MSTAR INTERVENTION

L14

Lesson 14: Writing and Solving Proportions From Word Problems

Lesson Objective

- Students will write and solve proportions with missing values from word problems.

Instructional Materials

Material	Quantity	Description
How Am I Doing? graph	1 per student	
Colored pencils	1 per student	
Display Masters	1 each	• Preview: Key Ideas: Writing Proportions From Word Problems • Demonstrate: Lunchtime A–I • Demonstrate: Racecar A–F
Handouts	1 per student	• Cumulative Review • Practice • Independent Practice
Answer Keys	1 each	• Cumulative Review • Practice • Independent Practice

Cumulative Review

Have students answer the questions on the Cumulative Review handout. Go over the answers. Correct misconceptions. Have students use a colored pencil to make corrections as needed. Collect student papers to determine who needs additional instruction.

Preview

This lesson will build on students' conceptual knowledge of proportionality and equivalent ratios.

Display and introduce through a brief explanation the key ideas for this lesson:

- A proportion can be written to find a missing value from a situation that models a proportional relationship.
- When writing a proportion, using units or labels for the quantities being compared is important to make sure like ratios are compared.

Use the Key Ideas: Writing Proportions From Word Problems DM display master as needed.

Engage Prior/Informal Knowledge

To open the lesson, present situations and questions to activate students' background knowledge and preskills, such as the following:

The Mendez family eats 3 boxes of cereal in 2 weeks. At this rate, they will eat 21 boxes of cereal in 14 weeks. Work in partners to answer the following questions:

- What 2 quantities are being compared in this situation?
- What are the steps for solving this type of problem? Write them.
- Can you write proportions in multiple formats for this situation? How do you know? Write them.

Solicit responses from 2–3 pairs. Ensure that students use the correct mathematical language in their answers and explanations.

If students cannot answer these questions, stop and explicitly teach the material.

Demonstrate

1. Write a proportion to solve a problem.

Say: *In the previous lesson, we learned how to write proportions in multiple formats from word problems. Today, we will learn how to write and solve proportions with missing values from word problems. Remember that a ratio is a comparison of quantities. When ratios are equivalent, they are proportional. From word problems modeling proportional situations, we can write equivalent ratios to find a missing value.*

Say: *Consider the following situation. A school survey found that 20 out of 50 students eat lunch in the cafeteria. If the school has 1,500 students, how many students eat lunch in the cafeteria?*

Use the Lunchtime A **DM** display master as needed.

Say: *Let's highlight the key information.* 1

Use the Lunchtime B **DM** display master as needed.

Say: *From this situation, we can write a proportion comparing 2 ratios. When writing the proportion, it is important to record the units, or labels, of the quantities that are compared to ensure that like ratios are compared.*

Say: *Let's begin with the Understand section of the graphic organizer. What is this problem asking? (how many students eat lunch in the cafeteria if there are 1,500 students in the school)*

1 **TEACHER NOTE**
Model highlighting the key information. Have students use colored pencils to highlight and underline key information. Use the Lunchtime B display master as needed.

Say: *Now, let's plan how to solve this problem. Discuss these questions with your partner:*

- *What quantities am I comparing? (number of students eating in the cafeteria and total number of students)*
- *What do I know? (20 out of 50 students eat lunch in the cafeteria; there are 1,500 students in the school)*
- *What quantities go together? (20 students eat in the cafeteria and 50 total students; x students eat in the cafeteria and 1,500 total students in the school)*
- *What am I looking for? (the number of students who eat lunch in the cafeteria out of 1,500 total students)*
- *How would I set this up?* ($\frac{\text{students eat in cafeteria}}{\text{total students}} = \frac{\text{students eat in cafeteria}}{\text{total students}}$)

Solicit answers from different groups. Have the other students give a thumbs-up or a thumbs-down to show whether they agree with the given answers.

Use the Lunchtime C **DM** display master as needed.

Say: *When comparing these 2 ratios, we can create the proportion* $\frac{\text{20 students eat in cafeteria}}{\text{50 total students}} = \frac{x\text{ students eat in cafeteria}}{\text{1,500 total students}}$. *Notice that the numerators of both ratios represent the number of students who eat in the cafeteria, and the denominators of both ratios represent the total number of students. I use an x to represent the quantity that I am looking for.*

Use Lunchtime D **DM** display master as needed. 2

2 TEACHER NOTE
Allow students to use a calculator for computation as needed. It is more important for students to understand the concept than to do the calculations without a calculator.

Say: *Now, let's solve the problem by finding the missing value. What is the most efficient method? Because there is a whole number that we can multiply 50 by to get 1,500, we will use the method of multiplying by a value equivalent to 1 to solve.*

Say: *We can multiply 50 by 30 to get 1,500. If we multiply the denominator by 30, we must multiply the numerator by the same number. So, we multiply the numerator 20 by 30 and get 600. Therefore, using the same rate, 600 students eat in the cafeteria out of 1,500.*

Use the Lunchtime E DM display master as needed.

Say: *As long as we include units to ensure that we are comparing like ratios, we can set up the proportion in different ways.*

Say: *Another way to set up the proportion is to write it so that the total number of students is in the numerator, and the number of students who eat in the cafeteria is in the denominator. So, we could say* $\frac{\text{50 total students}}{\text{20 students eat in the cafeteria}} = \frac{\text{1,500 total students}}{x \text{ students eat in the cafeteria}}$.

Use the Lunchtime F DM display master as needed.

Say: *We could also set up the proportion with the number of students who eat in the cafeteria in 1 ratio and the total number of students in the other ratio. So, we could say* $\frac{\text{20 students eat in cafeteria}}{x \text{ students eat in the cafeteria}} = \frac{\text{50 total students}}{\text{1,500 total students}}$. *Notice that the numerators of the ratios reflect the 20 students who eat in the cafeteria out of 50 total students, and the denominators of the ratios reflect the x students who eat in the cafeteria out of 1,500 total students.*

Use the Lunchtime G DM display master as needed.

Say: *The last way we could write the proportion builds off the last example. We could again compare the number of students who eat in the cafeteria in 1 ratio and the total number of students in the other ratio. In* *this proportion, we could say* $\frac{x \text{ students eat in cafeteria}}{20 \text{ students eat in the cafeteria}} = \frac{1{,}500 \text{ total students}}{50 \text{ total students}}$*. Notice that the numerators of the ratios reflect the x students who eat in the cafeteria out of 1,500 total students, and the denominators of the ratios reflect the 20 students who eat in the cafeteria out of 50 total students.*

Use the Lunchtime H **DM** display master as needed.

Say: *We can confirm that the proportions are accurate by multiplying by a value equivalent to 1 to solve the proportion. Each time we solve the proportion, we get that 600 students out of 1,500 students eat in the cafeteria. Discuss the following questions with your partner:*

- *Is my answer reasonable? (yes)*
- *How do I know? (both ratios in the proportion simplify to the same ratio)*

Solicit answers from different groups. Have the other students give a thumbs-up or a thumbs-down to show whether they agree with the given answers.

Use the Lunchtime I **DM** display master as needed.

2. Write a proportion to solve a problem.

Say: *Consider the following situation. A racecar traveled 16 miles in 4 minutes. At this rate, how far will the racecar travel in 12 minutes?*

Use the Racecar A **DM** display master as needed.

Say: *Let's highlight the key information.*

TEACHER NOTE
Model highlighting the key information. Have students use colored pencils to highlight and underline key information. Use the Racecar B display master as needed.

Use the Racecar B DM display master as needed.

Say: *From this situation, we can write a proportion comparing 2 ratios. When writing the proportion, it is important to record the units, or labels, of the quantities that are compared to ensure that like ratios are compared.*

Say: *Let's begin with the Understand section of the graphic organizer. What is this problem asking? (how far the racecar travels in 12 minutes)*

Say: *Now, let's plan how to solve this problem. Discuss the following questions with your partner:*

- *What quantities am I comparing? (miles traveled to number of minutes)*
- *What do I know? (16 miles in 4 minutes; 12 minutes have passed)*
- *What quantities go together? (16 miles and 4 minutes; x miles and 12 minutes)*
- *What am I looking for? (the number of miles traveled in 12 minutes)*
- *How would I set this up? ($\frac{\text{miles}}{\text{minutes}} = \frac{\text{miles}}{\text{minutes}}$)*

Solicit answers from different groups. Have the other students give a thumbs-up or a thumbs-down to show whether they agree with the given answers.

Use the Racecar C DM display master as needed.

Say: *When comparing these ratios, I can create the proportion $\frac{16 \text{ miles}}{4 \text{ minutes}} = \frac{x \text{ miles}}{12 \text{ minutes}}$. Notice that the numerators of the ratios represent the number of miles traveled. Because I am looking for the number of miles the racecar can travel in 12 minutes, I use x to represent that number. Notice that the denominators of the ratios represent the number of minutes.*

Use Racecar D **DM** display master as needed.

Say: *Now, let's solve the problem by finding the missing value. What is the most efficient method to solve for the missing value? Because there is a whole number that we can multiply 4 by to get 12, we will use the method of multiplying by a factor equivalent to 1 to solve. We can multiply 4 by 3 to get 12. If we multiply the denominator by 3, we must multiply the numerator by the same number. So, we multiply the numerator 16 by 3 and get 48. Therefore, using the same rate, the racecar can travel 48 miles in 12 minutes.*

Use Racecar E **DM** display master as needed.

Say: *Let's check our answer. Discuss the following questions with your partner:*

- *Is my answer reasonable? (yes)*
- *How do I know? (both ratios in the proportion simplify to the same ratio)*

Solicit answers from different groups. Have the other students give a thumbs-up or a thumbs-down to show whether they agree with the given answers.

Use Racecar F **DM** display master as needed.

Practice

For the practice activity, provide detailed feedback to students, highlighting what was done correctly and what needs improvement. Provide opportunities for students to correct their errors. Collect student work to review and monitor student progress.

Activity: Help students complete the activity on the Practice handout. Have students check their answers with a partner and discuss reasoning. Select a few students to verbalize their reasoning. Ensure that students use the correct mathematical language in their explanations.

Independent Practice

1. Have students work independently to complete the activity on the Independent Practice handout.
2. Go over the answers (students self-check and correct, using a colored pencil).
3. Have students record the number correct in the box and complete their How Am I Doing? graph.
4. Collect the papers to review and monitor student progress. Review the key ideas. Have students provide examples from the lesson.

Closure

Have students discuss their answer to the following questions:

- How do you determine which strategy is most efficient for solving a proportion?
- Can you think of a reason that you might choose to set up a proportion in a different format?

Clear up any misconceptions. Students who struggle with writing and solving proportions from a word problem need additional instruction.