

Lesson 5: Find the Missing Value by Using the Scale Factor

Lesson Objective

- Students will find a missing value of a proportion by multiplying by the scale factor.

Instructional Materials

Material	Quantity	Description
How Am I Doing? graph	1 per student	
Colored pencils	1 per student	
Whiteboard and dry-erase marker	1 for teacher use and 1 per student	
Display Masters	1 each	<ul style="list-style-type: none"> Key Idea: Find the Missing Value by Using the Scale Factor Flour to Pizzas A–E Dinner Party A–F
Handouts	1 per student	<ul style="list-style-type: none"> Cumulative Review Practice Independent Practice
Answer Keys	1 each	<ul style="list-style-type: none"> 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



TEACHER NOTE

Explain that a fraction can represent a ratio. Then, students can use what they already know about fractions to determine proportionality. Revisit the Ratios and Rates module if necessary.

This lesson will build on students' conceptual knowledge of simplifying 2 ratios to determine whether they are proportional.

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

- To find the missing value in a proportion, determine and use the scale factor.



Use the Key Idea: Find the Missing Value by Using the Scale Factor  display master as needed.

Engage Prior/Informal Knowledge

To open the lesson, activate students' background knowledge and preskills by leading activities such as the following. Ensure that students use the correct mathematical language in their explanations.

- Have students discuss the following question with a partner: How do you know whether 2 ratios are proportional? Ask 2–3 pairs to share their answers with the group.
- Choose 1 of the following activities:
 - ◆ Have students write 2 ratios on a whiteboard and then trade with a partner. Then, have students decide whether

their partner's ratios are proportional. Have students share their answer with their partner. Ask 2–3 pairs to share their answers with the group. You may want to suggest ratios for a couple of students to write to ensure that some of the ratio pairs are proportional.

- ◆ Have students write a ratio on a whiteboard and trade with a partner. Then, have students create a ratio that is proportional to their partner's ratio. Have students share their answer with their partner. Ask 2–3 pairs to share their answers with the group.

If students cannot complete these activities, stop and explicitly teach the material. Reference the Ratios and Rates module as needed.

Demonstrate

1. Find the missing value in a proportion.

Say: *In the previous lesson, we learned how to find missing values in a multiplicative scenario by using a table. Today, we will learn how to find a missing value in a proportion. This skill will be useful when we know a ratio—for example, that there are 15 students per bus—but want to know the ratio for a different value—for example, how many total students would be on 12 buses.*

Say: *Recall that multiplying a ratio by a scale factor does not change the relationship the ratio describes.*

Say: *Let's use the example ratio of 2 dogs to 6 cats.*

Write the ratio $\frac{2 \text{ dogs}}{6 \text{ cats}}$ on a whiteboard.

Say: *If I scale $\frac{2 \text{ dogs}}{6 \text{ cats}}$ by a factor of 3, I am multiplying the ratio by $\frac{3}{3}$, or tripling the number of cats and dogs. There will still be 2 dogs for every 6 cats, but there will be 3 times as many altogether.*

Demonstrate on the whiteboard multiplying by $\frac{3}{3}$ to get $\frac{6}{18}$.

Say: $\frac{2 \text{ dogs}}{6 \text{ cats}}$ and $\frac{6 \text{ dogs}}{18 \text{ cats}}$ are equivalent ratios; therefore, they are proportional.

**TEACHER NOTE**

Draw an illustration if this concept is confusing to students.

Both ratios describe a situation in which there are 2 dogs for every 6 cats.

Say: Now, suppose I was given a proportion with a missing value. Listen to this example. I need 3 cups of flour for every 9 pizzas I make. I want to know how many cups of flour I would need to make 36 pizzas.

Use the Flour to Pizzas A display master as needed.

Say: The proportion is: $\frac{3 \text{ cups}}{9 \text{ pizzas}} = \frac{x \text{ cups}}{36 \text{ pizzas}}$

Say: In this proportion, x represents the missing value, which is the number of cups of flour for 36 pizzas. I need to determine the scale factor to find the missing value. Because there are more pizzas in the second ratio, I know I should scale up, or multiply by the scale factor.

Use the Flour to Pizzas B display master as needed.

Say: Because the ratios are proportional, I can figure out what factor is used to scale from 9 pizzas to 36 pizzas.

Say: I ask myself, "9 pizzas times what number equals 36 pizzas?" If I'm not sure, I can also use the inverse operation, division, to find the answer: 36 divided by 9 equals what number? 36 divided by 9 equals 4, which means that 9 pizzas times 4 equals 36 pizzas. The scale factor is 4.

Say: Because the scale factor is 4, I multiply the top by 4 as well. Because I now know there are 4 times as many pizzas, there must be 4 times as much flour.

Use the Flour to Pizzas C display master as needed.

Say: *Because there is 4 times as much flour as in the original ratio, I can say that 3 cups of flour times 4 equals the missing amount of flour. I know that 3 times 4 equals 12; therefore, 12 cups of flour are needed to make 36 pizzas.*

Use the Flour to Pizzas D  display master as needed.

Say: *By determining the scale factor and finding the value of x, I know if 3 cups of flour are needed to make 9 pizzas, 12 cups of flour are needed to make 36 pizzas. It takes 4 times as many cups of flour to make 4 times as many pizzas.*

Use the Flour to Pizzas E  display master as needed.

2. Complete a proportion.

Say: *Now, suppose I have the following scenario: Juan is having a dinner party. He needs to feed only 3 people. He was planning on feeding 18 people, so he bought 30 pounds of potatoes. How many pounds of potatoes does he need for only 3 people? The proportion is:*

$$\frac{3 \text{ people}}{x \text{ pounds of potatoes}} = \frac{18 \text{ people}}{30 \text{ pounds of potatoes}}$$

Say: *In this case, the value in the second ratio, 18, is greater than the value in the first ratio, 3. This means that I will scale up, or multiply by the scale factor.*

Use the Dinner Party A  display master as needed.

Say: *Because the ratios are proportional, I can figure out what factor is used to scale from 3 people to 18 people.*

Say: *I ask myself, "3 people times what number equals 18"*



WATCH FOR

Some students do not have a solid foundation with multiplication and division facts. This problem will become evident when students attempt to simplify and find missing values. The Multiplication and Division Facts module may need to be taught or revisited if students need additional support in this area.

people?" If I'm not sure, I can use the inverse operation, division, to find the answer: 18 divided by 3 equals what number? 18 divided by 3 equals 6, which means 3 people times 6 equals 18 people. The scale factor is 6.

Use the Dinner Party B  display master as needed.

Say: Because the scale factor is 6, I multiply the bottom by 6 as well. Because I now know there are 6 times as many people, there must be 6 times as many pounds of potatoes.

Use the Dinner Party C  display master as needed.

Say: Because there are 6 times as many pounds of potatoes as in the original ratio, I can say that x pounds of potatoes times 6 equals 30 pounds of potatoes.

Use the Dinner Party D  display master as needed.

Say: So I ask myself, "What times 6 equals 30?" 5 times 6 equals 30; therefore, Juan will need 5 pounds of potatoes for 3 people.

Use the Dinner Party E  display master as needed.

Say: By determining the scale factor and finding the value of x , I know that 5 pounds of potatoes are needed to feed 3 people, if 30 pounds of potatoes are needed to feed 18 people. It takes 6 times as many pounds of potatoes to feed 6 times as many people.

Use the Dinner Party F  display master as needed.

Practice

For each 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 1: Help students complete the Practice handout. Have students stop after every 2 problems to check with their partner and discuss reasoning. Select a few students to verbalize their reasoning. Ensure that students use the correct mathematical language in their explanations.

Activity 2: Have students work in pairs and verbalize their reasoning and each step in the following process to their partners. Ensure that students use the correct mathematical language in their explanations.

Have students create a proportion on scratch paper and then rewrite the proportion with 1 of the numbers missing. Have students trade with their partner. Give students several chances to figure out the missing value for their partner's proportion.

Circulate to monitor student progress.

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.

Closure

Review the key idea. Have students provide examples from the lesson.

Have students discuss their answer to the following questions:

- How do you know whether to multiply to find the missing value in a proportion?
- What are 2 examples of proportions for which you must multiply to find the missing value?

Clear up any misconceptions. Students who struggle with finding the missing value in proportions need additional instruction.