NPS ActivitY SHEETS

Activities to Accompany

Stop Pointless Personal Pollution

For Grades 6-8

Objectives:
This is a set of exercises based on some of the topics addressed in the accompanying article. They emphasize personal participation and creation of a program. In Exercise I, students are encouraged to take charge of their environment through an Adopt-A-Street program. Exercise 2 is a problem that uses math interpretation to lead students to think about a more water-conservative strategy for car washing. In particular, students are asked to work with fractions. The third exercise uses a case study to evoke thought and discussion among students about pet sources of bacteria in densely populated areas. The last exercise is a lab experiment that leads students into thinking about the effects of phosphates from household fertilizers and detergents on their waterways.

Exercises:
Exercise I. Create an Adopt-A-Street Program in Your 'Hood
Exercise II. The Superior Car Wash
Exercise III. A Suburban Bacterial Dilemma
Exercise IV. Phosphates in Your Water

Time Required:
Individual exercises are designed to be approximately ½ hour to 45 minutes long.

Curricular Standards and Skills:

Natural Science:
- stream/pond ecology
- pollutants
- lab methods

Math:
- fractions
- percents

Language Arts:
- reading comprehension
- discussion/critical thinking
- writing

Civics:
- map reading/geography
- population density
- urban related challenges
- community service

Vocabulary:

acutely toxic
chronically toxic
impervious
integrated pest management
nitrogen and phosphorus
pesticides
storm drain
wastewater

Web sites:

EPA's Nonpont Source Pollution Prevention page
http://www.epa.gov/owow/nps/prevent.html

Water Action Volunteers Storm Drain Stenciling
http://clean-water.uwex.edu/wav/stormdrain/index.htm

EPA's Combined Sewer Overflows page
http://cfpub1.epa.gov/npdes/home.cfm?program_id=5

Adopt-A-Street Program, City of Little Rock, Arkansas:
http://www.accesslittlerock.org/departments/publicworks_p2.html

Adopt-A-Street Program, Greensboro, North Carolina:
http://www.ci.greensboro.nc.us/gdot/operations/Adopt_a_Street/index.htm

Adopt-A-Street Program, Westminster, Colorado:
http://www.ci.westminster.co.us/gov/depts/pwu/adopt.htm

Northern Virginia Regional Commission Bacteria Research page
http://www.novaregion.org/4MileRun/bacteria.htm

U.S. Census Bureau
http://www.census.gov

City of Seattle's page on Preventing Pet Waste Pollution
http://www.ci.seattle.wa.us/util/surfacewater/bmp/petwaste.htm

Northern Virginia Regional Commission's page on Why a Dog Park Will Make a Difference
http://www.novaregion.org/4MileRun/dog_park.html

Exercise I. Adopt-A-Street Program in Your 'Hood

Before You Get Started...

Visit EPA's Web site on combined sewer overflows at http://cfpub1.epa.gov/npdes/home.cfm?program_id=5

What is a CSO (combined sewer overflow)?

What is a wet weather discharge?

Why is it important not to throw trash and pollutants into a storm drain?

First, Few Good Examples

Everything that is washed down street gutters affects the health of the waterways around you. Storm drain stenciling is a good way to remind people not to throw used oil, trash, and other objects down the gutters. Adopt-A-Street is a similar program.

Many cities have Adopt-A-Street programs. Adopt-A-Street is a partnership between a city and its residents. Groups or individuals agree to adopt a mile or more of city streets and keep them clean. The city provides organizational help, cleanup supplies, free hauling, and street signs that identify the Adopt-A-Street sponsors. Little Rock, Arkansas; Greensboro, North Carolina; and Westminster, Colorado are three good examples of cities that have successfully started Adopt-A-Street programs. You can see what these cities are doing by visiting the following Web sites:

Little Rock, Arkansas:
www.accesslittlerock.org/departments/publicworks_p2.html

Greensboro, North Carolina:
www.ci.greensboro.nc.us/gdot/operations/Adopt_a_Street/index.htm

Westminster, Colorado:
www.ci.westminster.co.us/gov/depts/pwu/adopt.htm

Now, Create Your Own

Activity 1:
Are you part of an Adopt-A-Street program? Investigate whether your city will provide support for an Adopt-A-Street program by calling the Department of Public Works.

Activity 2:
As a class, you can set up an Adopt-A-Street group for the stretch of road outside your school. You can also start an Adopt-A-Street program for your neighborhood or housing development.

Exercise II.
The Superior Car Wash

How Much Water Does It Take?
It takes 25 gallons of water for a 5-minute shower and 35 gallons to fill a normal bathtub. In comparison, the average person washing a car uses more than 500 gallons of water! All that water and the suds from car shampoo washes down the street's storm drain into the waterways. Over time car wash runoff adds up to some serious "personal" pollution!

Making a Superior Car Wash—Doing the Fractional Math
The exercise below suggests how you can make a superior car wash – superior in terms of not only car cleaning but also water pollution reduction.

Imagine that you have a weird bucket that holds as much as you want, but no matter how hard you try, you can never empty the last ounce when you drain it. In your weird bucket, there is now 1 undrainable ounce of some sort of gunk you want to rinse away.

Part 1:
Start out with 1 ounce of gunk in your bucket. Draw it!

Do the math!
Mix in 1 ounce of water. You now have a 2-ounce mixture of gunk and water. Drain away half of the mixture. How much total mixture is left? How much of that is water? How much of it is gunk?

Repeat. Pour in an ounce of water so that you have a 2-ounce mixture. Drain away half of the mixture. How much gunk do you have now?

Repeat again. After three dilutions, how much gunk is left?

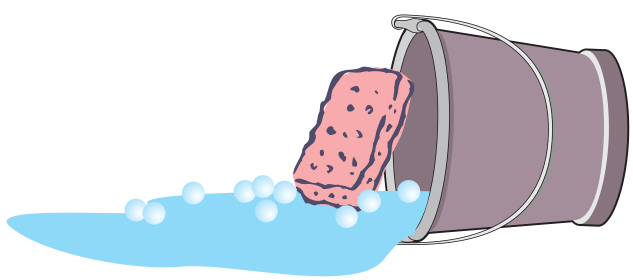
Part 2:
Suppose you want to get down to 1/8 ounce of gunk by adding water just once to your weird bucket. How much water will you need to add?

Making a Superior Car Wash—Thinking It Through

How many total ounces of water did the one-big-wash method take?

How many ounces of water did the small-repeated-washes method take?

Which method is better? Explain your answer.



Putting It All Together

When you wash your car, soap attaches to the dirt and loosens the hold the dirt has on the car. This makes it easier for water to rinse away the dirt. If you were to closely examine the water left on your car after rinsing it, you would find a thin layer of water containing dirt with soap attached to it.

Think of the dirt with soap attached as the gunk talked about in the questions above. If you rinse your car with just enough water to cover the surface of the car, it acts like diluting the gunk with water as you did in the examples above. Each time you add water and drain the mixture, you are left with a smaller amount of soapy dirt gunk still in the mixture than you had before. If this mixture works the same way as the mixture in the weird bucket, which method would use less water - one big rinse or several small rinses?

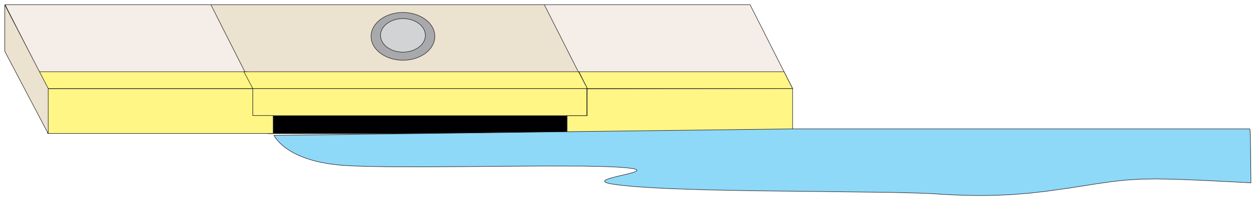
Think about this the next time you wash your car. You can use less water if you use several small rinses instead of one large one.

For Best Results

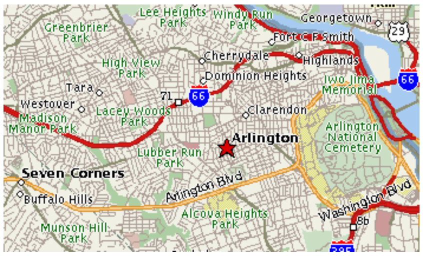
- Try using an adjustable hose nozzle. It is better to cover the car with a thin sheet of water than to use a powerful spray. The spray causes tiny beads of water to form, which attract dust and dry on the surface.
- Make sure that the car is parked away from direct sunlight. This slows down evaporation and keeps water spots from forming.

Why Use Less Water?

- You'll send fewer suds into your waterways and keep phosphates and other chemicals out of streams and lakes.
- Many cities face water shortages during the hot summer months. Using less water on your car will leave more water for other uses.



Exercise III.
A Suburban Bacterial Dilemma



The Four Mile Run watershed drains an urban suburb of Washington, DC.

On a map of the United States, locate Washington D.C. To the west of the city are suburbs in the state of Virginia. Four Mile Run stream runs through the suburbs. Four Mile Run drains a watershed made up of an urban area with closely packed houses, streets, and shopping centers. The watershed is less than 20 square miles, but almost 183,000 people live there (according to the U.S. Census of 2000).

Nearly 40 percent of the watershed is covered with impervious surfaces (surfaces that do not absorb water) such as buildings, parking lots, pavement, and roads.

Population Density
A way of measuring how closely people live together. It is measured in people per square mile.

Urban and suburban areas like the Four Mile Run watershed often face problems with pollution. Agencies that have been monitoring Four Mile Run have found that it contains high amounts of bacteria. It does not meet minimum state standards and therefore has been labeled "unsafe for fishing or swimming."

Bacteria Pollution
Information on bacteria pollution in waterways can be found at http://www.novaregion.org/4milerun/bacteria.htm

Where do all the bacteria come from? As the Four Mile Run watershed mostly has houses, offices, malls and shops, it is easy to rule out industries and factories as the source of bacteria. Scientists discovered that along with some waste generated by animals such as raccoon, geese, and deer that survive in suburban areas, domestic pet waste is also a significant source. At approximately 800 per square mile they estimated that dogs contribute more than **5,000 pounds** of pet droppings every day in the 20 square mile watershed.

How do they know it's pet waste?
Scientists have been studying bacteria in the watershed's streams and ponds to try to find out the exact sources of bacteria. They are trying to find the sources by doing DNA fingerprinting studies. These studies show scientists what type of animal created the bacteria. The studies examine *Escherichia coli,* also known as *E. coli*. This strain of bacteria lives in the intestines of humans and warm-blooded animals, mammals, and many birds. Because each warm-blooded species has a unique DNA fingerprint, scientists can examine DNA from the *E. coli* and link it to the animal that produced it. Then they will know which animals are responsible for the bacteria in the waterways.

Calculating Population Density

Hint: To find the population density of an area, you divide the area's population by the area's size.

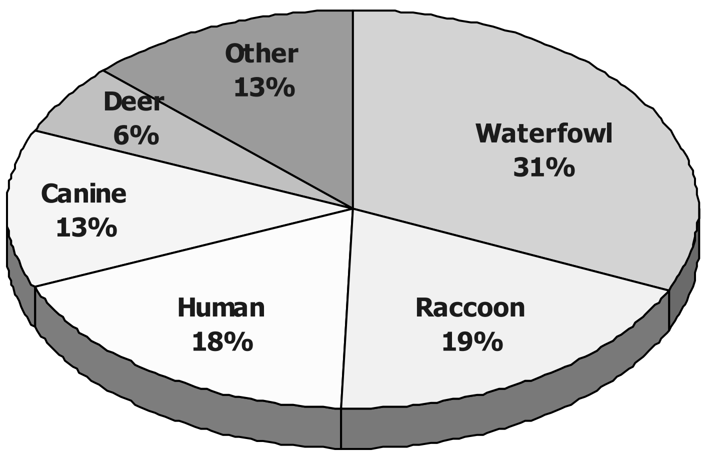
Population Density = population ÷ size

If the population of the Four Mile Run watershed is 160,000 and its size is 20 square miles. What is its population density?

What is the population density of your area? Get population figures at http://www.census.gov/population/www/censusdata/density.html

Reading a Pie Chart

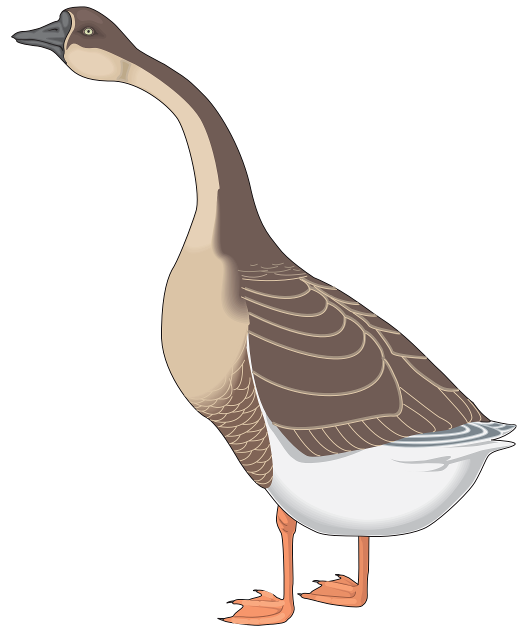
Look at the pie chart below. What are the top 3 sources of bacteria in the Four Mile Run watershed?



Sources of Bacteria in the Four Mile Run Watershed.
Source: Northern Virginia Regional Commission, Don Waye, March 25, 2002

Using the Internet

There are many ways to reduce the amount of bacteria that enters streams and lakes. They are called best management practices. In the space provided, write a paragraph on the best management practices that could be used to reduce the amount of animal-related bacteria that enters waterways in urban and suburban areas.



Hint: Best management practices are described on the Internet. Two good pages that talk about best management practices for bacteria are http://www.ci.seattle.wa.us/util/surfacewater/bmp/petwaste.htm and http://www.novaregion.org/4MileRun/dog_park.html

Group Activity

In a group of three, come up with a public planning strategy for reducing animal-related bacteria. For each part of your strategy, list the possible objections and roadblocks you might run into and the steps you would take to address them.

Public Planning Strategies

To reduce bacteria pollution, many cities have come up with a combination of best management practices they would like to use. This combination of ideas is known as a public planning strategy.

Exercise IV. Phosphates in Your Water

Goals and Objectives

This experiment looks at how fertilizer runoff affects waterways. Students will:

- Examine the effects of detergents and fertilizers on aquatic life.
- Test for dissolved oxygen in water samples.
- Determine the relationship between pollutants and dissolved oxygen in water.
- Collect and interpret data.

Materials Needed

- Access to a nearby pond or stream
- Dissolved oxygen test kit
- 10 jars
- Trowel
- Water, plants (get some with roots), and mud from a pond
- Detergent containing phosphates
- Fertilizer in powder form
- Measuring spoons

Procedure

1. Label jars 1 through 10. Cover the bottom of each jar with mud and plants (roots and all). Fill each jar with pond water.
2. Place the appropriate amount of fertilizer or detergent in each jar using the amounts listed in the following chart.
3. Following test kit directions, measure the amount of dissolved oxygen in the pond water.
4. Put all the jars in a sunny location.
5. Make observations daily for 2 weeks.
6. Measure the amount of dissolved oxygen, according to the kit directions, on day 7 and day 14 of the experiment.
7. Discuss your observations.

Jars	Treatments	Dissolved Oxygen Day 1	Dissolved Oxygen Day 7	Dissolved Oxygen Day 14
1.	CONTROL			
2.	CONTROL			
3.	1/8 tsp detergent			
4.	1/4 tsp detergent			
5.	3/8 tsp detergent			
6.	1 tsp detergent			
7.	1/8 tsp fertilizer			
8.	1/4 tsp fertilizer			
9.	3/8 tsp fertilizer			
10.	1 tsp fertilizer			

Note: tsp = teaspoon

Analysis

At the end of the experiment, which jar had the most vigorously growing plants?

Which jar had the least dissolved oxygen?

Conclusions

What would happen in a stream that has an excess of phosphates, warm temperatures, and good sunlight?

How are phosphates in the water important?

Look around your home and school and list possible sources of phosphates that might be entering local streams.

Does your state have a phosphate detergent ban? What does it do? When was it implemented?