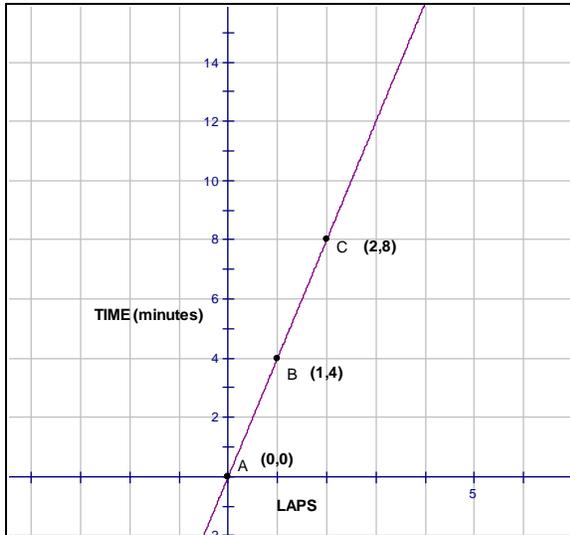


## Graphs of Proportional Relationships

### Student Probe

Susan runs three laps at the track in 12 minutes. A graph of this proportional relationship is shown below.

Explain the meaning of points A (0,0), B (1,4), and C (2,8) in terms of this relationship.



Answer:

A—Susan runs 0 laps in 0 minutes. This is the y-intercept.

B—Susan runs 1 lap in 4 minutes. This is the same as  $\frac{1}{4}$  of a lap in one minute (unit rate or constant of proportionality).

C—Susan runs 2 laps in 8 minutes.

### Lesson Description

This lesson expands upon students' understanding of ratio tables and unit rates to graph and interpret proportional relationships. If students have difficulty with this lesson more time should be spent on the prerequisite lessons [Ratios and Proportional Thinking](#), [Unit Rates](#), and [Equations of Proportional Relationships](#).

### At a Glance

**What:** Describe the graph of a proportional relationship in terms of the situation.

**Common Core State Standard:** CC.7.RP.2d.

Recognize and represent proportional relationships between quantities. (d)

Explain what a point  $(x, y)$  on the graph of a proportional relationship means in terms of the situation, with special attention to the points  $(0, 0)$  and  $(1, r)$  where  $r$  is the unit rate.

**Mathematical Practices:**

Reason abstractly and quantitatively.

Model with mathematics.

Use appropriate tools strategically.

**Who:** Students who cannot describe the graph of a proportional relationship in terms of the situation.

**Grade Level:** 7

**Prerequisite Vocabulary:** ratio, proportion, ratio table, unit rate

**Prerequisite Skills:** graphing on the coordinate plane, finding unit rates, creating ratio tables

**Delivery Format:** Individual, small group

**Lesson Length:** 30 minutes

**Materials, Resources, Technology:** graph paper, graphing calculator (optional), straight edge

**Student Worksheets:** Coordinate Grid Paper (.pdf)

## Rationale

This lesson builds upon students' understanding of proportional relationships to begin their study of functions. As students become more adept at graphing and interpreting these relationships, they are building the foundation for graphing more general linear functions, and then all functions.

## Preparation

Provide straight edges and several copies of Coordinate Grid Paper for each student.

## Lesson

The teacher says or does...	Expect students to say or do...	If students do not, then the teacher says or does...																		
<p>1. Complete a ratio table for this proportional relationship: One out of three students at Central Middle School take Spanish.</p>	<table border="1"><thead><tr><th>Spanish Students</th><th>All Students</th></tr></thead><tbody><tr><td>1</td><td>3</td></tr><tr><td>2</td><td>6</td></tr><tr><td>3</td><td>9</td></tr><tr><td>4</td><td>12</td></tr><tr><td>5</td><td>15</td></tr></tbody></table>	Spanish Students	All Students	1	3	2	6	3	9	4	12	5	15	<p>Refer to <a href="#">Ratio Tables</a>.</p>						
Spanish Students	All Students																			
1	3																			
2	6																			
3	9																			
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<p>2. What is the unit rate of this relationship? How do you know?</p>	<p>3. There are 3 students in the school for each Spanish student.</p>	<p>Refer to <a href="#">Unit Rates</a>.</p>																		
<p>3. How many students are in the school if 0 students take Spanish?</p>	<p>0</p>																			
<p>4. Add a column to your ratio table and write the numbers as ordered pairs.  Let's graph the ordered pairs on your grid paper.</p>	<table border="1"><thead><tr><th>Spanish Students</th><th>All Students</th><th>Ordered Pairs</th></tr></thead><tbody><tr><td>1</td><td>3</td><td>(1,3)</td></tr><tr><td>2</td><td>6</td><td>(2,6)</td></tr><tr><td>3</td><td>9</td><td>(3,9)</td></tr><tr><td>4</td><td>12</td><td>(4,12)</td></tr><tr><td>5</td><td>15</td><td>(5,15)</td></tr></tbody></table>	Spanish Students	All Students	Ordered Pairs	1	3	(1,3)	2	6	(2,6)	3	9	(3,9)	4	12	(4,12)	5	15	(5,15)	<p>Prompt students. Refer to <a href="#">Graph Ordered Pairs on a Coordinate Plane</a>.</p>
Spanish Students	All Students	Ordered Pairs																		
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5	15	(5,15)																		
<p>5. What does the ordered pair (5,15) tell us?</p>	<p>If 5 students take Spanish, there are 15 students in the school.</p>	<p>What do the numbers on the x-axis represent? What do the numbers on the y-axis represent?</p>																		

The teacher says or does...	Expect students to say or do...	If students do not, then the teacher says or does...
<p>6. Using your straight edge, draw a line through all the points. Notice that the line goes through the point (0,0). What does that mean?</p>	<p>Students' lines should go through the origin.</p> <p>If there are no students taking Spanish, then there are no students in the school.</p>	<p>Monitor students. Model, if necessary.</p>
<p>7. Another important point is (1,3). What does this ordered pair mean? What was important about 3 in this problem?</p>	<p>For every 3 students in the school, there is one student taking Spanish.</p> <p>3 is the unit rate.</p>	<p>Remind students that the unit rate was 3.</p>
<p>8. Since the line goes through the origin, we say the y-intercept (where the line crosses the y-axis) is 0. Since the unit rate of the relationship is 3, we say 3 is the slope of the line. We can graph any line if we know its slope and y-intercept.</p>		
<p>9. Let's use what we have learned to investigate another proportional relationship: Tracy can ride her bike 30 miles in 3 hours. What is the unit rate? How do you know?</p>	<p>10 miles per hour. In one hour she can bike 10 miles.</p>	<p>Refer to <a href="#">Equations of Proportional Relationships</a>.</p>
<p>10. So that gives us the ordered pair (1,10).</p>		
<p>11. If she bikes for 0 hours, how far did she travel? What ordered pair does that give us?</p>	<p>0 miles (0,0)</p>	
<p>12. Notice that we have the slope (the unit rate is 10) and the y-intercept (0).</p>		
The teacher says or does...	Expect students to say or do...	If students do not, then the

		teacher says or does...
13. Now we have two ordered pairs to plot. Plot them on grid paper and draw a line through them with your straight edge.	Students should graph the line with a slope of 10 and passing through the origin.	Monitor students. Model, if necessary.
14. Pick another point on the line. What does this point mean?	Answers will vary. For example, the point (4, 40) means that Tracy bikes 40 miles in 4 hours.	
15. Repeat with additional problems as necessary.		

### Teacher Notes

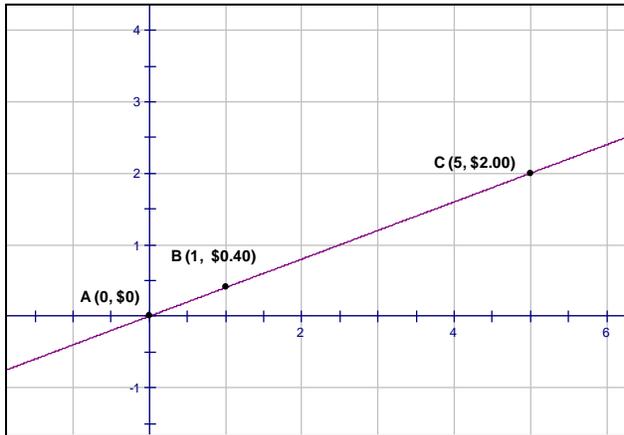
1. This lesson is a good vehicle for introducing the terms slope and y-intercept if students are not already familiar with them.
2. It is important for students to make the connection between unit rate (constant of proportionality) and slope.
3. The concept of independent and dependent variables may need to be revisited during this lesson.

### **Variations**

This lesson may be adapted to graph equations of proportional relationships on the graphing calculator and interpret the points using technology.

## Formative Assessment

Jill bought a box of 12 cupcakes for \$4.80. A graph of this proportional relationship is shown below. Explain the meaning of points A (0, \$0), B (1, \$0.40), and C (5, \$2.00) in terms of this relationship.



Answer:

A—Jill paid \$0 for 0 cupcakes. The y-intercept is 0

B—Cupcakes cost \$0.40 each. This is the unit rate and the slope of the line.

C—Five cupcakes cost \$2.00.

## References

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