

## Step Up

ID: 13647

Time required

45 minutes

### Activity Overview

*In this activity, students will explore the concept of slope. They will measure the vertical height (rise) and horizontal length (run) of a set of stairs then find the ratio to describe the steepness. A graph will then be created to show the relationship.*

### Topic: Algebra

- *Slope, ratio, rise, run*
- *Graphing equations*

### Teacher Preparation and Notes

- *Students should be familiar with the vocabulary terms ratio, slope, rise, run, origin, and coefficient.*
- *TI-Navigator is not required for this activity, but an extension is given for those teachers that would like to use it.*
- *Before beginning the activity, students should turn off all plots ( $\text{2nd}$   $\text{Y=}$ ) and select **4:PlotsOff**) and turn off all equations ( $\text{2nd}$   $\text{PRGM}$ ) and select **FnOff**).*
- ***To download the student worksheet and TI-Navigator files, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter "13647" in the quick search box.***

### Associated Materials

- *MGAct23\_StepUp\_worksheet\_TI73.doc*
- *MGAct23\_StepUp\_Nav01\_TI73.act*
- *MGAct23\_StepUp\_Nav02\_TI73.act*
- *MGAct23\_StepUp\_Nav03\_TI73.act*

### Suggested Related Activities

*To download the activity listed, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter the number in the quick search box.*

- *Match Me! (TI-84 Plus family) — 2057*
- *Math TODAY – Population on the Move (TI-73 explorer & TI-Navigator) — 2278*
- *Identifying Slope & Y-Intercept (TI-73 explorer & TI-Navigator) — 3668*
- *Step Up (TI-73 explorer) — 4491*

**Problem 1 – How Steep are the Steps?**

In this lesson, you will need to identify a set of steps in your school to use. If stairs are not available, you can replicate the stairs using uniform boxes stacked. A string should be attached along the edges of the steps for students to be able to use for measuring. Students will measure the height (rise) and depth (run) of the stairs in both centimeters and inches.

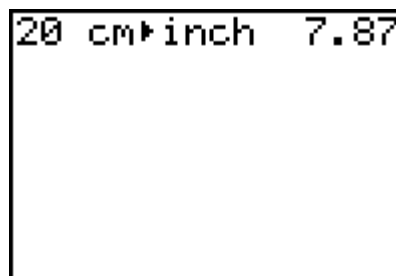
Questions 1–2

Students can use the Convert menu (2nd UNIT) to convert cm to inches. First select the unit the measurement is currently in (cm) and then select the unit it is being converted to (inches). As soon as “inch” is selected, the screen will return to the Home screen.



Question 3

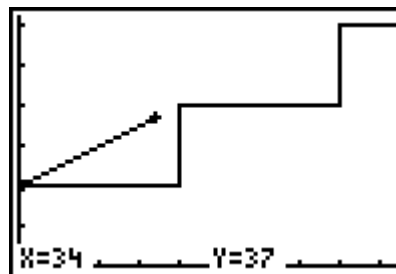
Students may initially stray from their stairs when drawing. Simply have them use the **ClrDraw** command (DRAW 1) to clear the screen and start over.



After they have successfully drawn the steps, they will need to store the image as a picture to recall throughout the lesson. With the graph showing, press (DRAW) 4 1 1 (ENTER).

Questions 4–5

After students have stored their picture, they will use the Manual-Fit command to draw the string from step to step. From a clear Home screen, press (2nd) LIST 4 and select **3:Manual-Fit**. Then press (2nd) APPS 2 1 (ENTER) to set up the equation to be stored into Y1. Students will then go to the Graph screen. Move the cursor to the first edge of Step 1, which should be (0, x), where x will be the height of the first step. Then, students will move the cursor to the edge of Step 2 and press (ENTER). Pressing (ENTER) one more time stores the equation to Y1 and their original set of stairs will disappear. This is okay. They will recall the picture later.



**Problem 2 – Exploring Other Lines**

Now that students have found the equation for their original set of stairs, and identified M and B, they will look at the affects of changing M and B.

Questions 6–8

Students initially store their values of M and B to a generic form of the linear equation. They will enter MX+B into Y2 to use as a comparison to Y1.

The Y1 equation will vary depending on your data.

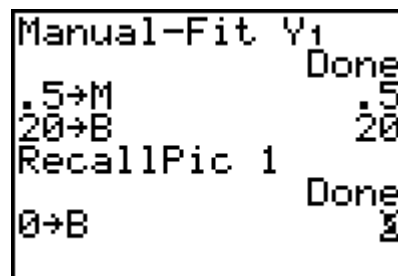
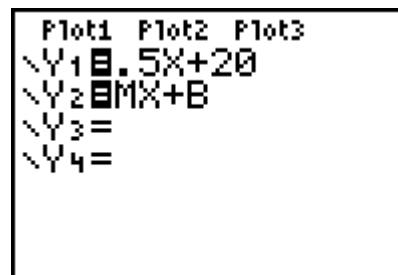
Students can use either the X in the Text menu or the  $\boxed{x}$  variable key to enter X.

Once students press  $\boxed{\text{GRAPH}}$ , they should see only one line. This is because the initial values of M and B have been set to those found by the manual fit line.

To recall the image of the stairs, press  $\boxed{\text{DRAW}}$   $\boxed{\leftarrow}$   $\boxed{2}$   $\boxed{1}$   $\boxed{\text{ENTER}}$ .

To change the value of B, students can either scroll back up the Home screen (using  $\boxed{\uparrow}$  and  $\boxed{\text{ENTER}}$  to select the entry line they want to change) or they can simply type in the command again.

They will change the value of B from the original value to 0 and observe the changes in the graph. When they press  $\boxed{\text{GRAPH}}$  again, they may need to recall the picture of the stairs again. This is not necessary as they are comparing the two lines, not the position of the lines to the stairs.



Questions 9–11

Allow students to adjust the values of M and B until they feel comfortable describing how the change in value affects the graph.

Questions 12–14

Students will see that the ratio of the rise over run will be the same regardless of the measurements used. This can lead to a discussion on how slope is a good descriptor of steepness and how it communicates across units.

**Extension – TI-Navigator™**

1. Three files with background images of stairs are available. Open ***MGAct23\_StepUp\_Nav01\_TI73.act***. This activity sets up students to enter two equations and to graph the equations over the given picture. Students are allowed to resubmit equations in case they need to adjust the slope or y-intercept.

The two other files, ***MGAct23\_StepUp\_Nav02\_TI73.act*** and ***MGAct23\_StepUp\_Nav03\_TI73.act*** have stairs with different slopes. You can also find other images of your own and use the File/Load Background Image command to bring in your own pictures.

As extra credit, you could assign students to find an image that has a slope greater or less than a given number. They could find an image with a negative slope.

2. Use **Screen Capture** throughout to monitor student progress.
3. To shorten the activity time, you can draw the image of the stairs in advance and send the picture to students through TI-Navigator. This will also ensure all students are working from the same image.

**Solutions – student worksheet**Problem 1

1. Answers will vary based on the stairs you are using. Check students' work for appropriateness.
2. Answers will depend on class data.
3. Graphs will vary. Ensure graph looks like original stairs.
4. Answer will depend on class data.
5. Answer will depend on class data.

Problem 2

7. Students should see one line.
8. The slopes should be the same. The location of the line has shifted down.
9. Students may explain that M shifts the graph up or down but does not change the slope of the line. B adjusts the steepness of the line.
10. The slope should be adjusted to be slightly greater than the original equation.
11. The slope should be adjusted to be slightly less than the original equation and the graph should reflect this change.
12. Answers will depend on class data.
13. Values will vary but the two calculations should be the same or very close to the same.
14. Answers will depend on student response to Question 9.