Topography: Measuring Slope

Activity Overview

Students measure slopes and calculate the percent slope in their schoolyard.

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 human uses of the land and the ecological restoration

Subjects Covered:
Science and Math

Grades:
3 through 12

Activity Time
1-2 hours

Season:
Spring or Fall

Materials:
2 meter sticks, level or marked jar of water (To make a level using a jar of water, set a jar of water on a flat surface. Place a line of masking tape on the jar to mark the top surface of water in jar.)

State Standards:

*Adapted to California by Return of the Natives

Background

In restorations, it is important to determine the slope of the land in order to estimate the erosion potential of the site and to select the most appropriate planting techniques. The degree of slope also affects soil moisture and, therefore, influences species selection. The slope of a land area is expressed as the number of feet the land rises or falls over a distance of 100 feet. The amount of slope is written as a percent. Slopes of 15 to 20% may be erosion prone. Under some circumstances, slopes of less percent —- such as recently graded or de-vegetated slopes, and slopes with clay soil—-can also be erosion prone. Usually steep upper slopes are drier than lower or gentle slopes.

The easiest way to determine the percent slope of an area is to measure the change in height (elevation over a measured distance), then calculate the percentage of slope. Use the following formula to determine slope:

Rise ÷ Run x 100 = Slope %

OR

(Change in elevation (rise) ÷ horizontal distance (run) x 100 = slope %)

23‘ ÷ 100‘ x 100 = 23%

Activity Description

Measure an area that seems to represent the average slope of land surface. For greater accuracy, you may want to measure a few different areas on the slope and compute the average slope.

1. Place an end of the meter stick on the slope holding it approximately level.
2. Place the level or jar of water on the meter stick and level off the stick. It is level when the top of the water is parallel to the stick.
3. Measure, in centimeters, the distance from the ground to the end of the level meter stick not resting on the ground. Record the rise.
4. When back in the classroom calculate percent slope for each measured incline.
5. Label the slopes on the Topography overlay map.

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Extensions

o Discuss how percent of slope affects human uses of the land. To learn about land use in relation to slope for the soils in your area, contact the Soil Conservation Service (U.S. Department of Agriculture). The combination of soil type and steepness of slope affects how an area may be used. Environmental problems created by inappropriate land use include:

- o interruption of drainage patterns causes increased runoff, erosion, downstream sedimentation, and flooding
- o loss of topsoil
- o loss of vegetation
- o natural disasters such as slides, slippage, and floods. As soil becomes soaked it gains weight, and eventually gravity pulls it downslope. Sandy soils will stand on steeper slopes better then clay soils because they drain faster.
- o destruction of unique landscapes and sensitive habitats
- o Compare the slopes on your site with the recommended grading standards and critical grades for North America.

Maximum grade for trails:

- o Easy: 10% for a maximum distance of 50 feet.
- o Moderate: 14% for a maximum distance of 50 feet
- o Difficult: 20% for a maximum distance of 50 feet
- o Grade for playing fields:
- o Maximum: 3% to 5% (allowable)
- o Minimum: 2%

Streets and Drives:

- o Maximum: 5% to 11% (allowable)
- o Minimum: 1%
- o Mowed banks with grass: 3%
- o Un-mowed banks: 5%

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Additional Resources

• Douglas, William Lake. (1993). Hillside gardening: Designing views and planting slopes.
Longmeadow, MA: Longmeadow Press (Reprint edition).
• Brown, Lloyd N. (1954). Contour planting and irrigating on moderate-to-steep slopes.
Berkeley, CA: University of California, Division of Agricultural Sciences.
• Engstrom, Linda, (2006). Design dilemmas: Planting on a slope - What to do? http://www.gardenaesthetics.com/dilemmas.html

Assessments

• Describe the steps to accurately measure the slope on your schoolyard.
• Explain how steepness of slope affects human uses of the land.
• Measure a slope at three places along a line and plot the results on a graph.