# 6th Grade Unit "Stormwater Runoff"

SPLASH! Stormwater Pollution: Learn and Share

*Objective: In this unit, students will calculate the volume of stormwater that runs off their school grounds. They will also collect, categorize and analyze debris and pollutants from impervious surfaces that are carried with the stormwater into local waterways.*

## Materials and supplies to support this lesson: *

- Masking tape, whisk brooms, dust pans, plastic gloves, pollen masks, sifters and tongs.

## Lesson 1: Calculate Stormwater Runoff

To help students understand the concept of runoff and its impact on local waterways, they will use their own school as a test site to calculate stormwater runoff. The purpose of this activity is to have the students use annual rainfall statistics and their school's impervious surface area to determine the volume of stormwater that drains from the school grounds, untreated, directly into local waterways.

### Background

The City has collected stormwater user fees as part of its sewer user charge since the 1960s. The fees help the City operate and maintain the stormwater system which includes publicly maintained pipes, culverts, gutters, catch basins, ditches, channels, ponds and wetlands.

The basis of the stormwater fee has changed from "water meter size" to "impervious surface." Impervious (or hard) surfaces are areas such as rooftops, driveways, parking lots and patios. The more impervious surface a property has, the greater the amount of stormwater runoff. Any pollutant the runoff collects as it flows over these surfaces is ultimately carried into local rivers, streams and wetlands. The greater the runoff, the greater the impact on the stormwater system.

### Definitions:

**Stormwater system** - includes publicly maintained pipes, culverts, gutters, catch basins, ditches, channels, ponds, wetlands and their related waterways.

**Impervious Surface** - hard (non-porous) surfaces such as rooftops, driveways, sidewalks and patios. These surfaces do not absorb and filter water as vegetation and soil does. Water and any pollutants it carries flows across these surfaces ("runoff") into local waterways and wetlands.

**Gallon** - 1 equal to a volume of 231 cubic inches in English system measurement.

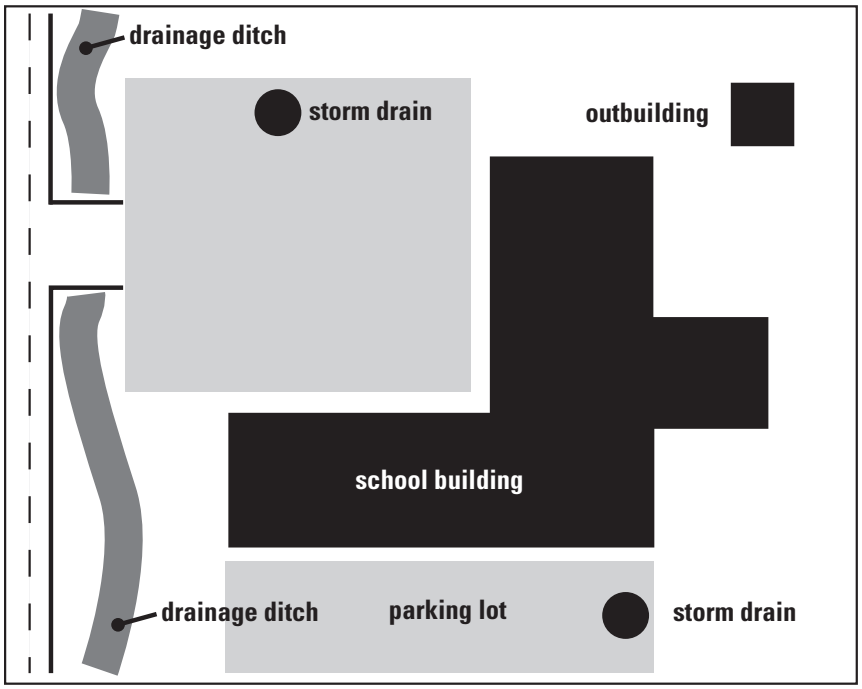
1 equal to a volume of 3.785 liters in metric system measurement.

**Nonpoint Source Pollution** - includes materials and chemicals which are washed into the stormdrain system from a variety of sources. These pollutants are washed by rainwater and other means from streets, neighborhoods, farmlands, construction sites and parking lots. Because storm drains are separate from household sewer systems, these polluted waters flow directly into our creeks and rivers without treatment. The Environmental Protection Agency calls nonpoint source pollution the greatest remaining threat to America's fresh water supplies.

**Point Source Pollution** - Pollutants that come from a single point source such

* available for teachers from the City of Eugene. See end of unit to order.

## Sample Site Map




as the end of a pipe, factories or sewage treatment plants. The source is easily identifiable.

### Materials:

- Class set of school grounds map (available from school custodian or main office)
- Tape measures or yardsticks
- Annual rainfall statistics available from the National Weather Service, www.nws.noaa.gov. Rainfall statistics for Lane County are also available at this website: http:geography.uoregon.edu/infographics/lcweb/lcindex.htm
- *Calculate Impervious Surface Runoff* worksheet

**Note:** If a school ground map is not available, assign a team of students to measure schools building and parking lots. Have them create a simple site map similar to the sample on this page.

### Procedure

Divide the class into groups of two or three students.

Use the school grounds map and assign areas to be measured by each team.

**Option:** Have class examine the map and come to agreement about who will measure what areas.

As a class, determine the kind of measurements the students will need to take. **Note:** Decide whether the metric or English system will be used.

Distribute copies of the school grounds map and have students use their copies to plan what and how they are going to measure before they go out to do it.

Send students out to measure. Each team records measurements for their section on their copy of the school grounds map. **Note:** Since students will be spread out all over the school grounds, advise your colleagues in advance of the procedure. Parent volunteers could also help with this stage.

Have students note the location of storm drains or open ditches on the school grounds and mark them on their site maps.

When students return with measurements, distribute the *Calculate Impervious Surface Runoff* worksheet.

Direct students to calculate the area of their team's section of the school's impervious surface. (See "Math Calculations")

Record each group's calculation on the board or an overhead (made from *Calculate Impervious Surface Runoff* worksheet) while students copy onto their individual copies.

### Math Calculations

Add all the areas together. Multiply the total area times the average yearly rainfall. Divide the result by the cubic volume of either a gallon or a liter. The result is the number of gallons or liters of total rainfall that fall onto the school's impervious surfaces. This rainfall gathers surface pollutants and drains directly into local streams and rivers and is not absorbed and filtered by natural vegetation and soil.

### Discussion

Use a gallon or liter container to help the students visualize how much water runs off into the stormwater system.

Through questions and discussion, help them understand what happened to that runoff before the school was built and what happens to it now.

### Questions

1. Where does the runoff from the school's impervious surfaces go?
2. Is the runoff cleaned up or treated in any way?
3. Before the school was built, where did the water go?
4. What would happen if we let all the runoff from the school's impervious surfaces just run onto the ground around the building?
5. If you were designing a school building, how would you deal with the impervious surface runoff? Why?
6. What effect does the impervious surface runoff water have on the stormwater system and the ecosystem/environment of the school grounds?

## Lesson 2: Determine Pollutants in Local Waters

Once the students determine the volume of water that runs off their school's impervious surfaces into the stormwater system from Lesson 1, they can now determine what
pollutants that water carries into local waterways.

Student teams will take debris samples from different locations on their school's impervious surfaces. These samples will be analyzed and categorized to estimate the total amount of debris/pollutants that are washed into local waterways.

**Note:** The week before starting this lesson, have students bring containers (preferably plastic and recyclable) from home to be used for collecting and sorting debris.

### Materials for Each Student Team

- Map of school grounds (reuse from Lesson 1)
- Meter or yard stick and masking tape
- Whisk broom, dust pan and bucket
- Plastic gloves and pollen masks
- Tongs, sifters
- Containers into which collected debris can be sorted and categorized such as plastic food containers, baby food jars or even milk cartons.
- Labels
- Scale for measuring debris/pollutants
- Copy of *Pollutants* worksheet for each student.
- *Calculate Impervious Surface Runoff* worksheet used in Lesson 1.

Divide students into teams of two or three students. Teams formed for Lesson 1 may be used.

### Prepare

Assign sample plots or have the class examine the school grounds map and come to agreement about who will sample what areas. If the same groups are used as in Lesson 1, students may like to gather the samples for this activity from the same area they measured in Lesson 1.

Using the meter or yard sticks, the student teams measure and mark off one square yard of the impervious surface in their assigned area using masking tape.

### Collect

Wearing gloves and pollen masks, students sweep up and collect the debris and dirt within their marked area. Place the debris in a bucket marked with student names, date and location.

**Note:** Parent volunteers could be helpful at this stage.

After the collection is complete, have the students remove the masking tape so that it won't be worn away and eventually enter the stormdrain system.

## Sort

Students take the debris back to class and use sifters and tongs to sort the debris into containers according to type. Labels are included to identify the debris in the containers.

## Weigh

Using the scales, each team weighs the debris in each category and records the weight next to their group number or name on *Pollutants* worksheet.

## Report

Using the blackboard or show the *Pollutants* worksheet. Have the students report their categories and weights. As each group reports, record the data as students copy it onto their own copies of *Pollutants* worksheet.

## Calculate

Continuing with *Pollutants* worksheet, lead the class in calculating the average per yard weight of each type of debris by averaging all the groups' weights in each category.

Have the class estimate the total weight of each debris category by multiplying the averages by the total area they calculated in Lesson 1. Use the *Pollutants* worksheet (from Lesson 1) as a reference.

## Discussion

1. Are the estimates of the total weights of each debris type realistic? Why/ Why not?
2. Where does the debris go when it rains? Is it washed off the impervious surface?
3. Is this debris/pollutant treated or filtered in any way?
4. What effects might each of the debris/ pollutant types have on the environment?
5. What alternatives are there?
6. What could be done at school to decrease the negative effects of this runoff?

**Note:** A large portion of a school's impervious surface area is its roof. Because roofs are not safe places for students, they should not be included in the area from which samples of debris/pollutants are collected.

School custodians and district maintenance crews may periodically clean the school's impervious surfaces. Have students undertake this activity before such a cleaning if possible.

## Extension

The debris/pollutants gathered from one sample plot could be emptied into a glass tank with the amount of rain that would fall on that plot in a year added to the tank. Students can see what the runoff entering the stormwater system might actually look like.

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SPLASH! was developed by the City of Eugene Stormwater Management program to support education about water quality in our community. This program is funded by City of Eugene stormwater user fees.

* For more information, supplies for use with these lessons, the SPLASH! Songs CD, or a visit from Lily, contact jeffrey.j.flowers@ci.eugene.or.us or call 541-682-8482 (Eugene schools only )

**SPLASH! classroom materials are online at happyrivers.org**

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# *Calculate Stormwater Runoff* Worksheet

Group: _____

Date: _____

Name: _____

Name: _____

Name: _____

| Student Group | Area Description | Dimensions | Area |
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**TOTAL AREA** = **(A)**

**(A)** _____ **X** **(B)** _____ = **(C)** _____

Total area of school's impervious surface

Annual Rainfall

**(C)** _____ ÷ **(D)** _____ = **(X)** _____

(AxB)

Cubic volume of gallon (231 inches) or liter (3.785 liters)

Number of gallons or liters of rainfall that fall on the school's impervious surface and runs off into local streams and rivers.

# *Determine Pollutants in Local Waters*

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Name: _____

Date:_____

## Weight by Category

| Student Team | Rock | Sand | Dirt | Glass | Paper | Plastic | Plant | Food | Fabric | Metal | Wood | Other | Unknown |
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**Math Calculations:** Determine the average weight for each category by adding all the weights for that category and dividing by the number of student teams.
Example: The total weight for the "Sand" category collected by Groups 1-6 = 10 pounds. Divide 10 pounds by 6 groups = 1.67 pounds. The average amount of collected sand was 1.67 pounds per square yard or meter.

**Calculation #1: Determine Average Weight of Each Debris Category.**
Toal Weight of Each Debris Category _____ Divided by # of Student Groups_____
= Average Weight of That Debris Per Square Yard/Meter_____

**Calculation #2: Determine Total Debris Washed into Stormwater System from School Grounds**
This can be calculated for each debris type , and then added for a grand total for all of the solid pollutants
Average Weight of Debris_____ x Total # of Square yards/meters _____ =Total Debris _____