Follow the Drop

Activity Overview: Students observe and collect information about water runoff on their school property.

Objectives: Students will

- practice observation and investigative skills
- survey and collect information about their school site
- calculate the volume of rain water falling and forming runoff on their school grounds
- Use critical thinking skills to develop ideas for storm water management on their school grounds

Subjects Covered: science, math

Grades: 4 - 12

Activity Time: 2 hours: 1 hour on the school grounds, 1 hour in the classroom

Season: Any, preferably spring or fall

Materials: clipboards, pencils (or colored pencils), "Follow the Drop" handout, map of schoolyard showing property lines and building locations (and/or graph paper), average annual rainfall data obtained from the weather bureau, local newspapers or TV weather newscaster, etc.

State Standards: Math: A.4.1, A.4.2, A.4.4, A.8.1, A.8.3, A.12.1, B.8.5, C.4.4C.12.1, D.4.2D.12.2; Science: F.8.9, F, F.4.4.12.7, F.12.8

Note: See Governor's Council on Model Academic Standards. (1998). *Wisconsin's Model Academic Standards*. Madison, WI: Wisconsin Department of Public Instruction for detailed descriptions.

Background: Water moving over the landscape in a large city, a medium-sized subdivision or single school yard after a rain event will flow basically the same, only the scales are different. A larger volume of water moves across the landscape in a large city compared to a small school yard. Nevertheless, in either case, water may flow in sheets, collect in channels, drain into pipes, accumulate in puddles or soak into the ground during a rain storm. Rain water will eventually drain to a river, a lake or to ground water. To have a life sustaining, healthy watershed with clean water, each site, whether large or small, requires thoughtful storm water management planning. One of the best ways to ensure clean water is to control runoff near its source and to start management at the point where water first contacts the earth. Keeping water out of storm sewer systems lessens erosion and sediment carried into lakes and rivers, reduces pollutants carried by moving water, and decreases chances of flooding. See Background Section of this *Storm Water Curriculum and Teaching Guide* for more information.

Activity Description: The purpose of this activity is to promote students' understanding of the patterns of water movement on their school grounds and the larger watershed. It will provide a first hand experience that will lead them to critically think about issues related to storm water and develop ideas to manage storm water on their school grounds to support a healthy watershed. Information collected can be used to determine what steps can be taken to improve water quality in the watershed and reduce runoff leaving the school.

Pre-activity Preparations:

- Make a copy of an existing school map showing the location of buildings, drives, and property lines. Locate north and indicate a scale on the map.
- If desired, divide the map into sections. Assign a section to each student team. The team will locate and record all features described below that are inside their section. Each section can be reassembled to form a composite map.
- Another option is to give every team one complete map and assign one or more of the features described below to each team. Each team will locate only the assigned feature(s) such as the location of downspouts on the school building.

Directions: This activity involves three steps. First students will survey the school grounds, identify how water moves over the land, and mark this information on a map. Second, they will take measurements of designated areas on the school grounds to calculate the amount of annual rain and runoff produced in that area. Third, students will begin to identify locations for reducing runoff on the school grounds. These three steps are described below in more detail.

Step 1: Identify Water Patterns.

Have students form teams, and go outside to identify the patterns of water movement. Locate the following features on your map.

- Locate high and low points. Indicate high points with a "+" sign and low points with a "-" sign.
- Locate hard surfaces (impervious) such as parking lots and sidewalks, where water runs off. Next locate porous surfaces (pervious) such as planted beds or lawn areas where water may soak in or infiltrate the ground. If desired, differentiate lawn verses garden. Color code these areas.
- Identify patterns in water movement such as where water might flow in sheets or in gullies or channels. Draw arrows to show direction of movement.
- Locate storm drains on school property. Write "D" on the map to represent storm drains.
- Locate where water enters the school grounds from hillsides, streets or other locations. Show with arrows.
- Identify where water exits the school grounds such as through ditches or off school parking lots. Show with arrows.
- Locate places where water puddles. Hint: areas that puddle may have different plants than the surrounding area; the soil may always be wet or hard and cracked when dry.

- Identify where water spills from one surface to another. For example, if water is moving from a hard, impervious surface like a sidewalk to a pervious, vegetated area or vice versa.
- Determine where the water goes that falls on the roof. Locate any downspouts around the buildings. Mark an "X" where you see a downspout.

Step 2: Measure Areas for Rain and Runoff Calculations.
Select areas to measure in order to calculate for rain and runoff statistics. Possible areas to measure include the school roof, parking lots, and playing fields or play areas. You may also consider measuring pervious areas compared to impervious areas. If your base map is drawn to scale, these measurements may be made in the classroom using rulers or a grid system. Use measuring tapes or paces to make on-the-ground measurements.

Calculations:

1. Calculate the area of your selected site (roof, parking lot, play area, etc.) by multiplying length by width to equal area in square feet.

   Example: 30 feet X 50 feet = 1,500 square feet area

Calculate Area	30 ft.	X	50 ft.	= 1,500 sq. ft.

2. Multiply average annual rainfall data by area to determine the volume of rainfall falling on a particular site. In this example, the average annual rainfall data is 30 inches per year.

   a) Convert average annual rainfall data from inches to feet.

   Example: 30 inches ÷ 12 inches = 2.5 feet.

Convert annual rainfall from inches to feet	30 in.	÷	12 in.	= 2.5 feet

   b) Multiply average annual rainfall data by area.

   Example: 2.5 feet X 1,500 square feet = 3750 cubic feet for annual rainfall.

3. Calculate how much of the rain becomes surface runoff on the school grounds.

Determine rainfall on area	2.5 ft	X	1,500 sq. ft.	= 3750 cu. ft.

   c) If rain is falling on hard surfaces such as a parking lot, all or 100% is runoff.

   Example: 3750 X 1.00 = 3750 cubic feet is surface runoff.

Calculate surface runoff from a parking lot	3750 cu. ft.	X	1	= 3750 cu. ft.

d) If rain is falling on a lawn, about 60% (approximate) is runoff. Runoff from lawns can be variable depending upon soil type, condition of the lawn, and topography.

Example: 3750 X .60 = 2250 cubic feet is surface runoff. (1482 cubic feet infiltrates)

Calculate surface runoff from a lawn	3750 cu. ft.	X	.60	= 2250 cu. ft.

e) If water runs into a rain garden (collects and infiltrates rain water), calculate no or 0% runoff.

Example: 3750 X .00 = 0 cubic feet is surface runoff.

Calculate surface runoff from a rain garden	3750 cu. ft.	X	.00	= 0 cu. ft.

Step 3: Discuss Observations and Results of Calculations.
As a class, share your findings based on observations and calculations on the school grounds. Discuss the big picture of water movement by identifying unique characteristics observed, possible problem areas, etc. Talk about ways the school can reduce runoff on school grounds. Identify likely areas to create a rain garden to collect and infiltrate water.

Assessments:

- Describe the topography of your schoolyard and how it affects the flow of water during a heavy rainfall.
- Tell a story about a rain drop falling on the school grounds. Describe its journey as it moves on the school property.
- List positive aspects and things that could change on the school grounds to develop a healthy watershed.
- Have students give oral reports on their findings and suggestions for storm water management on their school grounds.

Extensions:

- Go outside when it is raining, and observe storm water runoff in action. (See Rainy-Day Hike. *Project Wet: Curriculum and Activity Guide*. Bozeman, Montana. Pages 186 – 190.)
- Pour a bucket of water or balls on the ground to get a sense of how water moves. Students may make predictions before pouring the contents of the bucket.
- Identify the watershed (s) the school is located in, and then map what route the school's runoff will take to the nearest body of water.
- Calculate, using the activity formulas, the amount of water falling on the school grounds after a single rain event. Use a rain gauge to obtain rainfall quantity.
- Observe what the rain water runoff is picking up along its route – sediment, trash, oil and gas, etc.

- Determine the number of showers that can be taken with the calculated results. A five minute shower uses 25 gallons of water. 1 cubic foot = 7.2827 gallons.

Example: 3750 cubic feet X 7.2827 = 27410.125 gallons
27410.125 gallons ÷ 25 gallons = 1093 showers

Convert cubic feet to gallons	3750 cu. ft.	X	7.2827	= 27410.125 gallons
Calculate possible number of showers	27410.125	÷	25	= 1093 showers

Resources:

Leopold, Luna B. 1974. *Water: A Primer*. W.H. Freeman & Co. San Francisco, CA.

Where Does Water Run Off after School? *Project WILD. Western Regional Environmental Education Council. Bethesda, MD.*

Sample Follow the Drop Calculation Form

Calculate areas				
Site	Width	X	Length	Area
Total area	feet	X	feet	square feet
Parking lot/roof	feet	X	feet	square feet
Lawn	feet	X	feet	square feet
Rain garden	feet	X	feet	square feet
Other	feet	X	feet	square feet
Convert annual rainfall from inches to feet				
	Annual rainfall			Annual rainfall in feet
	inches	÷	12 inches	feet
Determine rainfall on area				
Site	Annual rainfall in feet		Area	Total rainfall
Total area	feet	X	square feet	cubic feet
Parking lot/roof	feet	X	square feet	cubic feet
Lawn	feet	X	square feet	cubic feet
Rain garden	feet	X	square feet	cubic feet
Other	feet	X	square feet	cubic feet
Calculate surface runoff				
Site	Total rainfall		% runoff calculator	Surface runoff
Parking lot/roof	cubic feet	X	1	cubic feet
Lawn	cubic feet	X	.60	cubic feet
Rain garden	cubic feet	X	0	cubic feet
Other	cubic feet	X	1 - 0	cubic feet
Total surface runoff	**Add all surface runoffs from above.**			**cubic feet**