children from kindergarten through grade 12. Project WET is sponsored by the Missouri Department of Natural Resources and offers interdisciplinary instructional activities, along with workshops and in-service programs for teachers, natural resource professionals, park and nature center staff and youth group leaders. Project WET activities are correlated with the Missouri *Show-Me Standards* and focus on teaching students "how to think" not "what to think."

Project WET workshops can be scheduled at your school site. Please contact the state coordinator at The Missouri Department of Natural Resources, 1-800-361-4827 to discuss the options available for on-site workshops.

Sum of the Parts

■ **Grade Level:**
Upper Elementary, Middle School

■ **Subject Areas:**
Environmental Science, Government

■ **Duration:**
Preparation time: 50 minutes
Activity time: 50 minutes

■ **Setting:** Classroom

■ **Skills:**
Gathering information (observing); Organizing (arranging); Analyzing (identifying components); Interpreting (identifying cause and effect); Applying (proposing solutions)

■ **Charting the Course**
Supplement this activity with activities on runoff ("Just Passing Through," "A-maze-ing Water," and "Rainy-Day Hike") and water use practices ("Common Water"). Aspects of water quality monitoring are introduced in "Macroinvertebrate Mayhem."

■ **Vocabulary**
point source pollution, nonpoint source pollution, Best Management Practices

You have just inherited valuable riverfront property with a new house and a resort on it. On the day you move in, you discover the beach polluted with oil and littered with construction materials and animal waste! Where did all this stuff come from?

Summary

Students demonstrate how everyone contributes to the pollution of a river as it flows through a watershed and recognize that everyone's "contribution" can be reduced.

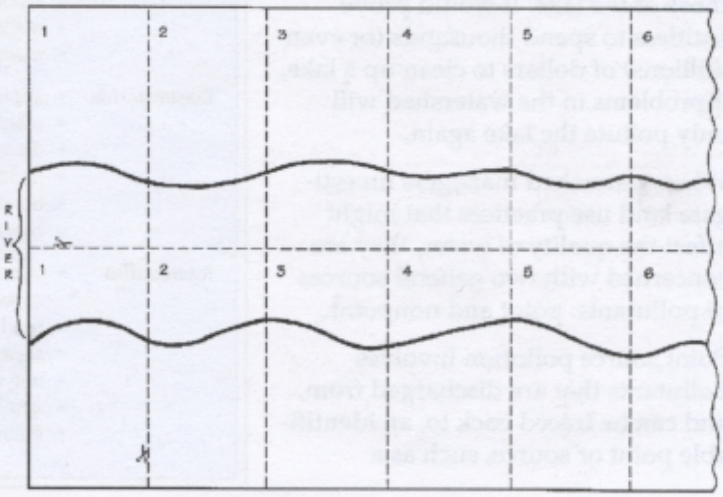
Objectives

Students will:

- distinguish between point and nonpoint source pollution.
- recognize that everyone contributes to and is responsible for a river or lake's water quality.
- identify Best Management Practices to reduce pollution.

Materials

- *Large piece of poster board or newsprint* (Using blue marker, draw and color a river on poster board, as shown below. Divide the stream in half down the middle and crosswise into sections. Each section should include a bit of river and blank space to allow room for students' drawings. The number of sections should correspond with the number of students or groups of students working together. Number the sections on one side of the river in sequential order, placing numbers in upper left-hand corners and repeat for the other side. Cut out the sections of stream. For durability, sections can be laminated.)
- *Drawing pens and pencils*
- *Items from students' desks (e.g., pencil, paper clip, book)*



Making Connections

In math class, students add a list of figures to obtain the total or "sum" (of the parts). Most students have attended a large gathering (concert, sporting event) and have been amazed at the amount of garbage left behind. Each person in attendance probably did not leave much on the ground, but with 500, 1,000, or more people doing the same, the total amount was large. Taking a closer look at how students can positively or negatively contribute to water quality helps them appreciate their role in water quality management.

Background

The quality of water in a river (or lake) is, to a large extent, a reflection of land uses and natural factors found in its watershed. If soil near a river or lake naturally erodes, chances are the river has sediment and turbidity problems. If

the land has stable vegetative cover, erosion is kept in check. When humans settle and develop land, water quality is affected. Breaking sod, cutting forests, building cities, mining, and other land uses make an impact upon water quality.

Everyone bears responsibility for the health of a watershed and the water systems (rivers, lakes, wetlands, etc.) within a drainage basin. Individual actions, both negative and positive, add up. Understanding a river or lake's water quality and quantity involves investigating the condition of the contributing watershed. If the watershed is polluted, the river will likely be polluted.

Watershed investigations are conducted for many reasons. Some investigations monitor changes in river and stream flows over time, to protect fisheries, to regulate floods, or to meet seasonal demands. Other studies determine the best method of protecting a river or lake from pollutants. One aim of a researcher might be to determine which areas of a watershed contribute the highest percentage of contaminants. This information is vital to policymakers and water managers when determining how best to spend money for improvements. For example, most lake improvement projects address problems in the watershed as well as those of the lake. It would prove fruitless to spend thousands (or even millions) of dollars to clean up a lake, if problems in the watershed will only pollute the lake again.

When watershed managers investigate land use practices that might affect the quality of water, they are concerned with two general sources of pollutants: point and nonpoint.

Point source pollution involves pollutants that are discharged from, and can be traced back to, an identifiable point or source, such as a

Major Sources of NPS Pollution and BMPs

Source	Best Management Practices:
Roads and Streets	• dispose of paints, solvents, and petroleum products at approved disposal sites, not in storm drains or street gutters • fix automobile oil and fuel leaks • stop oil dumping on rural roads • use nonchemical deicers (sand and ash) on roads, sidewalks, and driveways • construct a sediment catch basin to collect storm water runoff • reduce road construction runoff by building terraces and catch basins, and by planting cover crops
Agriculture	• read and follow all labels and ask for application directions before using chemicals, fertilizers, and pesticides • use conservation tillage • use contour farming • use strip cropping • leave filter strips and field borders along wetlands and streams • use a cover crop to protect exposed soil • rotate crops • plant shelter belts and windbreaks • institute pasture management • terrace areas prone to erosion • construct livestock waste collection and treatment ponds for confined livestock • use grassed waterways • seal abandoned or waste disposal wells • fence waterways to reduce riparian zone impact by livestock
Logging	• monitor water entering and leaving cut areas • prevent sediments from reaching streams and lakes by building terraces, catch basins, and natural filters • leave a vegetative buffer zone in riparian areas • maintain and restore effective watersheds • implement a plan to reduce erosion from roads
Mining	• monitor all water entering and leaving mine sites • intercept and reroute uncontaminated water away from contaminated areas (keep clean water clean!) • construct catch basins and terraces, and plant cover crops, to catch sediment and prevent erosion • catch and treat contaminated water (clean contaminated water!) • stabilize stream channels • stabilize mining waste areas to prevent release of materials to streams • maintain buffer strips along streams
Construction	• implement a sediment control plan • plant ground cover to reduce erosion • dispose of solvent, paint, and other wastes at approved disposal sites • build temporary, small dikes to slow and catch runoff • build sediment catch basins to collect construction runoff • build earth berms and filter runoff before water enters stream
Residential	• use nonchemical deicers (sand and ash) on residential driveways and sidewalks • read labels prior to using pesticides and fertilizers • consider xeriscaping • use nonchemical fertilizers (compost) on gardens • dispose of household hazardous waste at approved disposal sites • maintain septic tanks if sewers are not available

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factory's discharge pipe or a sewage ditch. Nonpoint source (NPS) pollution occurs when the source of a contaminant is unidentifiable; that is, the pollutant can come from one of many places. Examples of nonpoint source pollution include runoff from agricultural fields containing fertilizers and pesticides, motor oil filtering from urban areas, and sediments from eroded stream banks.

Surface runoff and ground water can transport both point and nonpoint source pollutants. Since point source pollutants are identifiable, they are easier to monitor.

The protection of surface and ground water resources from NPS pollution presents an enormous challenge because of the widespread and diverse nature of the problem. Land and water managers rely on methods called *Best Management Practices*, or BMPs, to describe land use measures designed to reduce or eliminate NPS pollution problems. A list of nonpoint source pollution sources and suggested BMPs can be found in the side bar on the previous page.

Procedure

▼ *Warm Up*

Determine student knowledge about watersheds by asking them to name several major North American rivers (e.g., Mississippi, Columbia, Missouri, Hudson, and Rio Grande). Where do these rivers originate (where are the headwaters) and end? How many states does each cross or touch?

Discuss some of the predominant types of land uses found along one river as it flows through a single state. Do students think these practices could affect the river? What do students think the attitude of downstream state residents might be about the water received from their upstream neighbors?

▼ *The Activity*

1. **Inform students that they have just inherited a piece of riverfront property and a million dollars. Have them list ways they could use the land and the money.**

2. **Pass out "pieces" of property and drawing pens and pencils. Explain that the blue is water and the blank space is land they own. They have one million dollars to develop their land as they wish.** They can farm or ranch; build resorts, homes, factories, or parks; plant forests, log, mine—whatever they like.

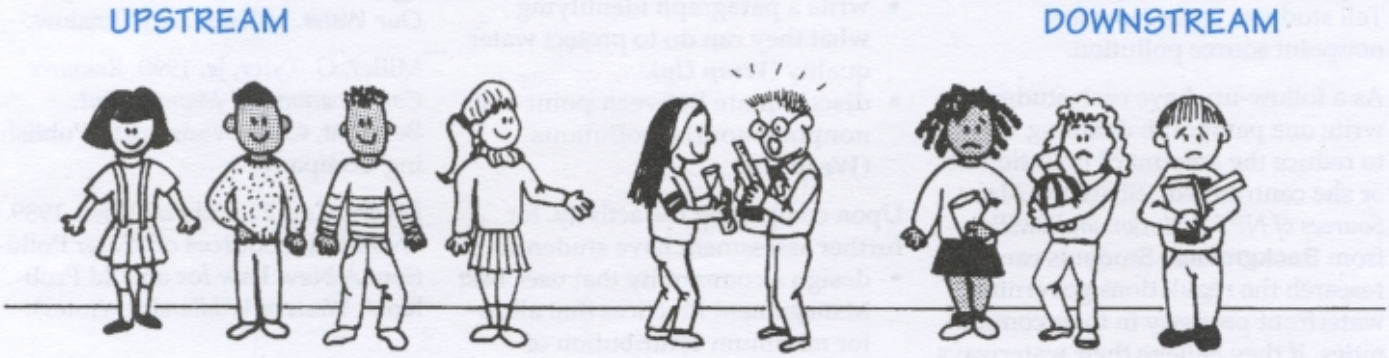
3. **When students have completed their drawings, ask them to look in the upper left-hand corner of their property for a number. Explain that each piece is actually a part of a puzzle. Starting with number one, have students assemble their pieces.** They will construct the stream pathway and adjacent land area in proper order. (The ones should face each other, with the twos next to them, and so forth.)

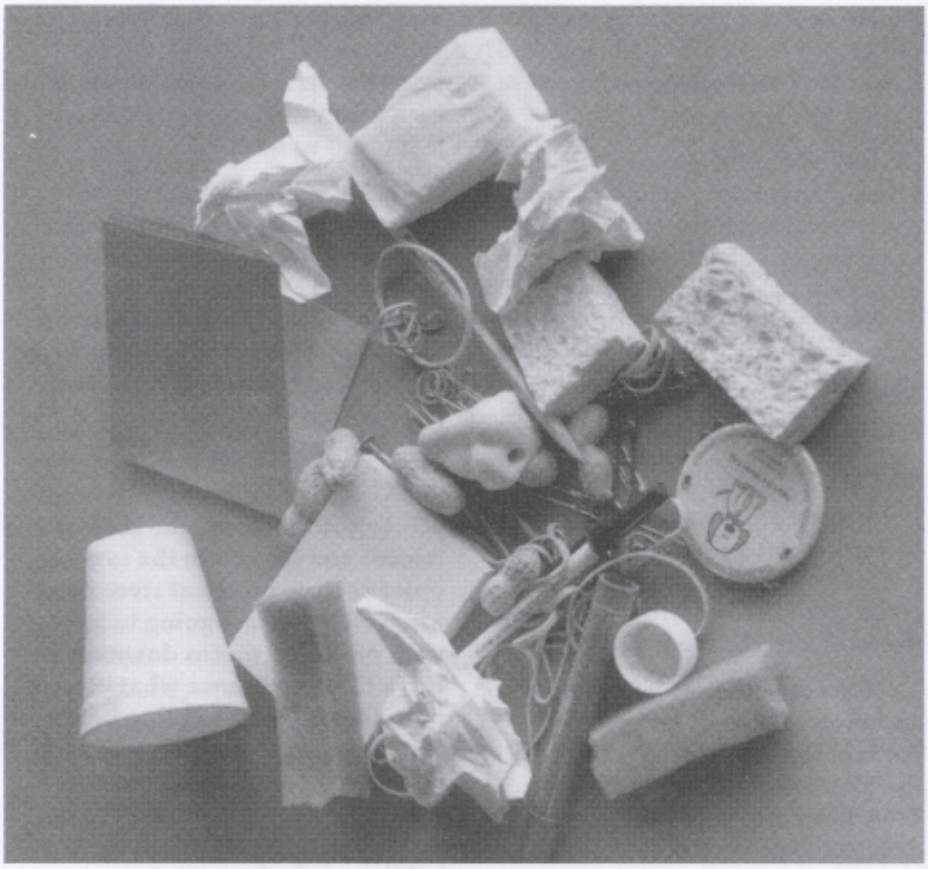
4. **Have students describe how they developed their land and how they used water. They should identify any of their actions that polluted or added materials to the waterway. Have students represent each of their contributions to the river with an item from their desks (e.g., book, piece of paper, pen, pencil).**

5. **Tell students to take their item(s) and line up in the same order as their pieces of river front property. They are going to pass their pollution pieces downstream. Have them announce what kind of pollutant they are holding before they pass it on.** The ones will pass their item(s) to the twos, the twos will pass everything to the threes, and so on, until the last students are holding all the items.

▼ *Wrap Up and Action*

After all the items have reached the final students, discuss the activity. How did those students toward the middle or at the end of the river feel? What about their property use plans? Could a student downstream be affected by the actions of a student upstream? Could upstream users





Simulated point and nonpoint source pollution collected during "Sum of the Parts."

alter the water quality of those downstream?

Tell students to reclaim their items. Explain that the items easily identifiable as their own simulate point source pollution. Other items (e.g., pencils, paper clips, notebook paper) may be more difficult to claim, because these kinds of pollutants originated from multiple sources. Tell students these represent nonpoint source pollution.

As a follow-up, have each student write one paragraph detailing ways to reduce the amount of pollution he or she contributed. (Share the *Major Sources of NPS Pollution and BMPs* from **Background**.) Students can research the regulations governing waterfront property in their communities. If they believe their waterways are poorly treated, they may want to write letters to local government officials supporting environmentally sound land use legislation.

Assessment

Have students:

- express their opinions about individual contributions to total water quality (***Wrap Up***).
- write a paragraph identifying what they can do to protect water quality (***Wrap Up***).
- discriminate between point and nonpoint source pollutants (***Wrap Up***).

Upon completing the activity, for further assessment have students:

- design a community that uses Best Management Practices that allow for minimum contribution of pollutants.

Extensions

Instead of a river, have students represent a lake system. One student represents a lake. A group of students encircle the student representing the lake; they are houses around the lake. Other students, standing in lines extending from the lake, can be streams flowing to the lake. Students pass their item(s) downstream and into the lake until all the items are held by the person in the middle who represents the lake.

Have students adapt the activity to represent a river system that includes tributaries flowing into a main channel.

Complete the main activity using real water users within the watershed where students live. Or assign roles (farmers, suburban dwellers, etc.) to students and have them develop their land accordingly. How would they manage their land to protect water resources?

Resources

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