Objectives

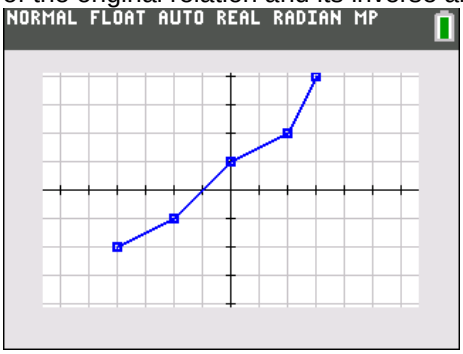
- The purpose of this activity is to graph a relation by connecting a set of points with line segments and explore the properties of its inverse relation. The points of the relation are dropped interactively onto the Graph Screen using QuickPlot&Fit-EQ. On the same graph, students graph a lineplot of the reverse of the ordered pairs, taking advantage of the GridLine, color, and TRACE. In the extension students modify their relation so it passes the vertical line test and the horizontal line test.
- Students are encouraged to create their own relations and unleash their creativity.

TIPS:

- A sample set of data is provided. It may work well to use this data first, and then encourage free play so that a variety of relations can be explored.
- The viewing window permits you to drop integer coordinates from $-6 \le x \le 6$; however, since the ordered pairs will also be reversed, points (x, y) with $-4 \le x \le 4$ and $-4 \le y \le 4$ work well.
- Include a point whose x-and y-coordinates are the same.
- Using the Draw Menu to overlay the graph of $y = x$ enables students to see the two relations are symmetric about this line, as well as be able to move from one curve to another using TRACE to see the how a point on its graph and its corresponding reflected image on its inverse.
- If a document camera is available, share students' work with the entire class. Or if you have a tablet computer with a built-in camera and a projection device, perhaps take photos of different students' screens to project to the class.

Summary Reflection Questions

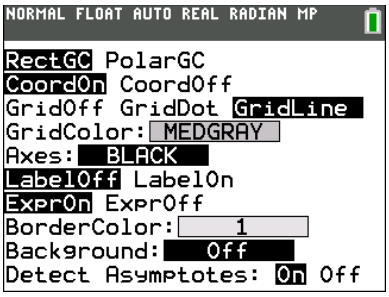
- Display a graph and its inverse relation to the class. Use TRACE to position your cursor on a point on one graph and ask a volunteer to come to the board and point where on the reflected image the corresponding point will be. Press the down arrow to confirm the answer. (Based on the original graph, you may wish to try this without displaying the reflected image.)
- A possible assessment question could be to provide the graph of a relation and ask students if it is a function, if it is one-to-one, and to sketch the graph of its inverse and describe how the graph of the original relation and its inverse are related. One example is shown.



- Given a relation which is not a function, how can it be modified so that the graph of its inverse is also a function?
- See the **Extensions** for additional discussion prompts.

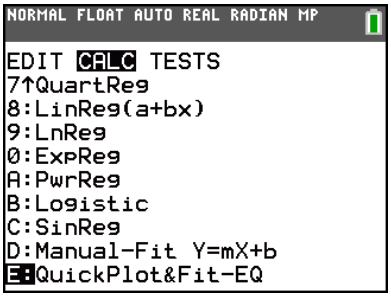
In this activity students graph a relation by connecting a set of points with line segments. The points are dropped interactively onto the Graph Screen using QuickPlot&Fit-EQ. On the same graph, students graph a lineplot of the reverse of the ordered pairs, taking advantage of the GridLine, color, and TRACE to explore the inverse of a relation and its properties.

1. Press [2nd] [FORMAT] to access the Graph Format menu and turn the Gridline on.

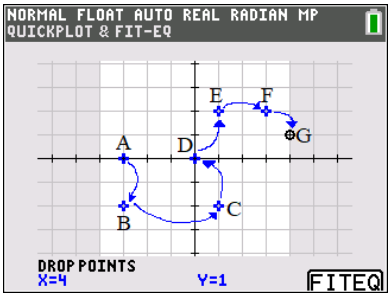


2. Clear any functions in Y=. Turn off any STAT Plots. Press ZOOM and use 4:ZDecimal.

   Press STAT and use the right arrow to reach the CALC menu. Scroll to the end of the menu to highlight E:QuickPlot&Fit-EQ. Press [ENTER].

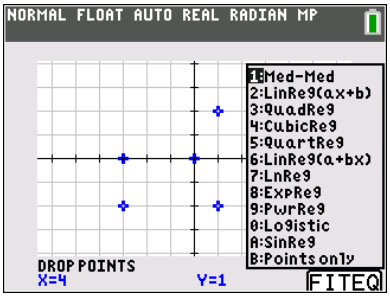


3. Drop points which will later be connected by line segments (in the order in which you dropped them) through the STAT PLOT menu. The viewing window permits you to drop integer coordinates from $-6 \le x \le 6$; however, since the ordered pairs will also be reversed, points (x, y) with $-4 \le x \le 4$ and $-4 \le y \le 4$ work well. One sample is shown. (Your screen will not have the restricted shading.) Tip: Include a point whose x-and y-coordinates are the same.
   If you wish, you can change the default color (blue) later when setting up the plots.



4. Once all the points have been dropped, press the GRAPH key to FITEQ. Pick **Points only.**

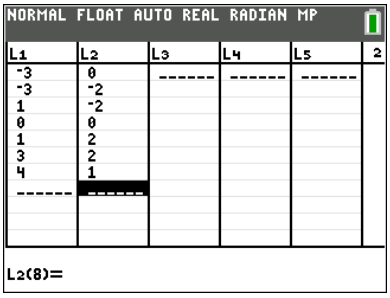
   This option is available for the TI-84 CE Operating System 5.3. (If you have an older OS, pick any regression model and ignore it. We are just interested in the dropped points.)



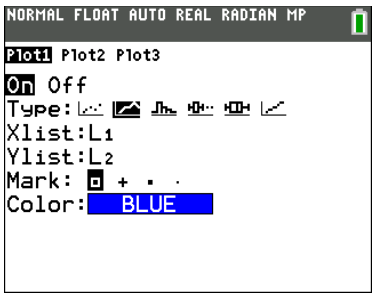
5. Press GRAPH to STORE the points. Use L1 and L2.

   (If using an older model OS, store a regression equation in Y1. Select OK and press ENTER. Press Y= and clear Y1.)

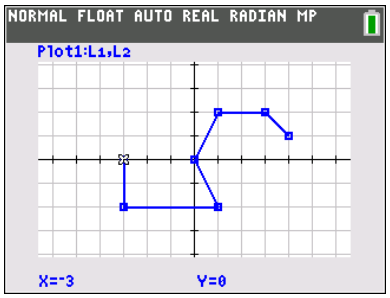
   You can see the coordinates in the Stat-List Editor by pressing STAT and 1:Edit.



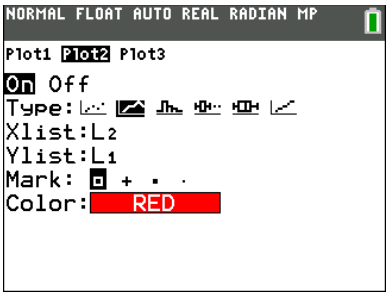
6. Press 2nd [STATPLOT] to change the Type from a Scatterplot to a connected Lineplot.



7. Press GRAPH to see the relation. Press TRACE and the left and right arrow keys to display the coordinates.



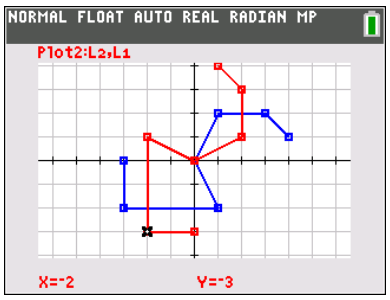
8. Press 2nd [STATPLOT] to set up Plot 2 as shown.



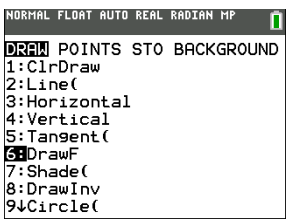
9. Press GRAPH to see both relations in the same window. Press TRACE.

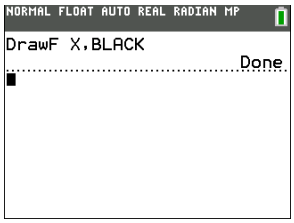
   Use the left and right arrow keys to move from one point to another on the same relation. Use the up and down arrow keys to move to the corresponding point.

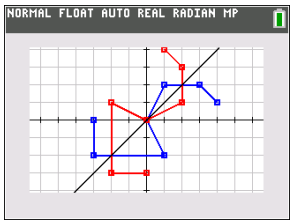
   Discuss the concept of the inverse of a relation.
   Ask students to describe how the graphs are related.
   Some do not readily see they are mirror images about the line $y = x$.



10. Press 2nd [DRAW] to overlay the graph of $y = x$ on the screen. (Using a "drawn" graph will not interfere when using the up and down arrows to trace between corresponding points.)





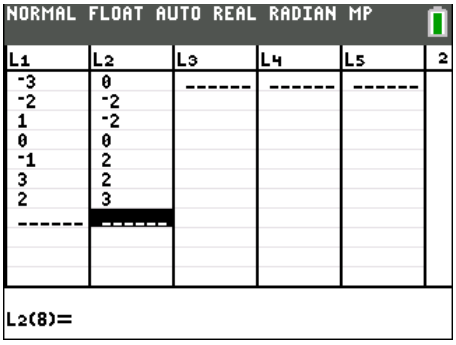


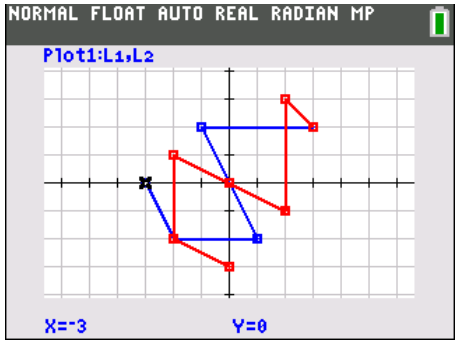
Extensions

1. Ask students whether or not the graph given by Plot1 (Xlist: L1, Ylist L2) represents a function, i.e., is L2 is a function of L1? If not, what values must be changed to this to be true?

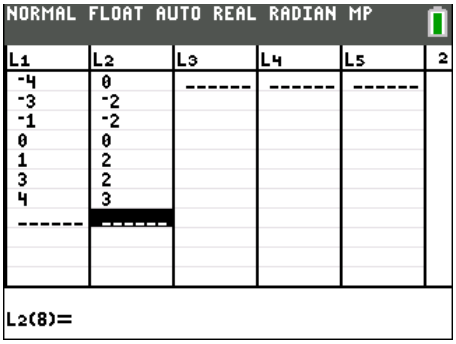
   Students can use the Stat Editor to directly make any modifications if necessary.

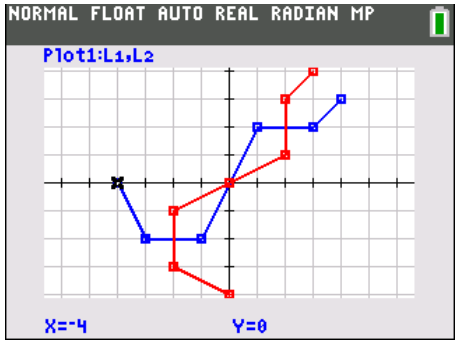
   Since the points are connected by line segments, more is needed than just making sure no value in the L1 appears more than once. For example, in the graph of Plot1 below is still not a function.



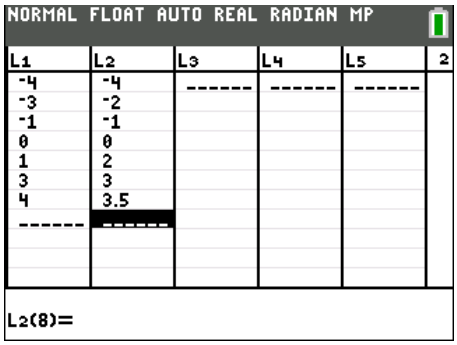


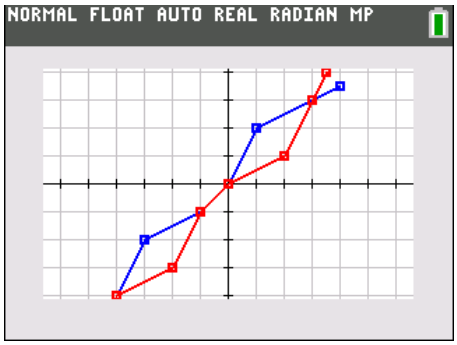
   However, a connected line plot of the following data (Xlist: L1, Ylist L2) represents a function. This can lead to a discussion of the vertical line test and whether or not Plot2 (Xlist: L2, Ylist L1) represents a function.





2. Ask students what values must be changed to make Plot2 (Xlist: L2, Ylist L1) represent a function. One sample set of data is shown. This can lead to a discussion of the horizontal line test and the definition of one-to-one.





3. Consider exploring this activity in **Graph-Table** mode. Press [2nd][table]. Dynamically change L1 and L2 by typing values.