## Math Objectives

- Students will use a ratio to create and plot points and will determine a mathematical relationship for plotted points.
- Students will compute the unit rate given a ratio.
- Students will predict ordered pairs based on a given ratio.

## Vocabulary

- ratio
- linear relationship
- unit rate
- proportional relationship

## About the Lesson

- This lesson involves the use of a given ratio to plot sets of points within a real-world context.
- As a result, students will:
  - Recognize the linear relationship of the set of points.
  - Predict ordered pairs based on the given ratio.
  - Compute and use the unit rate for a given ratio.
  - Recognize the set of points will include (0, 0) and (1, r) where r is the value of the unit rate.
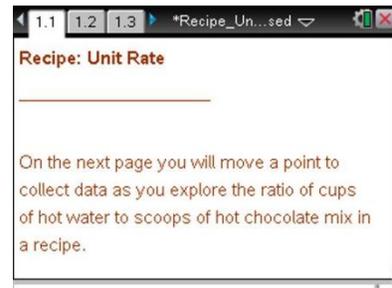
## TI-Nspire™ Navigator™

- Send out the *Recipe_Unit_Rate.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

## Activity Materials

- Compatible TI Technologies: TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software
- Optional: hot chocolate mix, hot water, cups for tasting



**Recipe: Unit Rate**

On the next page you will move a point to collect data as you explore the ratio of cups of hot water to scoops of hot chocolate mix in a recipe.

**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. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

**Lesson Files:**

*Student Activity*

- Recipe_Unit_Rate_Student.pdf
- Recipe_Unit_Rate_Student.doc

*TI-Nspire document*

- Recipe_Unit_Rate.tns
- Recipe_Unit_Rate_Assessment.tns (optional).

## Discussion Points and Possible Answers

> **Tech Tip:** If students experience difficulty dragging a point, check to
> make sure that they have moved the cursor (arrow) until it becomes a hand
> (✍) getting ready to grab the point. Also, be sure that the word point
> appears. Then select `ctrl` `✍` to grab the point and close the hand (✍).
> When finished moving the point, select `esc` to release the point.

**Move to page 1.2.**

1.  After trying to perfect your recipe for hot chocolate, you find that
    two cups of hot water dissolves four scoops of the hot chocolate
    mix. For you, this combination is just right. Now that you have
    found the right recipe, you envision making larger batches for
    your friends when they visit you.
    a.  Look at the graph on this page. Each point on the graph
        represents a recipe for adding hot chocolate mix to water.
        What is the meaning of one unit along the horizontal axis?
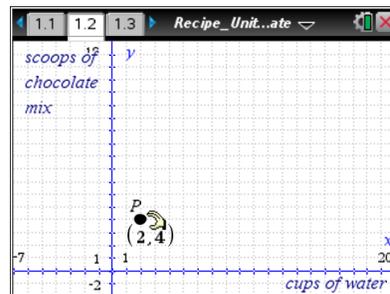
    **Answer:** A unit on the horizontal axis represents 1 cup of hot
    water. A unit on the vertical axis represents 1 scoop of hot
    chocolate mix.

2.  What does the ordered pair (2,4) represent? How does this point relate to the recipe for
    hot chocolate?

    **Answer:** The ordered pair (2,4) shows the location of a point that represents two cups of hot
    water and four scoops of chocolate mix.

3.  Use the recipe of two cups of hot water for four scoops of hot chocolate mix to answer
    these questions.
    a.  Given one cup of hot water, how many scoops of hot chocolate mix do you use?

    **Answer:** You use two scoops of hot chocolate mix with one cup of hot water.

b.   What ordered pair would you use to represent this point?

**Answer:** The ordered pair (1, 2).

c.   Move *P* to these coordinates, and select ⎡ctrl⎤ ⎡.⎤ once to mark the point.

> 📟 **Tech Tip:** You might need to demonstrate how to mark the point. Have students select ⎡ctrl⎤ ⎡.⎤ once to mark the point. Then move point P away and demonstrate to the students how the original point is marked on the coordinate plane.

> 👆 **Tech Tip:** The data capture with ⎡ctrl⎤ ⎡.⎤ does not work on the iPad. The original location of point P is marked automatically when P is moved to a new location. This does not affect the rest of the activity.

4.   Use the recipe to identify three more points. Describe the pattern you followed to plot these points. Record the ordered pairs below.

**Sample Answers:** Students will likely mark the three ordered pairs from the list: (3, 6), (4, 8), (5, 10), (6, 12), (7, 14), (8, 16), and (9, 18). The second value in each ordered pair is twice the first value.

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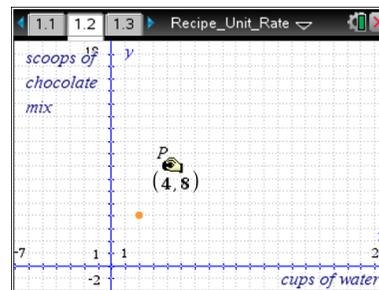
📟💻 **TI-Nspire Navigator Opportunity:** *Class Capture*
**See Note 1 at the end of this lesson.**

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5.   Is it possible to have the point (8, 14) on your graph if you continue with this pattern? Why or why not?

**Answer:** No, the point (8,14) does not follow the pattern. 14 is not 2 times 8. The point (8, 14) is not aligned with the other marked points.

6.   What is the total number of scoops of hot chocolate mix you need in each case below? Explain how you found your answer.

a.   12 cups of hot water.

**Answer:** 24 scoops of hot chocolate mix. The number of scoops is twice the 12 cups.

b.   20 cups of hot water.

**Answer:** 40 scoops of hot chocolate mix. The number of scoops is twice the 20 cups.

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📱💻 **TI-Nspire Navigator Opportunity:** *Quick Poll*

**See Note 2 at the end of this lesson.**

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7.   Rates are often measured *per single unit*. For example, for speed we usually say 30 miles per hour rather than 60 miles per 2 hours. Express the rate in the recipe as the number of scoops of how chocolate mix per one cup of hot water.
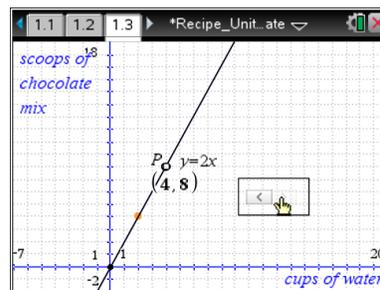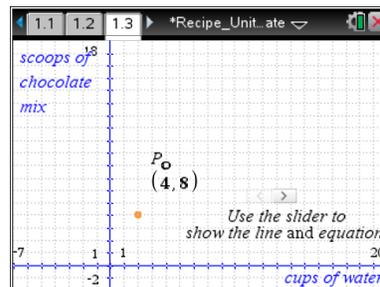
**Answer:** The unit rate is 2 scoops of hot chocolate mix per 1 cup of hot water.

**Move to page 1.3.**

8.   Use the slider button to make a line appear.
   a.   What is the equation of this line?

**Answer:** $y = 2x$

   b.   Does this line pass through the points you have marked? Why or why not?

**Answer:** The line passes through all correctly marked points because the correctly marked points have a *y*-value that is twice the value of the *x*-value. The equation $y = 2x$ includes all points with that relationship. The line also includes other points that satisfy the relationship where the *y*-value is twice the value of the *x*-value.

   c.   This line passes through (0,0). Explain why this makes sense for this recipe.

**Answer:** All points on the line have to satisfy the rule that the *y*-value should be twice the *x*-value. If $x = 0$, then $y = 2(0) = 0$, and thus the line passes through point (0, 0).

d.  According to our rule, the point (-2, -4) is on the line. Explain why this does or does not make sense for this recipe.

**Answer:** The point (-2, -4) satisfies the rule; however, it does not have a sensible meaning because we cannot have negative number of cups of water nor can we have a negative number of scoops of chocolate mix to make hot chocolate.

9.  Suppose one of your friends likes to put six scoops of hot chocolate mix into two cups of hot water.
    a.  What is the unit rate for this friend's recipe?

**Answer:** The unit rate is 3 scoops of hot chocolate mix per 1 cup of hot water.

b.  How would the graph for this friend's recipe compare to the graph for the original recipe?

**Answer:** The line should pass through all points where the *y*-coordinates have a value that is three times the value of the *x*-coordinate. The line for my friend's recipe would be steeper than the line for the original recipe.

c.  What is the equation of the line for this friend's recipe? Will the friend's hot chocolate be stronger or weaker than the original recipe?

**Answer:** The equation $y = 3x$ includes all points with that relationship. The friend's recipe will be stronger than the original recipe.

> **Teacher Tip:** You might want to make hot chocolate using these two recipes and let students taste and compare.

## Wrap Up

Upon completion of the discussion, the teacher should ensure that students can:
*   Recognize the linear relationship of proportional ordered pairs.
*   Determine equivalent ratios given a ratio.
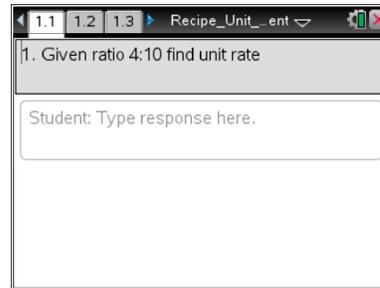*   Compute a unit rate given a ratio.

## Assessment

> **TI-Nspire Navigator Opportunity:** *Class Analysis and Slide Presentation*
> **See Note 3 at the end of the document**

1. Given ratio 4:10, find unit rate.

   **Answer:** $\dfrac{2}{5}$

   | 1.1 | 1.2 | 1.3 ▶ Recipe_Unit_...ent ▽
   | 1. Given ratio 4:10 find unit rate
   | Student: Type response here.

2. List three ordered pairs with the unit rate you found in question 1.

   **Sample Answers:** (2, 5), (3, 7.5), (4, 10), (5, 12.5), (6, 15)

   | 1.1 | 1.2 | 1.3 ▶ Recipe_Unit_...ent ▽
   | 2. List three ordered pairs with the unit rate you found in question 1.
   | Student: Type response here.
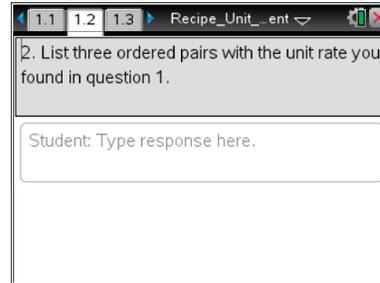
3. Select all points on the graph to the right that represent equivalent ratios.

   **Answer:** A, B, C

   | 1.1 | 1.2 | 1.3 ▶ Recipe_Unit_...ent ▽
   | 3. Select all points on the graph to the right that represent equivalent ratios.
   | ☐ A
   | ☐ B
   | ☐ C
   | ☐ D
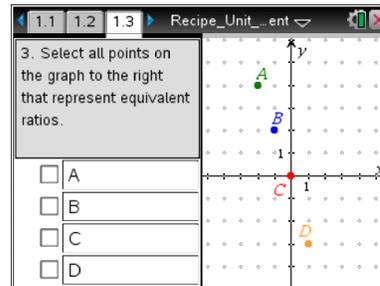
4. What is the unite rate for the points with equivalent ratios in question 3?

   **Answer:** -2

   | 1.2 | 1.3 | 1.4 ▶ Recipe_Unit_...ent ▽
   | 4. What is the unit rate for the points with equivalent ratios in question 3?
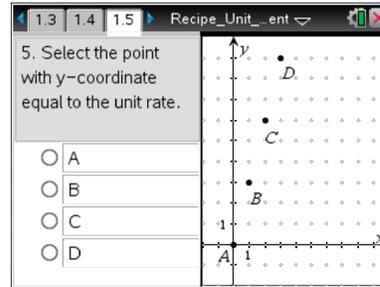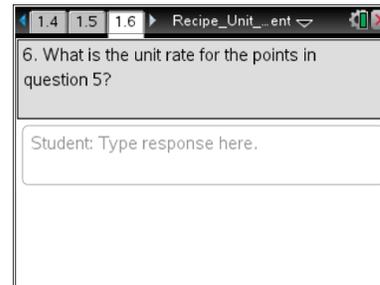   | Student: Type response here.
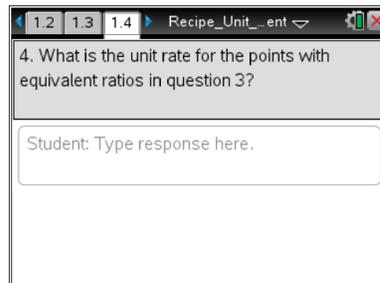
5.  Select the point with a *y*-coordinate equal to the unit rate.

    **Answer:** B

6.  What is the unit rate for the points in equation 5?

    **Answer:** 3

## TI-Nspire Navigator

**Note 1**

**Question 4, Class Capture**

**Note 1.**

Use Screen Capture to project students' screens as they are constructing points. Use the scatter plots created by the students to generate class discussion about properties of the plotted points.

**Note 2**

**Question 6, Quick Poll**

Use Yes/No option to collect students' answers for questions 5 and 8b. Use Open Response option to collect answers for questions 6 and 9a. Use equation prompt for questions 8a and 9c. Ask students to explain their answers for all questions.

**Note 3**

**Assessment, Class Analysis and Slide Presentation**

An assessment document can be sent to the students at the conclusion of the lesson. You can show a Class Analysis and a Slide Presentation to discuss possible misunderstandings students might have. Additional questions to assess students' understanding are listed below:

1.  What is the unit rate if the recipe is 6 cups of hot water for 8 scoops of hot chocolate mix?

    **Answer:** The unit rate would be $1\frac{1}{3}$ scoops per cup of water.

2.  Share a proportional ratio equivalent to the recipe: 6 cups of hot water to 8 scoops of hot chocolate mix.

    **Sample Answers:** 3 cups of hot water to 4 scoops, 9 cups of hot water to 12 scoops, etc.

3.  Would this recipe be stronger or weaker than the other two recipes?

    **Answer:** Weaker.