PBS Lesson Series

Math: Grade 7, Lesson 15, Apply Proportional Reasoning to Solve Problems

Lesson Focus: The focus of this lesson is to explain why a situation represents a proportional relationship and using representation to find entry points into problems.
Practice Focus: Students will be determining if a situation represents a proportional relationship and solving for quantities based of the constant of proportionality.
Objective: The objective of this lesson is be able to recognize proportional quantities and use information about proportional relationships in order to solve problems.
Key Vocabulary: Unit rate, Ratio, Proportion, Constant of Proportionality, Equivalent
TN Standards: 7.RP.A.1 and 7.RP.A.2
Teacher Materials:

- Paper or white board
- Pen/pencil/marker
- Prepared copies of the examples (to save time)
- Student Practice Packet

Student Materials:

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

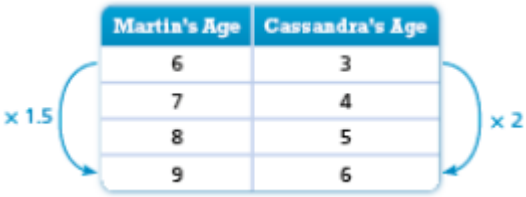
Teacher Do	Student Do
Opening (1 min) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 7th graders out there, though all children are welcome to tune in. This lesson is the fifteenth in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee 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. If you don't already have the student packet for this lesson, you can find it online at www.tn.gov/education. You can still tune in to today's lesson if you haven't seen 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 applying proportional reasoning in order to solve problems. Before we get started, to participate fully in our lesson today, you will need:** • **Paper, a pencil and a surface to write on and the optional student packet** **Ok, let's begin!**	Students get materials ready for the lesson.

Intro (3 minutes) **We have been working quite a bit with ratios over the past several lessons. It may beneficial for some review time prior to today's challenge.** **From the previous lessons we have learned what proportional relationships, unit rates, and constants of proportionalities are along with how to write equations using the very valuable information.** **What do you remember about proportional relationships? Write down your thoughts.** [Pause] **Let's talk about it… Two quantities are in a proportional relationship if all of the ratios that relate the quantities are equivalent or equal. What's that? Your right! If you graph a proportional relationship it passes through (0, 0) or the origin. Great job!** **So, what do you remember about a unit rate? Write down your thoughts.** [Pause] **A unit rate is a very special ratio that has a one in the denominator which is the number on the bottom of the ratio.** **Last one…what is the constant of proportionality? Write down your thoughts.** [Pause] **The constant of proportionality is the constant multiple that relates proportional quantities x and y. It is the value of the ratio $\frac{y}{x}$ and is represented by k in the equation $y = k(x)$.** **Today's lesson is going to focus on applying proportional relationships in order to solve a variety of problems. This is going to be really fun because we are going to take what we have learned in the previous lessons and apply it to real world problems! Can you think of a place where you have seen ratios or a proportional relationship? Maybe at your home or somewhere at school?** [Provide a long pause.] **That is a good example! I think proportional relationships every time I have to stop and get gas for my car. The big sign usually says the price per gallon which is actually a unit rate! Ratios and proportional relationships are very helpful! Let's solve some problems together!**	Student watches and listens. They think about ratios, unit rates, and constant of proportionality. Students think of examples of ratios and proportional relationships in the real world.
Teacher Model (10 minutes) Objective 1: Applying proportional relationships in order to solve problems. [Teacher reads problem aloud and displays on board.]	Objective 1: Students will apply proportional relationships in order to solve this problem.

The ratio of collectible cards DeShawn owns to cards that Stephanie owns is 5:2. Stephanie has 36 cards. How will the ratio of DeShawn's cards to Stephanie's cards change if they both sell half their cards? Explain your answer.	
Make sure you work the problem on your paper as I work it on the board. What do we know from the problem? Yes there is a ratio. What is the ratio of DeShawn's cards to Stephanie's cards? [Pause] **The problem says; The ratio of collectible cards DeShawn owns to cards that Stephanie owns is 5:2. What does this ratio actually mean?** [Pause] **Exactly, it means that for every 5 cards that DeShawn has Stephanie has 2 cards. How many cards does Stephanie currently have according to the problem?** [Pause] **36 good job! Now that the important information has been gathered from the problem, Can you figure out how many cards Deshawn has before he sells half of them?** [Pause] **The ratio is very important in this problem! If the ratio is $\frac{5}{2}$ then we are able to set up a proportional relationship.** [Teacher writes the proportional relationship as shown below.] $$\frac{5}{2} = \frac{x}{36}$$	Student answers question. Student answers questions.
Go ahead and write this equation on your paper. The $\frac{5}{2}$ is the ratio of DeShawn's cards to Stephanie's cards yet where did the 36 come from? [Pause] **That's right! It represents the 36 cards that Stephanie currently has. What does the variable x represent?** [Pause] **Right again! It represents what we are trying to solve for and that is the amount of cars that DeShawn has. How can we solve for the variable?** [Pause] **We can multiply each side of the equation by 36! Go ahead and do this process!** [Teacher performs work as shown below.] $$\frac{5}{2} = \frac{x}{36}$$ $$36 \cdot \frac{5}{2} = \frac{x}{36} \cdot 36$$ $$90 = x$$	Student writes down equation. Student answers prompts. Student solves the equation.
From the equation we calculated that Deshawn currently has 90 cards. With this information the ratio $\frac{90}{36}$ can be formed since Deshawn has 90 cards and Stephanie has 36 cards. [Teacher writes ratio on the board.] **The problem tells says**	

that both Deshawn and Stephanie sell half of their cards. How are you going to find their new totals? [Pause] **Right! Divide 90 by 2 and divide 36 by 2. Go ahead and write the new ratio!** [Pause] **The new ratio is $\frac{45}{18}$ after both Deshawn and Stephanie sell half of their cards.** [Teacher writes new ratio on the board.] **Now we need to simplify this ratio. What number goes into both 45 and 18?** [Pause] **9 is a multiple of both 18 and 45 so divide both 45 and 18 by 9! Go ahead tell me your answer!** [Pause] **It is $\frac{5}{2}$. The ratio did not change! The reason it didn't change is because both DeShawn and Stephanie sold the same multiple of cards! Great job!**	Student answers questions. Student writes new ratio. Student answers question.
Objective 2: Recognize When to Use Proportional Reasoning **Here is another example of how to properly apply proportional reasoning in a contextual problem. Take a look! Make sure you work the problem with me.** **Martin is 6 years old when his sister Cassandra is 3 years old. How old will Martin be when Cassandra is 6 years old?**	Objective 2: Students recognize when to use proportional reasoning.
Can you make a table in order to represent this problem? Great see if you can find the answer using your table. [Teacher pauses while student makes a table. Teacher will have table below ready to put on the board.]	Student creates table.
This is an example of a table. Do the values look similar to yours? [Pause] **From your table how old will Martin be when Cassandra is 6 years old?** [Pause] **Martin will be 9 years old when Cassandra is 6. Does this represent a proportional relationship? Why or why not?** [Provide a long pause.] **This does not represent a proportional relationship! Here is the reasoning.** [Teacher displays new table below.]	Student compares their table to the one on the board. Student answers questions.

Martin's Age	Cassandra's Age
6	3
7	4
8	5
9	6

 **There is no constant multiple so proportional reasoning cannot be used in this scenario! Notice that Martin's age increases by a multiple of 1.5 while Cassandra's age increases by a multiple of 2. Because these are not the same multiples it is not a proportional relationship thus proportional reasoning can't be applied to this problem. Great job!**	
Guided Practice (10 minutes) **You have been doing such a great job helping me through these problems! Thank you very much for your help and answering my questions. Will you please help me with this one?** [Pause] **Great let's do it!** [I do] [Teacher posts and reads problem aloud.] **A video streaming service charged Bryan $143.84 for a full year of access. According to the companies add, the video streaming service costs $8.99 per month. Bryan thinks he was not charged the correct amount. What should Bryan say when he calls customer service?** **For the first step can you create an equation to represent the scenario?** [Pause] **Perfect! What did you create?** [Pause] **Excellent! Since the rate is $8.99 a month, a possible equation is $y = 8.99\ x$** [Teacher writes equation on the board.] **Does this look like yours?** [Pause] **Great work! What do the x and y variables represent in the equation?** [Pause] **Absolutely! The y variable is the cost after x amount of months. Since Bryan has paid for a full year of service how many months should he have been charged for?** [Pause] **Correct there are 12 months in a years so Bryan should be charged for 12 months of service. What variable should we substitute the 12 in for x or y?** [Pause] **x is the right variable! Now we can solve! Write this down on your paper.** [Teacher writes equation and solves for amount on the board.] $$y = 8.99(x)$$ $$y = 8.99\ (12)$$ $$y = 107.88$$	Student thinks about a strategy. Student creates equation. Student answers questions.

What does this mean? [Pause] **You are right! Bryan should have been charged $107.88 for a year of streaming services. What should Bryan say when he talks to customer service?** [Pause] **Bryan should ask for a refund but for how much? Can you calculate Bryans refund?** [Pause] [Teacher shows worked out process below.] $\$143.84 - \$107.88 = \$35.96$ **Bryan should be asking for a refund of $35.96. Thank you so much for helping Bryan with that issue! Are you ready for another one?** [Pause] **Great!**	Student interprets answer.
[We do] [Teacher posts and reads aloud the problem.] **Marco needs to buy some cat food. At the nearest store, 3 bags of cat food cost $15.75 how much would Marco spend on 5 bags of cat food?**	Student reads problems and thinks of strategies.
What would your first step be in order to solve the problem? [Pause] **You are right! We need to calculate a unit rate price to see how much it will cost for 1 bag of cat food. Go ahead and calculate the price for one bag of cat food.** [Pause] **Did you divide $15.75 by 3?** [Pause] **Great this is exactly what you should have done. What did you get for a unit rate?** [Pause] **$5.25 is how much it costs for per bag of cat food.**	Student says their first step. Student calculates unit rate.
Look back in the problem and find how many bags of cat food Marco needs to buy. [Pause] **Right he needs to buy 5 bags of cat food. Since you have already solved and found the unit rate can you create an equation to represent the situation?** [Pause] **Awesome use x and y as your variables in your equation.** [Pause] **Does your equation look like this one?** [Teacher writes equation on the board.] $\boldsymbol{y = 5.25\ (x)}$**. That's great! If Marco needs to purchase 5 bags of cat food which variable will he substitute the 5 in for?** [Pause] **Right! You are going to substitute 5 for x. Go ahead and substitute and solve for the amount Marco will be charged.** [Pause][Teacher will perform solving process on the board as below.] $\boldsymbol{y = 5.25\ (x)}$ $\boldsymbol{y = 5.25\ (5)}$ $\boldsymbol{y = 25.25}$ **What does this mean?** [Pause] **Exactly! The store will charge Marco $25.25 for 5 bags of dog food. Awesome Job! Now**	Student answers question. Student forms equation. Student calculates how much the store will charge Marco. Student interprets answer.

Marco knows how much money he needs to take to the store! **Here is another one!** [You do] [Teacher reads problem and puts it up on the board.] **A recipe calls for 15 oz of flour for every 8 oz of milk. Is the relationship between ounces of flour and ounces of milk proportional? Explain. What do you think? Is this relationship proportional?** [Pause] **Can you explain why?** [long Pause] **Great job! It is a proportional relationship because you can write an equation $y = \frac{15}{8}x$ where $\frac{15}{8}$ is the ratio comparing the oz of flour to oz of milk.** [Teacher writes problem extension and says it aloud.] **What if a recipe calls for 15 oz of milk, how much flour should be used? Can you use your equation to solve for the amount of flour?** [Pause] **Excellent! Go ahead and solve!** [Pause] [After pausing the teacher will perform work below on the board.] $$y = \frac{15}{8}(x)$$ $$y = \frac{15}{8}(15)$$ $$y = 28.125$$ **What does this mean?** [Pause] **Exactly! 28.125 oz of flour is needed!** Additional problem if needed: Jasmine is ordering 3 new uniforms for work online. The 3 uniforms cost $83.97. The company charges a flat fee of $15.00 for shipping and handling for each order. Write an equation to relate the total cost of the order to the number of uniforms. Is the relationship proportional? Explain. How much would it cost for 10 uniforms?	Student determines is the relationship is proportional. Student uses equation to solve for missing value
<u>Independent Practice</u> (1 min) **Great work, 7th grade! Today, we worked on how to use constants for proportionalities in order solve problems and write equations! 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 do your best!**	
Closing (1 min) **I enjoyed reviewing finding unit rates with ratios of fractions, and use them to solve multi-step problems 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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