PBS Lesson Series

Math: Grade 6, Lesson 14, Ratios and Rates

Lesson Focus: Understand Rates and Unit Rates
Practice Focus: Students practice will focus on using rates to describe ratios when the terms have different units.
Objective: Students will use rates to describe ratios with a focus on unit rates.
Key Vocabulary: rate, unit rate
TN Standards: 6.RP.A.2
Teacher Materials:

- White board and markers (or projector)
- Printed set of problems and independent practice
- Student Practice Packet

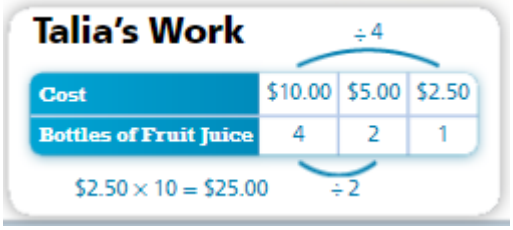
Student Materials:

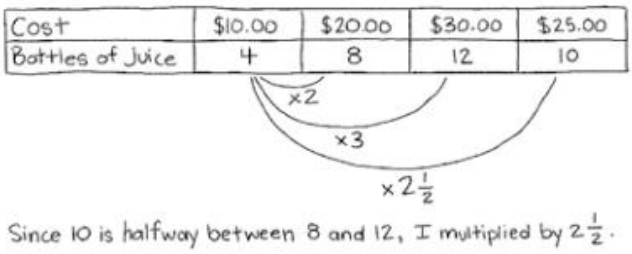
- Paper and a pencil, and a surface to write on
- Calculator, optional

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 fourteenth 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 understanding rates and unit rates 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 (you can even use the one on a phone)** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (4 minutes)	

We are going to start today by connecting to earlier lessons. Have you ever seen a sale that advertises a price to buy more than one of an item? If so, what were the items and how much did they cost? [Pause for student responses.]. **Those are some great examples! It happens with candy, 2 liter soft drinks and more!** **Let's look at an example to start us out today.** [Write problem on the board. Read the problem to students that might not be able to see it.] **What is the cost of 10 bottles of fruit juice if the fruit juice is sold 4 for $10? Solve this problem any way you choose.** [Pause to allow students to begin a solution path.] **Let's look together at 2 possible strategies you may have used to start working on this problem:** **One way you may have decided to solve this problem is with a ratio table. Talia decided to tap into what we've been learning and solve this with a ratio table. Let's look at her table together.** [Put ratio table on the board for students to see and fill the table in along with the students.] **Talia's work is below. Take a minute to look at it and we can discuss.** [Put Talia's work on the board with division by 4 on the top row and division by 2 on the bottom row.] **What did Talia do to find the cost of 10 bottles**? [Pause] **We can divide by 2 and we see that the juice is $5 for the 2 bottles. We can divide by 4 and we see that the juice is $2.50 for the 1 bottle. To find the cost of 10 bottles (Did you almost forget that?), Talia multiplied the $2.50 for 1 bottle by 10. She got a price of $25 for the 10 bottles** **Did you do something similar? Let's look at another solution path.** [Put Mary's work on the board with x2, x3 and x$2\frac{1}{2}$ on each column.]	Students will engage in the introduction to connect previous learning centered on equivalent ratios to lead to rates and unit rates in today's lesson. The students will compare the work of Talia and Mary to see how both division and multiplication can be used for equivalent ratios.

Cost	$10.00		
Bottles of Fruit Juice	4		



Let's see what Mary did. [Pause for students to read.] **Mary's Work**  Since 10 is halfway between 8 and 12, I multiplied by $2\frac{1}{2}$. **How did Mary go about finding the cost of 10 bottles?** [Pause] **It does look like she multiplied. Let's look closely** [Follow along on the ratio table as you discuss this with the students.] **Mary first multiplied both cost and bottles by 2. She saw that 8 bottles costs $20. What did she multiply by next?** [Pause]. **She next multiplied by 3 and saw that 12 bottles costs $30. Why did she go back to 10 bottles of juice?** [Pause]. **Yes! She is trying to find out the cost of 10 bottles.** **Since 10 is halfway between 8 and 12, she recognized that she needed to multiply the terms in the rate by the number halfway between 2 and 3. What number is halfway between 2 and 3?** [Pause] **Yes! 2.5 or $2\frac{1}{2}$.** **Mary multiplied by $2\frac{1}{2}$. Multiply the cost, which is $10, by $2\frac{1}{2}$ and we'll see what we both got.** [Pause] **What is 10 x 2.5?** [Pause] **It is 25** **What does her ratio table show that Mary found for the cost of 10 bottles of juice?** [Pause] **You're right. Mary found that 10 bottles of juice does cost $25.** **Did you notice that $25 is also halfway between $20 and $30? Isn't that a cool noticing?** **We are going to use your understanding of finding equivalent ratios today to extend to finding rates.**	
<u>Teacher Model</u> (14 min) **You're probably thinking…what is a rate**? [Pause] **Let's dig in and see!** Objective 1: Find Equivalent Rates **Does anyone remember what a rate is defined as in mathematics?** [Pause] **Let's remind ourselves.** [Write the definition of rate on the board as you read it.]	Objective #1: Students will be reviewing finding equivalent rates. They will connect generating equivalent ratios to equivalent rates.

A rate is a special type of ratio that compares two quantities with unlike units of measure. **An example of a rate is the following:** **Jan saw 9 full moons in 252 days. As a rate, we write this as $\frac{9\ full\ moons}{252\ days}$.** **Here's another example:** **It took Hannah 38 minutes to run 8 laps. As a rate, this is $\frac{38\ min}{8\ laps}$.** **To help you connect, you can find equivalent rates the same ways that you can find equivalent ratios. What were those ways?** [Pause]	Students respond.
Great job! We used ratio tables, multiplication, division, and graphs. **Let's try one!** Problem 1:  **We are given a race track where a race car travels 10 km in 3 min. If the race car continues to travel at the same rate, how long will it take it to travel 25 kilometers**? [Write the problem on the board and read it for the students. Pause for students to think.] **What is our rate in this problem?** [Pause] **That's right, 10 km every 3 minutes, or 10 km/3min.** **Let's solve it in a couple of ways to show you how it connects to what we have been doing.** **ONE WAY:** **Use a ratio table to find rates that are equivalent to $\frac{10\ km}{3\ min}$.** **Since we are given 10 km and we are trying to find 25 km, we can set up the column for distance in increments of 5 km.** **Let's see how we can find the times.**	Students respond.

Distance (km)	Time (min)
5	
10	3
15	
20	
25	

What operation was performed to go from 10 km to 5 km? [Pause] **Yes! We divided by 2. So, we use the same operation with the 3 min. What is 3/2?** [Pause] **Yes. 1.5 or $1\frac{1}{2}$.**

Since we have worked with ratio tables for a few lessons, I am going to let you complete the table. We will check it in a bit! [Pause for students to work.]

[Put ratio table up for students to check their work.]

Distance (km)	Time (min)
5	1 ½
10	3
15	4 ½
20	6
25	7 ½

How did you do? How can we use the table to find our solution? [Pause]

We are asked to find the time it will take to travel 25 km. According to our work in our ratio table, it will take the race car $7\frac{1}{2}$ minutes to travel 25 km.

We can also solve it ANOTHER WAY:

Write the rate as a fraction. Let's multiply both terms of the rate by the same number to find an equivalent rate.

$\frac{10\ km}{3\ min} = \frac{25\ km}{x\ min}$. **We need to find a way to solve for x.**

Think, ten multiplied by what number gets me 25 or 10 x ? = 25. [Pause].

In earlier grades, we learned that we can re-write this mathematical sentences as 25 ÷ 10 = ?. What is 25/10? [Pause]. **Yes! 25/10 = 5/2 = $2\frac{1}{2}$ or 2.5**

Let's use that fact to help us find the number of minutes.

Remember, when we generated equivalent ratios, we multiplied or divided both the numerator and denominator by the same number.

This allowed us to keep the same relationship between the numbers in the ratio. Since we need to generate an equivalent rate, we can do the same.

Students respond.

To find the number of minutes for 25 km, we have $\frac{10\ km\ x\ 2.5}{3\ min\ x\ 2.5}$ **We know that 10 x 2.5 = 25. What is 3 x 2.5?** [Pause] **I agree. It is 7.5.** **So,** $\frac{10\ km\ x\ 2.5}{3\ min\ x\ 2.5} = \frac{25\ km}{7.5\ min}$ **This allows us to see that it will take the race car 7.5 minutes to travel 25 kilometers. Make sure to include those units as you work and respond today! The comparison of quantities with unlike units of measure is what makes these rate problems.** Problem 2: **Try it!** [Write the following problem on the board and read it to students.] **At the same rate, how long would it take the car to travel 60 kilometers?** [Pause] **What can we do to extend what we know to find this answer?** [Pause] **Let's set up the rate as a fraction**. $\frac{10\ km\ x\ ?}{3\ \text{min}\ x\ ?} = \frac{60\ km}{?\ min}$ **What factor can we multiply 10 by to get a product of 60?** [Pause]. **Yes. 6. We will multiply both numerator and denominator by 6 to get:** $\frac{10\ km\ x\ 6}{3\ min\ x\ 6} = \frac{60\ km}{18\ min}$ **How long will it take the car to travel 60 km?** [Pause]. **It will take the car 18 minutes to travel 60 kilometers.**	
Objective 2: Compare Quantities in Two Ways **We are now going to look at two ways to use a rate to represent relationships between the given units. Remember, in rates the units are not the same when comparing the two quantities like miles per gallon or cost per ounce.** Problem 1: **Harvest Market sells a crate of 15 pounds of Fuji apples for $12.00. What are two different unit rates that could represent the situation?** [Write problem on the board and read it to students.] **Let's remind ourselves of what a unit rate is. What is a unit rate? [**Pause]. **You got it! A unit rate compares a quantity to 1 unit of another quantity.** **What are our units in this problem?** [Pause]	Objective #2: Students will be building off of their work with rates to find unit rates. They will write the unit rates in two different ways. This allows us to compare each quantity to 1 unit of the other.

I agree. We have pounds and dollars.

What are we asked to do in this problem? [Pause]
Yep. Find two different unit rates that could represent the situation.

Let's do this!
Since our units are pounds and dollars, we need to find the unit rate in pounds per 1 dollar and then we will find it in dollars per 1 pound. [Pause]
I'll give you a moment to get started and we will work together. [Pause]
Let's start with finding the unit rate in pounds per dollar. We will use the abbreviation for pound, lbs, and the $ for dollars. Always make sure the units are present.
We start with $\frac{15\ lbs}{\$12}$. To find the unit rate PER DOLLAR, we need to get $1 in the denominator. What can we divide $12 by to get $1? [Pause] **You got it! We will divide by 12.**

Remember, when we generate equivalent rates, we divide both the numerator and denominator by the same number. This allows us to keep the same relationship between the numbers in the ratio.
So, let's divide both the pounds and the dollars by 12.

$$\frac{15\ lbs \div 12}{\$12 \div 12} = \frac{1.25\ lbs}{\$1}$$

This shows that the unit rate in pounds per dollar is $\frac{1.25\ lbs}{\$1}$.
What does this mean? [Pause]
It means that we can get 1.25 lbs of Fuji apples for $1 at the Harvest Market.

You take a moment to find the unit rate in dollars per pound. We will check our answers. [Pause for student work. After allowing students time to work, put the following on the board for them to check. You can read the solution as you right it.]

Now, we want to find the unit rate in dollars per pound. How would this look different? [Pause] **Yep. We will now have the dollars in the numerator and the lbs in the denominator.**
This gives us $\frac{\$12}{15\ lbs}$.
What does that help us find? [Pause] **It means that we are finding how many dollars it will cost for 1 lb of apples.**

For a unit rate, we need 1 lb in the denominator. I see that you divided by 15 to get that.

$\frac{\$12 \div 15}{15\ lbs \div 15} = \frac{\$0.80}{1\ lb}$. **The unit rate is dollars per pound is** $\frac{\$0.80}{1\ lb}$. **What does this mean?** [Pause] **It means that it's 80 cents for 1 lb of Fuji apples at the Harvest Market.** Problem 2: **A recipe for scrambled eggs uses 2 tablespoons of milk for every 3 eggs. What are two unit rates that could represent the recipe?** [Write problem on the board and read it to students.] **What does this problem ask us to find?** [Pause] **Yes. Two unit rates. What are the units in this problem?** [Pause] **They are tablespoons of milk and eggs.** **What are two ways to use a rate to represent the relationship between tablespoons of milk and number of eggs in the recipe?** [Pause] **I agree! We can use** $\frac{2\ tbsp\ milk}{3\ eggs}$ **or** $\frac{3\ eggs}{2\ tbsp\ milk}$ **Let's start with finding the unit rate in tablespoons of milk per 1 egg.** **We are starting with** $\frac{2\ tbsp\ milk}{3\ eggs}$ **What can we divide 3 eggs by so that we have 1 egg for this unit rate?** [Pause] **Yes! We will divide by 3.** **Remember, when we generate equivalent rates, we divide both the numerator and denominator by the same number. This allows us to keep the same relationship between the numbers in the ratio.** **I will let try this one and we will see how you did.** [Pause] **I see that you did the following? I agree!** $\frac{2\ tbsp\ milk \div 3}{3\ eggs \div 3} = \frac{\frac{2}{3} tbsp\ milk}{1\ egg}$ **What does this unit rate tell us?** [Pause] **It tells us how many tablespoons of milk will be used in the recipe for every 1 egg. We will use 2/3 tbsp of milk for 1 egg in this recipe.** **We said the other way to represent the relationship between tablespoons of milk and number of eggs is** $\frac{3\ eggs}{2\ tbsp\ milk}$. **I want you to use what we've learned today to find the unit rate in**	Students respond. Tying the learning together: Students will listen to the teacher do a think aloud modeling the thought process and an example for what a rate is and what a unit rate is. Students work.

number of eggs per 1 tablespoon of milk. [Pause for students to set up and work.] **To find the number of eggs per 1 tablespoon of milk, we must divide by what number?** [Pause] **You're right. We divide by 2 since there are 2 tbsp of milk.** **Do we just divide the denominator by 2?** [Pause] **No**, **when we generate equivalent rates, we divide both the numerator and denominator by the same number.** **This allows us to keep the same relationship between the numbers in the ratio.** **Take a moment to find the unit rate for** $\frac{3\ eggs}{2\ tbsp\ milk}$ [Pause] $\frac{3\ eggs \div 2}{2\ tbsp\ milk \div 2} = \frac{\frac{3}{2}eggs}{1\ tbsp\ milk}$ **What does this unit rate tell us?** [Pause] **It tells us how many eggs we will use in the recipe for 1 tablespoon of milk. For this recipe, we will use** $\frac{3}{2}$ **or** $1\frac{1}{2}$ **eggs for 1 tablespoon of milk.** **Our problem asked us to find two unit rates that could represent the recipe. What are the two unit rates?** [Pause] $\frac{\frac{3}{2}eggs}{1\ tbsp\ milk}$ **and** $\frac{\frac{2}{3}tbsp\ milk}{1\ egg}$**.** **Can every comparison of two quantities with different units of measurement be represented with two different unit rates?** [Pause]. **Yes! Explain**. [Pause.] **You can compare each quantity to 1 unit of the other.** **Do you think this information is helpful in our everyday lives?** [Pause] **When we shop, we want to know the best deal! This is a clear way to help us determine that.** **When we run, we want to know the fastest mile! This is a clear way to help us determine that.** **When we cook, we want to know information on a single serving! This is a clear way to help us determine that.** **We could find many ways that the unit rate gives us valuable information.** Tying the learning together: **To tie this all together. We have worked today with rates and unit rates. We see the following example to help us summarize our learning.**	Students work.

A rate compares quantities with unlike units of measures. $\frac{\$3.50}{7\ oranges}$ **A unit rate compares a quantity to 1 unit of another quantity.** $\frac{\$3.50}{7\ oranges} = \frac{\$0.50}{1\ orange}$	
Guided Practice (8 min) **It's time for us to do some together. I know you've got this.** Problem 1: **An elephant charges an object that is 0.35 kilometer away. If elephants can charge at speeds of 0.7 km per minute, how long will it take the elephant to reach the object?** [Write problem on the board and read along for students.] [We do] **We can use a fraction to set up a rate. Do we have the information for a unit rate?** [Pause] **Ok! You're right! What would the unit rate look like?** [Pause]. **Yes! It can be** $\frac{0.7\ km\ x\ ?}{1\ min\ x\ ?} = \frac{.35\ km}{?\ min}$. **What can we multiply 0.7 by to get 0.35?** [Pause] **It is 0.5! That means that our fraction set up as a rate is what?** [Pause] **I agree!** **We have** $\frac{0.7\ km\ x\ 0.5}{1\ min\ x\ 0.5} = \frac{0.35\ km}{0.5\ min}$**. How long will it take the elephant to read the object?** [Pause for student response.] **You're correct. It will take 0.5 minutes. Remember, this is a** $\frac{1}{2}$ **minute! Not bad for an elephant!** Problem 2: [You do] **In this problem, I want you to work all the way through it. We will then check to see if we found the same solution. Here you go!** **It took Paola 8 games to score 30 points. At that rate, how many games will it take her to score 45 points?** [Pause for students to work.] **To make sure you have it, let's look at your answer. Did you determine that Paola needs to play 12 games to score 45 points?** [Pause] **How did you solve it?** [Pause] **Oh! You wrote it as a fraction? I heard someone say they did a table. Let's look at a table!**	Students will move with the teacher through the gradual release process. The teacher model allowed for the teacher to show steps to solve. In the guided practice, students will do more of the work and teachers will prompts as needed.

Games	1	4	8	12
Points	7.5	15	30	45

By looking at our table, we can see that the unit rate is 7.5 points for 1 game.

We can also see that 15 points were scored in 4 games. I think this information is the most helpful! $\frac{4\ games}{15\ points}$ = $\frac{?games}{45\ points}$. **We can easily see that 15 x 3 = 45, so 4 x 3 = 12. I think you've got it! Thank you for working alongside me today.**

Additional Problems (if Needed):
Use the given chart for both problems

Distance Driven Using 10 Gallons of Gasoline	
Vehicle	Miles
Car	285
Van	140
Motorcycle	640

1.) Mr. Ernest wants to know how many miles he can travel with his motorcycle for each gallon of gas. What is the unit rate in miles per gallon?
2.) Ms. Ellis used 25 gallons of gas delivering flowers in her delivery van. How many miles did she drive making the deliveries? Explain.

Independent Practice (1 min)

Great work! Today, we reviewed ways to understand rates and unit rates. 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)

I enjoyed reviewing rates and unit rates 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!	

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