TEACHER'S GUIDE

MATH SERIES
SLOPES: That's a Bit Steep
24 Minutes

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FOR USE IN: Mathematics

LEVEL: Grades 7-9, Advanced Grade 6

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EDUCATIONAL OBJECTIVES:
To help students understand these key concepts:
Horizontal and vertical lines
positive and negative slopes
calculating a slope by measuring its rise and run
calculating a slope by using two points on a coordinate plane.

BACKGROUND INFORMATION:
Slope is the key characteristic of the linear function. It is important both for constructing its graph and for investigating its features. This concept is used and generalized in further mathematical courses. This video offers the first introduction to this part of mathematics. Two subsequent videos in this Math Series titled, Linear Equations and Their Graphs, Parts I and II, provide the opportunity to learn more about this topic. A rigorous mathematical definition of slope is usually given for straight lines located on the coordinate plane. In the first part of the video, however, some real-world examples of lines are analyzed. Inevitably, these cases contain some ambiguity: a line that rises to the right turns out to be a line that rises to the left when the observer changes his/her position and perspective.. The sign of the slope depends on the observer's point of view. All of these details are made more precise in the Linear Equations and Their Graphs. .

BEFORE SHOWING THE VIDEO:

The video contains several optional pauses where the students are presented with calculations to complete, while the VCR may be placed on pause. After the pause, correct answers are given. If the teacher plans to use these pauses, the students may be requested to have paper and pens available before starting the video. For a more intensive interaction between students and parts of the video, the teacher may wish to pause the tape after the presentation of a particular concept to inquire if the students have understood it; and/or ask the students before starting the video to signal the teacher to stop at any point for clarification. The video may also be shown in its entirety without pause either as an introduction or a review of the subject. It is always helpful if teachers are able to view the video before showing it to the class.

There are many objects around us, which can be colloquially referred to as straight lines. We may use them as starting points in order to ask the question: how can we describe them? How can we explain which ones are steeper than others, and by precisely how much? It should be noted that the answer to this question is of great importance not only for architects or designers, but also for all of us in some real-world situations.

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CONTENT OF THE VIDEO:

The video explains several key concepts: horizontal and vertical lines, positive and negative slopes, calculating a slope by measuring the rise and run, or by two points on a coordinate plane.

Our charming young girl guide uses a row of inclined poles and a new architecturally angular museum to explore slopes:

The video can be divided in two parts. In the first part, some real-life examples are considered. In these examples, horizontal and vertical lines are introduced. Flat lines, like the horizon, have slopes of zero. These lines are horizontal. Lines that go straight up and down have no slope. They are all rise and no run. These lines are vertical.

In general, slope equals rise divided by run. If a line slopes up to the right, we say that it has a positive slope. If it slopes up to the left, we say that its slope is negative. In the first part of the video, the slopes of some real-world objects are defined by measurement.

In the second part, however, the narration turns to more rigorous mathematics. If the rise and run cannot by directly measured, the slope can still be determined. The coordinate plane is explained: the x-axis (horizontal) and the y-axis (vertical) are introduced, and it is explained that each point has two coordinates on the plane.

Students are then taught how to find the slope of a line on the coordinate plane. If a straight line passes through 2 points, each with coordinates (x1, y1) and (x2, y2), its slope equals rise divided by run

rise divided by run $\frac{y_2 - y_1}{x_2 - x_1}$. Although this formula itself is not presented in the video, a general idea of it is conveyed through several examples.

AFTER SHOWING THE VIDEO:

To make the explanation easier, the following approach is used in the first part of the video. The reader at first finds the absolute value of the slope as the ratio of the absolute values of the rise and the run. In other words, the reader measures the rise and the run without caring at first whether they are positive or negative. After this, the sign of the slope is defined and added. Students may be asked to figure out the slopes in several cases using the same approach. In particular the following questions may be suggested:

- Point out several vertical lines.
- Point out several horizontal lines.
- Put a textbook on the desk, and then put one end of a ruler on the textbook and the other end on the desk, and define the slope of the obtained straight line.
- Put another textbook on top of the first one and repeat the experiment described above with the end of the ruler now on top of two textbooks.

Several exercises may also be suggested involving lines on the coordinate plane.

- Construct a pair of coordinate axes and then draw a straight line through points with coordinates (1, 3) and (2, 5). Find the slope of this line.
- Construct a pair of coordinate axes and then draw a straight line through points with coordinates
  (-2, 3) and (3, 2). Find the slope of this line.

EXPLORING AND INVESTIGATING:

The following questions may be used to lead students into a more detailed discussion:

1.Draw straight lines going through a given point, such that when the run equals 1, the corresponding rise equals a) 3; b) 1; c) -2. Measure the angles formed by these lines and a horizontal line. Discuss the advantages of using slope to construct these lines.

2.Suggest several real-world situations in which rise and run are defined and find the slopes in all these cases, such as:

A ladder must be leaned up against a window 8 feet above the ground so that its base is 5 feet away from the wall.

To get to one's destination, one has to drive 10 miles to the right, then make a left turn, and then drive 7 more miles.

When an airplane is 3 miles high, its projection on the ground is 7 miles away from

its point of departure. - and so on
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The Math Series consists of 10 videos:

ALGEBRA: A Piece of Cake Part 1
ALGEBRA: A Piece of Cake Part 2
SLOPES: That's a Bit Steep!
PERCENTAGES That Make Sense
LINEAR EQUATIONS and Their Graphs: Let's Get It Straight Part 1
LINEAR EQUATIONS and Their Graphs: Let's Get It Straight Part 2
INTEGER OPERATIONS: Into the Negative Zone Part 1 Adding and Subtracting
INTEGER OPERATIONS: Into the Negative Zone Part 2 Multiplying and Dividing
FACTORING IS FANTASTIC Part 1: Common Factors
FACTORING IS FANTASTIC Part 2: Quadratic Trinomials

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