The Mathematical Focus

In earlier activities, students generated tables of equivalent ratios. In this TI-Nspire™ activity, students consider the values in a ratio table as ordered pairs and graph them on coordinate axes. The graph of a collection of equivalent ratios lies on a line through the origin. Careful inspection of tables containing equivalent ratios illustrates regularity in the entries and the corresponding graphs, which can be explained in terms of repeated addition or scalar multiplication. As pointed out in the Common Core State Standards' *Progressions on Ratios and Proportional Relationships*, the pattern of increments in the table can be seen in the graph as coordinated horizontal and vertical steps associated with plotting a point in the coordinate grid. Some students struggle in later grades with distinguishing between the plot of a point such as (2, 3) and how those values are related to an equation of a line through the point. Emphasize the connection between "for every 2 over to the right, go up 3" when moving from point to point using an additive strategy and the ordered pairs ($2a$, $3a$) that represent all the ratios equivalent to 2:3 from a multiplicative perspective. This can help students make sense of what the ordered pairs represent and how to plot them.

Connecting the point (2, 3) to the point (4, 6) by thinking "for every 2 over go up 3" can also be extended to consider the relationship between the point (2, 3) and the point (8, 12), which would be "for every 6 over go up 9." This gives students experience in visualizing equivalent ratios and interpreting them in different contexts. Interpreting the patterns in the ratio table and in the graph of equivalent ratios introduces students to the notion of rate of change – or slope and slope triangles – as well as to similar triangles.

The number 0 cannot be used in a ratio. For example, 0:0 does not make sense because equivalent ratios are generated by multiplying or dividing each value in a ratio by the same positive number.

Objective

From interacting with the TI-Nspire™ activity (.tns file), students should be able to:

- interpret ratios as ordered pairs and plot the points associated with a ratio;
- recognize that the graph of a collection of equivalent ratios lies on a ray;
- relate a table of ratios to a graph, including explaining the connections in terms of repeated addition or scalar multiplication;
- identify patterns in the graphs of the points associated with a ratio.

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Common Core Standards

The discussion questions and tasks presented in this activity are designed to engage students in the Standards for Mathematical Practice described in the Common Core State Standards.

Grade 6: Ratios and Proportional Relationships
Understand ratio concepts and use ratio reasoning to solve problems.
6.RP.3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

- **a.** Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
- **b.** Solve unit rate problems including those involving unit pricing and constant speed.

Grade 8: Expressions and Equations
Understand the connections between proportional relationships, lines, and linear equations.
8.EE.6. Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b.

Prerequisite Knowledge

Connecting Ratios to Graphs is the eighth activity in a series of activities that explore the concepts of ratios and proportion. This activity builds on students' prior knowledge of plotting points in a coordinate grid by associating a ratio with an ordered pair of values. Prior to working on this activity, students should have completed *Ratio Tables*, *Comparing Ratios*, and *Ratios and Fractions.* Students should understand:

- the concept of ordered pairs;
- how to plot points on a coordinate grid;
- how to complete a ratio table.

Vocabulary

- **Ordered pair:** a pair of numbers used to locate a point on a coordinate plane

Tech Tips

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App for iPad®. Slight variations to these directions may be required if using other technologies besides the handheld.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials
- To download the TI-Nspire activity (.tns file) and Student Activity sheet, go to http://education.ti.com/go/buildingconcepts

Activity Materials

- Compatible TI Technologies:

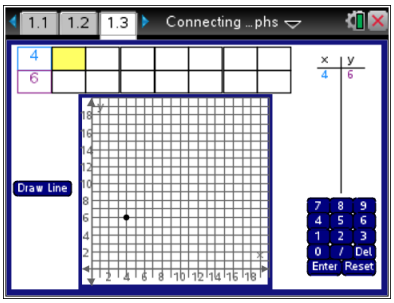
  TI-Nspire CX Handhelds, TI-Nspire Apps for iPad®, TI-Nspire Software
- Connecting Ratios to Graphs_Student.pdf
- Connecting Ratios to Graphs_Student.doc
- Connecting Ratios to Graphs.tns

References and Additional Resources

- Progressions for the Common Core State Standards in Mathematics." *Tools for the Common Core Standards.* The Common Core Standards Writing Team, 26 December 2011. Web. 05 Aug. 2014 http://commoncoretools.me/2011/09/12/progression-on-ratios-and-proportional-reasoning/
- National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards for Mathematics.* Washington, DC: Authors.

Activity 1 – Page 1.3

Objective: Students will complete a ratio table and relate them to points on a coordinate grid.



Page 1.3 displays an initial ratio in a ratio table, 4:6, the corresponding entries in a "t-table" and the corresponding point plotted in the grid. Arrows indicate the movement up and over to the right from the origin to locate the point in the coordinate grid. Selecting a cell in either row will highlight the cell. Students can use the keypad to specify any whole number value in the highlighted cell. Selecting [enter] will fill in the missing value for the equivalent ratio in both tables and show the point plotted on the grid. Selecting **Draw Line** will display the line through the origin containing the points in the table. Students can change the original ratio in the horizontal table by selecting each of the cells in the first column. Note that when 0 is entered into one of the cells, the corresponding cell in the column reads 0, but both values are greyed out because 0:0 is not a ratio. Any line that contains the graph of a collection of equivalent ratios goes through the point (0, 0); however, the point (0, 0) is not a member of the collection. Remind students that they can reset the table by selecting **Reset** on the keypad.

Tech Tip: Students may find it easier to use the [tab] key to toggle between objects and then use the arrow keys to move or change their selections. Students can also use the [esc] key to reset the document.

Teacher Tip: After students enter a value in the first cell of the column have them predict what the second number will be. Encourage students to identify the patterns they see in the table. Then have them explore graphing other patterns.

Have students generate a variety of ratio tables and graphs to reinforce their understanding of the concept. Then ask them a focused set of questions. This will help students internalize the concept. Encourage students to use the TNS activity to explain their reasoning.

Teacher Tip: ✓ indicates questions that also appear on the Student Activity sheet. The student activity is optional but may help students stay engaged, especially in the case of large-group instruction.

Discussion Questions:

1. On page 1.3,

   a. describe the connection between the ratio 4:6 and the point plotted on the grid. ***Answer: The point is the ordered pair (4, 6), which corresponds to the ratio 4:6***.

   b. highlight a cell in the top row of the table and type in a multiple of 2, then select enter. Highlight a cell in the bottom row and type in a multiple of 3, and then select enter. What can you say about the values that appear in the columns? ***Answer: They are equivalent ratios to 2:3.***

   c. each ratio has been associated with a point in the graph. Identify two ordered pairs displayed in the graph and explain how they were plotted. ***Answers will vary. Possible ordered pairs are: (2, 3) is located at 2 on the horizontal axis and 3 on the vertical axis, (4, 6) is located at 4 on the horizontal axis and 6 on the vertical axis, (6, 9) is over to the right 6 and up 9 from the origin (0, 0).***

   d. find three other ratios equivalent to 4:6 and enter them into the table. What observation can you make about the graph of the five ratios? ***Ratios will vary, but the points should all lie on a straight line.***

✓2. Which of the following points will also follow the same pattern even if they do not appear in the table? Explain your thinking. (Question #1 on the Student Activity sheet.)

   a. $(1, \frac{2}{3})$

   b. $(1, \frac{3}{2})$

   c. (24, 36)

   d. (3, 2)

   Answer: To be on the line, the ratios associated with the points have to be equivalent to 2:3. Only b and c are equivalent (multiply the values in 1:$\frac{3}{2}$ by 2 and divide the values in 24:36 by 12 to get 2:3).

3. Reset the page and use the keypad to enter the ratio 1:4 in the first column in the table at the top of the screen.

   a. Explain how to plot the point associated with 1:4. ***Answer: The point is 1 over to the right on the horizontal axis and 4 up on the vertical axis from the point (0, 0).***

   b. Find five equivalent ratios and enter them into the table. Use the **Draw Line** command. How do the points seem to be related? ***Answer. The points should be on the same straight line.***

c. What value for *x* will make the ratio *x*:3 equivalent to 1:4? Explain how you found your answer and how you know your answer is correct. ***Answer:*** $x = \frac{3}{4} = 0.75$. ***Students could enter 3 into the second column of the table, or they could draw a line and read the ordered pair from the graph.***

4. Changing the values in the first column will change the set of ratios in the table. With a partner, predict the values in three columns in the table and predict three points you think will be on the graph for each ratio.

   a. 2:1 ***Answers will vary. Possible answers might be 4:2; 6:3; 8:4 and the points (4, 2), (6, 3), (8, 4).***

   b. 1:2 ***Answers will vary. Possible answers might be 2:4; 3:6; 4:8 and the points (2, 4), (3, 6), (4, 8).***

   c. Have one partner check the predictions for question 3a, 2:1, and the other check the predictions for question 3b, 1:2. How do the two graphs compare? ***Answer: The line that would contain the points related to the ratio 2:1 is steeper than the line that would contain the points for the ratio 1:2.***

5. 2 pounds of fruit cost $5. Reset the ratio to 2:5 and draw the line on the graph.

   a. Find a point on the line and explain what it means in terms of the amount of fruit. ***Answers will vary. For example, (4,10) would mean 4 pounds of fruit cost $10.***

   b. Enter one of the coordinates of your point from part a in the table, and then select enter. How do the values in the table associated with the point relate to the other values in the table? ***Answers may vary. Some might note that the coordinates of the new point are some multiple of the original ratio (twice each of the original values for the example above). Others might read down the table, for example, the x-coordinate is two more and the y-coordinate is 5 more.***

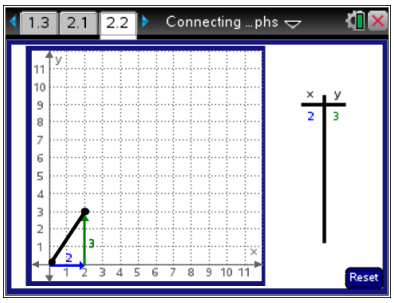
   ✓c. Sammy argued that 6 pounds of fruit should cost $9 because 4 more pounds of fruit should cost $4 more. Do you agree or disagree with Sammy? Find at least two different ways to explain your thinking. (Question #2 on the Student Activity sheet.) ***Answer: Sammy is wrong because to keep the same ratio, you need 2 pounds for every $5. Adding two 2 pounds would require you to add 2 times $5, or $10; so adding 4 pounds should cost more than $9. A second way to reason is that to have an equivalent ratio, you need to multiply or divide both values in the ratio by the same positive number. To go from 2 pounds to 6 pounds, you multiply by 3, so the price should be multiplied by 3, which is $15 for 6 pounds. A third strategy might be to figure out (either from the line or by dividing) that the price is really $1.50 per pound and so for 6 pounds you would need 6 × $1.50 or $15.***

c. Find at least three equivalent ratios such that at least one of the values in each of them is not a whole number. Explain how you found each and describe what each means in terms of the context. ***Answers will vary. Sample responses: (1, $\frac{5}{2}$) would mean 1 pound of fruit for \$2.50; (3, $\frac{15}{2}$) would be 3 pounds of fruit for \$7.50; and ($\frac{4}{5}$, 2) would mean 0.8 of a pound for \$2.***

Activity 2 – Page 2.2

Objective: Students will create points representing equivalent ratios on a coordinate grid.

Page 2.2 focuses on developing an additive strategy for creating points representing equivalent ratios. After setting a rate by using the horizontal arrow several times, it will generate the next point in the collection of equivalent ratios, connect the points with a line segment, and display the ordered pair in the table. To generate another point, use the new horizontal arrow. Move the point to set a new starting point.



Teacher Tip: Guide students in a discussion of the relationship between the entries in the t-table. Have students explain how that relationship is shown on the coordinate grid. Encourage students to explore the activity with other equivalent ratios.

Discussion Questions:

6. a. What ratio is represented by the point in the grid? ***Answer: The ordered pair (2, 3) represents the ratio 2:3.***

   b. Select the blue horizontal arrow several times at the lower left on the grid. Describe how what you see on the screen is related to a collection of equivalent ratios ***Answer: A new point on the line is (4, 6), which is over 2 and up 3 from the original point (2, 3).***

   c. Predict what you think will happen if you select the new blue horizontal arrow again. Explain your reasoning. ***Answers will vary. Possibly (6, 9) because the next point will again be over 2 from 3 and up 3 from 6.***

   d. Suppose you were able to select the horizontal blue arrows enough times to display six points on the line. What would be the coordinates of the sixth point? Explain how you know. ***Answer. Every time you select the blue arrows, you go over 2 and up 3, so the point would be at (10, 15), which would also be the table value.***

✓7. Use **Reset** to start over. Move the point to (2, 1). Generate four more points on the graph. Explain the correspondence between the table and the graph. (Question #3 on the Student Activity sheet.) ***Answer: The table shows points associated with the ratios equivalent to 2:1. The graph shows how you can get from one point to the other, by going over 2 and up 1. You can see the same thing in the table as you move down the table; each x-value is 2 more than the previous value, and each y-value is 1 more than the previous y-value.***

8. Use **Reset** to start over, and then move the point to (4, 3).

   a. If you select the blue horizontal arrow twice, what will the next point on the line be? Check your answer using the TNS activity. ***Answer: over 4 and up 3 or at (8, 6)***

   b. Identify two points you think will be on the line that you cannot generate by selecting on the blue horizontal arrow. Explain why you think those points will be on the line. ***Possible answer: Use the same ratio of 4 over to 3 up to generate the next two points from (8, 6), (12, 9), and (16, 12). Students might reason from the table that each successive row is generated by adding 2 to the x-value and 1 to the y-value in the previous row. Others might argue that points should be on the line because each point is a multiple of the values in the ratio 4:3, 3 times the values to get (12, 9) and 4 times the values to get (16, 12).***

9. Identify at least three points on each using the following instructions Assume for each that you begin at (0, 0). The TNS activity might help with thinking about the problem or checking your work.

   a. moving over 2 units and up 1 unit. ***Answers may vary: Possible responses include (2, 1); (4, 2); (6, 3); (8, 4).***

   b. moving up 2 units and over 4 units. ***Answers may vary: Possible responses include (2, 4); (4, 8); (6, 12); (8, 16).***

   c. moving over 1 unit and up 5 units. ***Answers may vary: Possible responses include (1, 5); (2, 10); (3, 15); (4, 20).***

✓10. If the ratio is 4:7, which of the following will always be true about the rate of change in moving from one point to another on the line? Explain your reasoning in each case.
(Question #4 on the Student Activity sheet.)

   a. moving over 4 units and up 7 units. ***Answer: True because the ratio 4:7 can be associated with the ordered pair (4, 7), which is over 4 and up 7 from the origin.***

   b. moving over 7 units and up 4 units. ***Answer: False because this would be the point (7, 4), which is not associated with a ratio equivalent to 4:7***

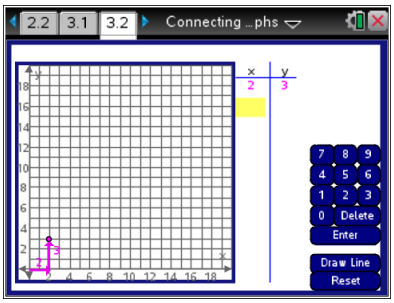
   c. moving over 1 unit and up $1\frac{3}{4}$ of a unit. ***Answer: True because the ratio 1: $1\frac{3}{4}$ can be multiplied by 4 to get the original ratio of 4:7.***

   d. moving up 2 units and over 3.5 units ***Answer: True because the ratio 2:3.5 is equivalent to $\frac{1}{2}$ of each value in 4:7.***

Activity 3 – Page 3.2

Objective: Students will continue to explore representing equivalent ratios on a coordinate grid.

Page 3.2 focuses on developing a multiplicative strategy for creating points representing equivalent ratios. Selecting a cell in the t-table will highlight it. Then, the keypad can be used to type a number in the cell. Using enter will fill in the corresponding cell in the row and display the horizontal and vertical moves to locate the point on the grid. **Draw line** will display the line through the points. The graph display has been restricted on this page, so points may appear on the table, but not on the graph.



Teacher Tip: Have students work together to write multiplication sentences that describe the relationship between the rows and the columns in the table.

Discussion Questions:

Teacher Tip: Question 11 provides an opportunity for students to explore generating equivalent ratios on a coordinate grid. Have students work in pairs and use their TI-Nspire technology to enter the terms in the table and generate the points on the grid. Encourage students to discuss how they used the TNS activity to find the solution to parts *a* - *d*.

11. Type 8 in the cell below 2, and then select enter. Draw the line.

    a. Explain how the table and the graph correspond. ***Answer: The graph shows how far over and how far up the change would be to move from (0, 0) to the point (8, 12) on the line determined by the ratios equivalent to 2:3. The table shows the coordinates of the original point (2, 3) and of the new point (8, 12).***

    b. What will the *y*-value be if the *x*-value is 15? Check your answer by typing a 15 in the third cell in the second column and selecting enter. ***Answer: The y-value will be 12.***

    c. How is the table for this set of ordered pairs the same as the table on page 2.2? How is it different? ***Answer: Both tables show the coordinates associated with values of ratios equivalent to 2:3, but on page 2.2, there is a pattern or regularity in the x-values, 2 more than the x-value in the previous row, and in the y-values, 3 more than the y-value in the previous row. The values in the table on page 3.2 are multiples of the original coordinates but do not have the same regularity as the values in the table on page 2.2***.

d. Compare the graphs on page 2.2 and 3.2. ***Answer: The graph on page 2.2 shows a "triangle" going over and up from each point in the table to the next point. All of the triangles have the base 2 and the height 3. The graph on page 3.2 shows just two triangles, the original one with base 2 and height 3 and then a triangle associated with the last point in the table, with the horizontal distance matching the x-value in the table and the vertical distance the y-value in the table.***

12. **Reset**, then enter the values for (4, 3) in the top row of the table.

    a. Predict the *y*-value for an *x*-value of 16. Then, predict the *x*-value for a *y*-value of 9. Check your answer using the TNS activity. ***Answer: The y-value will be 12 for an x-value of 16; the x-value will be 12 for a y-value of 9.***

    b. If you were to enter $x = 1$ in the first column, what would you expect the corresponding *y*-value in the second column to be? Explain your reasoning, and then check your answer using the TNS activity. ***Answer:*** $\frac{3}{4}$ ***because multiplying the values in the ratio 4:3 by*** $\frac{1}{4}$ ***(or dividing them by 4) will produce the ratio 1:*** $\frac{3}{4}$***, which will be associated with the point (1,*** $\frac{3}{4}$***).***

    c. Draw the line. Find the horizontal and vertical component of another point that is on the line but off the grid. ***Possible answer: a horizontal component of 24 and a vertical component of 18, for the point (24, 18).***

13. Set the TNS activity to display a ratio of 12 pieces of pizza for 18 people. Which of the following points will be on the line determined by the ratio? Explain what each point means in terms of the pizza.

    a. (2, 3) b. (8, 12) c. (10,16) d. $(\frac{2}{3}, 1)$

    Answer: All of the points except c will be on the line: a) is 2 pieces of pizza for every 3 people, b) is 8 pieces of pizza for every 12 people, and d) is $\frac{2}{3}$ ***of a piece of pizza per person.***

✓14. Set up the TNS activity for the following ratio: 2 centimeters on a blueprint represent 7 meters. (Question #5 on the Student Activity sheet.)

a. Create a table that would help the blueprint maker convert at least six dimensions from the blueprint into meters. Explain how you created your table. ***Answers may vary. Sample table entries are below. Students might find the table by adding or subtracting 7 meters for every more 2 centimeters in length, by using a rate of 3.5 meters for every centimeter, by multiplying a given number of centimeters by 3.5, or by finding multiples of the ratio 2:7.***

centimeters	meters
1	3.5 ($\frac{7}{2}$)
2	7
3	10.5 ($\frac{21}{2}$)
4	14
5	17.5 ($\frac{35}{2}$)
6	21
10	35

b. A room is 35 meters wide. How long would it be on the blueprint? ***Answer: 10 centimeters***

c. Geoff claims that every centimeter on the blueprint represents $3\frac{1}{2}$ meters. Do you agree? Why or why not? ***Answer: Yes, because 2 cm for every 7 m is equivalent to 1 cm for every 3.5 m.***

15. Use the TNS activity to help answer the following questions. Sari wants to make salad dressing using a recipe that calls for 2 tablespoons of vinegar and 5 tablespoons of oil.

    a. Suppose she wants to keep the same ratio of vinegar to oil. How much oil should she use for 1 tablespoon of vinegar? ***Answer:*** $2\frac{1}{2}$ ***or 2.5 tablespoons***

    b. Sari claimed that for 15 tablespoons of oil, she needed 9 tablespoons of vinegar. How can you use the graph to decide whether she was right or not? ***Answer: The line does not go through the point (9, 15). It should be (6, 15) or 6 tablespoons of vinegar for 15 of oil.***

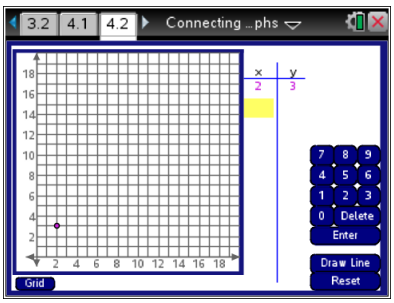
    c. If Sari added 2 more tablespoons of vinegar, how much more oil should she add to keep the same ratio? ***Answer: 2 more tablespoons of vinegar would make a total of 4 tablespoons of vinegar. So, to keep the same ratio of 2 vinegar to 5 oil, she would need to have added 5 tablespoons of oil to get the ratio 4 vinegar to 10 oil.***

    d. If Sari accidentally used 7 tablespoons of oil, how much vinegar should she use to keep the same ratio? ***Answer: 2.8 tablespoons of vinegar***

Activity 4 – Page 4.2

Objective: Students will continue to explore representing equivalent ratios on a coordinate grid.

Page 4.2 allows you to rescale the axes. Selecting **Grid** displays a menu for the **Grid Max** and **Grid Scale**. To exit the menu, you must select **Grid** once more.



Teacher Tip: Guide students in a discussion about choosing the appropriate scale for the grid axes. Ask them to think about how they might choose the right scale on the graph and why they might want to consider this as a constraint for their problems. Encourage students to explore using grids with different scales for the same table.

Discussion Questions:

This page can be used with contextual problems involving numbers larger than 20. You may want to do these problems with the TNS activity on page 4.2 or have students work the problems first, and then use the activity to check their results.

16. Use **Reset** to start over. The school band has 4 boys to every 5 girls. Enter the ratio in the table and draw the line.

    a. Use the TNS activity to plot the point representing the number of boys and girls in the band if there are 15 girls. How is this point related to the original point? ***Answer: Using the ratio of boys to girls as 4:5, the point would be (12, 15) and would represent 12 boys and 15 girls. The point represents a ratio that is equivalent to the original ratio. (Note some students may use the ratio 5:4, which will yield the same answers but from a different ratio and a different line. Allow for some discussion about why the different ratios may allow for the same result.)***

    b. Suppose there are over 40 students in band. Find three possible numbers of boys and girls in the band. ***Answers may vary: Possible responses include 20 boys and 25 girls, 24 boys and 30 girls, and 28 boys and 35 girls.***

    > **Teacher Tip:** A variation of the above question is included on the Student Activity sheet. Questions marked with the bulls-eye icon indicate key questions a student should be able to answer by the conclusion of the activity.

    c. How are the ordered pairs you found in part b related to the original ratio? ***Answer: They are all on the same line and represent ratios equivalent to 4:5.***

17. Simon usually runs at a steady pace of 5 meters every 2 seconds. Use the TNS activity to help you answer each question.

    a. If he triples the time he runs, will he triple the distance? Why or why not? ***Answer: Yes, as long as he runs at the same pace because the ratio of 5 meters in 2 seconds is equivalent to 15 meters in 6 seconds.***

    b. If he adds 6 seconds to the time he runs, will he add 6 meters to the distance he runs? Why or why not? ***Answer: No, because the ratio 5 meters in 2 seconds is not equivalent to 11 meters in 8 seconds.***

    c. If he runs for a minute, how far will he run? ***Answer: 150 meters***

    d. If he runs 100 meters, how long will it take him? ***Answer: 40 seconds***

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16. Simon walks at a rate of 3 meters every 2 seconds. Which of the following describes his pace? You may want to use the TNS activity to help your thinking.

    a. 1 meter every $\frac{2}{3}$ of a second

    b. 9 meters every 6 seconds

    c. 1.5 meters per second

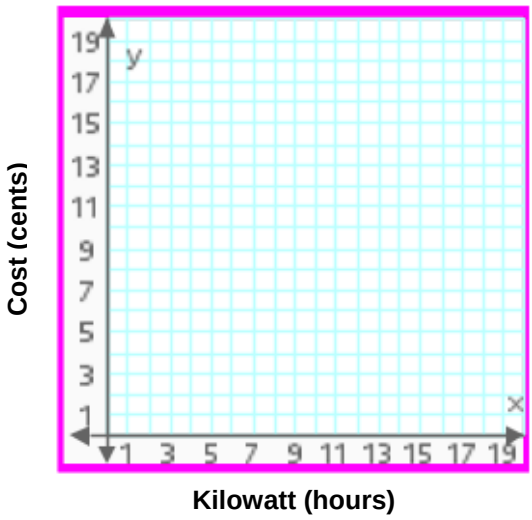
    d. 45 meters every half a minute

    Answer: All of the choices are correct. The ratios in each case are equivalent to 3:2; for 1:$\frac{2}{3}$, multiply the values by 3; for 9:6, divide the values by 3; for 1.5:1, multiply the values by 2; for 45:30, divide the values by 15.

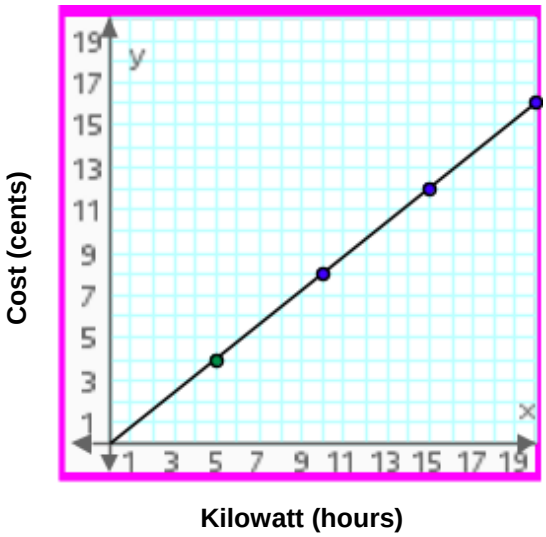
Assessment

After completing the activity, students should be able to answer the following questions. You may choose to write these on the board for students to answer in small groups or individually to assess understanding of the activity. Students should be able to answer the following questions without using the TNS activity.

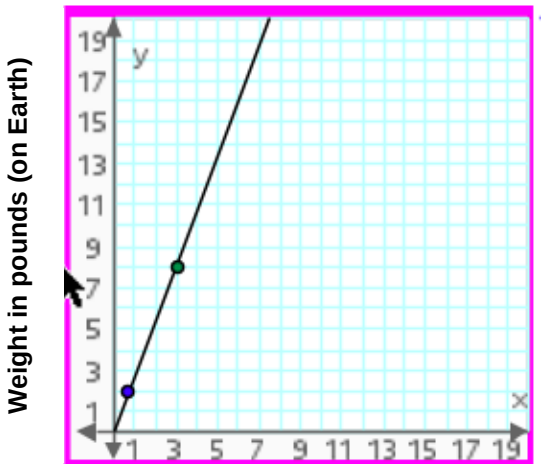
1. Solar energy in one region costs 4 cents for 5 kilowatt hours usage. Make a graph that shows how much it would cost for using up to 20 kilowatt hours of energy. Identify at least three points in your graph.



Sample Answer:



2. An object on Earth is heavier than the same object on Planet M. The graph shows the relationship between the two weights.



   a. What is the ratio of the weight on Earth to the weight on Planet M? ***Answer: 3 pounds on Planet M for every 8 pounds on Earth***

   b. If an object on Earth weighs 16 pounds, how much will it weigh on Planet M? ***Answer: 6 pounds***

   c. If an object on Planet M weighs 45 pounds, how much will it weigh on Earth? ***Answer: 120 pounds***

3. A game is set up so a player scores 7 points for every 2 hits, represented by the point (7, 2). Which of the following are possible outcomes in the game?

   a. (28, 8) b. (3.5, 1) c. (9, 4) d. (14, 49)

   Answer: a and b

4. Which of the following points will lie on the line that contains points associated with the collection of ratios equivalent to 8:5?

   a. (10, 16) b. (2, 1.25) c. (24, 15) d. (14, 11)

   Answer: b and c

Student Activity solutions

In this activity you will interpret ratios as ordered pairs and relate a table of ratios to a graph.

1. Which of the following points will also follow the same pattern even if they do not appear in the table? Explain your thinking.

   a. $(1, \frac{2}{3})$

   b. $(1, \frac{3}{2})$

   c. (24, 36)

   d. (3, 2)

   Answer: To be on the line, the ratios associated with the points have to be equivalent to 2:3. Only b and c are equivalent (multiply the values in 1:$\frac{3}{2}$ by 2 and divide the values in 24:36 by 12 to get 2:3).

2. 2 pounds of fruit cost $5. Sammy argued that 6 pounds of fruit should cost $9 because 4 more pounds of fruit should cost $4 more. Do you agree or disagree with Sammy? Find at least two different ways to explain your thinking. ***Answer: Sammy is wrong because to keep the same ratio, you need 2 pounds for every $5. Adding two 2 pounds would require you to add 2 times $5, or $10; So adding 4 pounds should cost more than $9. A second way to reason is that to have an equivalent ratio, you need to multiply or divide both values in the ratio by the same positive number. To go from 2 pounds to 6 pounds, you multiply by 3, so the price should be multiplied by 3, which is $15 for 6 pounds. A third strategy might be to figure out (either from the line or by dividing) that the price is really $1.50 per pound and so for 6 pounds you would need 6 $\times$ $1.50 or $15.***

3. Use **Reset** to start over. Move the point to (2, 1). Generate four more points on the graph. Explain the correspondence between the table and the graph ***Answer: The table shows points associated with the ratios equivalent to 2:1. The graph shows how you can get from one point to the other, by going over 2 to the right and up 1. You can see the same thing in the table as you move down the table; each x-value is 2 more than the previous value, and each y-value is 1 more than the previous y-value.***

4. If the ratio is 4:7, which of the following will always be true about the rate of change in moving from one point to another on the line? Explain your reasoning in each case.

   a. moving over 4 units and up 7 units. ***Answer: True because the ratio 4:7 can be associated with the ordered pair (4, 7), which is over 4 and up 7 from the origin.***

   b. moving over 7 units and up 4 units. ***Answer: False because this would be the point (7, 4), which is not associated with a ratio equivalent to 4:7***

   c. moving over 1 unit and up $1\frac{3}{4}$ of a unit. ***Answer: True because the ratio 1:1$\frac{3}{4}$ can be multiplied by 4 to get the original ratio of 4:7.***

   d. moving up 2 units and over 3.5 units ***Answer: True because the ratio 2:3.5 is equivalent to $\frac{1}{2}$ of each value in 4:7.***

5. Set up the TNS activity for the following ratio: 2 centimeters on a blueprint represent 7 meters.

   a. Create a table that would help the blueprint maker convert at least six dimensions from the blueprint into meters. Explain how you created your table. ***Answers may vary. Sample table entries are below. Students might find the table by adding or subtracting 7 meters for every more 2 centimeters in length, by using a rate of 3.5 meters for every centimeter, by multiplying a given number of centimeters by 3.5 or by finding multiples of the ratio 2:7.***

centimeters	meters
1	3.5 ($\frac{7}{2}$)
2	7
3	10.5 ($\frac{21}{2}$)
4	14
5	17.5 ($\frac{35}{2}$)
6	21
10	35

   b. A room is 35 meters wide. How long would it be on the blueprint? ***Answer: 10 centimeters***

   c. Geoff claims that every centimeter on the blueprint represents $3\frac{1}{2}$ meters. Do you agree? Why or why not? ***Answer: Yes, because 2 cm for every 7 m is equivalent to 1 cm for every 3.5 m.***

6. The drama club had 6 girls to every 8 boys. Enter the ratio in the table and generate a graph based on the information. Suppose there are fewer than 80 students in the club. Find three possible numbers of boys and girls in the club. ***Answers may vary: Possible responses include 18 girls and 24 boys, 24 girls and 32 boys, and 30 girls and 40 boys.***

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