About the Lesson

In this activity, students explore transformations and dilations with a two-dimensional fish figure. As a results students will

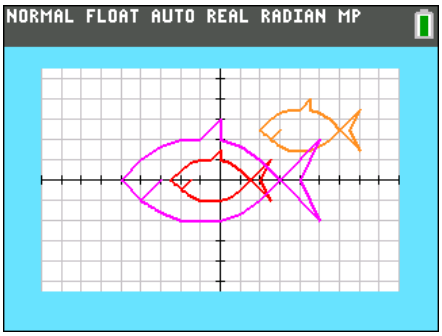
- Describe the effects of a transformation and dilation on a figure in a coordinate plane.
- Understand that a figure is congruent to a transformed figure if congruency transformations such as translations are done to the coordinates.
- Understand that a figure is similar to a transformed figure if dilations are done to the coordinates.

Vocabulary

- congruent
- dilation
- similar
- transformation
- translation

Teacher Preparation and Notes

- Students should be familiar plotting points. The student worksheet or teacher notes have tips for how to use lists and Stat Plot on the TI-84 Plus C Silver Edition or TI-84 Plus.
- Students can work individually or with a small group to discuss their observations and use the vocabulary they are learning. If students are in pairs, they can work cooperatively on their calculators. You may use the following pages to present the material to the class and encourage discussion. Students will follow along using their calculators.
- The student worksheet is intended to guide students through the main ideas of the activity. It also serves as a place for students to record their answers. Alternatively, you use the questions posed to engage a class discussion.



Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus C Silver Edition. It is also appropriate for use with the TI-84 Plus family with the latest TI-84 Plus operating system (2.55MP) featuring MathPrint™ functionality. Slight variations to these directions given within may be required if using other calculator models.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

Compatible Devices:

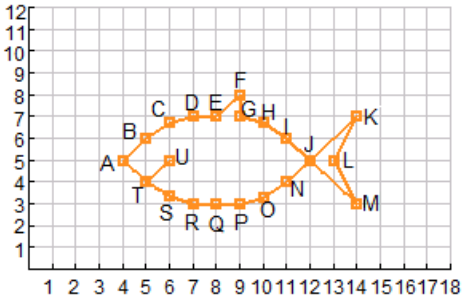
- TI-84 Plus Family
- TI-84 Plus C Silver Edition

Associated Materials:

- Transforming_Fish _ Student.doc
- Transforming_Fish _Student.pdf
- Fish _On_a_Grid.pdf
- FISH.8xp

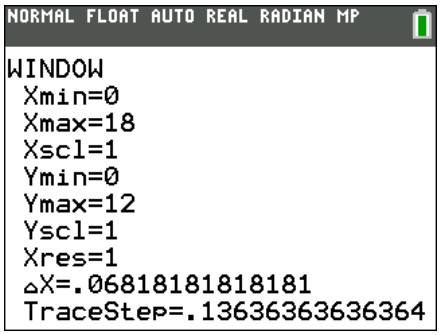
Part 1 – Plotting a Fish

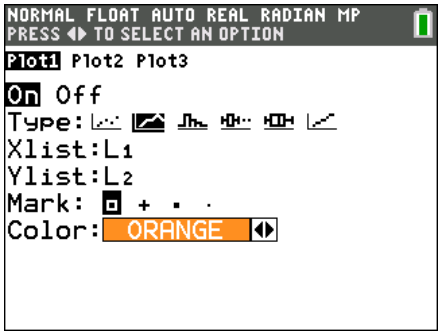
1. Students will list the ordered pairs for the fish on the graph to the right. They should start at the snout of the fish and move clockwise in the order shown below. Of the 24 ordered pairs used to make the fish, the remaining coordinates are integers. Some points are repeated. A larger image of the fish is also available in the document Fish_On_a_Grid.pdf.

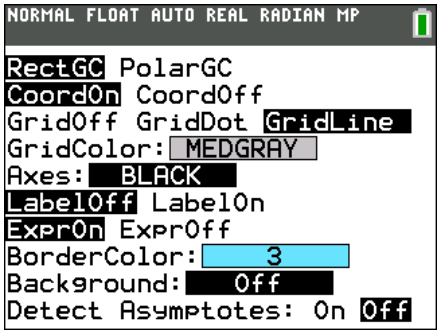


Answer:

A(4 , 5)	I(11 , 6)	P(9 , 3)
B(5 , 6)	J(12 , 5)	Q(8 , 3)
C(6 , 6.7)	K(14 , 7)	R(7 , 3)
D(7 , 7)	L(13 , 5)	S(6 , 3.4)
E(8 , 7)	M(14 , 3)	T(5 , 4)
F(9 , 8)	J(12 , 5)	U(6 , 5)
G(9 , 7)	N(11 , 4)	T(5 , 4)
H(10, 6.7)	O(10, 3.3)	A(4 , 5)







Students press [STAT] Edit to enter the data into L1 and L2, press [2nd][Y=] [STATPLOT] to set up the scatterplots, and set the window settings as shown to the right. Alternatively, the program FISH.8xp can be used if your students do not need to practice identifying ordered pairs, entering data in lists, and setting up scatterplots. Use TI-Connect™ to send the program to your calculator and then link the program to others. After running the program, students must press [2nd][ZOOM][FORMAT] to turn on the Gridline on the TI-84C and, if desired, change the background color. Students can use the GridDot on the TI-84 Plus.

2. How could you change coordinates to move the fish left three units? (Think about where the new tip of the fish would be and what you would have to do to the coordinates to move it there.)

   Answer: Subtract 3 from the *x*-coordinates.

3. How would you change the coordinates to move the fish up two units?

   Answer: Add 2 to the *y*-coordinates.

4. How would you change the coordinates to move the fish to the right four units and down three units?

   Answer: Add 4 to the *x*-coordinates and subtract 3 from the y-coordinates.

Part 2 – Move the Fish

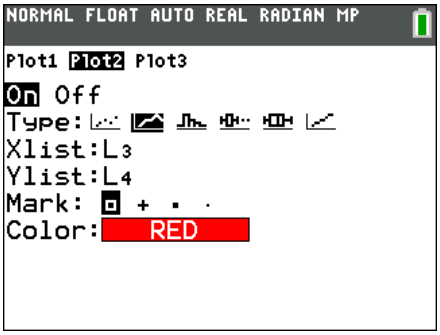
Tech Tip: Use the TI-84 SmartView to Show Keypress History.

Teacher Tip: Students will attend to precision by using vocabulary of congruent, similar, transformation, translation, and dilation correctly. Also, as students perform repeated operations on the coordinates of each figure, have them think about the more general rules that map coordinates from one figure onto another in translations and dilations.

On the Home screen students will perform operations on lists. Press 2nd MODE to [QUIT] out of a graph or other screen and return to the Home screen. First, turn on Plot 2 as shown to the right. To do this press 2nd Y= for StatPlot. Press 2nd 3 and 2nd 4 to get L3 and L4.

To enter the arrow, press STO▸.

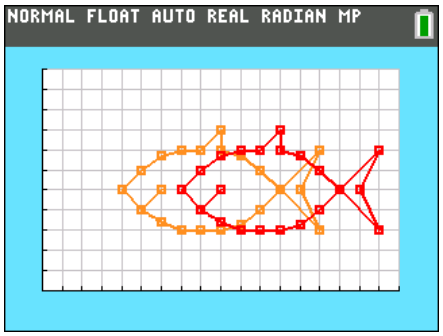
Students should sketch their graphs of L3 and L4 in their worksheets. They can press GRAPH to help sketch the graph.



5. L1 + 3 → L3

L2 → L4

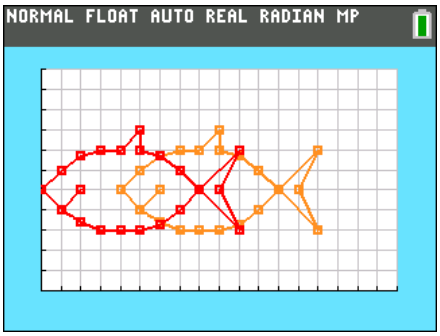
Answer:



6. L1 – 4 → L3

L2 → L4

Answer:



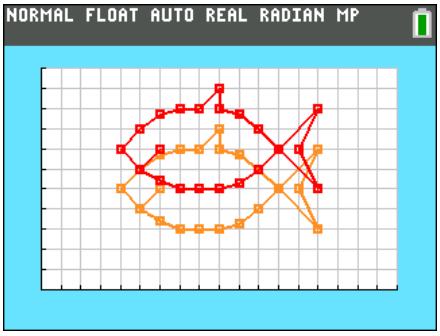
7. Describe the effect of the change in each of the above. How did the fish move? What happens when a number is added to or subtracted from the *x*-values of a figure? Is the new fish congruent or similar?

Answer: The fish moved to the left the number of units that were subtracted and moved to the right the number of units that were added to the *x*-coordinates. These fish are congruent because they are the same shape and size.

8. L1 → L3

L2 + 2 → L4

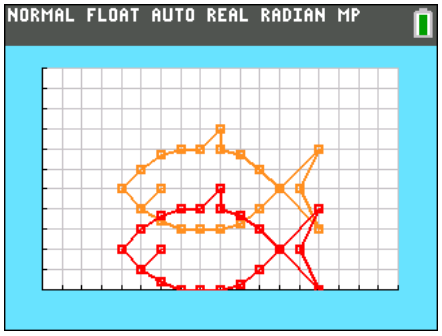
Answer:



9. L1 → L3

L2 – 3 → L4

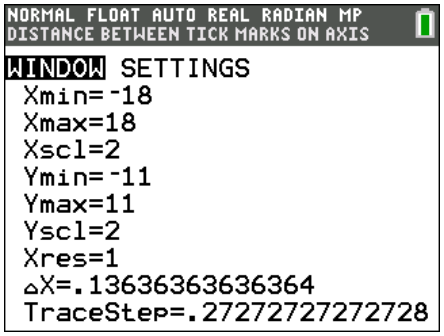
Answer:



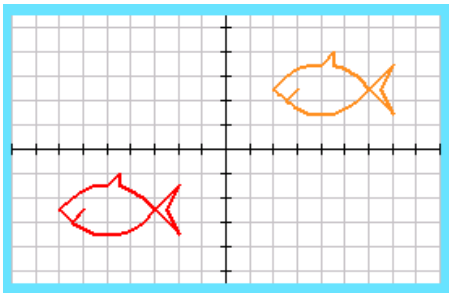
10. Describe the effect of the change in each of the above. How did the fish move? What happens when a number is added to or subtracted from the *y*-values of a figure? Is the new fish congruent or similar?

Answer: The fish moved down the number of units that were subtracted and up the number of units that were added to the *y*-coordinates. These fish are congruent because they are the same shape and size.

Students will change the window settings to see all four quadrants as shown to the right. Change the Xscl and Yscl to 2 so that there is a tick mark every two units. Press 2nd Y= and change the Stat Plot points from squares to dots.



11. What transformations would you need to do to the original coordinates in order to produce the fish in the third quadrant show to the right?



Answer: Subtract 18 from the *x*-coordinates and subtract 10 from the *y*-coordinates.

12. Describe the transformation you would do to move the snout of the fish to (−5,0). Do this transformation by storing the coordinates of your fish in L3 and L4. Record what you stored below.

Answer: Subtract 9 from the *x*-coordinates and subtract 5 from the *y*-coordinates.

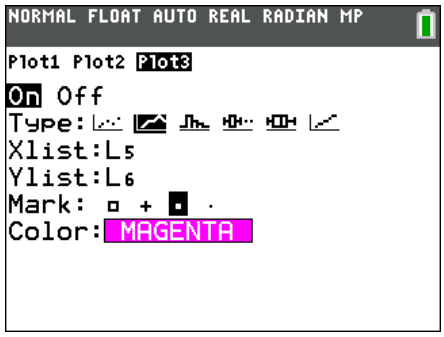
L1 – 9 → L3

L2 – 5 → L4

Part 3 – Grow Fish

Turn on Plot 3. The *x*-values are L5 and the *y*-values are L6. You will perform operations on L3 and L4 to dilate the fish you made near the origin, with its snout at (−5, 0). Again you will use 2nd 5 and 2nd 6 to get L5 and L6, and press STO▸ for the arrow.

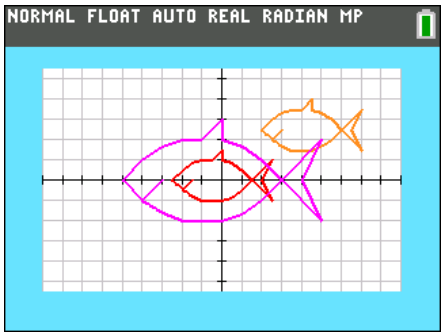
Sketch your graph of L5 and L6 below. Press GRAPH to help you sketch the graph.



13. 2L3 → L5

2L4 → L6

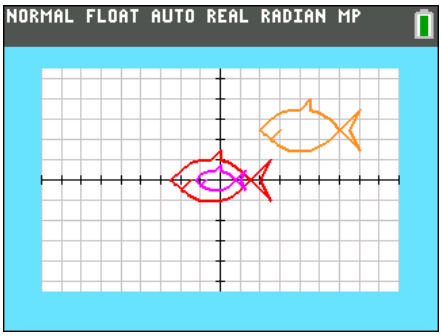
Answer:



14. ½ L3 → L5

½ L4 → L6

Answer:



15. How did the fish change? What happens when a number is multiplied by the *x*-values and *y*-values of a figure? Is the new fish congruent or similar?

Answer: The fish dilated by becoming larger when multiplied by a number larger than 1 and contract when multiplied by a positive fraction. The new fish is similar to the original fish because it is the same shape but not the same size.

16. Consider the following operations: rotations, reflections, translations, dilations. Which operation will yield a similar figure? Explain.

Answer: All operations will yield a similar figure because they may change the location or size of the figure but do not change its shape.

17. Consider the following operations: rotations, reflections, translations, dilations. Which operation will yield a congruent figure? Explain.

Answer: Rotations, reflections, and translations will yield a congruent figure because they preserve the shape and size of the figure. A dilation will produce a similar, not congruent, figure because it changes the size of the figure.

Teacher Tip: Students can explore additional effects by multiplying by negative numbers. Encourage and challenge students to create their own mathematical artwork.