The Right Size for a Rain Garden

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Overview


Turf and paved areas shed water at different rates. Measure how much of each your drainage area contains to determine how large your rain garden must be.

This is one of two lessons we've developed to guide students through the process of rain garden design (the other is The Right Spot for a Rain Garden). For full background information about the purpose of rain gardens and basic design principles, please read Rain Gardens to the Rescue.

Objective: Students will use math skills to determine how large their rain garden must be to effectively manage stormwater runoff at a chosen location.

Standards (Microsoft Word document)

Materials:
Measuring tape
Graph paper
Pencils
Calculators

Background

The size of a rain garden determines how much runoff it can collect and absorb within 2 to 4 days (standing water must be absorbed quickly to discourage mosquito breeding). Experts have devised formulas to help estimate runoff rate and the size a rain garden must be in order to handle it. This lesson takes students through this exercise. Please note that there may be other constraints that limit the ultimate size of your rain garden.

Laying the Groundwork

1. Introduce students to rain gardens and their benefits. (See Rain Gardens to the Rescue for this information.) To inspire thought about stormwater runoff, ask students to consider the stage of the water cycle where raindrops fall onto the earth's surface, especially in our built environment: buildings, roads, parking lots, and drainage systems.

Ask students to recall where they've seen water on rainy days – pooling on pavement or compacted soil, coursing down gutters, sheeting off the eaves, gushing out of a culvert into an eroded gully, or maybe dripping softly from the leaves of a tree onto vegetation below. They might even go for a rainy day walk and make direct observations of how water behaves around roads and buildings versus trees and turf. Just be sure to observe high-volume runoff from a safe location.

Exploration

There are a number of different formulas for estimating the size of garden necessary to

manage your stormwater volume. This one is from the Virginia Department of Forestry's Rain Garden Technical Guide.

1. A rain garden should be about 7 percent of the size of the surface area that will produce stormwater runoff. Begin by measuring all surfaces covered with vegetation (grass, gardens, etc.) that will produce runoff and add them together.

2. Next measure all impervious surfaces (roofs, sidewalks, driveways, roadways, etc.) that will produce runoff and add them together.

Keep these numbers separate — impervious surfaces produce more runoff than pervious surfaces (those that absorb moisture). Multiply them by an estimated runoff value:

- for parking lots, roofs and other pavement = 0.9
- for turf = 0.25

3. Multiply the surface area measurements by the runoff value, and then by .07 (since a rain garden should be 7 percent of total area producing runoff):

- Impervious surface area total X 0.9 X 0.07 = size of rain garden needed to manage runoff from impervious surfaces
- Turf/vegetative area total X 0.25 X 0.07 = size of rain garden needed to manage runoff from turf areas

4. Add these two numbers together for the total recommended size of your rain garden.

Here is a full example from the Rain Garden Technical Guide:

> **Step 1. Calculate the square footage of the impervious surfaces.**
>
> roof - 50 ft. x 50 ft. = 2500 sq. ft.
> driveway - 12 ft. x 20 ft. = 240 sq. ft.
> concrete Patio - 15 ft. x 12 ft. = 180 sq. ft.
> total impervious surface = 2920 sq. ft. = runoff surface area
>
> **Step 2. Calculate the square footage of the pervious surfaces.**
>
> lawn area 50 ft. x 30 ft. = 1500 sq. ft.
>
> **Step 3. Multiply the square footage obtained in steps 1 and 2 by the appropriate runoff coefficient, and by the 7 percent of runoff.**
>
> 2920 sq. ft. (impervious surfaces) x 0.07 (percent of runoff) x 0.9 (runoff value) = 183.96 sq. ft.
> 1500 sq. ft. (lawn area) x 0.07 (percent of drainage) x 0.25 (runoff value) = 26.25 sq. ft.
>
> **Step 4. Add both impervious and turf areas together to get total rain garden size.**
>
> 183.96 sq. ft. + 26.25 sq. ft. = 210.21 sq. ft.
>
> In this example, you'll need to install a rain garden that is 210.21 sq. ft. in order to accommodate 100 percent of the runoff from the property.

5. Keep in mind that this formula provides only an estimate, and that other experts may recommend the garden be a different percentage of total surface area. There are also other factors that can affect the ultimate size. One is soil type (e.g., with sandy soil your garden can be smaller because it will absorb the water more quickly; clay soil will

drain more slowly, so you'll need to expand area). In addition, you'll need to consider the amount of rain your area typically receives during a rain event – a lot of rain in a short time can flood and overflow a small rain garden.

Making Connections

- Use different formulas to calculate the size of your rain garden and compare the results. You can find other formulas at these sites:
  Designing Rain Gardens (PDF)
  Rain Gardens: A How-to Manual for Homeowners (PDF)
- Build a rain garden model using a 2-liter bottle to demonstrate the filtering process. Instructions can be found on the Rodale's Kidsregen.org Web site
- Visit a local water treatment facility to learn more about the sewer and storm drains in your community. If a field trip isn't possible, invite a staff member from the facility to make a presentation. Have students prepare questions for their guide/visitor related to how gardens and greenspace affect water quality.

Branching Out

- Learn about other ways to protect water resources in your area. To get started, visit the EPA's water resources site for kids.
- Research appropriate rain garden plants for your area. Native plants adapted to varying amounts of water are the best choice.
- Search the Web to find out if there's a rain garden group in your area or state, and see if they can offer advice, resources…or even a grant!