PBS Lesson Series

Math: Grade 6, Lesson 11, Ratios and Rates

Lesson Focus: Generate Equivalent Ratios
Practice Focus: Students will focus on practicing multiplying and dividing in order to generate equivalent ratios.
Objective: Students will use multiplication and division to generate equivalent ratios and determine if given ratios are equivalent.
Key Vocabulary: equivalent ratios, terms
TN Standards**:** 6.RP.A.3
Teacher Materials:

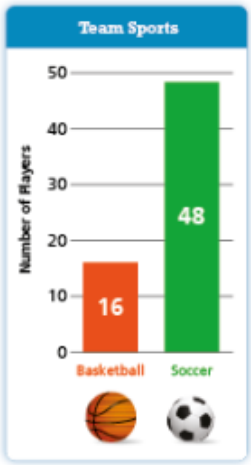
- White board and markers
- Student Practice Packet

Student Materials:

- Paper and a pencil, and a surface to write on
- Calculator, optional

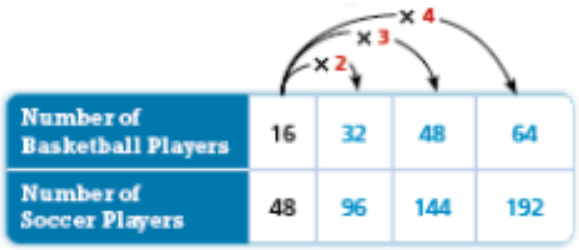
Teacher Do	Student Do
Opening (1 min) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 6th graders out there, though all children are welcome to tune in. This lesson is the eleventh in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee schools! I'm so excited to be your teacher for this lesson! Welcome to my virtual classroom!** **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.** **Today we will be learning about generating equivalent ratios in mathematics! Before we get started, to participate fully in our lesson today, you will need:** • **Paper and a pencil, and a surface to write on** • **Calculator, optional** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (3 min) **Have you ever mixed two colors of paint to make a new color?** [Pause] **Today, we are going to start out with a problem that has Sally trying to make a new paint color. Let's read it together.**	Students participate in the introduction discussion. Pauses are given for student response. This introduction will allow students to think about ratios through the lens of paint colors.

[Roughly sketch the paint cans below and label 3 with YELLOW and 4 with RED. Read the problem out loud.]  **Sally has 3 pints of yellow paint and 4 pints of red paint. She used all of the paint to make a certain tint of orange paint. How many pints of red paint should be mixed with 24 pints of yellow paint to make the same tint of orange? Solve this problem any way you choose.** **I will give you a moment to write down any thoughts you have to help Sally**. [pause**] Let's look for relationships! How can we use the relationship between the number of pints of yellow paint and the number of pints of red paint to answer the question?** [pause] **Let's look at two possible solutions**. [On the board, put up two different representations.] **Dante and Eva have solved this in two different ways.** **Dante used a bar diagram to find the solution. He knew that the same ratio of yellow to red had to be maintained; if there is more or less red included with the yellow paint, it will be a different shade of orange.**  **He said that he needs 32 pints of red paint.** **What did Dante do?** [pause]. **He knew the ratio of yellow paint to red paint was 3:4. Since we were told that Sally now has 24 pints of yellow paint, he divided 24 into 3 parts. Since 24 ÷3 = 8, he put 8 in each part of the diagram. This shows that each of the 3 parts now contains 8 pints. Because each part of the diagram now contained 8 pints, he did the same for the red paint. To maintain the ratio of 3:4, he now has 3x8:4x8 or 24:32. Dante is correct. He will need 32 pints of red paint!**	Students respond.

Eva did the following: **Since** **24 ÷ 3 = 8** **8 x 4 = 32**  **So, we need 32 pints of red paint.** **What do you notice and wonder about their solution paths?** [Pause]. **I noticed using a model helped Dante while using division and multiplication helped Eva. We will see how those can work together as we determine strategies we can use to generate equivalent ratios and solve problems like Sally's. I'm looking forward to working alongside you.**	
<u>Teacher Model</u> (12 min) Objective 1: Use Multiplication to Find Equivalent Ratios **How can we find equivalent ratios? Let's try a few examples to see!** Example 1: **For every 16 basketball players in Crystal County schools, there are 48 soccer players. If the ratio remains constant and there are 64 basketball players, how many soccer players are there**? [Draw the given bar graph before reading the problem for students to see the number of players.]  **What two quantities are being compared in this problem?** [Pause for student response]**.** **Yes! You're right! It's the number of basketball players and number of soccer players.** **One way to solve this problem is to make a table with equivalent ratios. Remember, equivalent ratios are ratios**	Objective #1: Students will be reviewing using multiplication to find equivalent ratios. This allows students to work with a familiar operation and tables. Students respond.

that express the same relationship. Let's make a table! [Draw a table as below with the given information inserted.] [Continue to fill the table with numbers as we multiply the given number of players for each team by 2, then 3, and then 4. Talk through this multiplication for each column.] **We are going to multiply both terms of the original ratio by the same number to find an equivalent ratio. When we multiply both by 2, we get**? [Pause]. **Yes! The terms are now 32 and 96.** **Let's multiply by 3.** [Pause]. **You're right. We now have 48 and 144.** **We are trying 64 basketball players. We aren't there yet. What should we do?** [Pause]**. I agree, let's multiply by 4. With that, we get 64 and 192.** **What does this table tell us?** [pause] **When we have 64 basketball players, we have 192 soccer players. Does this answer our original question**? [pause]. **Yes! It does!** **Another way we can do this same problem is to use multiplication. We can multiply both terms by the same nonzero number.** **We started with $\frac{16}{48}$. What do you think we can multiply both terms by? Remember, we need to have 64 basketball players.** [Pause]**. I agree. We can multiply 16 by 4 to get 64 basketball players, so we will multiply both terms by 4.** **We now have:** $\frac{16\ x\ 4}{48\ x\ 4} = \frac{64}{192}$ **There are 192 soccer players when there are 64 basketball players.**	Students work alongside the teacher. Students respond. Students respond.

Number of Basketball Players	16			
Number of Soccer Players	48			



Let's try another one using multiplication.
[Draw the following table on the board. We will fill the table in for this example.]

Complete the table using multiplication to find ratios that are equivalent to 4:5.

4			
5			

If we use what we did in the previous problem, we can multiply both terms by the same numbers to generate equivalent ratios. What would you like to multiply by 1st? [Pause]**. Ok, we'll start with 2. What are our new terms?** [Pause]**. Yes. You are correct. We now have 8 and 10** [Fill in the table as you work through this example with the students.] **What is another number you would like to multiply both terms by?** [Pause] **Ok! We can do 4. What are our new terms?** [Pause] **I agree. We now have 16 and 20. Let's try one more set of terms. We can multiply both by 5 this time! What do you get for your new terms?** [Pause]. **You got it! They are 20 and 25.**

4	8	16	20
5	10	20	25

Students respond.

How is finding equivalent ratios similar to finding equivalent fractions? [Pause]. **When you find equivalent fractions, you multiply OR divide the numerator and denominator by the same value. When you find equivalent ratios, we can do the same. Let's see what this looks like with division**.

Objective 2: Use Division to Find Equivalent Ratios

Objective #2:
Students will be building off of their work with equivalent fractions and generating equivalent ratios with multiplication to use division to find equivalent ratios.

Let's use division to find our equivalent ratios in a couple of problems. [Write problem on the board and draw table.] **Sarah made baskets on some of her shots in a basketball game. If she continues to make baskets at the same rate, how many baskets will Sarah make in her next 6 shots?**

[Draw a scoreboard for Sarah]

Let's start by looking at a table to find equivalent ratios:

Number of Shots Taken			18
Number of Baskets Made			12

How can we use the table to find out how many baskets she will need in her next 6 shots? [Pause] **We will need to divide 18 and 12 by the same number. Let's start by dividing by 2. What are the new terms?** [Pause]**. I got 9 and 6 also! We are looking for 6 shots, so what can we divide the 18 by to get 6?** [Pause]**. 3 is correct. If we divide both terms by 3, what are our new terms? They are 6 and 4! Good job.** [Fill in table as you work through the above discussion]

Number of Shots Taken	6	9	18
Number of Baskets Made	4	6	12

Great job! We can also use division to find this answer. If we start with $\frac{18}{12}$, by what number do you need to divide 18 by to get 6? [Pause**] Divide 12 by the same number.** [Pause]**. If we divide both terms by 3, we get**

$\frac{18 \div 3}{12 \div 3} = \frac{6}{4}$

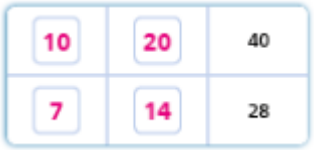
This tells us that Sarah will make 4 baskets in her next 6 shots. GO Sarah!

Let's try this one together. Complete the table using division to find the ratios that are equivalent to 40:28. [Draw table on the board. Pause for students to complete the table.]

Students will complete table.

		40
		28

Let's check your answer. Remember, we may have different answers. One possible answer is this table showing first dividing both terms by 2 and then dividing both terms by 4. I see that you got a few different answers. Yes, five was a good number to divide by also! I also see that someone divided by 10. That's great!

 **This reminds us that there are an infinite number of equivalent ratios just like we had when we worked in earlier grades with equivalent fractions. You are doing great with this!** Objective 3: Determine if the Given Ratios are Equivalent **There may be times where we are given ratios and asked to determine if other ratios are equivalent. We may multiply or divide to determine if they are equivalent. Let's practice!** [Write the given problem on the board and pause for student to read the given information.] **Pi (π) is the ratio of the circumference of a circle to its diameter. This ratio is approximately 66:21. Which of the following ratios are equivalent to 66:21?** **22:7, 33:10, 44:14, 88:28** [Pause for students to find an answer.] **In this problem, we can use both multiplication and division to determine if the given ratios are equivalent to 66:21. Let's start with the first given ratio, 22:7. Do you think we should multiply or divide 66:21 to find out if 22:7 is equivalent?** [Pause]. **I agree. Since it is smaller than 66:21, we will divide.** $\frac{66 \div 3}{21 \div 7} = \frac{22}{7}$**, so it is equivalent! Great job! We've got one from our list that works.** **Let's look at the next one, 33:10. You're right. We can divide for that one also since 33 is smaller than 66. What do you think we should divide by?** [Pause] **I think 2 will work also. Let's try it.** $\frac{66 \div 2}{21 \div 2} = \frac{33}{10.5}$**. Is that equivalent to 33:10?** [Pause]. **You're right again. It is not, so 33:10 is not equivalent to 66:21.** **Try the other two yourself and we will check them. Remember, since we discovered that 22:7 is equivalent, we can use it to help us.** [Pause for student work.] **If we use 22:7, we can see that** $\frac{22 \, x \, 2}{7 \, x \, 2} = \frac{44}{14}$ **and** $\frac{22 \, x \, 4}{7 \, x \, 4} = \frac{88}{28}$**. What does all of this mean?** [Pause]. **The ratios 22:7, 44:14 and 88:28 are equivalent to 66:21.**	Objective 3: In this portion, students will tie together the multiplication and division of both terms to determine if given ratios are equivalent. This section will help students to tie the work of the lesson together. Students respond. Students will work the problem. Students respond.

Here's one for you to try. **Are 4:7, 6:10, and 24:42 are equivalent ratios for $\frac{12}{21}$?** **I will wait for you so we can check our answers.** [Pause]. **You did great! When we used division, we can see that 4:7 is equivalent and when we use multiplication, we see that 24:42 is equivalent.** Tying the learning together: **As we pull our learning for the day together, we see a common thread of understanding. We see that we can find equivalent ratios by multiplying or dividing both terms of a ratio by the same nonzero number.** **For example:** **Multiply both terms by the same nonzero number.** $\frac{30 \times 2}{40 \times 2} = \frac{60}{80}$ **As well as, divide both terms by the same nonzero number.** $\frac{30 \div 10}{40 \div 10} = \frac{3}{4}$ **We will work together on a few to make sure you are able to work on your own.**	Tying the learning together: Students will listen to the teacher do a think aloud modeling the thought process for finding equivalent ratios.
Guided Practice (8 minutes) **You're doing great! Let's read through this problem together.** **Shiloh is sharing jellybeans. The jar of jellybeans has the ratio shown. If Shiloh keeps the ratio the same and gives his friend 7 pink jellybeans, how many green jellybeans should he also share?** **Take a minute to think about how to set it up.** [pause] **Right! We can use multiplication or division to find your ratios. You work this problem on your won. Then we'll discuss it.** [Pause] **Alright, let's check to see how you did.** [Complete the table as we walk through the answers.]	Students will be working on the problems independently. The first problem will gradually release the ownership to the student. After the student works the problems, discuss the answers. Students respond.

Green Jellybeans				**32**
Pink Jellybeans	**7**			**56**

Green Jellybeans	4	8	16	32
Pink Jellybeans	7	14	28	56

What can we divide by? [pause] Let's divide by 2. So 32 divided by 2 equals 16. 56 divided by 2 equals 28. **Now, let's divide by 4 or we can divide in half again. So 16 divided 2 equals 8, and 28 divided by 2 equals 14. Can we divide by 2 again?** [Pause] **Yes, we can. How do we know?** [Pause] **We know that we can divided by 2 again because 14 divided by 2 equals 7. So 8 divided by 2 equals 4. So what's our answer?** [Pause] **Yes, Shiloh should share 4 green jellybeans.** **Using what we've done today, I'd like for you to take a moment to write 3 equivalent ratios for $\frac{12}{16}$. Make sure to use both multiplication and division. Remember, there are many possible answers. You just find 3 and we will compare.** [Pause to allow students to answer.] **Let's compare! Remember, we are working with the ratio 12:16. Possible answers if you divide are:** **3: 4 and 6:8** **Possible answers if you multiply are:** **24:32 and 36:48.** **I think you are ready to try these on your own!** Additional Problems (if Needed): **1.) Corey is making key lime pies for the school fair. For every 3 egg yolks, he uses 2 Tbsp of key lime zest. A.) Complete a table to show equivalent ratios for 2, 4, 6, and 8 Tbsp of zest. B.) How many egg yolks are needed for 16 Tbsp of key lime zest?**	Students respond.
<u>Independent Practice</u> (1 min) **Great work! Today, we reviewed ways to generate equivalent ratios. I hope you're seeing some connections to equivalent fractions! 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.] **Good luck and thanks for hanging with me today!**	

Closing (1 min) **Boys and Girls, I enjoyed reviewing generating equivalent 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!**	