Teacher Notes

Grade level 6-7
Subject: Math
Time required: Day 1: 10 minutes
Day 2: 45 minutes

TI-73 Explorer™ Activity: Slope: One Step at a Time (Day 1)
By: Deborah Van Overbeke

Objective: In this activity, the students will explore the concept of slope by exploring the steepness of different staircases and graphing these on the TI-73 calculator.

Activity Overview:
To build staircases that are easy to climb, carpenters take into consideration the vertical distance and the horizontal distance (tread) of each step. The ratio of the rise to the run provides a measure of the steepness of the staircase. In this activity, students will explore slope as related to the steepness of staircases.

Concepts
- To develop the concept of slope

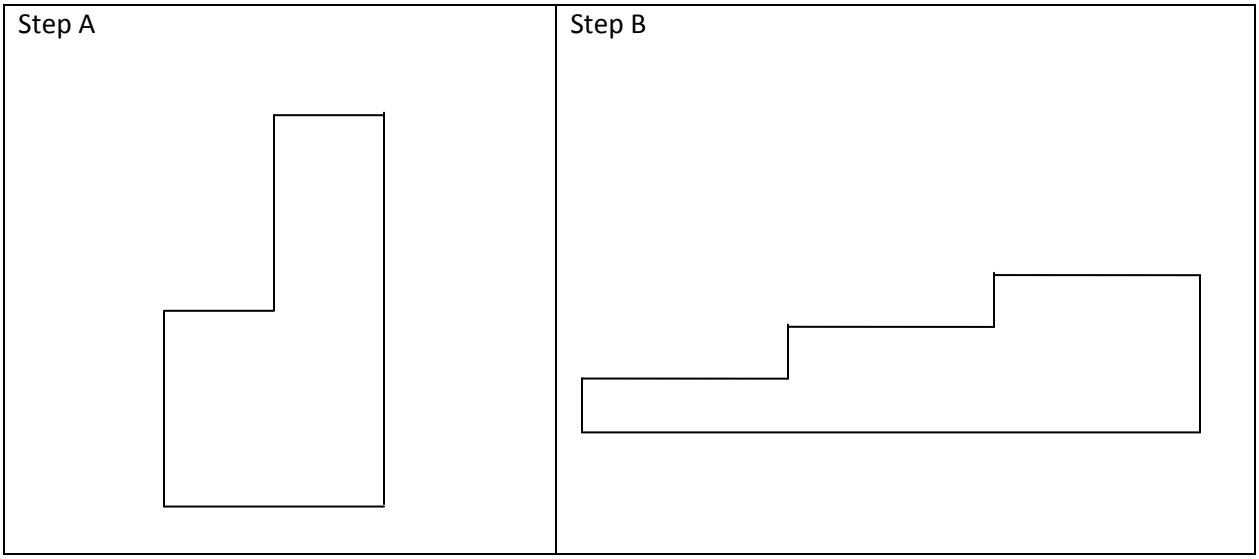
Teacher Preparation:

- Check that students have the prior knowledge of the meaning of vertical and horizontal distance
- Download a copy of the student handout, Slope: One Step at a Time, for each student
- Secure a TI-73 calculator for each student
- Prepare for a discussion and development of conceptual understanding of slope as related to the steepness of staircases

Day 1 Procedures: **Teacher directions in bold.**

- **Discuss the terms vertical and horizontal.**
- **Have students view Figure 1 and write their answer to number 1 below the figure, which staircase would be steeper to climb? Explain why?**
- **Assign for students to measure in inches to the nearest one-fourth inch the vertical distance and horizontal distance of a step on 2 different staircases before class tomorrow. They should record their answers in the Table in question 2.**

Figure1



1. Which staircase would be steeper to climb? Explain why? **Step A. Answers may vary and could include: the first step in Step A is taller than the first step in Step B**

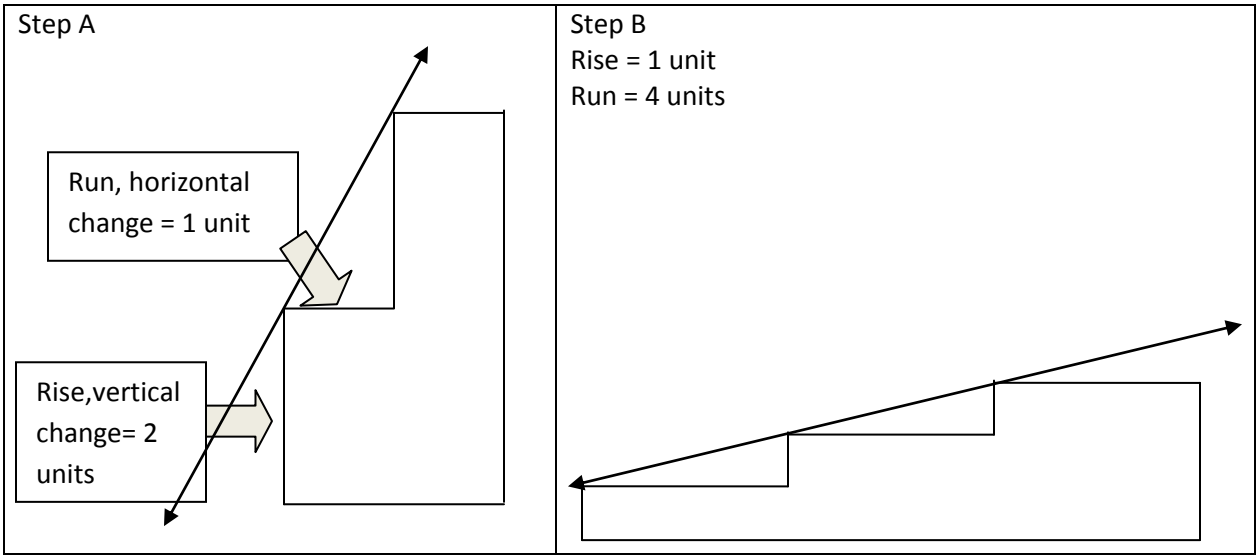
2. Measure the vertical distance and horizontal distance of a step on 2 different staircases before class tomorrow.

Staircase: one step	Vertical Distance	Horizontal Distance
1		
2		

Day 2 Procedure:

- **Discuss with students that in order to build a staircases which is easy to climb, carpenters take into consideration the vertical distance and the horizontal distance (tread) of each step. The ratio of the rise to the run provides a measure of the steepness of the staircase. See Figure 2.**

Figure 2



- **Continue discussion: For Step A the ratio of the rise to the run is 2/1 or 2, and for Step B the ratio of the rise to the run is 1/4 or .25**

- **Ask students to complete questions 3 - 4 on their own and then discuss as a group.**

3. What do you notice about the ratios for Step A and Step B in relation to the steepness of the stairs? **Answer: The greater the ratio the steeper the steps**

4. Using your TI-73 Explorer Calculator, determine the ratio of the rise to the run for each of the staircases you brought measurements for. **Answers will vary.**

   Staircase 1:

   Staircase 2:

5. Which staircase was steeper based upon the ratios. Why? **Answer: The greater the ratio the steeper the steps**

- **Develop the concept of slope through discussion of the following.**

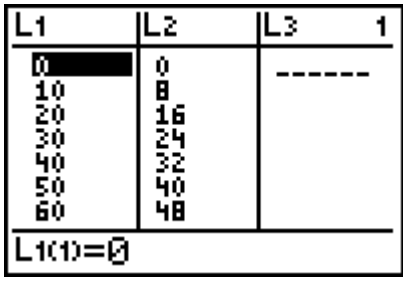
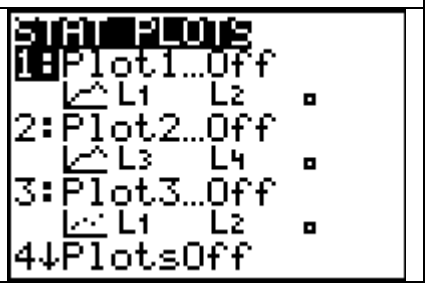
    - Actually, carpenters use this concept to build staircases. They aim to build steps with a ratio of the rise to the run between 0.45 and 0.60. Did your steps fall within this range?

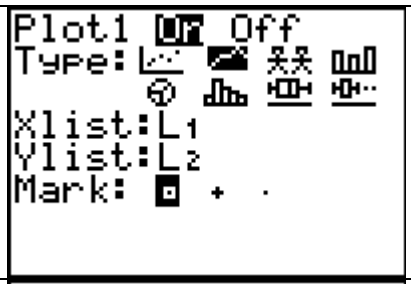
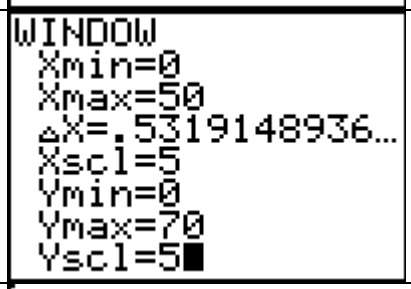
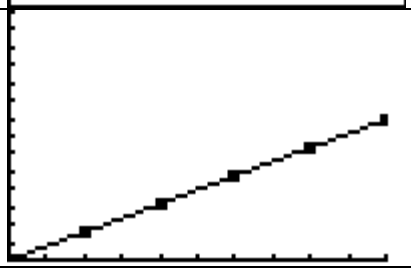
    - Look at Figure 1, Step A and Step B. A line has been drawn on each staircase that touches each step. The steepness of this line is also the slope of the line as it represents the vertical change/horizontal change.

    - You have determined the slope of each line.

      Slope = $\frac{\text{Vertical change}}{\text{Horizontal change}}$

- **Next, inform students that they will use the TI-73 calculator to set up a table of coordinates and to graph the line that would touch each of the steps in your staircases. Guide students through steps 1-6, then let the students work individually to complete questions 7 -8.**

1. Clear the Home screen and press [2nd] [MEM] **ClrAllLists.** Press [ENTER] then [CLEAR].	
2. Press [LIST] Enter coordinates for your first stair case. Move to L1 and enter the *x*-coordinates in order, pressing [ENTER] after each entry. Move to L2 and do the same for the *y*-coordinates. An example for a staircase with a rise of 8 and a run of 10 is to the right. Tip: You must have the coordinates matched in L1 and L2. Otherwise your graph will not run correctly.	
3. To graph the line, press [2nd] [PLOT] and see if Plots 2 and 3 are off. If not, select **4:PlotsOff** and press [ENTER].	

4. Select **On** and press ENTER. Press ▼ to move to **Type**, use the arrow keys to choose the connected line graph, and press ENTER. Move down to **Xlist** and choose the list that your *x*-coordinate data is in by pressing 2nd [STAT] moving to your list, and pressing ENTER. Do the same for **Ylist.** Move down to **Mark,** choose the first mark, and press ENTER.	
5. In order to see the graph, you need to set the viewing window before graphing. Press WINDOW and choose the **Xmin, Xmax, Ymin, Ymax, Xscl** and **Yscl** values based upon the numbers in the x and y list. Tip: Do not change the ΔX or ΔY = value. The calculator adjusts this value automatically.	
6. Press GRAPH to see the line.	
7. Repeat 2 through 6 for Staircase B. This time put your *x*-coordinate data in L3 and your *y*-coordinate data L4, turn off **Plot 1** and turn on **Plot 2.**	

7. Compare the steepness of the lines. Which Staircase had the steepest line. **Answers will vary.**

8. What comparison did you see between the steepness of the lines and the slope of the line?
   Answer: The greater the slope, the steeper the steps.

- **Discuss questions 7 -8, then have students complete question 9 for discussion at the end of the hour. Question 9, can be used as an assessment of understanding.**

9. Create one more graph on your calculator of a staircase that has a slope between 0.45 and 0.60, the recommended range for staircases. Repeat 2 through 6 for Staircase c. This time put your *x*-coordinate data in L5 and your *y*-coordinate data L6, turn off **Plot 1** and **Plot 2** and turn on **Plot 3.**
   Rise =
   Run =
   Slope =

Extensions

- Can explore the concepts of positive slope --going up the steps, and negative slope--going down the steps and 0 slope--walking across the floor

Adapted from Friel, S. (Ed.). (2001). *Navigating through Algebra in Grades 6-8*, pp. 47-48.Reston, VA: National Council of Teachers of Mathematics.