SAVVAS

Grade 7

Let's Investigate Take and Teach

enVision® MATHEMATICS

Real-World Math. Real-World Ready.

Let's Investigate

Lesson

2-3

Understand Proportional Relationships: Equivalent Ratios

FOCUS

Mathematics Objective

- Determine whether two sets of quantities are proportional by testing for equivalent ratios.

Language Objective Describe how to test for equivalent ratios and explain, orally and in writing, whether quantities are in a proportional relationship.

Essential Understanding A proportional relationship can be described by equivalent ratios.

COHERENCE

In Grade 6, students:

- found equivalent ratios.
- used ratio and rate reasoning to solve real-world problems.

In this lesson, students:

- look for equivalent ratios to identify proportional relationships.
- use proportions to solve problems.

Later in this topic, students will:

- use the constant of proportionality to write equations for proportional relationships and graph a line through the origin.
- decide whether they can use proportional reasoning to solve given problems.

Cross-Cluster Connection Students multiply and divide rational numbers as they use proportional relationships to solve multistep problems.

RIGOR

Conceptual Understanding Students extend their prior understanding of a unit rate and explore its relationship to equivalent ratios.

Application Students look for equivalent ratios to determine if a relationship is proportional.

Vocabulary

- proportional relationship
- proportion

Materials

- centimeter grid paper
- centimeter ruler

Student Resources

Family Engagement

Intervention System (IS)

M35 Solving Proportions

Teacher Resources

Using Manipulatives: Understand Proportional Relationships: Equivalent Ratios

enVision on the Go

Exit Ticket

Support for using the Exit Ticket is available online.

Step 1 Investigate

30-35 min

Investigate Scout Observational Assessment

Understand Proportional Relationships: Equivalent Ratios

Let's Investigate

Lesson 2-3

I can ... investigate equivalent ratios.

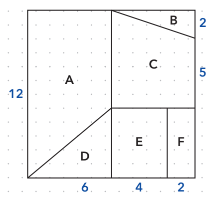
Many careers and hobbies involve the idea of enlarging patterns or designs. For example, architects draw small plans to build larger structures, and artists create small designs that need to be enlarged for public viewing.

An Even Bigger Puzzle

In this activity, you will make a larger puzzle from a smaller drawing.

You will know if you have done the enlargement correctly if the new puzzle pieces fit together the same way.

Use the information in this drawing of the puzzle to make a larger version of the puzzle in which the segment labeled 4 in the picture measures 7 cm in the new puzzle.

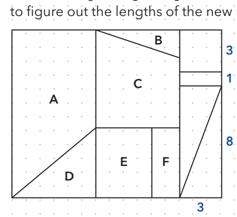


Be Precise Describe how you determined each measurement for the new puzzle.

Two quantities are in a **proportional relationship** if all of the ratios that relate the quantities are equivalent. A **proportion** is an equation that represents equal ratios.

Do the lengths in the puzzles have a proportional relationship? How do you know?

Generalize The puzzle is expanded to include the rectangular section along the right edge. Write an equation that can be used to figure out the lengths of the new measurements.



Build G.R.I.T. Resilience
If your solution is incorrect, check each step in order for errors. Stay determined to find the correct solution.

MTP Anticipate

Anticipate students' solution strategies. Think of various ways students will explore and use proportions and proportional relationships to enlarge a drawing of a puzzle. See the next page for sample student work.

Introduce the Investigation

Elevate Student Voice: Engage Students in the Context

- Does anyone know what an architect does?
- What do you think the architect in the photo is doing?

Use the Slow Reveal Slides Reveal part of the information. Ask: What do you notice? What do you wonder?

Check for Understanding

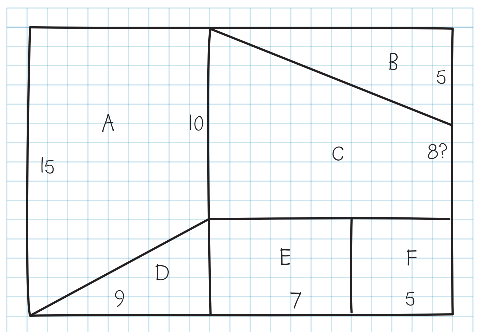
MLR5 Co-Craft Questions

Read *An Even Bigger Puzzle* aloud to the class. Have students write down possible mathematical questions that might be asked about the puzzle's enlargement. These should be questions that they think are answerable by doing math. Then, have students compare the questions they generated with a partner before sharing questions with the whole class.

Sample Student Work

Student 1 Work

- **incorrectly adds 3 to each measurement**

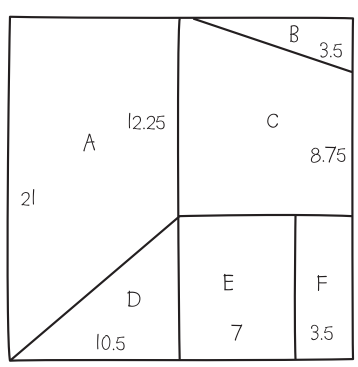


The difference from 4 to 7 is 3, so we added 3 to each length and then tried to draw it, but one length should be 8 long and there were only 5 squares left for it.

Ask: Adding 3 to 4 is almost doubling the measurement. Is adding 3 to 12 also almost doubling the measurement? [The pieces no longer fit together because they are increasing each by the same absolute quantity, not by an amount relative to the original size.]

Student 2 Work

- **correctly multiplies each length by 1.75**



We found that to get 7 from 4, we had to multiply 4 by 1.75, so we multiplied every measurement by 1.75 and it worked.

Ask: Why did you decide to multiply 4 by a number to get 7? [All measurements needed to enlarge the same number of times.]

Student 3 Work

- **incorrectly relates two ratios**

$\frac{4}{7} = \frac{x}{2}$ $7x = 8$ $x \approx 1.14$

$\frac{4}{7} = \frac{x}{5}$ $7x = 20$ $x \approx 2.86$

$\frac{4}{7} = \frac{x}{6}$ $7x = 24$ $x \approx 3.43$

$\frac{4}{7} = \frac{x}{7}$ $7x = 28$ $x = 4$

$\frac{4}{7} = \frac{x}{12}$ $7x = 48$ $x \approx 6.86$

We used a proportion to convert each measurement but it didnt work because the lengths got smaller.

Ask: Do these ratios make sense? [The ratio of 4 to 7 relates the original to the new measurement, so the other ratios should do the same.]

Student 4 Work

- **correctly relates two ratios**

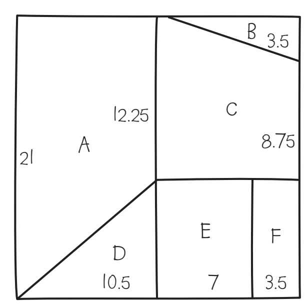
$\frac{4}{7} = \frac{2}{x}$ $4x = 14$ $x = 3.5$

$\frac{4}{7} = \frac{5}{x}$ $4x = 35$ $x = 8.75$

$\frac{4}{7} = \frac{6}{x}$ $4x = 42$ $x = 10.5$

$\frac{4}{7} = \frac{7}{x}$ $4x = 49$ $x = 12.25$

$\frac{4}{7} = \frac{12}{x}$ $4x = 84$ $x = 21$



We used the ratio of 4 to 7 to figure out the new lengths and then drew it.

Ask: How did you determine where to put each number in the ratios? [Relate the measurements in the same order—smaller over larger equals smaller over larger, or vice versa.]

Student 5 Work

- **correctly writes an equation**

$$\text{new length} = \frac{7}{4} \cdot \text{old length}$$

$$n = \frac{7}{4}x$$

$$n = \frac{7}{4} \cdot 3 = \frac{21}{4} = 5\frac{1}{4}$$

$$\frac{7}{4} \cdot 8 = 7 \cdot 2 = 14$$

$$\frac{7}{4} \cdot 1 = \frac{7}{4} = 1\frac{3}{4}$$

Ask: Is using an equation better than using a proportion? [The equation still uses a proportion, with the unknown isolated.]

Step 1 Investigate *continued*

MTP Monitor

Monitor Students at Work Ask questions to assess and advance students' thinking.

Assessing Questions

Questions for Students to Understand Their Thinking

- What operations might you use to enlarge measurements?
- What does the drawing tell you?
- How can you use the relationship between 4 cm and 7 cm to enlarge the other measurements?
- Why do you think you can't complete your puzzle?
- What could you try instead?

Questions for You as You Observe

- Which groups are struggling to relate the given measurements to a new pair of measurements?
- Which groups understand that they can increase each number in a similar way by using multiplication or a ratio?

Advancing Questions

Questions to Ask Students Who Need Help

- What would you do if 4 had been changed to 8?
- How many times greater than 4 is 7?
- How is this like zooming in on/enlarging a picture?

Questions to Help Students Think More Deeply

- How is a scale on a map like what you have done to enlarge the puzzle?

MTP Select and Sequence Solutions

Select and Sequence Students' Solutions for presentations with the goal of building understanding of key math concepts.

- **Start** with a correct solution that multiplies each measurement by the same number to create the enlargement (Student 2 Work).
- **Then** show solutions that show incorrect strategies (Student 1 and Student 3 Work) and address any misconceptions.
- **Finally,** show other correct solution strategies such as using ratios and equations (Student 4 and Student 5 Work) and connect those representations to proportional reasoning.

MTP Discuss Student Solutions

After allowing students to finish the questions for the lesson, return to an all-class discussion.

- What is an important step in enlarging the puzzle so that the pieces still fit together correctly? [Students should understand that each larger measurement has been increased the same number of times or by using the same ratio.]
- How do you find the missing measurements once you know the ratio? [Students might answer by writing equivalent ratios or by using the ratio as a multiplier for each measurement.]
- How can you recognize a proportional relationship? [Students might answer that the two ratios are equivalent, or they see how the numerator and denominator in one fraction can be easily multiplied by the same number to create the other fraction.]

MLL Multilingual Learners WRITING

Emerging Ask students to name pairs of ratios that are equivalent and pairs that are not.

Write the two categories on the board and start with examples of each.

Help students say sentences such as: "$\frac{2}{4}$ and $\frac{3}{6}$ are equivalent. They have a proportional relationship. $\frac{2}{3}$ and $\frac{4}{7}$ are not equivalent. They do not have a proportional relationship."

Expanding Have volunteers complete and read these sentences:

An equation that represents equal ratios is a ______. [proportion]

When ratios are equivalent, quantities are ______. [proportional]

Quantities have a ______ ______ if all of the ratios that relate the quantities are equivalent. [proportional relationship]

Bridging Have students work with a partner to identify equivalent ratios as proportional relationships.

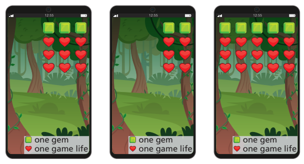
- Explain what *ratio* means.
- Explain how you can use ratios to determine whether quantities are proportional.

Step 2 Connect

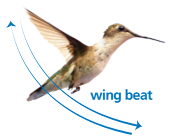
25-30 min

Choose a Problem

A How is the number of game lives awarded related to the number of gems found?



B How many times will the hummingbird beat its wings in 60 seconds?



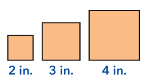
Hummingbird Wing Beats

Seconds (x)	2	7	10
Wing Beats (y)	160	560	800

C Dairy farmers produce milk to support the local economy. Is the ratio of dairy farmers to the number of cows milked proportional? Explain.

x	2	3	5	8
y	5	7.5	12.5	18

D Is the relationship between the area and the side length of the squares proportional? Explain.



Sample Student Work

A. Sample answer: Each ratio $\frac{\text{gems}}{\text{game lives}}$ is equivalent to $\frac{1}{3}$.
The number of game lives awarded is proportional to the number of gems found.

B. Sample answer: Verify that the quantities are proportional.
$\frac{160}{2} = \frac{80}{1}$ $\frac{560}{7} = \frac{80}{1}$ $\frac{800}{10} = \frac{80}{1}$
The ratios are equivalent, so the quantities are proportional.

Write and solve a proportion.
$\frac{80}{1} = \frac{y}{60}$
$\frac{80}{1} \cdot 60 = \frac{y}{60} \cdot 60$
$4{,}800 = y$

A hummingbird beats its wings 4,800 times in 60 seconds.

C. Sample answer: $\frac{5}{2} = \frac{7.5}{3} = \frac{12.5}{5} = 2.5$, but $\frac{18}{8} = 2.25$, so the ratio of dairy farmers and cows milked is not proportional.

D. Sample answer: The ratios are not equivalent, so the relationship between the area and side length is NOT proportional.

Side Length (x)	Area (y)	$\frac{\text{Area } (y)}{\text{Side Length } (x)}$
2	4	$\frac{4}{2} = \frac{2}{1}$
3	9	$\frac{9}{3} = \frac{3}{1}$
4	16	$\frac{16}{4} = \frac{4}{1}$

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Engage Students Through Choice

Allow students to select a problem to solve individually.

Problem A is for students who are still working on understanding the result of multiplying or dividing by a constant value.

Problem B is for students who need more work on recognizing sets of equivalent ratios.

Problem C is for students who are ready to apply understanding of equivalent ratios in a proportional relationship.

Problem D is for students who understand proportionality and will benefit from using their reasoning to identify a nonproportional relationship.

Early finishers may choose more than one problem.

MTP Choose a Problem

Discuss Solution Strategies

Group students based on the chosen problem to discuss their solution strategies. Consider having groups record their solutions on a vertical surface. Do a gallery walk so they can discuss different problems and solution strategies.

Problem A

- What ratio can you write to compare the number of gems to the number of game lives?

Problem B

- What ratio represents the number of wing beats per second?

Problem C

- Notice that *x*-values of 3, 5, and 8 are given. How can you use addition of y-values to find whether the numbers in the table all are proportional?

Problem D

- Is it necessary to find the area of every square?

Present and Analyze

Prioritize discussion about ratios and proportional relationships. If needed to promote discussion, ask questions such as:

Problem A

- Is the ratio of gems to game lives the same in every row? [Yes. In every row there are 3 game lives for every gem.]

Problem B

- How can you tell how many times the hummingbird will beat its wings in 1 second? [Simplify the ratio in the first column of the table: $\frac{2}{160} = \frac{1}{80}$. The hummingbird beats its wings 80 times in 1 second.]

Problem C

- How can you tell if the relationship is not proportional? [If the relationship is not proportional, the ratio of dairy farmers to cows milked will not be the same in every example.]

Problem D

- How can you use ratios to test if the relationship is proportional? [First find the area of each square and then set up ratios using each side length and area to test if they are equal.]

Connect

1. **Make Sense and Persevere** How was the strategy you used in *Choose a Problem* the same as your strategy in *An Even Bigger Puzzle*? How were your strategies different?

   You compare ratios in each problem.

   A. The ratios are all equivalent.

   B. Since all of the ratios are equivalent, you can apply proportional reasoning.

   C. Some ratios were equivalent, but one was not, so the relationship is not proportional.

   D. Although there was a pattern, the ratios were not equivalent so there is not a proportional relationship.

2. **Look for Relationships** How do you know if a relationship between two quantities is NOT proportional?

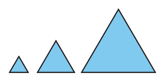
   The ratios $\frac{y}{x}$ for all pairs of x and y will not be equivalent.

3. **Reasoning** If the ratio $\frac{y}{x}$ is the same for all related pairs of x and y, what does that mean about the relationship between x and y?

   It means that x and y have a proportional relationship.

4. **Look for Relationships** Each triangle is equilateral. Is the relationship between the perimeter and the side length of all equilateral triangles proportional? Explain.

   Yes; the quantities are proportional because the ratios $\frac{3}{1}$, $\frac{6}{2}$, and $\frac{9}{3}$ are equivalent.



Key Concept

If a set of numbers is multiplied or divided by a constant factor, the comparison of the original set of numbers to the resulting set of numbers is a set of equivalent ratios.

For example, multiplying each element of {1, 3, 5} by 2 gives {4, 12, 20} and $\frac{1}{4} = \frac{3}{12} = \frac{5}{20}$. A set of equivalent ratios represents a proportional relationship.

Talk About Big Ideas

How does a picture on a phone camera show proportionality? What is another example of a proportional relationship in your world?

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MTP Connect

Connect Solution Strategies Use your students' work or the sample student work to facilitate responses phrased in students' own words. Encourage students to use the vocabulary *equivalent ratios, proportion,* and *proportional relationship*.

Item 1 Comparing and contrasting different solutions builds understanding of problems that involve proportional relationships. Have students focus on their use of equivalent ratios.

Item 2 Compare equivalent ratios to unit rates. The unit rate defines the relationship between quantities. All ratios that relate the quantities in a proportional relationship can be simplified to the unit rate.

Item 3 If the related elements in two sets of quantities do not form equivalent ratios, the relationship is not proportional.

Item 4 Discuss why this is true of all equilateral triangles, not just the three shown in the problem. *What about an equilateral triangle with a side length of 10 inches? x inches? Can you write an equation that models this relationship?*

MTP Key Concept

- How can you use structure to help you decide whether two sets of related quantities have a proportional relationship? [If you calculate the ratio $\frac{y}{x}$ for each data pair and they are equivalent, then the two sets of quantities have a proportional relationship.]
- When testing ratios to see if they are equivalent, why is order important? [Ratios must be created by pairs of numbers that are related to each other in the situation (e.g., corresponding sides in a shape) and those numbers must be used in the same order in the ratios.]

MTP Talk About Ideas

Have students engage in a think-pair-share to discuss the response to the question about phone cameras and proportionality. Listen for discussions about proportionality maintaining the same multiplicative relationship, which maintains the shape of an object that has been enlarged or reduced, or relative values in two sets of data.

Step 3 Practice and Problem-Solving

15-20 min

Interactive Practice   Adaptive Practice

You may opt to have students complete automatically scored practice items online.

Name ______________________

Lesson Help

Practice and Problem Solving

5. The amount of seed a landscaper uses and the area of lawn covered have a proportional relationship. Complete the table.

Lawn Seed

Seed (oz)	2	3	4
Area Covered (ft^2)	50	75	100
$\frac{\text{Area Covered}}{\text{Seed}}$	$\frac{50}{2} = \frac{25}{1}$	$\boxed{\frac{25}{1}}$	$\boxed{\frac{25}{1}}$

6. **Construct Arguments** Is the relationship between the number of slices of salami in a sandwich and the number of Calories in the sandwich proportional? Explain.

Calories in a Sandwich

Slices of Salami	Calories
1	66
2	96
3	126
4	156

No; the ratios of Calories to slices of salami are not all equivalent.

7. **Look for Relationships** A wholesale club sells eggs by the dozen. Does the table show a proportional relationship between the number of dozens of eggs and the cost? Explain.

Cost of Dozens of Eggs

Dozen	Cost ($)
6	21
8	28
10	35
14	49

Yes; the ratios of cost to dozens of eggs for all related pairs are equivalent.

8. Does the table show a proportional relationship? If so, what is the value of *y* when *x* is 11?

x	4	5	6	10
y	64	125	216	1,000

No; the quantities *x* and *y* do not have a proportional relationship, so you cannot use equivalent ratios to find the value of *y* when *x* is 11.

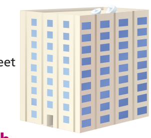
9. Does the table show a proportional relationship? If so, what is the value of *y* when *x* is 10?

x	5	6	7	8
y	$1\frac{2}{3}$	2	$2\frac{1}{3}$	$2\frac{2}{3}$

Yes; $y = 3\frac{1}{3}$

10. The height of a building is proportional to the number of floors. The figure shows the height of a building with 9 floors.

h = 135 feet



a. **Reasoning** Write the ratio of height of the building to the number of floors. Then find the unit rate, and explain what it means in this situation.

$\frac{135 \text{ ft}}{9 \text{ floors}}$; $\frac{15 \text{ ft}}{1 \text{ floor}}$; Each floor of the building is 15 ft high.

b. How tall would the building be if it had 15 floors?
225 ft

11. **Higher Order Thinking** Do the two tables show the same proportional relationship between *x* and *y*? Explain how you know.

x	160	500	1,200
y	360	1,125	2,700

x	2	5	7
y	4.5	11.25	15.75

Yes; All the ratios of *y* to *x* are equivalent. Every ratio $\frac{y}{x}$ is equivalent to $\frac{9}{4}$.

Assessment Practice

12. The table shows the number of cell phone towers a company will build as the number of its customers increases.

Cell Phone Towers

Customers (thousands)	Towers
5.25	252
6.25	300
7.25	348
9.25	444

PART A
Is the relationship between the number of towers and the number of customers proportional? Explain.
Yes; The ratios of towers to customers are all equivalent.

PART B
If there are 576 towers, how many customers does the company have? Create a proportion and solve.
12,000 customers

13. Select all true statements about the table.

x	12	18	22	26
y	1.5	2.25	2.75	3.25

- [x] The table shows a proportional relationship.
- [ ] When *x* is 20, *y* is 2.55.
- [ ] All the ratios $\frac{y}{x}$ for related pairs of *x* and *y* are equivalent to 8.
- [x] The unit rate of $\frac{y}{x}$ for related pairs of *x* and *y* is $\frac{1}{8}$.
- [x] If the table continued, when *x* is 30, *y* would be 3.75.

Practice and Problem Solving

Error Intervention

Item 6 Construct Arguments Students may see a pattern that shows that each slice of salami adds 30 Calories. Remind them that patterns can exist, but for the relationship to be proportional, the ratios of Calories to slices of salami have to be equivalent.

- What is the ratio of the number of Calories to the number of slices of salami in a sandwich with 1 slice? 2 slices? Are the ratios equivalent? [$\frac{66}{1}$; $\frac{96}{2} = \frac{48}{1}$; No]

Multilingual Learners

Item 7 Look for Relationships

- What is unit rate in this problem? [The cost of 1 dozen eggs, or $3.50]

Engage Through Student Choice

Go online for an assignment strategy.

Item Analysis: Practice and Problem Solving

Items	DOK
5–8, 10	1
9, 11–13	2

Step 4 Assess and Differentiate

15-30 min

Additional Practice

Name ______________________

2-3 Additional Practice

Lesson Help

1. At a café, the cook uses a recipe that calls for eggs and milk. The amounts of eggs and milk have a proportional relationship. Complete the table.

Ingredients in Recipe			
Number of Eggs	2	3	4
Cups of Milk	6	9	12
$\frac{\text{Milk}}{\text{Eggs}}$	$\frac{3}{1}$	$\frac{3}{1}$	$\frac{3}{1}$

2. **Use Structure** Is the relationship between x and y proportional? Explain.

x	y
5	25
6	30
7	35
8	40

Yes; Sample answer: All the ratios of y to x are equivalent. Every ratio $\frac{y}{x}$ is equivalent to 5.

3. **Construct Arguments** Does the table show a proportional relationship between x and y? Explain.

x	y
2	4
4	16
7	79
10	100

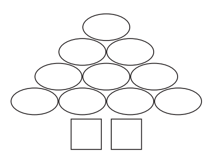
No; Sample answer: All the ratios $\frac{y}{x}$ are not equivalent.

4. Does the table show a proportional relationship? If so, what is the value of y when x is $\frac{3}{5}$?

x	y
30	150
$\frac{1}{6}$	$\frac{5}{6}$
199	995
$\frac{2}{15}$	$\frac{2}{3}$

Yes; $y = 3$

5. In a stationery design, the number of ovals is proportional to the number of squares. How many squares will there be when there are 75 ovals?



15 squares

6. The table shows a proportional relationship between x and y.

a. Complete the table.

x	y	$\frac{y}{x}$
3	30	$\frac{30}{3} = \frac{10}{1}$
5	50	$\frac{50}{5} = \frac{10}{1}$
7	70	$\frac{70}{5} = \frac{10}{1}$

b. Katerina says the ratio $\frac{y}{x}$ is $\frac{1}{10}$. What error did she likely make?

She found $\frac{x}{y}$ instead of $\frac{y}{x}$.

7. **Higher Order Thinking** Do the two tables show the same proportional relationship between x and y? Explain.

x	500	750	1,000
y	1,250	1,875	2,500

x	3	4	5
y	4.2	5.6	7

No; Sample answer: The first table shows $\frac{y}{x} = 2.5$. The second table shows $\frac{y}{x} = 1.4$. $2.5 \neq 1.4$.

Assessment Practice

8. During snowstorms, the city sends out trucks to plow. The amount of snowfall and the number of trucks sent out are shown in the table.

Snow Plowing Plan	
Snowfall (in.)	Trucks
6	15
8	20
12	30
18	45

PART A

Is the relationship between the amount of snowfall and the number of trucks proportional? Explain.

Yes; the ratios of trucks to inches of snowfall are all equivalent to 2.5.

PART B

For a 23-inch snowfall, how many trucks would the city send out? Explain.

Sample answer: For a 23-inch snowfall, the number of trucks would be 57.5. The city should send out 58 trucks to keep the roads safe.

9. Which of the following statements about the table is true? Select all true statements about the table.

x	y
10.5	3.5
15.9	5.3
22.5	7.5
27	9

- [x] The table shows a proportional relationship.
- [ ] All the ratios $\frac{y}{x}$ for related pairs of x and y are equivalent to 7.5.
- [x] When x is 13.5, y is 4.5.
- [ ] When y is 12, x is 4.
- [x] The unit rate of $\frac{y}{x}$ for related pairs of x and y is $\frac{1}{3}$.

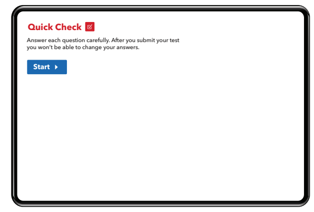
Item Analysis: Additional Practice

Items	DOK
1–3	1
4–9	2

MTP Quick Check

Formative Assessment

The Quick Check is available in the Assessment Sourcebook. The online Quick Check is automatically scored and appropriate remediation, practice, or enrichment will be assigned based on student performance



Differentiation Library

The **Differentiation Library** at the beginning of this topic shows the differentiation options available, each of which can be appropriate for all students. However, based on the **Quick Check** results, you may prescribe:

0–3 points: Reteach to Build Understanding and Additional Vocabulary Support Activities

4–5 points: Enrichment Activity

In addition, **Multilingual Learners** may benefit from the Build Mathematical Literacy Activity.

Video Tutorials

Students can access instructional tutorials online.

- Determine Whether Values in a Table are Proportional
- How Do You Know if Two Ratios are Proportional?

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Understand Proportional Relationships: Equivalent Ratios

I can … investigate equivalent ratios.

Let's Investigate

Lesson 2-3

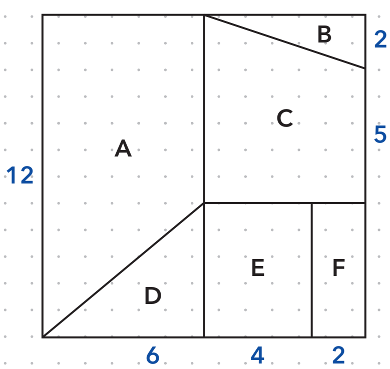
Many careers and hobbies involve the idea of enlarging patterns or designs. For example, architects draw small plans to build larger structures, and artists create small designs that need to be enlarged for public viewing.

An Even Bigger Puzzle

In this activity, you will make a larger puzzle from a smaller drawing.

You will know if you have done the enlargement correctly if the new puzzle pieces fit together the same way.

Use the information in this drawing of the puzzle to make a larger version of the puzzle in which the segment labeled 4 in the picture measures 7 cm in the new puzzle.

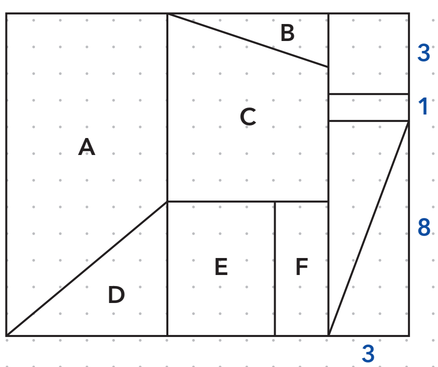


Be Precise Describe how you determined each measurement for the new puzzle.

Two quantities are in a **proportional relationship** if all of the ratios that relate the quantities are equivalent. A **proportion** is an equation that represents equal ratios.

Do the lengths in the puzzles have a proportional relationship? How do you know?

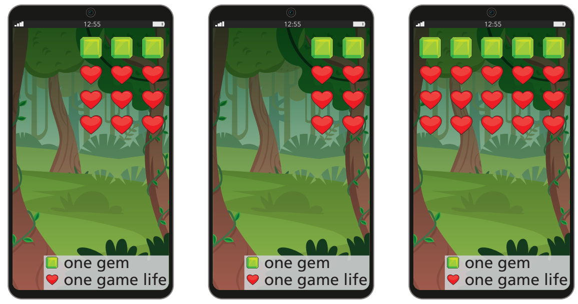
Generalize The puzzle is expanded to include the rectangular section along the right edge. Write an equation that can be used to figure out the lengths of the new measurements.



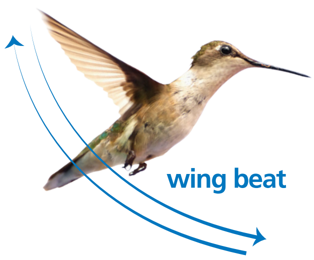
Build G.R.I.T. Resilience
If your solution is incorrect, check each step in order for errors. Stay determined to find the correct solution.

Choose a Problem

A How is the number of game lives awarded related to the number of gems found?



B How many times will the hummingbird beat its wings in 60 seconds?



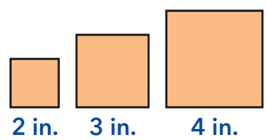
Hummingbird Wing Beats

Seconds (x)	2	7	10
Wing Beats (y)	160	560	800

C Dairy farmers produce milk to support the local economy. Is the ratio of dairy farmers to the number of cows milked proportional? Explain.

x	2	3	5	8
y	5	7.5	12.5	18

D Is the relationship between the area and the side length of the squares proportional? Explain.



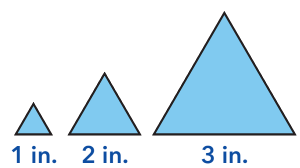
Connect

1. **Make Sense and Persevere** How was the strategy you used in *Choose a Problem* the same as your strategy in *An Even Bigger Puzzle*? How were your strategies different?

2. **Look for Relationships** How do you know if a relationship between two quantities is NOT proportional?

3. **Reasoning** If the ratio $\frac{y}{x}$ is the same for all related pairs of x and y, what does that mean about the relationship between x and y?

4. **Look for Relationships** Each triangle is equilateral. Is the relationship between the perimeter and the side length of all equilateral triangles proportional? Explain.



Key Concept

If a set of numbers is multiplied or divided by a constant factor, the comparison of the original set of numbers to the resulting set of numbers is a set of equivalent ratios.

For example, multiplying each element of {1, 3, 5} by 4 gives {4, 12, 20} and $\frac{1}{4} = \frac{3}{12} = \frac{5}{20}$. A set of equivalent ratios represents a proportional relationship.

Talk About Big Ideas

How does a picture on a phone camera show proportionality? What is another example of a proportional relationship in your world?

Name ______________________________

Practice and Problem Solving

Lesson Help

5. The amount of seed a landscaper uses and the area of lawn covered have a proportional relationship. Complete the table.

Lawn Seed

Seed (oz)	2	3	4
Area Covered (ft^2)	50	75	100
$\frac{\text{Area Covered}}{\text{Seed}}$	$\frac{50}{2} = \frac{25}{1}$	$\square$	$\square$

6. Construct Arguments Is the relationship between the number of slices of salami in a sandwich and the number of Calories in the sandwich proportional? Explain.

Calories in a Sandwich

Slices of Salami	Calories
1	66
2	96
3	126
4	156

7. Look for Relationships A wholesale club sells eggs by the dozen. Does the table show a proportional relationship between the number of dozens of eggs and the cost? Explain.

Cost of Dozens of Eggs

Dozen	Cost ($)
6	21
8	28
10	35
14	49

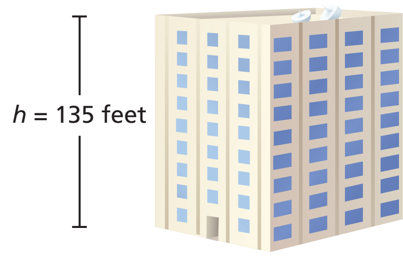
8. Does the table show a proportional relationship? If so, what is the value of y when x is 11?

x	4	5	6	10
y	64	125	216	1,000

9. Does the table show a proportional relationship? If so, what is the value of y when x is 10?

x	5	6	7	8
y	$1\frac{2}{3}$	2	$2\frac{1}{3}$	$2\frac{2}{3}$

10. The height of a building is proportional to the number of floors. The figure shows the height of a building with 9 floors.



a. **Reasoning** Write the ratio of height of the building to the number of floors. Then find the unit rate, and explain what it means in this situation.

b. How tall would the building be if it had 15 floors?

11. **Higher Order Thinking** Do the two tables show the same proportional relationship between x and y? Explain how you know.

x	160	500	1,200
y	360	1,125	2,700

x	2	5	7
y	4.5	11.25	15.75

Assessment Practice

12. The table shows the number of cell phone towers a company will build as the number of its customers increases.

Cell Phone Towers

Customers (thousands)	Towers
5.25	252
6.25	300
7.25	348
9.25	444

PART A

Is the relationship between the number of towers and the number of customers proportional? Explain.

PART B

If there are 576 towers, how many customers does the company have? Create a proportion and solve.

13. Select all true statements about the table.

x	12	18	22	26
y	1.5	2.25	2.75	3.25

- ☐ The table shows a proportional relationship.
- ☐ When x is 20, y is 2.55.
- ☐ All the ratios $\frac{y}{x}$ for related pairs of x and y are equivalent to 8.
- ☐ The unit rate of $\frac{y}{x}$ for related pairs of x and y is $\frac{1}{8}$.
- ☐ If the table continued, when x is 30, y would be 3.75.