

Math: Grade 6, Lesson 13, Ratios and Rates

Lesson Focus: Represent and Graph Ratios

Practice Focus: Students will focus on practicing tables and graphs in order to represent equivalent ratios.

Objective: Students will use tables and graphs to represent equivalent ratios

Key Vocabulary: equivalent ratio, ordered pair, point, ratio table, independent variable, dependent variable and graph

TN Standards: 6.RP.A.3a

Teacher Materials:

- White board and markers or smart board
- Coordinate plane (projected or on chart paper)
- Student Practice Packet

Student Materials:

- Paper and a pencil, and a surface to write on
- Graph paper, optional

Teacher Do	Student Do
<p><u>Opening</u> (1 min)</p> <p>Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 6th graders out there, though all children are welcome to tune in. This lesson is the thirteenth in our series.</p> <p>My name is ____ and I'm a ____ grade teacher in Tennessee schools! I'm so excited to be your teacher for this lesson! Welcome to my virtual classroom!</p> <p>If you didn't see our previous lesson, you can find it on the TN Department of Education's website at www.tn.gov/education. You can still tune in to today's lesson if you haven't see any of our others. But, it might be more fun if you first go back and watch our other lessons since we'll be talking about things we learned previously.</p> <p>Today we will be learning about representing and graphing ratios in mathematics! Before we get started, to participate fully in our lesson today, you will need:</p> <ul style="list-style-type: none"> • Paper and a pencil, and a surface to write on • Graph paper, optional <p>Ok, let's begin!</p>	<p>Students get materials ready for the lesson.</p>
<p><u>Intro</u> (4 min)</p> <p>[Draw the given Frayer Model on the board prior to starting lesson with the given word bank beside it.]</p>	

Use the words, expressions, and equations from the word bank to complete the graphic organizer about our study of ratios.

Word Bank:

division ratio equivalent x units
 \$4.00b graph y units 7:11
 2+4 = 5+1 3 cats to 5 dogs $\frac{x}{y}$ relationship

Definition A _____ is a relationship in which for every _____ of one quantity there are _____ of another quantity.		Facts <ul style="list-style-type: none"> Ratios are considered to be _____ if they express the same _____. A ratio compares two like or unlike quantities by _____. Ratios can be shown visually using a _____ or a ratio table.
Examples	Ratios	Nonexamples

[After pausing for student responses, share correct responses with students using the key below.]

Definition A ratio is a relationship in which for every x units of one quantity there are y units of another quantity.		Facts <ul style="list-style-type: none"> Ratios are considered to be equivalent if they express the same relationship. A ratio compares two like or unlike quantities by division. Ratios can be shown visually using a graph or a ratio table.
Examples 3 cats to 5 dogs 7:11 $\frac{x}{y}$	Ratios	Nonexamples 2 + 4 = 5 + 1 \$4.00b

There may be some of the words or expressions that you were not certain about as we begin today. We will reinforce equivalent ratios today as we connect our learning to

<p>previous knowledge you have from graphing ordered pairs on the coordinate plane.</p>	
<p><u>Teacher Model</u> (12 min)</p> <p>Let's jump in and get started! You noticed that we mentioned graphs in our introduction. Today, we are going to build on what we've learned in earlier lessons to connect equivalent ratios to tables and graphs.</p> <p>Objective 1: Explore Ratios in Tables and Graphs How can we use tables and graphs to show equivalent ratios? [Pause for student response. This will be our learning goal for the lesson.] Keep that question in mind as we move through the lesson today. We are going to build our understanding of how to plot points in the coordinate plane using information from the tables of equivalent ratios that we have seen and learned about in earlier lessons. Let's get started! [Write the given problem on the board and allow students time to read.]</p> <p>Example 1: Ellen is shopping for supplies at Jake's Party Store. Make a table to show how much Ellen would spend to buy 3, 6, 9 or 12 balloons. Then plot the pairs of values in a coordinate graph. Use the ratio table and the graph to find the cost of 18 balloons. [Read the problem aloud.]</p> <p>What is the problem asking us to do? [Pause] We are asked to make a table, plot points and use the graph. That is quite a bit for one problem, so let's think of how we should begin. [Pause]</p> <p>I think you are right! We have been working with tables for the last few days, so let's start with a table. How can we make a table of equivalent ratios? [Pause] I agree! We need two pieces of information from our problem.</p> <p>What information are we given? [Pause for response.] Yes. We are given number of balloons that Ellen wants to buy. What are we asked to find? [Pause for response.] You're right again. We are asked to find the cost of the balloon. Let's make a ratio table. Since Ellen is buying 3, 6, 9 or 12 balloons, we can start with 4 columns. We will then decide if our table provides all of the information we need to solve the problem. [Draw table emphasizing the two pieces of</p>	<p>Objective #1: Students will be reviewing using number bonds to find a missing added within 10. This allows students to work with numbers that are more familiar to them before moving to teen-based numbers.</p> <p>Students will draw and complete the table alongside the teacher.</p>

information that we are working with today. We will build on that for graphing.]

Number of Balloons	3	6	9	12
Cost in Dollars	2			

What is the ratio of balloons to cost? [Pause]

Yes! 3 balloons: \$2

How can we find the cost of 6 balloons? [Pause] **You got it!**

Since we multiplied the number of balloons by 2, we will also double the cost. That will make the cost of 6 balloons equal to \$4.

Since we have worked with tables for a few days now, I will give you time to complete the table for equivalent ratios.

[Pause for students to complete table. After pause, put completed table up for students to check their work.]

Number of Balloons	3	6	9	12
Cost in Dollars	2	4	6	8

You did great! Do we have the information we need to solve the problem? [Pause] **No, we don't. The problem asks for**

the cost of 18 balloons. How can I extend the table to show the cost of 18 balloons? [Pause and add additional columns.

In this, we are trying to help students understand how to make the table, not just copy one.] **We can now see the cost for 18 balloons. What is that cost?** [Pause] **You got it! \$12**

Number of Balloons	3	6	9	12	15	18
Cost in Dollars	2	4	6	8	10	12

What does the problem ask for next? [Pause]

It does ask for us to plot the pairs of values in a coordinate graph. How do we find the pairs of values? [Pause] **Yes! We do need x and y. How can we determine which is x and which is y?** [Pause]

Connection to previous knowledge

You might remember that we did spend time working with independent and dependent variables earlier in the school year.

By definition, the independent variable causes the dependent variable to change, while the dependent variable changes in response to another variable.

Students extend the table.

Our x-value is our independent variable, while our y-value is our dependent variable. In our given problem, which set of values in our table do you think are the independent values?

[Pause] Yes. Number of balloons in the independent set of values, so that will be our x. What does cost in dollars represent? [Pause] You may have said y or dependent variable. You are correct with both! I'm excited that you remembered those definitions. [Add in (x) and (y) to your table we used above.]

Number of Balloons (x)	3	6	9	12	15	18
Cost in Dollars (y)	2	4	6	8	10	12

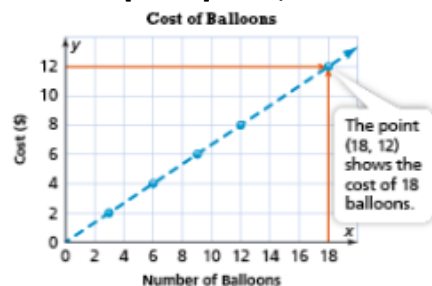
The values in the table can be used to write the ordered pairs (3, 2), (6, 4), (9, 6), (12, 8), (15, 10) and (18, 12). We are asked to plot these points. What do we need to plot the points on?

[Pause] Let's draw a coordinate plane (it can be a rough sketch since you may not have graph paper) and plot these points. [Pause to sketch a coordinate plane. As you draw the coordinate plane, label the x-axis as number of balloons and the y-axis as cost. Talk through plotting each point and connect the points and extend the line.]

We have the ordered pairs from the table to graph. Let's start with (3, 2) and work our way to (18, 12). Remember, yours may not look as straight as mine, but you can see the constant change in cost as the number of balloons increases. Let's look at the graph. [Draw the given graph.]

Notice there is a dashed line drawn through the points. This helps us to see the pattern and also shows us the whole number answers as points on the line. The points on the line between the graphed points do not make sense in this situation. We won't have fractional or decimal parts of balloons.

What cost of balloons is paired with the number of 18 balloons? [Pause] It is \$12.



Students respond

I want to see what you understand, so let's try another one.

[Write the problem on the board. Pause to allow students to read it and then read it aloud.]

Example 2: Complete the table to show equivalent ratios representing a cost of \$8 for every 3 boxes. Then write the pairs of values as points to be plotted on a coordinate plane.

Number of Boxes	Cost of Boxes (\$)
3	8
6	16
9	24
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

Since we have spent quite a bit of time on ratio tables of equivalent ratios, I'd like to see if you can complete it alone. We'll check our answers in a bit. [Pause]

Check your table to see if we got the same values and write the pairs of values as points.

Number of Boxes	Cost of Boxes (\$)
3	8
6	16
9	24
12	32
15	40

The points are (3, 8), (6, 16), (9, 24), (12, 32), (15, 40).

We know we could graph them, but this question only asked for us to find the points. Pay close attention to what each problem is asking us to find. We will keep working with ways to represent ratios in tables and graphs.

Objective 2: Graph Ratios Using Repeated Addition

As we continue to work with ratio tables and graphs, we have another strategy that might help us. We can use repeated addition. Repeated addition is a strategy you used in lower grades to discover and understand multiplication. I can't wait for us to see how we can use it connected to ratios! Let's dive in!

Example 1: Jack is making juice. He has 25 celery sticks. If Jack uses all 25 celery sticks, how many apples will he need to make the juice? [Draw the given ratio table.]

Students complete ratio table.

Objective #2:

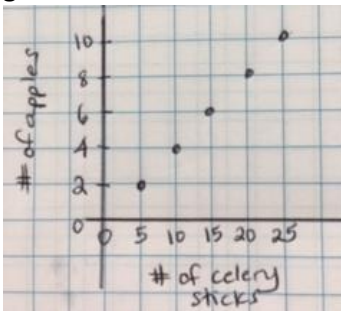
Students will be building off of their work with coordinate planes and tables to begin seeing relationships in the tables by using repeated addition. Students will connect these relationships between the tables and graphs.

Celery Sticks	Apples
5	2
10	4
15	

We are given the ratio table. We want to see if we can discover the pattern using repeated addition. Let me show you how! For each row in the table for celery sticks, we see that 5 is added to the number of celery sticks. For each row in the table for apples, we see that 2 is added to the number of apples. If we continue, our table looks like this: [Draw complete table.]

	Celery Sticks	Apples	
+5	5	2	+2
+5	10	4	+2
+5	15	6	+2
+5	20	8	+2
+5	25	10	+2

How can we use this information to help with our graph? Let's plot the pairs of values on a coordinate plane. What is our x-axis? [Pause] Ok! We can do celery sticks. That means that the apples are the y-axis. What scale do you think we should use for the x-axis? [Pause]. Yes! We can go by 5s since the number of celery sticks is going by 5s. What about the y-axis? [Pause]. I think 2s are right since the number of apples are growing by 2 each time. [Draw coordinate plane and label.] Let's plot the points from the ratio table, (5, 2), (10, 4), (15, 6), (20, 8), and (25, 10). Remember, yours can be a rough sketch if you don't have graph paper. Our goal today is to see the relationships in the graphs, so your sketch works great for that!

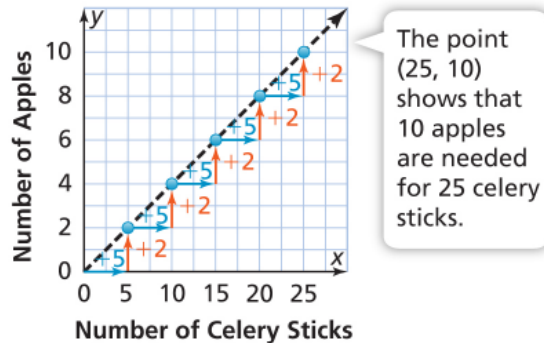


What do you notice about the graph of the ordered pairs? [Pause] Yes! The pairs form a line. We will again draw a dashed line since the numbers between the whole numbers do not make sense in this situation. Let's look at the pattern

Students graph the ordered pairs

using our repetition of adding 5 to the number of celery sticks and adding 2 to the number of apples.

[Show students graph with an emphasis on reading plus 5, plus 2 for each point.]



Let's try this one: [Write problem on the board and read to students.]

Example 2: **Suppose you read 4 pages every 3 minutes. How would you use repeated addition to make a table of equivalent ratios?**

Where should we begin? [Pause] **Go for it! Draw the table with two columns and let's see where the 4 and 3 can go.** [Pause]

Pages Read	Time (min)
4	3

Does your look similar to this? We don't have a certain number of times we will use repeated addition, so you may have fewer or more rows. You are still right! What number of pages read will we add each time to the 4? [Pause]. Yes. It is 4, since we are reading 4 more pages each time. What amount of time will we add each time to the 3? [Pause] You got it! It is 3, since we are taking 3 minutes for every 4 pages. Complete the table using repeated addition and we can compare. [Pause]

Add 4	Pages Read	Time (min)	Add 3
	4	3	
	8	6	
	12	9	
	16	12	
	20	15	

Students follow thought process with teacher on graph with repeated addition

How did you do? I think we are ready to practice together.

Tying the learning together:

Did you notice how we used the ratio tables of equivalent ratios from the previous lessons to create a graph? I hope you saw how the graphs were a great way to represent the ratios. Graphs are a way for us to see patterns and see where our solution paths are going.

Tying the learning together:
Students will listen to the teacher do a think aloud connecting the ratio tables to graphs.

Guided Practice (8 min)

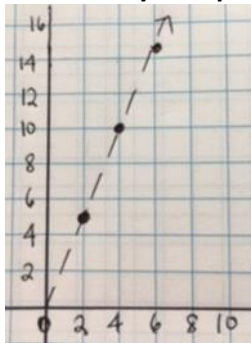
Let's practice two more problems to represent and graph ratios.

Problem 1: **Make a graph that illustrates the equivalent ratios shown in the table.** [Pause and give student table on the board.]

x	y
2	5
4	10
6	15

We are asked to make a graph. What are the points that will be on our graph? [Pause]. You're right! (2, 5), (4, 10), and (6, 15). What do we need to do to get our coordinate plane ready? [Pause]. Yes! We need to label the x-axis and y-axis. We can use the scale as given in our table. This looks like the x values go by 2s and the y values go by 5s.

Take a moment to graph and we'll check it together. [Pause]
This is a way to represent the points on the coordinate plane:



Problem 2: **Complete the table using repeated addition. Then determine what each label should be on the coordinates along the y-axis and plot the pairs of values on the coordinate plane.**

Students will move through the gradual release process. They will work with the teacher and then alone to solidify the learning centered on connecting tables of equivalent ratios to graphs on the coordinate plane.

Teacher starts the guided practice

Teacher and student work together

Student is released to work through a problem. Teacher prompts student to ensure all parts of the problem are complete.

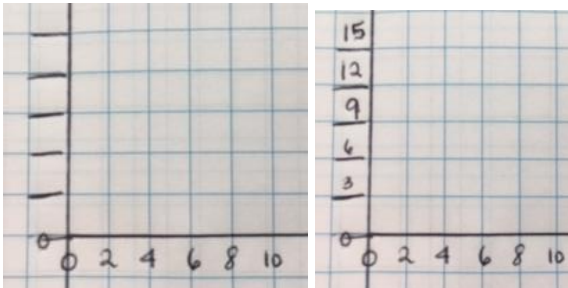
Let's start with the 1st part. On your own, complete the table using repeated addition. [Pause]

2	4			
3	6			

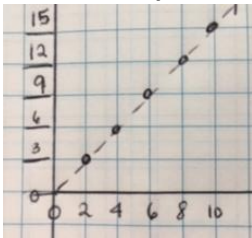
We see that we add 2 to the top row each time and we add 3 to the bottom row each time [Fill in table.]

2	4	6	8	10
3	6	9	12	15

Now, we are asked to label the y-axis. See what values you think should be there. [Pause. After showing the graph with blanks. Pause again and then write in the values for them to check.]



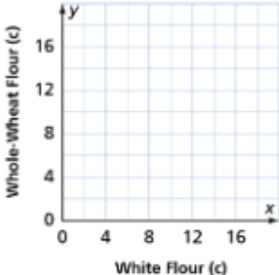
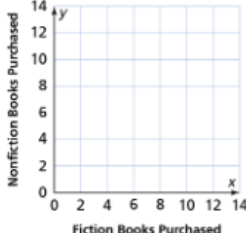
What else does the problem ask? [Pause]. It asks us to plot the ordered pairs. You go plot those on your sketch! [Pause]



Additional Problems (if needed):

- 1.) A bread recipe calls for 4 cups of white flour for every 5 cups of whole wheat flour. Complete the table to show how many cups of whole wheat flour are needed to mix with 16 cups of white flour. The graph the pairs of values.

White Flour (c)	4	8	12	16
Whole-Wheat Flour (c)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

 <p>2.) Plot the equivalent ratios (3, 4), (6, 8), and (9, 12) on the graph. Use the graph to find the number of nonfiction books purchased if 10 fiction books are purchased.</p> 	
<p><u>Independent Practice</u> (1 min)</p> <p>Great work! Today, we reviewed ways to represent and graph ratios. I hope you're seeing some connections to using the coordinate plane and independent and dependent variables! You sure did a great job! After the video, you will have some problems to practice on your own. I will show you the independent practice problems now, or you can find them in the student practice for this lesson posted on our website, www.tn.gov/education. [Teacher shows student practice page under document camera or camera zooms in on student practice page.]</p> <p>Good luck and thanks for hanging with me today!</p>	
<p><u>Closing</u> (1 min)</p> <p>I enjoyed reviewing representing and graphing ratios with you! Thank you for inviting me into your home. I look forward to seeing you in our next lesson in Tennessee's At Home Learning Series! Bye!</p>	

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