PBS Lesson Series

Math: Grade 6, Lesson 15, Ratios and Rates

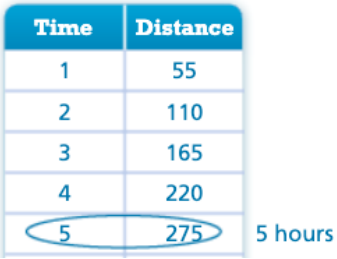
Lesson Focus: Solve unit rate problems
Practice Focus: Students will focus on using unit rates to solve problems involving constant speed and unit price.
Objective: Students will use unit rates to solve problems involving constant speed and unit prices.
Key Vocabulary: unit rate, constant speed, and unit price
TN Standards: 6.RP.A.3b
Teacher Materials:

- White board and markers
- 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 fifteen 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 using unit rate to solve problems involving constant speed and unit price 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 – If you don't have a calculator, you can grab a phone and use the calculator on it.** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (3 min)	Students participate in the introduction discussion by

Let's get started with a problem to get your brain engaged. [Write the problem and table on the board as you talk through it.] **Suppose you and a friend are traveling by train to visit a friend who lives 275 miles away. If the train travels at a constant speed of 55 miles per hour, how long will the trip take?**  **Use what you know about unit rates to model and solve this problem.** [Pause for students to solve.] **Let's look at how two students solved this problem. Logan used a ratio table to show equivalent ratios of distance to time for each distance up to 385 miles.** [Display Logan's work.] **He started with the unit rate that was given in the problem. The unit rate is 55 miles per hour. How did he use the unit rate to solve the problem?** [Pause] **Exactly, Logan calculated the time for each hour by multiplying by 2, x 3, x 4, x 5. He stopped at 5 since it equaled 275.** **Logan's Work**  5 hours **Let's look at another way to solve this problem. Zoe used the unit rate to find an equivalent rate. [**Display the work or write the work on the board.] **Zoe's Work**  **Zoe knew that she could set up an equivalent ratio to solve this problem. She models the division problem and the multiplication problem for us. Did you use either of these ways?** [Pause**] Great work! We're going to apply what we have learned about equivalent rates and unit rates to solve**	completing the question. Pauses are given for student response. This introduction will allow students to solve a problem involving a constant rate and connect it to solving constant speed problems. Students solve the problem.

Time	Distance
1	55
2	110
3	165
4	220
5	275

problems involving constant speed and unit price. Let's get started!	
Teacher Model (12 min) Objective 1: Solve constant speed problems **First, let's look at a constant speed problem. Be thinking about how we could use unit rate to help us solve it.** [Write the problem on the board as you read it or display it.] **The jet flies at a constant speed. If the jet continues to fly at the same rate, how far could the jet fly in 85 minutes?**  **Constant speed means that the speed stays the same over time. What is an example of something that would not travel at a constant speed?** [Pause] **One example I thought about is someone riding a bike down a hill or over a hilly terrain. The rate we are given is 175 miles in 7 minutes. Why is it difficult to find a rate equivalent to $\frac{175}{7}$ that has 85 as the second denominator?** [Pause] **You probably said that it is difficult to find an equivalent rate. Seven is not a factor of 85, so you cannot multiply the numerator and denominator of the given rate by a whole number. What is another way we could solve it?** [Pause] **You're right we could make a table to set up equivalent rates. Let's try a table. Draw one on your paper as I create one on mine.** [Write information into table as you go through this entire problem.] | Time (min)	Distance (miles)
7	175
	| **How could you find the unit rate in this problem?** [pause] **You're right, we can divide both 7 and 175 by the given rate of 7 to find the number of miles per 1 minute.** [Write divide by 7 on both side of the table.]	Objective #1: Students will solve constant speed problems by making connections to ratio tables and equivalent rates. Students will listen to the teacher do a think aloud working a contextual problem modeling the thought process for a problem from the start of the problem through finding the solution. Students respond. Students respond. Students draw the table on their paper. Students respond.

Time (min)	Distance (miles)
1	25
7	175

What is the unit rate? [Pause] $\frac{25\ miles}{1\ minute}$**. It is helpful to start the table with the unit rate so you can find equivalent rates for any number of minutes. To find how many miles in 85 minutes you multiply both terms by 85 to equal 2,125 miles in 85 minutes.**

Time (min)	Distance (miles)
1	25
7	175
25	625
50	1,250
85	2,125

×85 ×85

Another way we can solve this is to write is to write constant speed as unit rate.

$$\frac{175\ miles\ \div 7}{7\ minutes\ \div 7} = \frac{25\ miles}{1\ minute}$$

We can use the unit rate to find how many miles in 85 minutes.

$$\frac{25\ miles\ \times\ 85}{1\ minute\ \times\ 85} = \frac{2,125\ miles}{85\ minutes}$$

The airplane travels 2,125 miles in 85 minutes.

Objective 2: Solve unit price problems

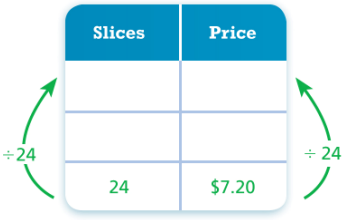
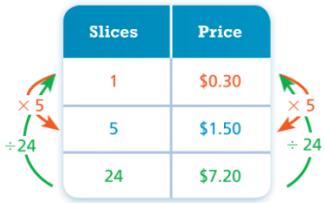
Let's see how we can use unit rate to find unit price. What do you think a unit price is? [pause] **Since a unit rate compares a quantity to one unit of another quantity, the unit price is the cost of one item.**

[Write the problem on board as you talk through it.]

Grocery Giant is having a sale on Swiss cheese. You can buy 24 slices for $7.20. How much would it cost to buy 5 slices of cheese at the same rate? [Pause]

Objective #2:
Students will use unit rate to solve unit price problems.

Students respond.

Take a minute to think about how we could solve this problem. [Pause] **Let's try using a ratio table to solve this problem.** | Slices	Price
24	$7.20 | **How can we find the unit rate which is the unit price?** [Pause] **Right, we need to find the price of one piece of cheese. Since we want the price per slice of cheese, we need 1 in the slice column. How can we do this?** [Pause] **Right, we need to divide both terms by 24.**	Students respond.
 **When we divide both terms by 24 we get $0.30 for 1 slice. The unit cost is $0.30 – this means that each piece of cheese costs 30 cents. How can we figure out how much is costs for 5 slices?** [Pause] **Exactly, we can multiply the unit rate by 5.**  **At this rate, it would cost $1.50 for 5 slices of cheese.** **Another way we could solve is to find the unit rate.** $\frac{\$7.20 \div 24}{24\ slices \div 24} = \frac{\$0.30}{1\ slice}$ **We can use the unit rate to find how many 5 slices cost.**	Students respond.

$\frac{\$0.30 \times 5}{1\ slice \times 5} = \frac{\$1.50}{5\ slices}$ **This shows us that the cost for 5 slices is $1.50. You can choose which method works best for you.**	
Objective 3: Use an equation to represent unit rate problems **Let's see how we can use equations to represent unit rate problems!**	Objective 3: Students will use unit rate to connect to the distance formula and solving constant speed problems.
A ferryboat travels at a constant speed of 57.5 miles in 2.5 hours. How long would it take the ferryboat to travel 92 miles? [Talk the student through making a ratio table similar to the one below.] **We know that it takes 2.5 to go 57.5 miles. How can we find out how many miles it travels in 1 hour?** [Pause] **You're right we can divide both terms by 2.5.**	Students respond.
	
The ferryboat travels 23 miles in 1 hour. That's the unit rate for the speed of the boat! How can we use unit rate to determine how far the boat travels if we know the time? [Pause] **That's it! We would multiply the unit rate times the amount of time and that tells us distance. This can be written as an equation to show how many miles it goes. Distance equals the unit rate times the time travelled or $d = r \times t$. The equation show that distance is the product of rate and time. This is a formula you will use a lot in later grades. Let's try it out!**	Students respond.
Now let's substitute 92 miles for the distance and 23 for the rate. $92 = 23t$	
How can we solve this equation? [Pause] **Exactly! Divide both side by 23. Remember, you can use a calculator to help you solve this problem.**	Students respond.
$\frac{92}{23} = \frac{23t}{23}$ ***t* = 4**	Students respond.

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Is our answer 4? [Pause] **You're exactly right. We need to include units. The answer is 4 hours. It would take the ferryboat 4 hours to travel 92 miles.**

Typically we use an hour for the time.

Tying the learning together:
We learned that we can use 3 different strategies -ratio tables, finding the unit rate, and an equation- to solve constant speed and unit price problems. We've done a couple of problems together, and you're doing great! Let's transition to you trying some problems and then we'll discuss them together.

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Tying the learning together:
Student will listen to the teacher connect how the ratio table and unit rate connect to constant speed and unit price.

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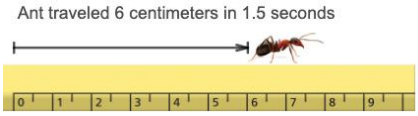
<u>Guided Practice</u> (8 min)

Let's look at another problem.
[Write or display the problem as you read it.]

1. An ant traveled 6 centimeters in 1.5 seconds. How far did it travel in 9 seconds?



Think about what we've done today. How can we solve this problem? [Pause] **You're right. We've got a couple options to choose from. Let's start with a ratio table. Build your table on your paper as I write on the board.**

Time (s)	Distance (cm)
1.5	**6**

How can we figure out how far the ant travels in 1 second? [Pause] **Exactly, we can divide both terms by 1.5.**

Time (s)	Distance (cm)
1	**4**
1.5	**6**

The ant travels 4cm in 1 second. We could find how far the ant travels in 2 sec, 3 sec, and so, but since we want to know how far in 9 seconds, we can multiply by 9. [The highlighted row shows the answer.]

Time (s)	Distance (cm)
1	**4**

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Students will work through problems to compare ratios. The teacher will work alongside the students in the gradual release process. The first problem will show all three methods to solve the problems with the teacher thinking aloud.

Students draw the table.

Complete the ratio table.

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1.5	**6**
2	**8**
3	**12**
9	**36**

What is another way we could solve this problem? [Pause] **We could set up an equivalent ratio.**

$$\frac{6cm}{1.5\ sec} \div \frac{1.5}{1.5} = \frac{4cm}{1\ sec}$$

Students respond.

Now we can use the unit rate to find how far the ant travels in 9 seconds

$$\frac{4cm}{1\ sec} \times \frac{9}{9} = \frac{36\ cm}{9\ sec}$$

Great work using ratios to solve! What is the last way we learned to solve constant speed? [Pause] **You're right! We use our new equation- $d = r \times t$ - to solve for distance.**

Students respond.

What does the r stand for? [Pause] **Perfect! It stands for the unit rate. What is the rate in our problem?** [Pause] **That's right. The rate is 4. You might have said 6. Why isn't the rate 6?** [Pause] **Exactly! The rate is the unit rate, so we have to use 4. If we didn't already know the unit rate, we would need to calculate it first. What does the t stand for?** [Pause] **That's right – time. What is our t in this problem? 9 seconds.**

Students respond.

d = r t
$d = 4 \times 9$
d = 36 seconds

Students respond.

Wow! We solved the same problem in three ways. Let's try another one.

[Write or display the problem as you read it.]
2. Jarod paid $13.80 for 5 tickets to the game. At the same rate, how much would it cost for 3 tickets?

Take a minute to think about how you want to solve this problem? [Pause] **How did you decide to solve this problem?** [Pause] **You could have said you want to solve using a ratio table, using equivalent ratios, or by using an equation. You try to solve the problem. Remember, you can use a calculator to help you.** [Pause for about a minute to give students time to solve.]
Let's check to see how you did. Remember, you can choose the method that makes the most sense to you. When I show

Students will do this problem with the teacher. This is the "we do" section of the lesson.

a couple different ways, I want you to pay close attention to a different method to see if you can figure out how to do it that way so you can try a new method on the next problem. **We'll start with the ratio table. What are the terms I need to have in the table?** [Pause] **That's right! We need number of tickets and the price.**	Students respond.
How can we determine how much one ticket costs? [Pause] **Exactly, we can divide both terms by 5. The price for 1 ticket is $2.76. Now, we can multiply both terms x 2, x 3.** [The highlighted row is the answer.]	Students respond.
3 tickets cost $8.28. **You might have solved the problem using equivalent ratios. Let's do that method next.** $\frac{\$13.80}{5\ tickets} \div \frac{5}{1.55} = \frac{\$2.76}{1\ ticket}$ $\frac{\$2.76}{1\ ticket} \times \frac{3}{3} = \frac{\$8.28}{3\ tickets}$ **The last method we use is an equation. What is an equation we could use to solve this situation?** [Pause] **You might have said something similar to this one.**	Students respond.
$Total\ Cost = Number\ of\ tickets \times Price\ of\ 1\ ticket$ **C = n x t** **Where C equals the total cost, n equals the number of tickets, and t equals the price of 1 ticket. You could have use**	

Number of Tickets	Price
1	
2	
3	
5	$13.80

Number of Tickets	Price
1	$2.76
2	$5.52
3	$8.28
5	$13.80

different variables in your equation. The important part is to make sure you define them. **Remember, we want to use the unit rate when we're solving in an equation. Let's substitute in our information.** $$\boldsymbol{Total\ Cost = Number\ of\ tickets \times Price\ of\ 1\ ticket}$$ $$\boldsymbol{C = 3 \times \$2.76}$$ $$\boldsymbol{C = \$8.28}$$ **It is really exciting that you can solve the same problem in several ways. Let's try one more involving the equation.** [Write the problem or display as you read it.] **3. A submarine travels 19 miles in $\frac{1}{2}$ hour. Write an equation to find out how long it would take the submarine 57 miles at the same rate. Then find the time.** **Take a minute to answer the problem. I know you can do it!** [Pause] **Let's see how you did. In order to solve the problem, we've got to find the unit rate first. So if the submarine travels 19 miles in $\frac{1}{2}$ hour, we can multiply both terms by 2 to get the unit rate.** $$\frac{19\ miles}{\frac{1}{2} hour} \times \frac{2}{2} = \frac{38\ miles}{1\ hour}$$ **You could have use a ratio table to find the unit rate. Now, let's answer the second part of the problem.** **Write an equation for how long it will take the submarine to go 57 miles. What equation this you write?** [Pause] **You probably wrote something similar to this one.** $$\boldsymbol{d = r \times t}$$ $$\boldsymbol{57 = 38\ x\ t}$$ **How can we solve for t? [pause] That's right, divide both side by 38.** $$\frac{57}{38} = \frac{38t}{38}$$ **Let's calculate 57 divided by 38. That equals 1.5. It will take the submarine 1.5 hours to travel 57 miles.**	Students complete this problem, then the teacher models a think-aloud. Students respond.

Additional Problem (if needed): 1. **If a driver drives at a constant rate of 38 miles per hour, how long would it take the driver to drive 209 miles?**	
Independent Practice (1 min) **Woohoo, we made it! Today, we reviewed ways to use unit rates to solve problems involving constant speed and unit price. I hope you're seeing some connections to problems you can solve around your house and at the store! 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) **Students, I enjoyed reviewing how unit rates can help us solve problems involving constant speed and unit price! 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!**	