
Measuring Slope for Rain Gardens

Activity Overview: Students measure the slope and calculate percent slope for their rain garden project.

Objectives: Students will:

- measure and calculate degree of slope using simple tools
- use math concepts in problem-solving a real-world situation
- understand how the percent slope, i.e., steepness of a slope, affects the construction of a rain garden

Subjects Covered: Science and Math

Grades: 3 through 12

Activity Time: 1-2 hours

Season: Spring or Fall

Materials: For each team of 4 students - 1 Line level*, 15 feet of string, 2 wooded stakes, 1 ruler, clipboard and field sheet

State Standards: Math: A.4.1, A.4.2, A.4.3, A.4.4, A.4.5, A.8.1, A.8.2, A.8.3, A.8.4, A.8.5, A.8.6, A.12.1, A.12.2, A.12.3, A.12.4, A.12.5, A.12.6, B.4.1, B.4.3, B.4.5, B.8.1, B.8.3, B.8.5, B.8.7, B.12.1, B.12.2, B.12.5, B.12.6, C.4.1, C.4.3, C.4.4, C.8.1, C.8.2, C.8.3, C.12.1, C.12.2, D.4.1, D.4.2, D.4.3, D.4.4, D.8.1, D.8.2, D.8.3, D.8.4, D.12.1, D.12.2, D.12.3, E.4.1, E.4.2, E.4.5, E.8.1, E.8.2, E.8.3, E.8.4, E.8.7, E.12.1, E.12.2, E.12.4, E.12.5

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.

Note: See EPS activity, Topography: Measuring Slope for additional information about the relationship among slope, soil, vegetation and human uses. This activity also provides an alternative technique for measuring slope.

Background

Slope is the change in elevation between two points. It is expressed as a percent change in elevation per unit of distance. When planning a rain garden the percent slope of the garden space determines the depth of the rain garden and how to dig your garden. The goal is to keep the garden level so that water spreads out and does not puddle. When digging your garden you will cut soil from the upper slope and fill in the lower slope with the cut soil to create this flat bottom. To determine how much cut and fill in necessary you calculate the depth of the garden based on the slope. Generally the greater the slope the deeper the garden will need to be dug. A slope less than 4% equals a 3 – 5 inch deep garden, 5 – 7% slope equals a 6 – 7 inch deep garden, and 8 - 12% slope equals an 8 inch deep garden. If the slope is more than 12%, it's best to talk to a professional landscaper or find a different site.

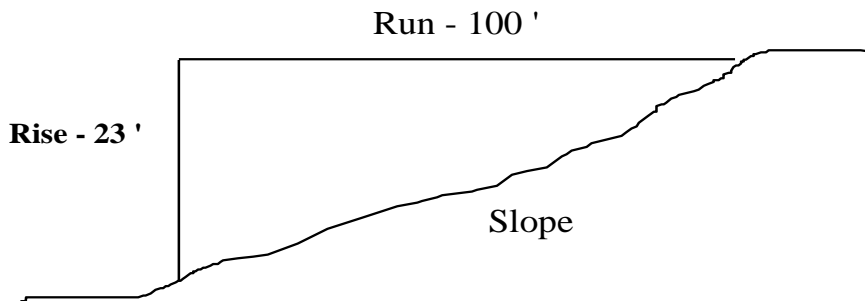
The percent slope is calculated by measuring the change in height (elevation) over a measured distance. The following formula determines slope:

$$\text{Rise} \div \text{Run} \times 100 = \text{Slope \%}$$

OR

$$(\text{Change in elevation} \div \text{measured distance} \times 100 = \text{slope \%})$$

$$\text{For example: } 23' \div 100' \times 100 = 23\%$$



Pre-Activity Preparation

For each team:

- Make 2 – 20 inch stakes
- Cut a piece of string about 10 feet long plus 6 inches for tying the string to the stakes. It is helpful to use a nylon-type string that is less prone to knotting. Mark the string at 10 feet (120 inches). You may mark the string in 10 inch intervals for easier measuring. Tie the string to one of the stakes and wrap the string around the stake. Make a loop at the other end of the string that will slip over the second stake.
- Assemble a measuring tool packet with stakes, string, line level, ruler, clipboard, field sheet and a pencil.

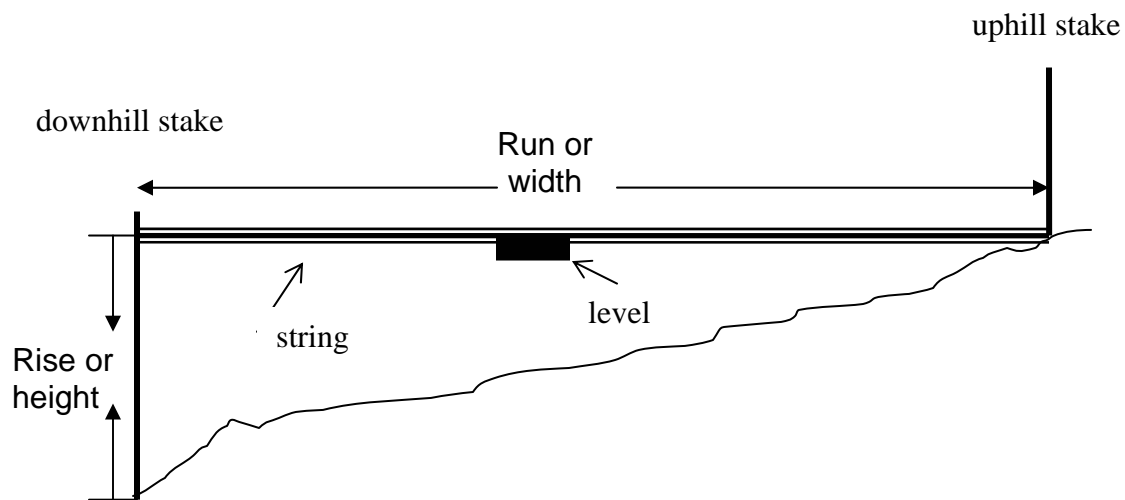
Activity Description

1. Form teams of 5 students each and hand out measuring tool packets. Each student has a different role. One student is in charge of the uphill stake, another has the downhill stake, one student records the data, and 2 students pull and level the string. All calculate the numbers.
2. Explain/demonstrate procedure of measuring slope in the classroom. Explain how the line level works and allow the students to practice holding the instrument to make it level. Go out to proposed rain garden site.

- Have students select measuring sites in and around the proposed rain garden. Not all students will be able to measure the slope in the rain garden. Locate other sites for comparison, especially if different slopes are evident. Another option is to have all students practice in different spots, then measure the rain garden as a group, in which students take turns doing and describing each step.

Directions for measuring the slope

- Hold the stake with the string attached at the uphill end of the measuring site. Push the string down to the bottom of the uphill stake.
- Place the second stake at the downhill end.
- Run the string to the downhill stake. You may need to move the stake to meet the string. The distance between the stakes is 10 feet or 120 inches. Write this number as the run on the field sheet.
- Loop the string around the downhill stake.
- Attach the line level to the string. It should hang down. Slide the string up or down on the downhill stake until the line level indicates the string is horizontal and level.
- Measure the height in inches on the downhill stake between the string and ground. Write this number as the rise on the field sheet.
- If desired, repeat at a different site and trade roles.
- Back in the classroom, calculate slope and determine depth of rain garden.



Extensions

- Measure a slope at three places along a line and plot the results on a graph.

Assessments

- Describe the steps to accurately measure the slope on your schoolyard.
- If you had to dig a rain garden by hand, identify what kind of slope you would want to minimize your work, and why.

Additional Resources

...Soil Erosion, The Work of Uncontrolled Water," Agriculture Information Bulletin #260, Soil Conservation Service, U.S. Department of Agriculture.

...Teaching Soil and Water Conservation, Program Bulletin #341, Soil Conservation Service, U.S. Department of Agriculture.

*Line Levels are available at hardware stores for about \$1 to \$2.