LESSON 11.1

Investigate • Model Perimeter

FOCUS COHERENCE RIGOR

LESSON AT A GLANCE

F C R Focus:

Common Core State Standards

3.MD.D.8 Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.) **MP1** Make sense of problems and persevere in solving them. **MP3** Construct viable arguments and critique the reasoning of others. **MP4** Model with mathematics. **MP7** Look for and make use of structure.

F C R Coherence:

Standards Across the Grades

Before	Grade 3	After
2.MD.B.5	3.MD.D.8	4.MD.A.3

F C R Rigor:

Level 1: Understand Concepts.....*Share and Show* (Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Explore perimeter of polygons by counting units on grid paper.

Language Objective

Student pairs point to an example in the textbook and explain how can you find perimeter.

Materials

MathBoard, geoboard, rubber bands

F C R For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

Teaching for Depth

This lesson involves modeling perimeter. An important goal of the lesson is for students to understand that perimeter represents the distance around a shape. It may help some students to think of perimeter as the length of a fence that encloses a space, like a yard or a garden.

The term *perimeter* can refer to the distance around polygons (such as triangles and rectangles) or the distance around non-polygons (such as shapes with curved paths). In these lessons, students are finding only the perimeter of polygons to transition into finding the perimeter and area of rectangles. If students are having difficulty with the concept of perimeter, have them place string around the edge of a shape and then find the length of the string.

Professional Development Videos

GO DIGITAL

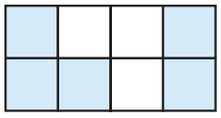
- iSE Interactive Student Edition
- Personal Math Trainer
- Math on the Spot Video
- Animated Math Models
- iTools: Geometry
- HMH Mega Math

Daily Routines

Common Core

Problem of the Day 11.1

What fraction of the rectangle is shaded blue?



$\frac{5}{8}$

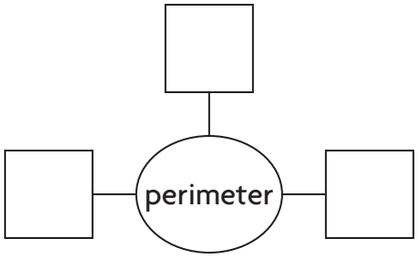
Vocabulary perimeter

- Interactive Student Edition
- Multimedia eGlossary

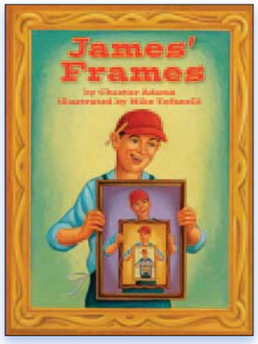
Vocabulary Builder

Materials Semantic Map (*see eTeacher Resources*)

Have students list words or phrases that are related to the term *perimeter*.



Literature Connection



James' Frames

From the Grab-and-Go™ Differentiated Centers Kit

Students read about using perimeter to find how much wood is needed to make picture frames.

1 ENGAGE

with the Interactive Student Edition

Essential Question

How can you find perimeter?

Making Connections

Invite students to tell you what they know about the distance around objects.

Have you ever measured the distance around an object? If so, how?
Possible answer: I used a ruler or walked around the object.

Learning Activity

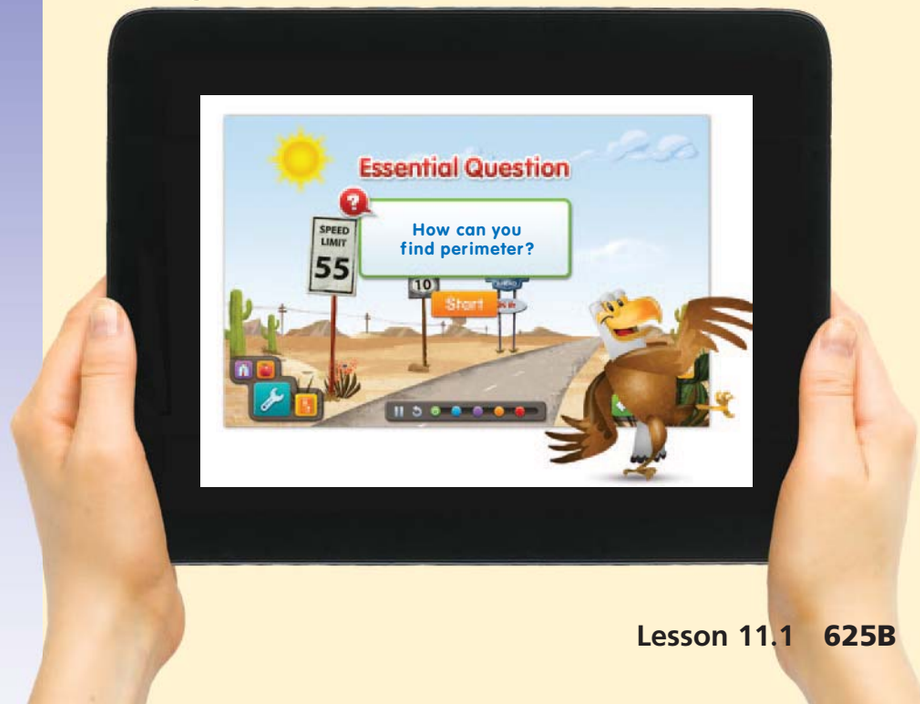
What is the problem the students are trying to solve? Connect the story to the problem.

- **What problem are you trying to solve?** find the perimeter of the sign
- **What type of sign is it?** the speed limit sign
- **What shape is the speed limit sign?** rectangle
- **What might you use to help solve this problem?** grid paper
- **What will each square represent on the grid paper?** a unit of measurement

Literacy and Mathematics

Choose one or more of the following activities.

- Have students discuss what mathematical operation they might use to solve the problem. Why did they choose this mathematical operation? Have students write the reasons why the other operations would not work.
- Have students discuss different ways to measure the distance around an object. Have students measure objects in the classroom using these methods.



2 EXPLORE

Investigate

MATHEMATICAL PRACTICES

Make sure students understand that *perimeter* is a measure of the distance around a figure.

The vertical distance or horizontal distance between 2 pegs on the geoboard is 1 unit. The diagonal distance between 2 pegs is not 1 unit.

- **What do you notice about the lengths of the opposite sides of the rectangle you made on the geoboard?** The lengths of the opposite sides are equal.

Point out that we can say the rectangle measures 2 units by 3 units or we can say that it measures 3 units by 2 units.

Have students note that three dots are connected to draw a length of 2 units, and four dots are connected to draw a length of 3 units. The unit is the distance *between* the dots, not the number of dots.

MP7 Look for and make use of structure.

- **Why are four addends used to find the perimeter of the rectangle?** A rectangle has four sides.
- **How many addends would there be if you need to find the perimeter of a pentagon?** 5

ELL Strategy: Restate

Students can demonstrate understanding of perimeter when the definition is restated.

- Read aloud the definition of perimeter.
- Restate the definition using gestures, drawings or by modeling with real objects such as a piece of paper or a MathBoard.
- Use the sentence frame: **When I measure the perimeter, I measure _____ .**
- Have students write or draw the restated definition in their Math Journal.

MP4 Model with mathematics.

- **Use the geoboard to make a pentagon with side lengths of 3 units. Write an addition equation to show the perimeter.** 3 + 3 + 3 + 3 + 3 = 15

3.MD.D.8 Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Name _____

Model Perimeter

Essential Question How can you find perimeter?

Measurement and Data—3.MD.D.8

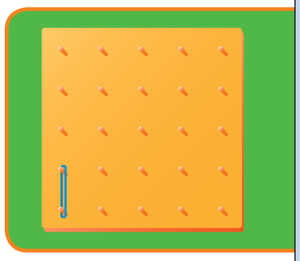
MATHEMATICAL PRACTICES MP1, MP3, MP4, MP7

Investigate

Perimeter is the distance around a figure.

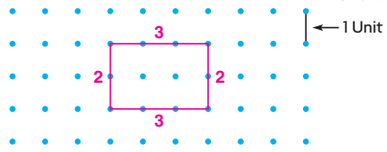
Materials ■ geoboard ■ rubber bands

You can find the perimeter of a rectangle on a geoboard or on dot paper by counting the number of units on each side.



A. Make a rectangle on the geoboard that is 3 units on two sides and 2 units on the other two sides.

B. Draw your rectangle on this dot paper. Possible drawing is shown.



C. Write the length next to each side of your rectangle.

D. Add the number of units on each side.

3 + 2 + 3 + 2 = 10

E. So, the perimeter of the rectangle is 10 units.

- How would the perimeter of the rectangle change if the length of two of the sides was 4 units instead of 3 units?

The perimeter would increase by 2 units. 4 + 2 + 4 + 2 = 12 units

Reteach 11.1

RtI

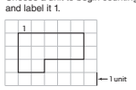
Name _____ Lesson 11.1 Reteach

Model Perimeter

Perimeter is the distance around a figure.

Find the perimeter of the figure.

Step 1 Choose a unit to begin counting and label it 1.

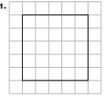


Step 2 Count each unit around the figure to find the perimeter.

16 units

So, the perimeter of the figure is 16 units.

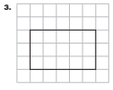
Find the perimeter of the figure. Each unit is 1 centimeter.

1. 

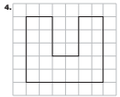
20 centimeters

2. 

12 centimeters

3. 

16 centimeters

4. 

28 centimeters

Chapter Resources © Houghton Mifflin Harcourt Publishing Company 11-5 Reteach

Enrich 11.1

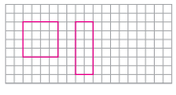
Differentiated Instruction

Name _____ Lesson 11.1 Enrich

Draw Your Perimeter

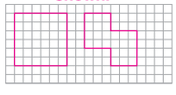
Use the grid to draw two different figures that have the given perimeter. Check students' drawings.

1. 16 units

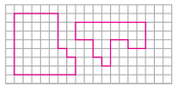


2. 24 units

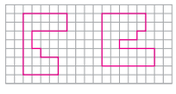
Possible drawings are shown.



3. 28 units



4. 30 units



5. Write Math Eduardo drew a figure that had a perimeter of 20 units. The length of each side was 5 units. What figure could Eduardo have drawn? **Explain.**

Possible explanation: Eduardo could have drawn a square because each side has the same length.

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Draw Conclusions

1. Describe how you would find the perimeter of a rectangle that is 5 units wide and 6 units long.

I can add, 5 + 6 + 5 + 6 = 22 units.

2. THINK SMARTER A rectangle has two pairs of sides of equal length. Explain how you can find the unknown length of two sides when the length of one side is 4 units, and the perimeter is 14 units.

Possible explanation: since a rectangle has two pairs of sides of equal length, 4 + 4 = 8; then I subtract; 14 − 8 = 6. Since the other two sides are also equal, I divide by 2; 6 ÷ 2 = 3. So, the unknown side length is 3 units.

3. MATHEMATICAL PRACTICE 1 **Evaluate** Jill says that finding the perimeter of a figure with all sides of equal length is easier than finding the perimeter of other figures. Do you agree? Explain.

Yes; possible explanation: because all of the sides have equal length, I can multiply the length of one side by the number of sides the figure has.

Make Connections

Hands On

Math Talk

MATHEMATICAL PRACTICES 3

Apply If a rectangle has a perimeter of 12 units, how many units wide and how many units long could it be?

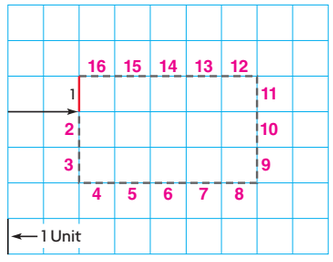
You can also use grid paper to find the perimeter of figures by counting the number of units on each side.

Start at the arrow and trace the perimeter. Begin counting with 1. Continue counting each unit around the figure until you have counted each unit.

Possible answers are given.

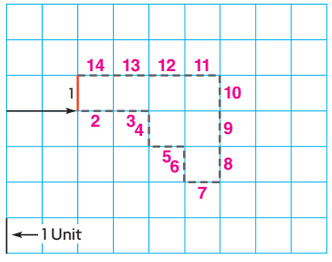
See Additional Answers, TE p. 626.

A



Perimeter = 16 units

B



Perimeter = 14 units

Advanced Learners

Logical / Visual
Individual

Materials rulers, poster board

- Give students an opportunity to find the perimeter of five classroom objects, such as desks, windows, doors, and storage containers. Have them order the objects from least perimeter to greatest perimeter.
- Have students make a poster that shows the name of the item and its perimeter.
- Allow time for students to present their posters.
- **Which object has the least perimeter? Which object has the greatest perimeter?**
  Answers will vary.
- Have students predict more perimeters and order the objects from least to greatest perimeter. Then they should measure to check their perimeters.

Draw Conclusions

THINK SMARTER

Exercise 2 requires students to use what they know about perimeter to find an unknown side length of a rectangle.

MP1 Make sense of problems and persevere in solving them.

- **Each side of a six-sided figure is 2 units long. Give two ways you could find the perimeter of the figure.** Multiply 2 × 6 or add 2 + 2 + 2 + 2 + 2 + 2.

MP6 Attend to precision. After students complete the exercises, ask:

- **Explain how multiplication *and* addition can be used to find the perimeter of a rectangle.** Double the length and double the width (or multiply each measure by 2), and then find the sum of the products.

Make Connections

Hands On

Ask students to count the units in a counterclockwise direction.

- **Were there places that you miscounted the units?** Possible answer: I miscounted units at the corners, or right angles.
- **Is there anything you can do to prevent miscounting in those places?** Possible answers: I can write the number *on* the side rather than next to it while counting or mark each side as I count it.

Math Talk Use **Math Talk** to focus on students' understanding of perimeter.

Answer for Math Talk in the Student Edition: Possible explanation: if a rectangle has a perimeter of 12 units, it could be 3 units wide and 3 units long; 2 units wide and 4 units long; 4 units wide and 2 units long; 1 unit wide and 5 units long; 5 units wide and 1 unit long.

COMMON ERRORS

Error Students count incorrectly when finding the perimeter of an irregular figure.

Example Students might give the perimeter of figure B as 12 units.

Springboard to Learning Demonstrate how students can check their answer by moving around the figure in the opposite direction, counting by ones and placing a mark on each side that has been counted.

3 EXPLAIN

Share and Show MATH BOARD

The first problem connects to the learning model. Have students use the MathBoard to explain their thinking. Encourage students to place a mark on the figure where they begin counting the units so they will know when to stop counting.

Use the checked exercises for **Quick Check**.

Quick Check RtI

If a student misses the checked exercises

Then **Differentiate Instruction** with

- Reteach 11.1
- Personal Math Trainer 3.MD.D.8
- RtI Tier 1 Activity (online)

4 ELABORATE

Problem Solving • Applications Real World

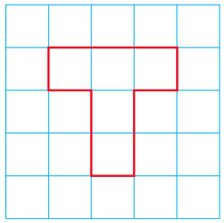
Common Core MATHEMATICAL PRACTICES

MP6 Attend to precision. For Exercise 7, you may need to remind students that they can use either addition or multiplication to find the perimeter of a triangle with three sides of equal length.

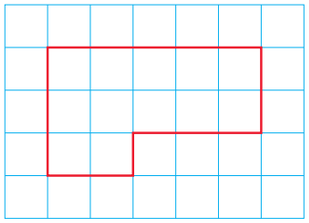
Name _____

Share and Show MATH BOARD

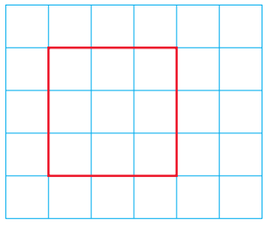
Find the perimeter of the figure. Each unit is 1 centimeter.

1. 

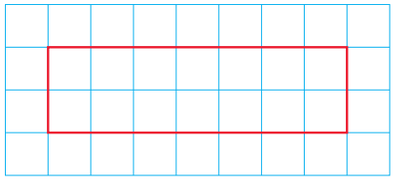
12 centimeters

2. 

16 centimeters

3. 

12 centimeters

4. 

18 centimeters

Find the perimeter.

5. A figure with four sides that measure 4 centimeters, 6 centimeters, 5 centimeters, and 1 centimeter

16 centimeters

6. A figure with two sides that measure 10 inches, one side that measures 8 inches, and one side that measures 4 inches

32 inches

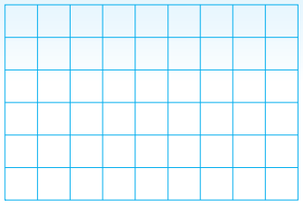
Problem Solving • Applications Real World

7. MATHEMATICAL PRACTICE 6 **Explain** how to find the length of each side of a triangle with sides of equal length and a perimeter of 27 inches.

Possible explanation: since the three sides are equal lengths, you can divide the perimeter by the number of sides; the perimeter is 27 inches, so each side is 9 inches.

8. THINK SMARTER Luisa drew a rectangle with a perimeter of 18 centimeters. Select the rectangles that Luisa could have drawn. Mark all that apply. Use the grid to help you.

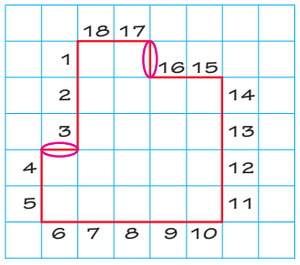
- (A) 9 centimeters long and 2 centimeters wide
- ● 6 centimeters long and 3 centimeters wide
- (C) 4 centimeters long and 4 centimeters wide
- ● 5 centimeters long and 4 centimeters wide
- ● 7 centimeters long and 2 centimeters wide



9. THINK SMARTER **What's the Error?** Kevin is solving perimeter problems. He counts the units and says that the perimeter of this figure is 18 units.

Look at Kevin's solution.

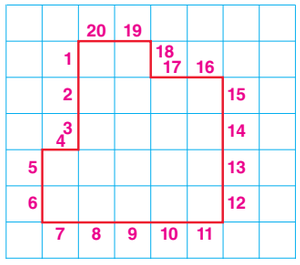
A



Perimeter = 18 units

Find Kevin's error.

B



Perimeter = 20 units

• GO DEEPER Describe the error Kevin made. Circle the places in the drawing of Kevin's solution where he made an error.

Kevin did not count all of the units in the figure. At two of the corners, he did not count correctly.

DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™

Differentiated Centers Kit

Activities
Jump to 9

Students complete blue Activity Card 6 by measuring and then adding lengths.

Activities
Perimeter Parade

Students complete orange Activity Card 10 by finding the perimeter of pattern blocks.

Literature
James' Frames

Students read about using perimeter to find how much wood is needed to make picture frames.

Common Core MATHEMATICAL PRACTICES

THINK SMARTER

This item assesses students' understanding of perimeter. Using the grid as an aid to sketch a rectangle, students should realize that a correct answer must be 2 × (length + width) = 18. Students who incorrectly select A, likely multiplied the two given measures.

THINK SMARTER

Discuss and complete Exercise 9 as a class.

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

MP3 Construct viable arguments and critique the reasoning of others. Extend the activity by encouraging volunteers to draw a figure of their own design. Designs can be exchanged among volunteers who will be challenged to find the perimeters, or they can be displayed on the overhead and completed as whole-class activities.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students work in pairs to find an example in the textbook and then explain to answer the Essential Question.

How can you find perimeter? Possible answer: to find the perimeter of a figure, I can add the lengths of its sides to find the sum. If all of the sides are equal in length, I can multiply the length of each side by the number of sides.

Math Journal WRITE Math

Draw a rectangle and another figure that is not a rectangle by tracing lines on grid paper. Describe how to find the perimeter of both figures.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.

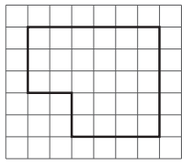
Name _____

Practice and Homework
Lesson 11.1

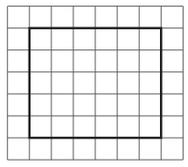
Model Perimeter

Common Core
COMMON CORE STANDARD—3.MD.D.8
Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

Find the perimeter of the figure. Each unit is 1 centimeter.

1. 

22 centimeters

2. 

22 centimeters

Problem Solving Real World

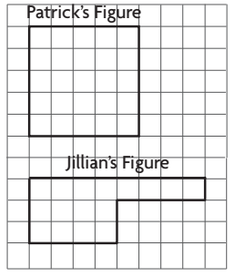
Use the drawing for 3–4. Each unit is 1 centimeter.

3. What is the perimeter of Patrick's figure?

20 centimeters

4. How much greater is the perimeter of Jillian's shape than the perimeter of Patrick's figure?

2 centimeters



5. WRITE Math Draw a rectangle and another figure that is not a rectangle by tracing lines on grid paper. Describe how to find the perimeter of both figures.

Check students' work.

Chapter 11 629

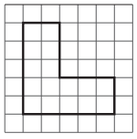
Common Core PROFESSIONAL DEVELOPMENT Math Talk in Action

The class is discussing a strategy that can be used to find the perimeter of any polygon in which all the sides are the same length.

Teacher:	A triangle has side lengths of 9 inches. It is a special shape because all its sides are the same length. One way to find the perimeter of the triangle is to add the three lengths. Who can think of another way to find the perimeter of this triangle?
Jana:	Multiply the length of one side by 3.
Teacher:	Why can you multiply?
Jana:	All the sides have the same length, so it's like combining equal groups.
Teacher:	Right. All four sides of a square have the same length. How could we use multiplication to find the perimeter of a square?
Yvonne:	Multiply the length of one side by 4.
Teacher:	Right. Can we find a pattern? How could we find the perimeter of any shape in which all the sides are the same length?
Marcus:	Multiply the length of one side by the number of sides the shape has.
Teacher:	Yes! You have just stated something mathematicians call a generalization, and it is an awesome one!

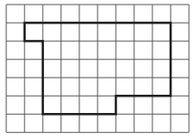
Lesson Check (3.MD.D.8)

1. Find the perimeter of the figure. Each unit is 1 centimeter.



20 centimeters

2. Find the perimeter of the figure. Each unit is 1 centimeter.



26 centimeters

Spiral Review (3.NF.A.3d, 3.MD.A.1, 3.MD.A.2)

3. Order the fractions from least to greatest.

$\frac{2}{4}, \frac{2}{3}, \frac{2}{6}$

$\frac{2}{6}, \frac{2}{4}, \frac{2}{3}$

4. Kasey's school starts at the time shown on the clock. What time does Kasey's school start?

8:30

5. Compare. Write <, >, or =.

$\frac{4}{8} > \frac{3}{8}$

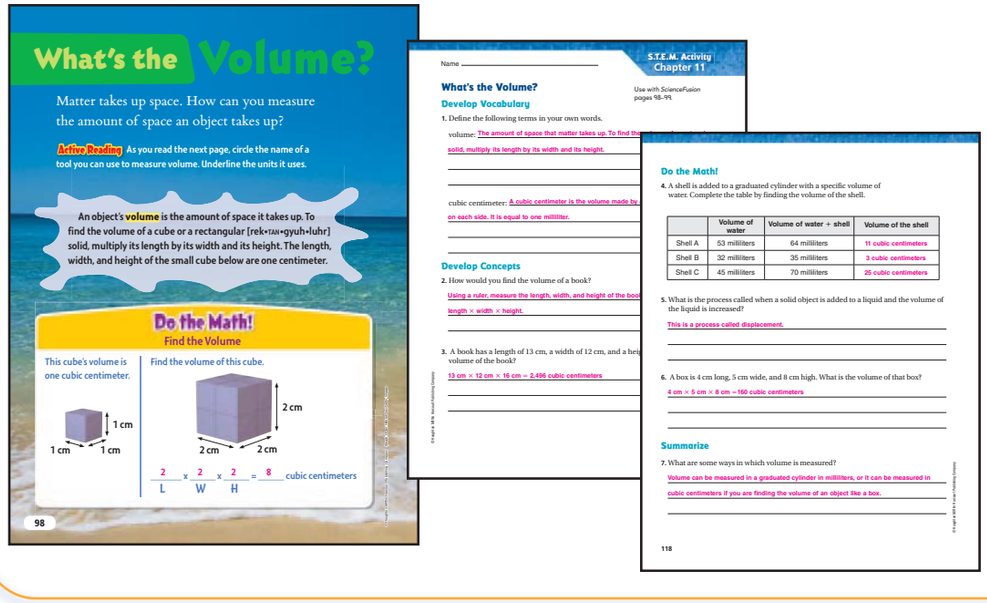
6. Aiden wants to find the mass of a bowling ball. Which unit should he use?

kilogram

FOR MORE PRACTICE GO TO THE Personal Math Trainer

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

S.T.E.M. Connecting Math and Science



In Chapter 11, students extend their understanding of perimeter and area to volume by finding the volume of a book. These same topics are used often in the development of various science concepts and process skills.

Help students make the connection between math and science through the S.T.E.M. activities and activity worksheets found at www.thinkcentral.com. In Chapter 11, students connect math and science with the S.T.E.M. Activity *What's the Volume?* and the accompanying worksheets (pages 117 and 118).

Through this S.T.E.M. Activity, students will connect the *GO Math!* Chapter 11 concepts and skills with various methods to calculate volume, including multiplying the length, width, and height of a box. Students will also discover the overall role that math plays in science. It is recommended that this S.T.E.M. Activity be used after Lesson 11.8.

LESSON 11.2

Find Perimeter

FOCUS COHERENCE RIGOR

LESSON AT A GLANCE

FCR Focus:

Common Core State Standards

3.MD.D.8 Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Also 3.NBT.A.2, 3.MD.B.4

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.)
MP4 Model with mathematics. **MP5** Use appropriate tools strategically.
MP6 Attend to precision. **MP7** Look for and make use of structure.

FCR Coherence:

Standards Across the Grades

Before	Grade 3	After
2.MD.B.5	3.MD.D.8	4.MD.A.3

FCR Rigor:

Level 1: Understand Concepts.....*Share and Show* (Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Estimate and measure perimeter of polygons using inch and centimeter rulers.

Language Objective

Students write in their Math Journal the steps you take to measure perimeter.

Materials

MathBoard, inch ruler, centimeter ruler

FCR For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

Why Teach This

In this lesson, students will estimate and measure perimeter. Estimating perimeter is valuable when students check their answer for reasonableness. An estimate is used as a benchmark or a standard to which an actual answer is compared.

- Although an estimate of a perimeter can be made before or after finding that perimeter, we typically ask students to estimate first. Then answers are compared to the estimates and judged for reasonableness.
- Using an estimate not only enables students to check for reasonableness, it also fosters critical thinking skills. The ability to estimate (and find) perimeter is not only a useful math skill but also a practical life skill.

Professional Development Videos

GO DIGITAL

- iSE Interactive Student Edition
- Personal Math Trainer
- Math on the Spot Video
- Animated Math Models
- iTools: Geometry
- HMH Mega Math

Daily Routines

Common Core

Problem of the Day 11.2

What is the unknown number in the table?

Tents	4	5	6	7
Campers	32	40	■	56

48

Vocabulary

GO DIGITAL
- Interactive Student Edition
- Multimedia eGlossary

Fluency Builder

Common Core Fluency Standard 3.NBT.A.2

Mental Math Students should recall how to add more than two numbers. Have them find the sums.

3 + 6 + 3 + 6 18

11 + 6 + 15 32

2 + 1 + 3 + 4 + 3 13

2 + 2 + 2 + 1 7

12 + 5 + 12 29

3 + 4 + 3 + 4 14

2 + 2 + 2 + 2 8

3 + 4 + 3 + 1 + 2 + 1 14

Pages 102–103 in *Strategies and Practice for Skills and Facts Fluency* provide additional fluency support for this lesson.

1 ENGAGE

with the Interactive Student Edition

Essential Question

How can you measure perimeter?

Making Connections

Invite students to tell you what they know about triangles.

What is a triangle? A triangle is a plane figure with three straight sides and three angles. **Where do you see triangles in everyday life?** Possible answer: in art work; on your math textbook

Learning Activity

What is the problem the students are trying to solve? Connect the story to the problem.

- **What is the problem you are trying to solve?** Find the perimeter of the triangle.
- **What tool are you going to use?** a ruler
- **What are you going to measure with the ruler?** the perimeter of the triangle
- **Have students think about how they found the perimeter using grid paper in the past.**

Literacy and Mathematics

Choose one or more of the following activities.

- Have students explain how they might find the perimeter without using grid paper. Have students write a set of instructions on how to find the perimeter of a figure without using grid paper. Then have the students explain their reasoning to a partner.
- Have students discuss how they have used rulers in the past. Have students explain how they used rulers to measure various objects.

2 EXPLORE

Unlock the Problem

MATHEMATICAL PRACTICES

Activity

Review customary benchmarks for length.

- **What part of your hand is about 1 inch long?** Possible answer: the distance from the tip of my thumb to the first knuckle is about 1 inch.
- **What is the length of a sheet of notebook paper?** The length is about 12 inches, or 1 foot long.

MP5 Use appropriate tools strategically. Ask students to give an example of how each benchmark can be used to estimate a length. Then complete the activity.

Students will measure to the nearest inch instead of the nearest half inch so that they do not have to add fractional parts.

Math Talk Use **Math Talk** to check students' understanding of using an estimate to check for reasonableness.

Try This!

If the sides of the figures are measured correctly, each length will be a whole number of inches or centimeters.

MP6 Attend to precision.

- **Compare and contrast the meanings of "length" and "perimeter."** Possible answer: length is a measurement from one end to another of a line segment or side. Perimeter is also a length, but it is the total distance around a figure.

ELL Strategy:

Cooperative Grouping

Students solidify their understanding of perimeter through cooperative grouping.

- Partner students with similar language levels.
- Have them measure perimeter using examples in the lesson.
- Have students describe to one another how to measure perimeter with an inch ruler using the sentence frame, **The sides measure ___ inch(es), ___ inch(es), and ____ inch(es), which equals a total perimeter of _____ inch(es).**

Common Core **3.MD.D.8** Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Name _____

Find Perimeter

Essential Question How can you measure perimeter?

You can estimate and measure perimeter in standard units, such as inches and centimeters.

Common Core **Measurement and Data—3.MD.D.8** *Also 3.NBT.A.2, 3.MD.B.4*

MATHEMATICAL PRACTICES **MP1, MP2, MP4, MP5**

Unlock the Problem

Find the perimeter of the cover of a notebook.

Activity **Materials** ■ inch ruler **Possible answers are given.**

STEP 1 Estimate the perimeter of a notebook in inches. Record your estimate. 40 inches

STEP 2 Use an inch ruler to measure the length of each side of the notebook to the nearest inch.

STEP 3 Record and add the lengths of the sides measured to the nearest inch.

9 + 12 + 9 + 12 = 42

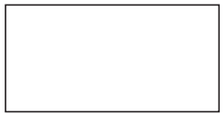
So, the perimeter of the notebook cover measured to the nearest inch is 42 inches.

Math Talk MATHEMATICAL PRACTICES 1

Evaluate How does your estimate compare with your measurement?

Try This! **Find the perimeter.** **Answers will vary. Possible answer: the estimate, 40 inches, is close to but less than the actual measurement, 42 inches.**

Use an inch ruler to find the length of each side.

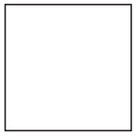


Add the lengths of the sides:

1 + 2 + 1 + 2 = 6

The perimeter is 6 inches.

Use a centimeter ruler to find the length of each side.



Add the lengths of the sides:

3 + 3 + 3 + 3 = 12

The perimeter is 12 centimeters.

Reteach 11.2

RtI

Name _____ Lesson 11.2 Reteach

Find Perimeter

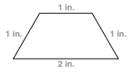
Kelsey wants to know the perimeter of the figure below. She can use an inch ruler to find the perimeter.

Step 1 Choose one side of the figure to measure. Place the zero mark of the ruler on the end of the side. Measure to the nearest inch. Write the length.

Step 2 Use the ruler to measure the other three sides. Write the lengths.

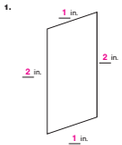
Step 3 Add the lengths of all the sides. 1 + 1 + 2 + 1 = 5

So, the perimeter of the figure is 5 inches.



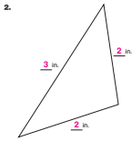
Use an inch ruler to find the perimeter.

1.



6 inches

2.



7 inches

Chapter Resources 11-7 Reteach

Enrich 11.2

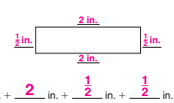
Differentiated Instruction

Name _____ Lesson 11.2 Enrich

Find My Perimeter

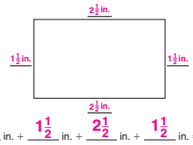
Measure each side to the nearest $\frac{1}{2}$ inch. Then find the perimeter of each figure. (Hint: $\frac{1}{2} + \frac{1}{2} = 1$).

1.



2 in. + 2 in. + $\frac{1}{2}$ in. + $\frac{1}{2}$ in. = 5 inches

2.



$2\frac{1}{2}$ in. + $1\frac{1}{2}$ in. + $2\frac{1}{2}$ in. + $1\frac{1}{2}$ in. = 8 inches

3. Write Math **Explain** how you added the measurements in Exercise 2 to find the perimeter.

Possible explanation: I first added 2 + 1 + 2 + 1, which is 6. Then I added $\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2}$, which is 2. Then I added 6 + 2 to get 8 inches.

Chapter Resources 11-8 Enrich

Share and Show MATH BOARD

1. Find the perimeter of the triangle in inches.

Think: How long is each side?

3 inches

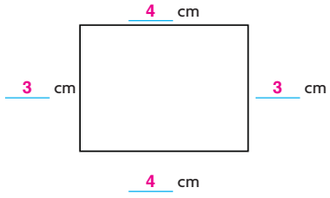
Math Talk MATHEMATICAL PRACTICES 2

Reason Abstractly How do you use addition to find the perimeter of a figure?

Possible explanation: I add the length of each of the sides of the figure. The sum of all the side lengths is the perimeter of the figure.

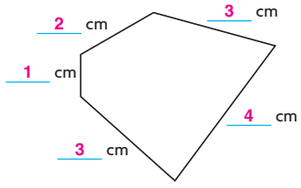
Use a centimeter ruler to find the perimeter.

2.



14 centimeters

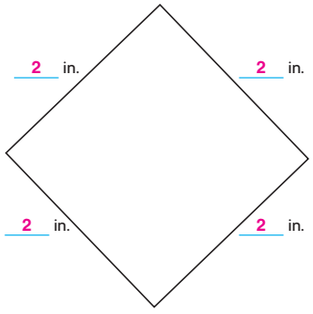
3.



13 centimeters

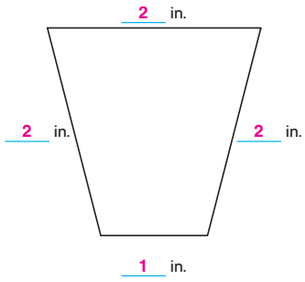
Use an inch ruler to find the perimeter.

4.



8 inches

5.



7 inches

3 EXPLAIN

Share and Show MATH BOARD

The first problem connects to the learning model. Have students use the MathBoard to explain their thinking.

Math Talk Use **Math Talk** to focus on how to use addition to find the perimeter.

Before the figures on this page are measured, you might choose to have students estimate each perimeter. After the figures have been measured, discuss how the estimates can be used to help decide the reasonableness of the exact answers.

Use the checked exercises for **Quick Check**.

Quick Check RtI

If a student misses the checked exercises

Then **Differentiate Instruction** with

- Reteach 11.2
- Personal Math Trainer 3.MD.D.8
- Rtl Tier 1 Activity (online)

Advanced Learners

Visual
Individual

Materials crayons, 1-Inch Grid Paper (see *eTeacher Resources*)

- Write the following perimeters on the board:

  perimeter = 12 units

  perimeter = 15 units

  perimeter = 8 units

- Have students begin by drawing a rectangle with a perimeter of 12 units. Then, have students draw other rectangles and figures with a perimeter of 12 units.
- Challenge students to draw at least 3 different figures for each perimeter.

COMMON ERRORS

Error When a length is not given, the length is assumed.

Example One side of the triangle in Exercise 1 is measured. The lengths of the other sides are assumed, not measured.

Springboard to Learning Discuss the triangle in Exercise 1, and point out that we are not told that the triangle has three sides of equal length. Lead students to understand that although all of the sides of the triangle appear to be the same length, they must measure each side to check that they are the same.

On Your Own

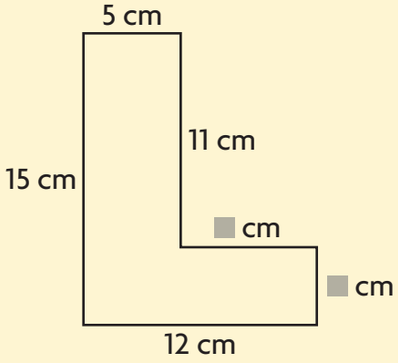
If students complete the checked exercises correctly, they may continue with the On Your Own section.

If the sides of the figures are measured correctly, each length will be a whole number of inches or centimeters.

MP4 Model with mathematics. Students should recognize that they need to keep track of the length of each side of the figure as they draw. If they draw three sides that equal 20 centimeters, then the length of the final side can be only 4 centimeters. Students must plan their figure so that the perimeter has no more than 24 centimeters.

Have students share their figures with the class. Discuss how different figures can have the same perimeter.

MP7 Look for and make use of structure. After students complete Exercises 6 and 7, sketch the figure shown below on the board. (The figure has two unknown side lengths.)



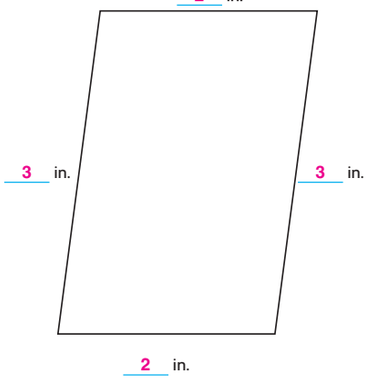
Challenge students to find the perimeter of the figure. 54 centimeters. The unknown horizontal length is 7 cm; the unknown vertical length is 4 cm.

Name _____

On Your Own

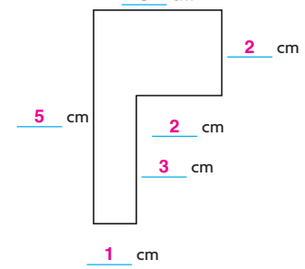
Use a ruler to find the perimeter.

6.



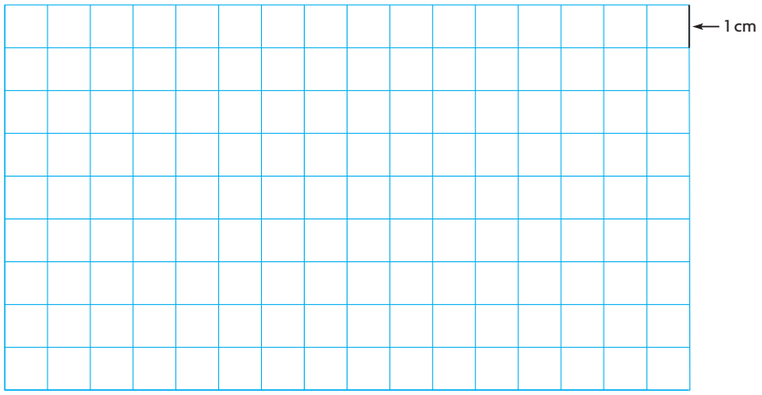
10 inches

7.



16 centimeters

8. MATHEMATICAL PRACTICE 4 **Model Mathematics** Use the grid paper to draw a figure that has a perimeter of 24 centimeters. Label the length of each side. Check students' drawings.



PROBLEM TYPE SITUATIONS

Addition and Subtraction

Put Together/Take Apart • Total Unknown
Exercises: 9, 10, 11, 12, 13

Put Together/Take Apart • Addend Unknown
Exercise: 12

Compare • Difference Unknown
Exercise: 10

Multiplication and Division

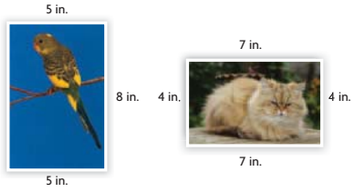
Equal Groups • Unknown Product
Exercise: 11

Equal Groups • Group Size Unknown
Exercise: 12

Common Core MATHEMATICAL PRACTICES COMMUNICATE • PERSEVERE • CONSTRUCT ARGUMENTS

Problem Solving • Applications (Real World)

Use the photos for 9–10.



9. Which of the animal photos has a perimeter of 26 inches?

bird photo

10. GO DEEPER How much greater is the perimeter of the bird photo than the perimeter of the cat photo?

4 inches

11. THINK SMARTER Erin is putting a fence around her square garden. Each side of her garden is 3 meters long. The fence costs $5 for each meter. How much will the fence cost?

$60

12. WRITE Math Gary's garden is shaped like a rectangle with two pairs of sides of equal length, and it has a perimeter of 28 feet. Explain how to find the lengths of the other sides if one side measures 10 feet.

Possible explanation: I know that his garden has four sides with two pairs of sides of equal length; 10 + 10 = 20; 28 − 20 = 8; 8 ÷ 2 = 4; so, each of the other two sides is 4 feet; 10 + 4 + 10 + 4 = 28.

13. THINK SMARTER Use an inch ruler to measure this sticker to the nearest inch. Then write an equation you can use to find its perimeter.

3 + 2 + 3 + 2 = 10, or (3 × 2) + (2 × 2) = 10

WRITE Math • Show Your Work

DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™ Differentiated Centers Kit

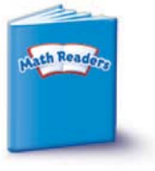
Activities
Jump to 9

Students complete blue Activity Card 6 by measuring and then adding lengths.

Activities
Perimeter Parade

Students complete orange Activity Card 10 by finding the perimeter of pattern blocks.

Literature
James' Frames



Students read about using perimeter to find how much wood is needed to make picture frames.

4 ELABORATE

Problem Solving • Applications (Real World)

Common Core MATHEMATICAL PRACTICES

THINK SMARTER

For Exercise 11, students need to analyze and solve a multistep problem.

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

For Exercise 12, some students may find it helpful to first sketch the rectangle and label one of its sides as 10 feet.

THINK SMARTER

Students should recognize that this is a two-step problem. They must first measure the sticker to determine whole number inches for length and width. Then students use those numbers to write an equation to find perimeter. Some students may have difficulty writing the equation, even though they find the correct perimeter. Help them translate the steps they took into numbers and symbols.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students write in their Math Journal to answer the Essential Question.

How can you measure perimeter?

Possible answer: I can estimate the perimeter of a figure by using benchmarks. I can use an inch ruler to find the length of each side. Then I add the lengths and compare the perimeter to the estimate.

Math Journal WRITE Math

Draw two different figures that each have a perimeter of 20 units.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.

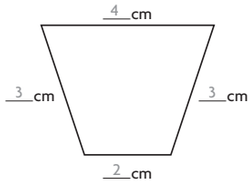
Name _____

Practice and Homework
Lesson 11.2

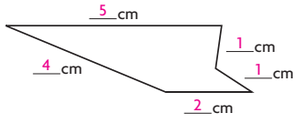
Find Perimeter

Common Core **COMMON CORE STANDARD—3.MD.D.8**
Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

Use a ruler to find the perimeter.

1. 

12 centimeters

2. 

13 centimeters

Problem Solving Real World

Draw a picture to solve 3–4.

3. Evan has a square sticker that measures 5 inches on each side. What is the perimeter of the sticker?

20 inches

4. Sophie draws a shape that has 6 sides. Each side is 3 centimeters. What is the perimeter of the shape?

18 centimeters

5. WRITE Math Draw two different figures that each have a perimeter of 20 units.

Check students' work.

Extend the Math Activity

Two Ways to Measure Perimeter

Materials string, scissors, ruler, paper, pencil

Investigate In this activity, students explore two ways to measure perimeter. For both ways, students translate the side measures to a straight-line measure and then find that length.

- Have students choose a small object in the classroom.
- They should cut a length of string to be the same length as one side of the object. They should repeat this for each side of the object.
- Have students line up all the strings to form one line and then measure the length of all the string.

Math Talk **Why does the length of the string represent the perimeter of the object?** Possible answer: the perimeter is the length all the way around an object, and the string went all the way around the object, so it is the same length as the perimeter.

For this part of the activity, students will measure a line that they make for the length of the sides of the object.

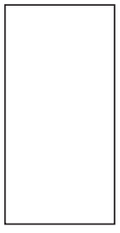
- Have students measure the length of one side of the object. They should then draw a line that is the same length.
- Have students measure the next side of the object. Then, students should draw a line that length so that it forms a straight line with the first length. They should continue measuring and drawing for each side of the object.
- Have them measure the length of the line they drew.

Summarize Have students describe how this method is like finding perimeter in the lesson.

Lesson Check (3.MD.D.8)

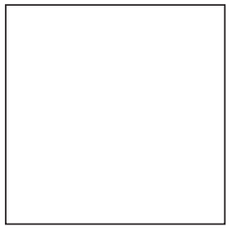
Use an inch ruler for 1–2.

1. Ty cut a label the size of the shape shown. What is the perimeter, in inches, of Ty's label?



6 inches

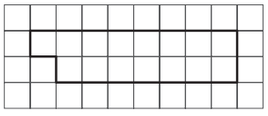
2. Julie drew the shape shown below. What is the perimeter, in inches, of the shape?



8 inches

Spiral Review (3.NF.A.3d, 3.MD.A.1, 3.MD.A.2, 3.MD.D.8)

3. What is the perimeter of the shape below?



20 units

4. Vince arrives for his trumpet lesson after school at the time shown on the clock. What time does Vince arrive for his trumpet lesson?

3:26 P.M.

5. Matthew's small fish tank holds 12 liters. His large fish tank holds 25 liters. How many more liters does his large fish tank hold?

13 liters

6. Compare. Write $<$, $>$, or $=$.

$\frac{1}{6} \bigcirc \frac{1}{4}$

$\frac{1}{6} < \frac{1}{4}$

FOR MORE PRACTICE GO TO THE Personal Math Trainer

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

LESSON 11.3

Algebra • Find Unknown Side Lengths

FOCUS COHERENCE RIGOR

LESSON AT A GLANCE

FCR Focus:

Common Core State Standards

3.MD.D.8 Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Also 3.NBT.A.2

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.)
MP1 Make sense of problems and persevere in solving them. **MP4** Model with mathematics.
MP7 Look for and make use of structure. **MP8** Look for and express regularity in repeated reasoning.

FCR Coherence:

Standards Across the Grades

Before	Grade 3	After
2.MD.B.5	3.MD.D.8	4.MD.A.3

FCR Rigor:

Level 1: Understand Concepts.....*Share and Show* (Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Find the unknown length of a side of a polygon when you know its perimeter.

Language Objective

Student teams develop a concise explanation of how to find the unknown length of a side in a plane figure when you know its perimeter.

Materials

MathBoard

FCR For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

MP2 Reason abstractly and quantitatively

In this lesson, students use algebra concepts that require them to think abstractly. They have not yet learned the formal definition of a variable, but they should understand that they can represent an unknown value, such as a side length, with a letter or symbol.

Students will also write addition and multiplication equations to find perimeter in this lesson. Students learn to represent the perimeter of a figure by using its side lengths, some of which are represented by letters, in an equation. They can solve the equation using inverse operations or predict and check. Then, they can interpret the results within the context of the problem.

Professional Development Videos

GO DIGITAL

- iSE Interactive Student Edition
- Personal Math Trainer
- Math on the Spot Video
- Animated Math Models
- iTools: Geometry

Daily Routines

Common Core

Problem of the Day 11.3

What is the value of *b*?

$16 - 4 + 5 = b$

17

Vocabulary

- Interactive Student Edition
- Multimedia eGlossary

Fluency Builder

Common Core Fluency Standard 3.NBT.A.2

Materials number cubes (labeled 1–6)

Subtract 2-Digit Numbers Have students work in pairs. Give each pair of students two number cubes. Have one student roll the cubes and record a 2-digit number using the cubes. Then have the second student do the same. Both students should subtract the lesser number from the greater number. Have students compare their answers to check for accuracy.

Pages 108–109 in *Strategies and Practice for Skills and Facts Fluency* provide additional fluency support for this lesson.

1 ENGAGE

with the Interactive Student Edition

Essential Question

How can you find the unknown length of a side in a plane figure when you know its perimeter?

Making Connections

Invite students to tell you what they know about quadrilaterals.

What is a quadrilateral? A quadrilateral is a four-sided figure with four straight sides. **What are examples of quadrilaterals in your classroom?** Possible answer: Top of desk, front of door, and shape of the cover of a textbook.

Learning Activity

What is the problem the students are trying to solve? Connect the story to the problem.

- **What problem are you trying to solve?** Find the length of the unknown sides of the speed-limit sign.
- **What type of polygon is the speed-limit sign?** a quadrilateral
- **How many sides does the speed-limit sign have?** 4
- **What is the length of the left and right side of the speed-limit sign?** Each side is 4 feet in length.

Literacy and Mathematics

Choose one or more of the following activities.

- Have students read the problem aloud with partners. Have students brainstorm what mathematical operations may be used to find the missing length.
- Have students review the concept of perimeter by explaining how they have found the perimeter in the past.

2 EXPLORE

Unlock the Problem

Common Core MATHEMATICAL PRACTICES

MP4 Model with mathematics.

- **Explain how to write an equation for the perimeter.** Possible answer: I can use the side lengths I know as four addends and the letter *n*, which stands for the unknown side length, as the fifth addend. I can make that sum equal to the perimeter, 27.
- **Explain why you used subtraction to solve the equation.** Addition and subtraction are inverse operations, so I can use subtraction to undo addition.
- **How can you check your answer?** Possible answer: I can replace 8 for *n* in the equation and see if the addends add to 27.

ELL Strategy:

Restate

Restate that the perimeter of a figure is the distance around the figure.

- Draw a rectangle on the board with the length labeled 3 feet and the width labeled 4 feet. Put your finger on a corner of the rectangle and follow along the side lengths.
- Have students say the length of the side aloud as you write it as an addend on the board. Then help students add to find the perimeter. 14 feet
- Have students rephrase the definition using this context.

Try This!

Remind students to include all side lengths when they find the perimeter of a figure.

MP2 Reason abstractly and quantitatively. To extend Try This!, ask students to assume they did not know the perimeter of the figure. Have students use reasoning to find the value of *w*. Possible answer: I know that $w + 2$ must equal 5 by looking at the figure, so $w = 3$.

MP8 Look for and express regularity in repeated reasoning.

- **If you know the measurement of three sides of a rectangle, how do you find the fourth side?** The fourth side has the same measurement as the side opposite it.

Common Core **3.MD.D.8** Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Name _____

ALGEBRA
Lesson 11.3

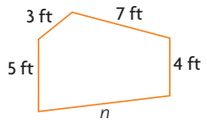
Algebra • Find Unknown Side Lengths

Essential Question How can you find the unknown length of a side in a plane figure when you know its perimeter?

Common Core **Measurement and Data—3.MD.D.8** *Also 3.NBT.A.2*
MATHEMATICAL PRACTICES
MP3, MP4, MP7

Unlock the Problem

Chen has 27 feet of fencing to put around his garden. He has already used the lengths of fencing shown. How much fencing does he have left for the last side?



Find the unknown side length.

Write an equation for the perimeter.

$5 + 3 + \underline{7} + \underline{4} + n = 27$

Think: If I knew the length *n*, I would add all the side lengths to find the perimeter.

$5 + 3 + 7 + \underline{4} + n = 27$

Add the lengths of the sides you know.

$\underline{19} + n = 27$

Think: Addition and subtraction are inverse operations.

Write a related equation.

Problem Type: Put Together/Take Apart • Addend Unknown

$n = 27 - 19$

So, Chen has $\underline{8}$ feet of fencing left.

$\underline{8} = 27 - 19$

Math Idea
A symbol or letter can stand for an unknown side length.

Try This!

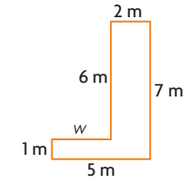
The perimeter of the figure is 24 meters.
Find the unknown side length, *w*. See below.

$\underline{6} + \underline{2} + \underline{7} + \underline{5} + \underline{1} + w = \underline{24}$

$\underline{21} + w = \underline{24}$

$w = \underline{24} - \underline{21}$

$\underline{3} = \underline{24} - \underline{21}$



So, the unknown side length, *w*, is $\underline{3}$ meters.

Problem Type: Put Together/Take Apart • Addend Unknown

Reteach 11.3

RtI

Name _____ Lesson 11.3 Reteach

Algebra • Find Unknown Side Lengths

An unknown side length is a side that does not have its length labeled with a number. Instead the side is labeled with a symbol or letter, such as *a*.

The perimeter of the figure is 20 meters. Find the length of side *a*.

Think: There is only one unknown side length.

Step 1 Add the *known* side lengths.
$6 + 9 = 15$

Step 2 Subtract the sum of the known side lengths from the perimeter.
$20 - 15 = 5$

Step 3 Add to check your work.
$6 + 9 + 5 = 20$ ✓

So, the unknown side length, *a*, is 5 meters.

The perimeter of the square is 12 feet. What is the length of each side of the square?

Think: A square has four sides of equal length.

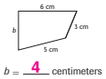
Step 1 Divide the perimeter by the number of sides.
$12 \div 4 = 3$

Step 2 Multiply to check your work.
$4 \times 3 = 12$ ✓

So, the length of each side, *x*, is 3 feet.

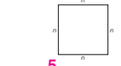
Find the unknown side lengths.

1. Perimeter = 18 centimeters



$b = \underline{4}$ centimeters

2. Perimeter = 20 yards



$n = \underline{5}$ yards

Enrich 11.3

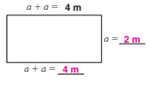
Differentiated Instruction

Name _____ Lesson 11.3 Enrich

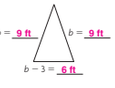
Perimeter Reasoning

Find and label the length of each unknown side.

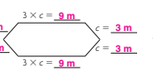
1. Perimeter = 12 meters



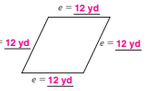
2. Perimeter = 24 feet



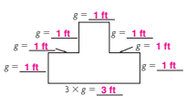
3. Perimeter = 30 meters



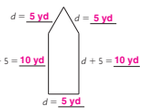
4. Perimeter = 48 yards



5. Perimeter = 10 feet



6. Perimeter = 35 yards



Example Find unknown side lengths of a rectangle.

Lauren has a rectangular blanket. The perimeter is 28 feet. The width of the blanket is 5 feet. What is the length of the blanket?

See below.

Hint: A rectangle has two pairs of opposite sides that are equal in length.

You can predict the length and add to find the perimeter. If the perimeter is 28 feet, then that is the correct length.

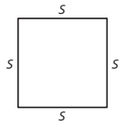
Predict	Check	Does it check?
l = 7 feet	5 + 7 + 5 + 7 = 24	**Think:** Perimeter is not 28 feet, so the length does not check.
l = 8 feet	5 + 8 + 5 + 8 = 26	**Think:** Perimeter is not 28 feet, so the length does not check.
l = 9 feet	5 + 9 + 5 + 9 = 28	**Think:** Perimeter is 28 feet, so the length is correct. ✓

So, the length of the blanket is 9 feet.

Problem Type: Put Together/ Take Apart • Addend Unknown

Try This! **Find unknown side lengths of a square.**

The square has a perimeter of 20 inches. What is the length of each side of the square?



Think: A square has four sides that are equal in length.

You can multiply to find the perimeter.

- Write a multiplication equation for the perimeter. $4 \times s = 20$
- Use a multiplication fact you know to solve. $4 \times 5 = 20$

So, the length of each side of the square is 5 inches.

Problem Type: Equal Groups • Group Size Unknown

Example

Students can test their predictions for the length of the blanket by replacing their predictions into the equation for perimeter.

- **How can you make a good first prediction?** Possible answer: to make a good first prediction, I can use the diagram. The blanket looks a few feet taller than it is wide, so I can try using 7 feet as the first prediction.
- **How do you know what to try next if your first prediction is not correct?** Possible answer: The first prediction gives a perimeter of 24 feet, which is less than the actual perimeter, 28 feet. So, I should try a number greater than 7.

Try This!

Have students complete the exercise. Point out that each side length is labeled with the same variable because their lengths are all equal.

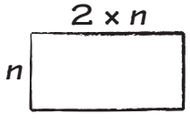
- **What does *s* stand for in the equation?** the length of one side of the square
- **Explain why you can use multiplication to find the unknown side lengths of a square.** I can use multiplication because a square has four sides that are equal in length.
- **Could you use addition to solve the problem? Explain.** Yes, I could find $s + s + s + s = 20$, since the sum of the side lengths is equal to the perimeter.

If students use addition to solve, they will need to use the predict and check method in order to find the length of each side.

Advanced Learners

Visual
Small Group

- Draw a rectangle with side lengths labeled n and $2 \times n$ on the board. Draw the sides labeled $2 \times n$ so that they are twice as long as sides labeled n.



- Tell students that the perimeter of the rectangle is 48.
- Have students find the unknown side lengths. 8 and 16
- If time permits, students should repeat the activity for a rectangle with a perimeter of 40 and side lengths n and $n + 2$. 9 and 11
- Have students write a problem of their own for a classmate. Have students exchange problems and check each other's work.

COMMON ERRORS

Error Students forget to add a side length when finding perimeter.

Example Students write the following equation to solve the first example of the lesson: $5 + 3 + 7 + n = 27$.

Springboard to Learning Tell students that in order to be sure they include each side length when finding perimeter, they may want to mark or circle the side lengths as they use them in their perimeter equations.

3 EXPLAIN

Share and Show

The first problem connects to the learning model. Have students use the MathBoard to explain their thinking.

Quick Check

If a student misses the checked exercises

Then **Differentiate Instruction** with
- Reteach 11.3
- Personal Math Trainer 3.MD.D.8
- RtI Tier 1 Activity (online)

Use the checked exercises for **Quick Check**.

On Your Own

THINK SMARTER

Exercise 5 allows students to connect perimeter to multiplication. Discuss how the equation *number of sides* × *side length* = *perimeter* can be used for any figure with equal side lengths.

MP4 Model with mathematics. Extend Exercise 6 by asking students to identify which operation can be used to solve the problem and why. Possible answer: I used division to write an equation because the lengths of all four sides are equal.

Math Talk Use **Math Talk** to check students' understanding of the relationship between side length and perimeter.

- **How do you find the perimeter of a square?**
  Possible answer: Multiply a side length by 4.
- **How are multiplication and division related?**
  They are opposite operations.

Name _____

Share and Show

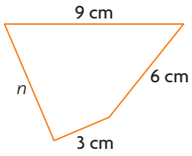
Find the unknown side lengths.

1. Perimeter = 25 centimeters

$9 + \underline{6} + \underline{3} + n = 25$

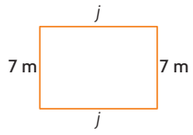
$\underline{18} + n = 25$

$\underline{7} = \underline{25} - \underline{18}$



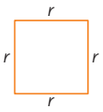
$n =$ 7 centimeters

2. Perimeter = 34 meters



$j =$ 10 meters

3. Perimeter = 12 feet



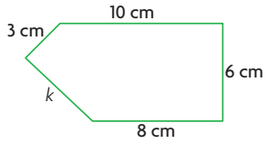
$r =$ 3 feet

Math Talk: Possible explanation: since all 4 sides of a square are equal in length, you can divide the perimeter by 4 to find the length of one side.

On Your Own

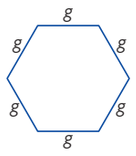
Find the unknown side lengths.

4. Perimeter = 32 centimeters



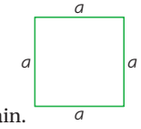
$k =$ 5 centimeters

5. THINK SMARTER Perimeter = 42 feet



$g =$ 7 feet

6. MATHEMATICAL PRACTICE 4 **Use a Diagram** Eleni wants to put up a fence around her square garden. The garden has a perimeter of 28 meters. How long will each side of the fence be? Explain.



7 meters; possible explanation: all four sides are equal in length; 28 ÷ 4 = 7.

Math Talk MATHEMATICAL PRACTICES 3
Apply How can you use division to find the length of a side of a square?

PROBLEM TYPE SITUATIONS

Addition and Subtraction

Put Together/Take Apart • Addend Unknown
Exercises: 7, 8, 9

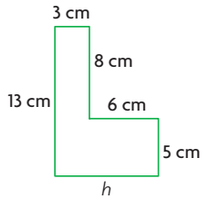
Multiplication and Division

Equal Groups • Group Size Unknown
Exercises: 6, 8. 9

Common Core MATHEMATICAL PRACTICES ANALYZE • LOOK FOR STRUCTURE • PRECISION

Unlock the Problem Real World

7. GO DEEPER Latesha wants to make a border with ribbon around a figure she made and sketched at the right. She will use 44 centimeters of ribbon for the border. What is the unknown side length?



a. What do you need to find?

the unknown side length

b. How will you use what you know about perimeter to help you solve the problem?

I know the sum of the lengths of all the sides is the perimeter, so I can add the sides I know and then write a related equation.

c. Write an equation to solve the problem.

$13 + 3 + 8 + 6 + 5 + h = 44$

d. So, the length of side h is 9 centimeters.

8. THINK SMARTER A rectangle has a perimeter of 34 inches. The left side is 6 inches long. What is the length of the top side?

11 inches

Personal Math Trainer

9. THINK SMARTER+ Michael has 40 feet of fencing to make a rectangular dog run for his dog, Buddy. One side of the run will be 5 feet long. For numbers 9a–9d, choose Yes or No to show what the length of another side will be.

9a.	20 feet	○ Yes	● No
9b.	15 feet	● Yes	○ No
9c.	10 feet	○ Yes	● No
9d.	8 feet	○ Yes	● No

DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™

Differentiated Centers Kit

Activities
Roll To 100!

Students complete orange Activity Card 1 by finding the sum of three numbers.

Activities
Perimeter Parade

Students complete orange Activity Card 10 by finding the perimeter of pattern blocks.

Literature
James' Frames

Students read about using perimeter to find how much wood is needed to make picture frames.

4 ELABORATE

Unlock the Problem Real World

Common Core MATHEMATICAL PRACTICES

GO DEEPER

MP7 Look for and make use of structure. Exercise 7 walks students through each step of writing an equation to find an unknown side length. Be sure that students use the correct inverse operation when solving the equation.

THINK SMARTER

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

THINK SMARTER+ **Personal Math Trainer**

Be sure to assign this problem to students in the Personal Math Trainer. It features an animation to help them model and answer the problem. This item assesses whether students can find an unknown side length of a rectangle when given its perimeter and the length of one side.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students work in teams to develop a concise explanation to answer the Essential Question.

How can you find the unknown length of a side in a plane figure when you know its perimeter? Possible answer: I can add the side lengths I know and subtract the sum from the perimeter to find the unknown side length.

Math Journal WRITE Math

Explain how to write and solve an equation to find an unknown side length of a rectangle when given the perimeter.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.

Name _____

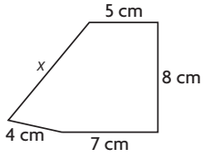
Practice and Homework
Lesson 11.3

Find Unknown Side Lengths

Common Core **COMMON CORE STANDARD—3.MD.D.8**
Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

Find the unknown side lengths.

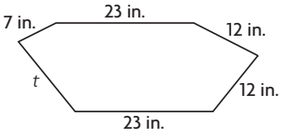
1. Perimeter = 33 centimeters



$5 + 8 + 7 + 4 + x = 33$
$24 + x = 33$
$x = 9$

$x =$ 9 centimeters

2. Perimeter = 92 inches



$t =$ 15 inches

Problem Solving Real World

3. Steven has a rectangular rug with a perimeter of 16 feet. The width of the rug is 5 feet. What is the length of the rug?

3 feet

4. Kerstin has a square tile. The perimeter of the tile is 32 inches. What is the length of each side of the tile?

8 inches

5. WRITE Math Explain how to write and solve an equation to find an unknown side length of a rectangle when given the perimeter.

Check students' work.

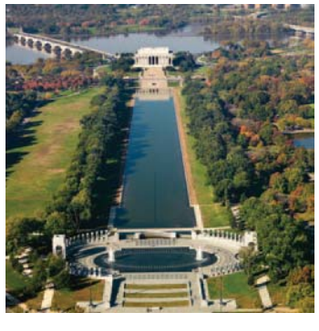
Cross-Curricular

S.T.E.M.

- Memory cards are used in many portable electronic devices, like cell phones and digital cameras. Memory cards store information so that data, such as photos, can be transferred from a device to a computer.
- In devices like digital cameras and cell phones, memory cards are often small and rectangular in shape.
- A rectangular memory card has a perimeter of 38 millimeters and a length of 9 millimeters. What is the width of the memory card? 10 millimeters

SOCIAL STUDIES

- The National Mall is a park in Washington, D.C. Famous monuments and buildings like the Lincoln Memorial, the National Museum of Natural History, and the Washington Monument are in the park.
- The Reflecting Pool, located at the foot of the Lincoln Memorial, is rectangular in shape. A scale model of the pool has a perimeter of 26 inches and a length of 12 inches. What is the width of the model? 1 inch



Lesson Check (3.MD.D.8)

1. Jesse is putting a ribbon around a square frame. He uses 24 inches of ribbon. How long is each side of the frame?

6 inches

2. Davia draws a shape with 5 sides. Two sides are each 5 inches long. Two other sides are each 4 inches long. The perimeter of the shape is 27 inches. What is the length of the fifth side?

9 inches

Spiral Review (3.OA.A.1, 3.OA.D.8, 3.NF.A.3c, 3.MD.A.1)

3. What multiplication expression represents $7 + 7 + 7 + 7$?

4×7

4. Bob bought 3 packs of model cars. He gave 4 cars to Ann. Bob has 11 cars left. How many model cars were in each pack?

5 model cars

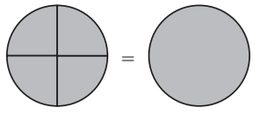
5. Randy read a book in the afternoon. He looked at his watch when he started and finished reading. How long did Randy read?

Start

End

45 minutes

6. What fraction and whole number does the model represent?



$\frac{4}{4} = 1$

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

LESSON 11.4 | Progress to Algebra

Understand Area

FOCUS | COHERENCE | RIGOR

LESSON AT A GLANCE

F C R Focus:

Common Core State Standards

3.MD.C.5 Recognize area as an attribute of plane figures and understand concepts of area measurement.

3.MD.C.5a A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.

Also 3.MD.C.5b, 3.MD.C.6, 3.MD.D.8

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.)
MP2 Reason abstractly and quantitatively. **MP4** Model with mathematics.
MP5 Use appropriate tools strategically. **MP6** Attend to precision.

F C R Coherence:

Standards Across the Grades

Before	Grade 3	After
2.G.A.2	3.MD.C.5	4.MD.A.3
	3.MD.C.5a	

F C R Rigor:

Level 1: Understand Concepts.....*Share and Show* (✓ Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Explore perimeter and area as attributes of polygons.

Language Objective

Students complete a 2-column chart to show how finding the area of a figure differs from finding the perimeter of a figure.

Materials

MathBoard, geoboard, rubber bands

F C R For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

Progress to Algebra
Why Teach This

Area is a mathematical topic that has connected geometry and measurement since ancient times. In the time of the pharaohs, Egyptian surveyors knew how to measure plots of land and calculate their areas. These area measurements assured farmers that they could locate their plots every year after the Nile River flooded and also formed the basis for the amount of grain that a farmer had to pay in taxes.

This lesson introduces the concept of area and helps students establish the similarities and differences between area and perimeter. This lesson also provides the foundation for which students will build their knowledge of area. In later courses, they will use formulas to find areas of shapes.

Professional Development Videos

GO DIGITAL

- Interactive Student Edition
- Personal Math Trainer
- Math on the Spot Video
- Animated Math Models
- *i*Tools: Geometry
- HMH Mega Math

Daily Routines

Common Core

Problem of the Day 11.4

Kevin meets his friend for the movies at twenty-five minutes after seven. What is another way to show this time?

7:25

Vocabulary area, square unit, unit square

- Interactive Student Edition
- Multimedia eGlossary

Fluency Builder

Common Core Fluency Standard 3.OA.C.7

Practice multiplication facts including finding the missing factor. Write problems similar to the following on the board and have students fill in the missing number.

$3 \times 4 = ?$

$7 \times 2 = ?$

$4 \times 8 = ?$

$2 \times ? = 18$

$3 \times ? = 21$

$5 \times ? = 30$

$? \times 8 = 24$

$? \times 6 = 36$

$? \times 3 = 27$

Pages 62–63 in *Strategies and Practice for Skills and Facts Fluency* provide additional fluency support for this lesson.

1 ENGAGE

with the Interactive Student Edition

Essential Question

How is finding the area of a figure different from finding the perimeter of a figure?

Making Connections

Invite students to think about squares and perimeter.

- **How many sides does a square have?** 4 **How do you find the perimeter of a square?** Find the total length of the four sides **Have you ever seen a floor covered in square tiles?** yes **Did the tiles overlap?** no **How could you describe the size of a room that has a square-tile floor?** I could count the number of square tiles that are on the floor.

Learning Activity

What is the problem the students are trying to solve? Connect the story to the problem.

Ask the following questions:

- **What are you asked to find?** the area inside the fenced vegetable garden
- **Describe the shape the fence makes.** a rectangle

Literacy and Mathematics

View the lesson opener with the students. Then, choose one or more of the following activities:

- Have students make a chart to list real-world examples of perimeter and area. For example, fencing around a yard would be perimeter and grass covering a yard would be area. Have students share their examples with the class.
- Have students summarize the difference between perimeter and area.

2 EXPLORE

Progress to Algebra

3.MD.C.5 Recognize area as an attribute of plane figures and understand concepts of area measurement.
3.MD.C.5a A square with side length 1 unit, called a "unit square," is said to have "one square unit" of area, and can be used to measure area.

Unlock the Problem

Common Core MATHEMATICAL PRACTICES

CONNECT

MP6 Attend to precision. Discuss real-world examples of area such as using square feet to describe the area of a room.

- **How is perimeter similar to area?** Both describe figures and are measurements.
- **How is perimeter different from area?** Perimeter is the distance around a figure and is measured in linear units. Area is the measure of the number of unit squares needed to cover a flat surface and is measured in square units.

Activity

Some students may make half squares by making a diagonal with their rubber bands. If they do this, explain that two half squares equal one whole square. However, if students do not make a half square, do not mention this concept.

Explain to students that the area of the figure they create is described by the space inside the rubber band, not by the number of pegs or the distance between them.

- **Explain the difference between using the geoboard to find area and using it to find perimeter.** To find area, I count the number of unit squares inside a figure, using the space inside the rubber band. To find perimeter, I count the number of units around the outside of the figure, using the distance between the pegs.

ELL Strategy:

Illustrate Understanding

To show their understanding of the term *area*, have students draw a rectangular shape on dot paper.

- Model a rectangle for students.
- Have students shade as they count unit squares.
- **What does the total number of unit squares represent?** the area of the shape
- Have students count the total number of unit squares in the shape that they drew in order to find its area. Students say, **There are ___ unit squares in this shape.**

Name _____

Lesson 11.4

Understand Area

Essential Question How is finding the area of a figure different from finding the perimeter of a figure?

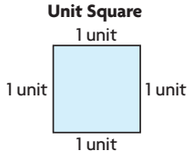
Common Core **Measurement and Data—**
3.MD.C.5, 3.MD.C.5a *Also 3.MD.C.5b, 3.MD.C.6, 3.MD.D.8*
MATHEMATICAL PRACTICES
MP2, MP3, MP5, MP8

Unlock the Problem

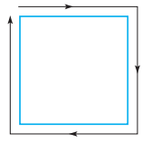
CONNECT You learned that perimeter is the distance around a figure. It is measured in linear units, or units that are used to measure the distance between two points.

Area is the measure of the number of unit squares needed to cover a flat surface. A **unit square** is a square with a side length of 1 unit. It has an area of 1 **square unit**.

Unit Square

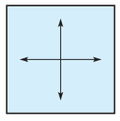


Perimeter



1 unit + 1 unit + 1 unit + 1 unit = 4 units

Area



1 square unit

Math Idea

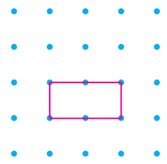
You can count the number of units on each side of a figure to find its perimeter. You can count the number of unit squares inside a figure to find its area in square units.

Activity

Materials ■ geoboard ■ rubber bands

Possible drawings are shown.

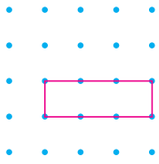
A Use your geoboard to form a figure made from 2 unit squares. Record the figure on this dot paper.



What is the area of this figure?

Area = 2 square units

B Change the rubber band so that the figure is made from 3 unit squares. Record the figure on this dot paper.



What is the area of this figure?

Area = 3 square units

Math Talk MATHEMATICAL PRACTICES 3

Compare Representations
For B, did your figure look like your classmate's figure?

Math Talk: Answers will vary.

Reteach 11.4

RtI

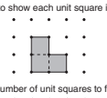
Name _____ Lesson 11.4 Reteach

Understand Area

A unit square is a square with a side length of 1 unit. Area is the measure of the number of unit squares needed to cover a surface. A square unit is used to measure area.

What is the area of the figure?

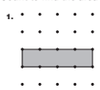
Step 1 Draw lines to show each unit square in the figure.



Step 2 Count the number of unit squares to find the area.

The area of the figure is 3 square units.

Count to find the area of the figure.

1. 
Area = 4 square units

2. 
Area = 6 square units

3. 
Area = 6 square units

Chapter Resources 11-11 Reteach

Enrich 11.4

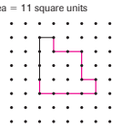
Differentiated Instruction

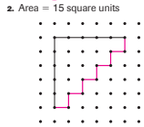
Name _____ Lesson 11.4 Enrich

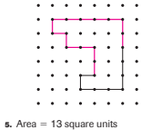
Connect the Dots to Show the Area

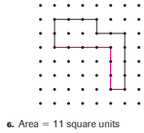
On each piece of dot paper below, a figure has been started. Use the area to complete the figure by connecting the dots. Connect the dots to complete the figure with the given area.

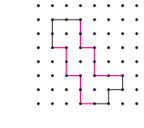
Possible drawings are shown.

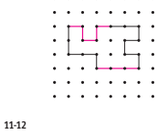
1. Area = 11 square units


2. Area = 15 square units


3. Area = 16 square units


4. Area = 11 square units


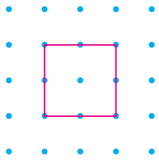
5. Area = 13 square units


6. Area = 11 square units


Chapter Resources 11-12 Enrich

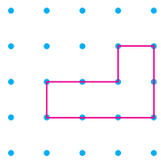
Try This! **Draw three different figures that are each made from 4 unit squares. Find the area of each figure.** Possible drawings are shown.

Figure 1



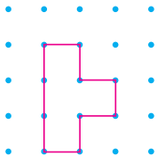
Area = 4 square units

Figure 2



Area = 4 square units

Figure 3



Area = 4 square units

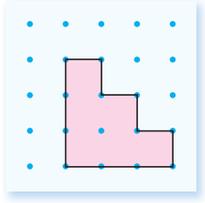
- How are the figures the same? How are the figures different?

Possible answer: they have the same area. Their shapes look different.

Share and Show

MATH BOARD

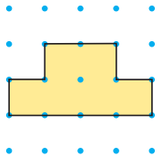
1. Shade each unit square in the figure shown. Count the unit squares to find the area.



Area = 6 square units

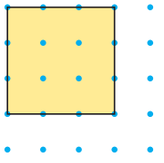
Count to find the area of the figure.

2.



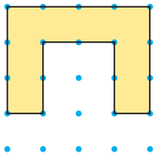
Area = 6 square units

3.



Area = 9 square units

4.



Area = 8 square units

Write *area* or *perimeter* for the situation.

5. buying a rug for a room

area

6. putting a fence around a garden

perimeter

Math Talk

MATHEMATICAL PRACTICES 8

Generalize What are other situations where you need to find area?

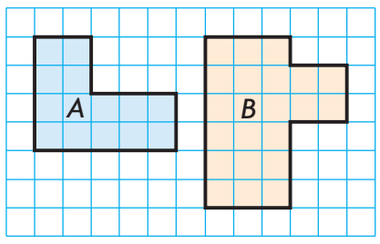
Situations will vary.

Advanced Learners

Logical / Mathematical Partners

Materials 1-Centimeter Grid Paper (see *eTeacher Resources*)

- Display the two figures below. Have the students find the perimeter of each figure. figure A: 18 units, figure B: 22 units
- Challenge students to find the area of each figure by using multiplication and by breaking them into two rectangles.



Try This!

Have students complete the exercise. Explain there will be a variety of correct drawings.

MP2 Reason abstractly and quantitatively.

- **How can two different figures have the same area?** Possible answer: because the measure of the number of unit squares covering a figure is its area, you can rearrange the unit squares used in one figure to make a different figure and the area will not change.

3 EXPLAIN

Share and Show

MATH BOARD

The first problem connects to the learning model. Have students use the MathBoard to explain their thinking.

Use the checked exercises for Quick Check.

Quick Check

RtI

If a student misses the checked exercises

Then Differentiate Instruction with

- Reteach 11.4
- Personal Math Trainer 3.MD.C.5, 3.MD.C.5a
- RtI Tier 1 Activity (online)

Math Talk

Use **Math Talk** to focus on when to use area and perimeter. Remind students that perimeter is the distance around a figure and area is the measure of the number of unit squares needed to cover a figure.

- **What are other situations when you would need to find perimeter?** Situations will vary.

COMMON ERRORS

Error Students find the perimeter instead of the area.

Example Students find that the area of the figure in Exercise 2 is 12 units.

Springboard to Learning Tell students that to find area, they should be counting unit squares, not side lengths of squares.

On Your Own

If students complete the checked exercises correctly, they may continue with the On Your Own section. Allow students time to complete Exercises 7–9 on their own. If students are having difficulty finding the correct answer, have them draw lines between the dots on the dot paper to form the unit squares. Then have them count to find the area.

MP2 Reason abstractly and quantitatively. Extend Exercises 13–16 by asking students to write two different situations, one for perimeter and one for area. Answers will vary.

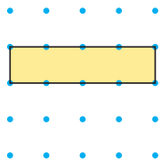
GO DEEPER

Exercise 17 is a multi-step problem. Students first find the total number of tiles (the area) and then multiply by $2 (the cost of each tile) to find the total cost.

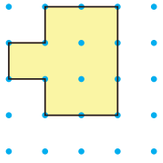
Name _____

On Your Own

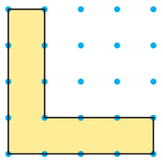
Count to find the area of the figure.

7. 

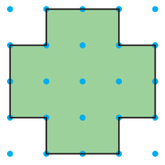
Area = 4 square units

8. 

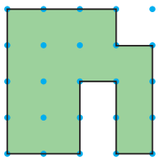
Area = 7 square units

9. 

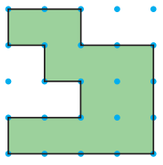
Area = 7 square units

10. 

Area = 12 square units

11. 

Area = 13 square units

12. 

Area = 11 square units

Write *area* or *perimeter* for the situation.

13. painting a wall

area

14. covering a patio with tiles

area

15. putting a wallpaper border around a room

perimeter

16. gluing a ribbon around a picture frame

perimeter

17. GO DEEPER Nicole's mother put tiles on a section of their kitchen floor. The section included 5 rows with 4 tiles in each row. Each tile cost $2. How much money did Nicole's mother spend on the tiles?

$40

PROBLEM TYPE SITUATIONS

Addition and Subtraction

Put Together/Take Apart • Total Unknown
Exercises: 18, 21

Multiplication and Division

Equal Groups • Unknown Product
Exercise: 17

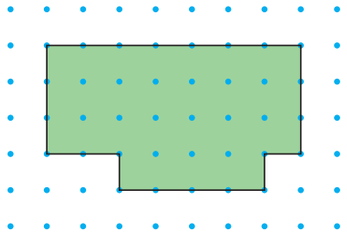
Arrays • Unknown Product
Exercise: 17

Common Core MATHEMATICAL PRACTICES MODEL • REASON • MAKE SENSE

Problem Solving • Applications (Real World)

Juan is building an enclosure for his small dog, Eli. Use the diagram for 18–19.

Eli's Enclosure



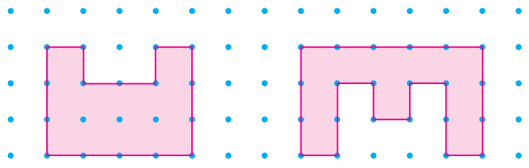
18. Juan will put fencing around the outside of the enclosure. How much fencing does he need for the enclosure?

22 units

19. MATHEMATICAL PRACTICE 5 **Use Appropriate Tools** Juan will use grass sod to cover the ground in the enclosure. How much grass sod does Juan need?

25 square units

20. THINK SMARTER Draw two different figures, each with an area of 10 square units. Possible drawings are shown.



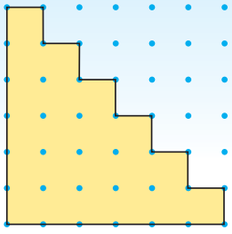
Math on the Spot

21. THINK SMARTER What is the perimeter and area of this figure? Explain how you found the answer.

Perimeter 24 units

Area 21 square units

Possible explanation: For perimeter, I counted the unit edges around the figure: 6 + 6 + 12 = 24. For area, I counted the unit squares inside the figure: 1 + 2 + 3 + 4 + 5 + 6 = 21.



DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™

Differentiated Centers Kit

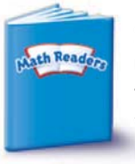
Activities

Perimeter Parade

Students complete orange Activity Card 10 by finding the perimeter of pattern blocks.

Literature

James' Frames



Students read about using perimeter to find how much wood is needed to make picture frames.

4 ELABORATE

Problem Solving • Applications (Real World)

Common Core MATHEMATICAL PRACTICES

MP5 Use appropriate tools strategically. Exercises 18–19 highlight the differences in situations when students would need to use perimeter and when they would need to use area.

THINK SMARTER

Exercise 20 requires students to use higher order thinking skills to draw two figures that have the same area.

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

THINK SMARTER

Students must be able to count units to find the perimeter and area of an irregular figure on dot paper. Students who give incorrect answers likely made a counting error. Some students might reverse the answers if they are unclear about the measures of perimeter and area.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students complete a 2-column chart to answer the Essential Question.

How is finding the area of a figure different from finding the perimeter of a figure?

Possible answer: to find area, I find the number of unit squares needed to cover the figure. To find perimeter, I find the number of units around the figure.

Math Journal WRITE Math

Draw a rectangle using dot paper. Find the area, and explain how you found your answer.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.

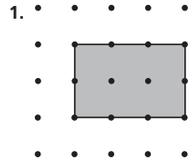
Name _____

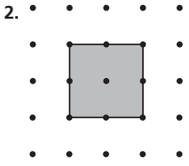
Practice and Homework
Lesson 11.4

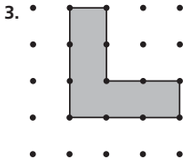
Understand Area

COMMON CORE STANDARDS—3.MD.C.5, 3.MD.C.5a *Geometric measurement: understand concepts of area and relate area to multiplication and to addition.*

Count to find the area for the shape.

1. 
Area = 6 square units

2. 
Area = 4 square units

3. 
Area = 5 square units

Write *area* or *perimeter* for each situation.

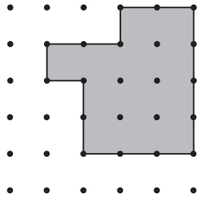
4. carpeting a floor
area

5. fencing a garden
perimeter

Problem Solving Real World

Use the diagram for 6–7.

6. Roberto is building a platform for his model railroad. What is the area of the platform?
12 square units



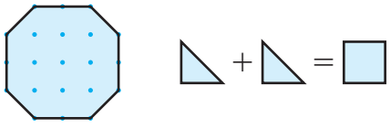
7. Roberto will put a border around the edges of the platform. How much border will he need?
16 units

8. WRITE Math Draw a rectangle using dot paper. Find the area, and explain how you found your answer.
Check students' work.

Extend the Math Activity

Find Area Using Half Unit Squares

Investigate Students have found the area of shapes using whole-unit squares. Now they will use whole-unit squares and half-unit squares to find the area of a shape.

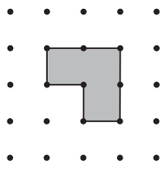


- Count the number of whole unit squares in the shape.
There are 12 whole-unit squares.
- Count the number of half unit squares in the shape.
There are 4 half-unit squares.
- How many half-unit squares make a whole-unit square? 2
- What is the area of the shape? Explain how you found your answer. 14 square units; There are 12 whole-unit squares. The 4 half-unit squares make 2 whole-unit squares, so the area is 12 + 2 = 14 unit squares.

Summarize In order to find the area of a shape that contains both whole and half-unit squares, students can count the number of whole-unit squares, then the number of half-unit squares. Student can then convert each set of 2 half-unit squares to one whole-unit square and add to find the area.

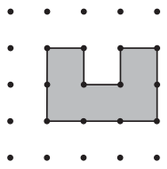
Lesson Check (3.MD.C.5, 3.MD.C.5a)

1. Josh used rubber bands to make the shape below on his geoboard. What is the area of the shape?



3 square units

2. Wilma drew the shape below on dot paper. What is the area of the shape she drew?



5 square units

Spiral Review (3.OA.C.7, 3.NF.A.1, 3.MD.A.1, 3.MD.A.2)

3. Leonardo knows it is 42 days until summer break. How many weeks is it until Leonardo's summer break? (Hint: There are 7 days in a week.)

6 weeks

4. Nan cut a submarine sandwich into 4 equal parts and ate one part. What fraction represents the part of the sandwich Nan ate?

$\frac{1}{4}$

5. Wanda is eating breakfast at fifteen minutes before eight. What time is this? Use A.M. or P.M.

7:45 A.M.

6. Dick has 2 bags of dog food. Each bag contains 5 kilograms of food. How many kilograms of food does Dick have in all?

10 kilograms

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

LESSON 11.5 | Progress to Algebra

Measure Area

FOCUS COHERENCE RIGOR

LESSON AT A GLANCE

FCR Focus:

Common Core State Standards

3.MD.C.5b A plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units.

3.MD.C.6 Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).

Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.7, 3.MD.C.7a

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.)
MP2 Reason abstractly and quantitatively. **MP4** Model with mathematics.
MP5 Use appropriate tools strategically. **MP6** Attend to precision.

FCR Coherence:

Standards Across the Grades

Before	Grade 3	After
2.G.A.2	3.MD.C.5b	4.MD.A.3
	3.MD.C.6	

FCR Rigor:

Level 1: Understand Concepts.....*Share and Show* (Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Estimate and measure area of plane figures by counting unit squares.

Language Objective

Students rephrase the directions on how to find the area of a plane figure.

Materials

MathBoard, scissors, green and blue paper, 1-Inch Grid Paper (see *eTeacher Resources*)

FCR For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

Progress to Algebra

Using concrete tools that students are familiar with allows them to approach new concepts with a degree of comfort. It also provides them with a strategy to fall back on when they extend the concepts in future lessons and courses. When students move on to finding areas of figures using formulas, they know that they have square tiles to use as a tool should they need them.

In this lesson, students find the areas of figures by tiling them. Students see that in order to tile correctly, they should not leave any gaps or have any tiles overlap. When there are gaps, the space between the tiles is not measured. When the tiles overlap, the space where the tiles overlap is measured twice. Students also learn that the smaller the unit square, the more unit squares will be needed to cover the same area.

Professional Development Videos

Using Square Tiles

The side length of 1 square-inch tile is 1 inch. Students cover flat surfaces with square tiles and count in order to find areas of figures.

There are 2 square tiles, so the area of this rectangle is 2 square inches.

Daily Routines

Common Core

Problem of the Day 11.5

Write four multiplication expressions that are equal to 24. Use only two factors in each expression. Possible answers:

4×6, 8×3, 2×12, 1×24, 6×4, 3×8, 12×2, 24×1

Vocabulary

- Interactive Student Edition
- Multimedia eGlossary

1 ENGAGE

with the Interactive Student Edition

Essential Question

How can you find the area of a plane figure?

Making Connections

Invite students to tell you what they know about figures.

If one side of a square measures 1 cm, what does each other side measure? 1 cm **If two squares are set side by side, what shape is formed?** A rectangle **If the two squares that are set side by side have side lengths that are 1, what are the dimensions of the rectangle formed?** 1 cm, 2 cm, 1 cm, 2 cm

Learning Activity

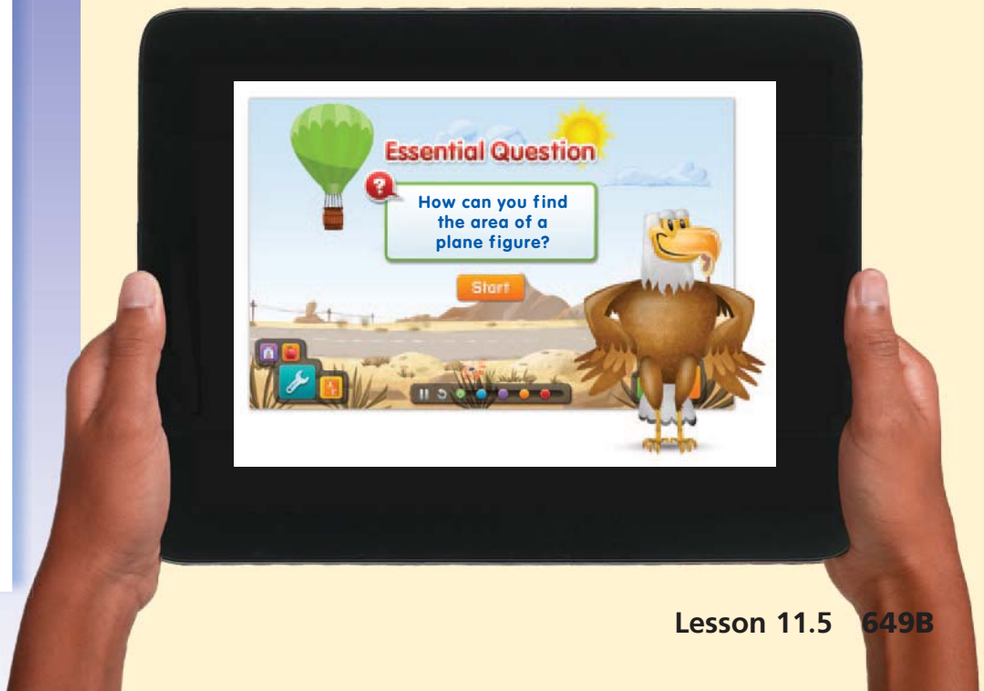
What is the problem the students are trying to solve? Connect the story to the problem.

- **How is area measured?** in unit squares
- **What is the problem asking for?** the area of each side of the hot air balloon basket
- **How many sides of the basket are there?** 4

Literacy and Mathematics

Choose one or more of the following activities.

- Have students draw the balloon basket, then color in a pattern.
- Have students restate the problem in their own words.
- Have students create two more word problems that deal with finding the area of a figure.



Progress to Algebra

3.MD.C.5b A plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units.
3.MD.C.6 Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).

2 EXPLORE

Unlock the Problem

Real World

Hands On

Common Core MATHEMATICAL PRACTICES

To introduce the lesson, have students watch the Real World Video, *Solar Energy Voltaics*. How does the area of a solar panel relate to how much power it will put out?

Activity 1

MP5 Use appropriate tools strategically. Use paper square tiles when completing the activity because square plastic tiles will not work when demonstrating overlaps.

- **Why is it important that there are no gaps when you measure area using tiles?** If there are gaps between tiles when I measure area that means there is space in the shape that I haven't measured.

For Part B, students should place tiles so that the right side of the tiles line up against the dashed lines. The right side of the last tile should line up with the right side of the rectangle.

- **Did you measure the space where there are overlaps more than once?** Yes
- **Why is it important that no tiles overlap when you measure area using tiles?** If the tiles are overlapping when I am measuring area, then that means I have measured some of the area more than once.

For Part C, make sure students notice that the tiles line up exactly in the rectangle, with the edges just touching.

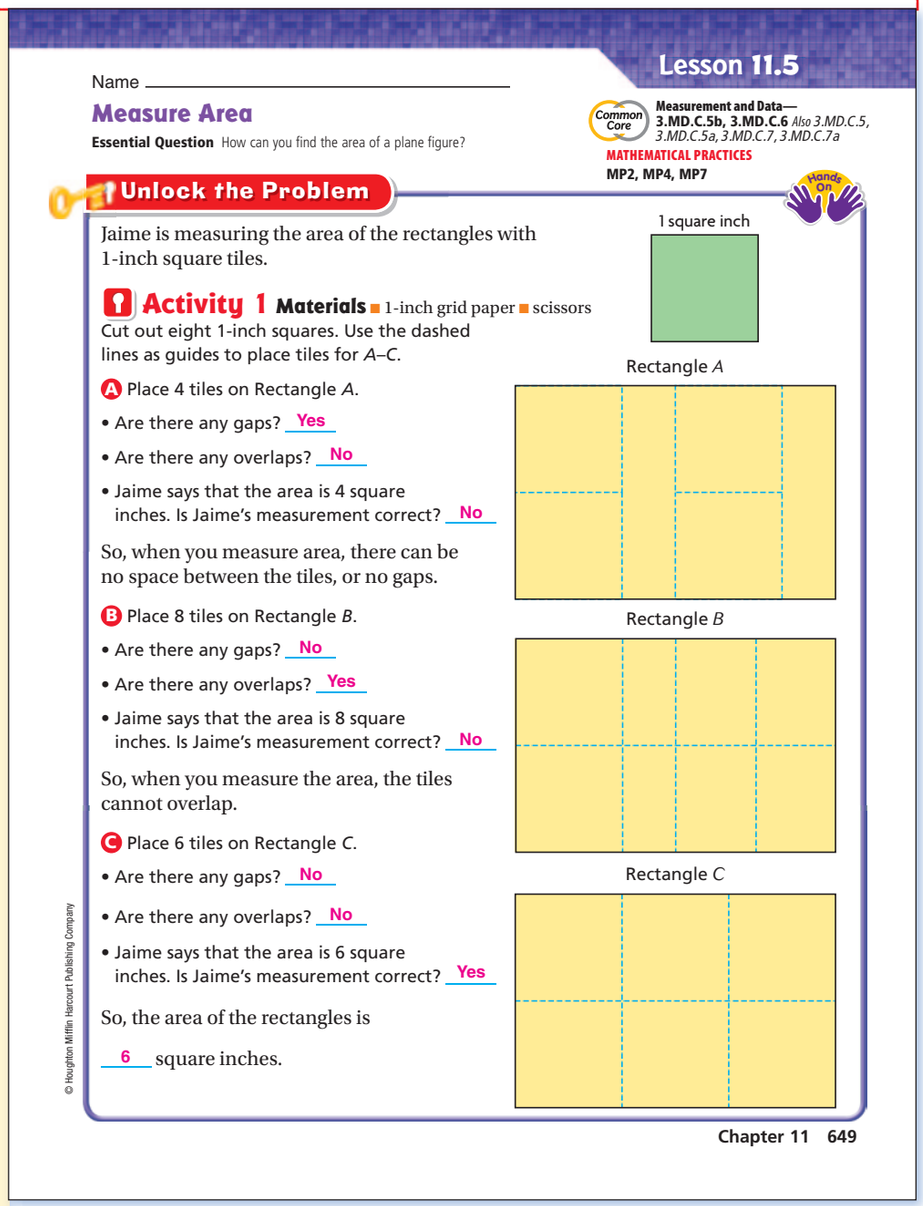
ELL Strategy: Restate

Restate that the area is the number of unit squares needed to cover a flat surface.

- Draw and label a square inch and square centimeter on the board. Have emerging level students listen and point to the square as you call out square inch or square centimeter.

MP2 Reason abstractly and quantitatively.

- **How could you use what you've learned to draw a new figure with an area of 10 square inches?** Possible answer: I could put 10 tiles together and make sure there were no gaps or overlaps.



Name _____

Lesson 11.5

Measure Area

Essential Question How can you find the area of a plane figure?

Common Core **Measurement and Data—** **3.MD.C.5b, 3.MD.C.6** *Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.7, 3.MD.C.7a*
MATHEMATICAL PRACTICES **MP2, MP4, MP7**

Unlock the Problem Hands On

Jaime is measuring the area of the rectangles with 1-inch square tiles.

1 square inch

Activity 1 **Materials** ■ 1-inch grid paper ■ scissors

Cut out eight 1-inch squares. Use the dashed lines as guides to place tiles for *A*–*C*.

A Place 4 tiles on Rectangle *A*.

- Are there any gaps? Yes
- Are there any overlaps? No
- Jaime says that the area is 4 square inches. Is Jaime's measurement correct? No

So, when you measure area, there can be no space between the tiles, or no gaps.

Rectangle *A*

B Place 8 tiles on Rectangle *B*.

- Are there any gaps? No
- Are there any overlaps? Yes
- Jaime says that the area is 8 square inches. Is Jaime's measurement correct? No

So, when you measure the area, the tiles cannot overlap.

Rectangle *B*

C Place 6 tiles on Rectangle *C*.

- Are there any gaps? No
- Are there any overlaps? No
- Jaime says that the area is 6 square inches. Is Jaime's measurement correct? Yes

So, the area of the rectangles is 6 square inches.

Rectangle *C*

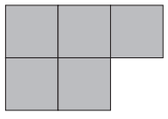
Chapter 11 649

Reteach 11.5 RtI

Name _____ Lesson 11.5 Reteach

Measure Area

Find the area of the figure. Each unit square is 1 square inch.



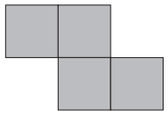
Think: How many unit squares are needed to cover this flat surface?

Step 1 Use 1-inch square tiles. Cover the surface of the figure with the tiles. Make sure there are no gaps (space between the tiles). Do not overlap the tiles.

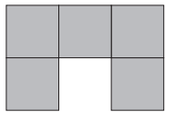
Step 2 Count the tiles you used. 5 tiles are needed to cover the figure.

So, the area of the figure is 5 square inches.

Count to find the area of the figure. Each square is 1 square inch.

1. 

Area = 4 square inches

2. 

Area = 5 square inches

Chapter Resources 11-13 Reteach

Enrich 11.5 Differentiated Instruction

Name _____ Lesson 11.5 Enrich

Find Area

Find the area of each figure. 1 unit square is 1 square centimeter. (Hint: two half-unit squares make one unit square.)

1. 

Area = 12 square centimeters

2. 

Area = 8 square centimeters

3. 

Area = 10 square centimeters

4. 

Area = 13 square centimeters

5. 

Area = 11 square centimeters

6. 

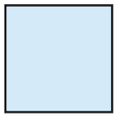
Area = 8 square centimeters

7. Write Math How did you find the area in Exercise 6?

Possible answer: I counted the 4 whole unit squares. Then I counted on by pairs of half unit squares: 5, 6, 7, 8.

Chapter Resources 11-14 Enrich

Activity 2 Materials ■ green and blue paper ■ scissors



ERROR Alert
Be sure that there are no gaps or overlaps when you use square tiles to find area.

STEP 1	Estimate the number of blue square tiles it will take to cover the gray figure.	Estimates will vary. Possible estimates: 6 blue square tiles
STEP 2	Estimate the number of green tiles it will take to cover the gray figure.	30 green square tiles
STEP 3	Trace the blue square pattern ten times and cut out the squares.	
STEP 4	Trace the green square pattern thirty-six times and cut out the squares.	
STEP 5	Cover the gray figure with blue square tiles. Count and write the number of blue square tiles you used. Record the area of the figure.	8 blue square tiles Area = 8 blue square units
STEP 6	Cover the gray figure with green square tiles. Count and write the number of green square tiles you used. Record the area of the figure.	32 green square tiles Area = 32 green square units

Math Talk

MATHEMATICAL PRACTICES 7

Identify Relationships Explain why the number of green square tiles needed to cover the figure is different than the number of blue square tiles needed.

Possible explanation: the blue square tiles are larger than the green square tiles, so it takes fewer blue square tiles than green square tiles to cover the figure.

Try This! Count to find the area of the figure.

 is 1 square centimeter.

There are 17 unit squares in the figure.

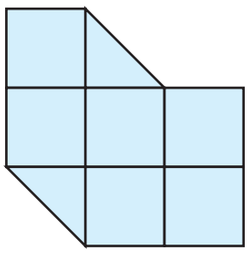
1	4	7	10			15
2	5	8	11			16
3	6	9	12	13	14	17

So, the area is 17 square centimeters.

Advanced Learners

Visual / Spacial
Individuals

- Draw a figure that involves half-unit squares like the one below.
- Tell students that a triangle is one half of a unit square and that two triangles form one unit square.
- Have students find the area. The area is 7 square units.
- Have students use grid paper to draw a figure that involves half-unit squares. Have students exchange drawings with a classmate in order to find the area.



Activity 2

Have students read through the activity.

- **In Steps 1 and 2, why do you think it is important to estimate the number of tiles?** I can use my estimate to check my answer.
- **Based on your estimates, do you think you will need more blue tiles or more green tiles? Why?** I estimated that I will need more green tiles because a green tile is smaller than a blue tile and will cover less space inside the rectangle.

This activity will provide a foundation for students to understand that you will need more of a smaller unit than a larger unit in order to cover the same area.

- **In Steps 5 and 6, did you use more blue tiles or green tiles to find the area? Is this what you expected? Explain.** I used more green tiles. Possible explanation: yes; it matched my estimate. I knew it would take more green tiles to find the area because they are smaller.

Math Talk Use **Math Talk** to focus on why the size of square tiles used to find area matters.

Try This!

MP6 Attend to precision. It is important for students to understand the sizes of a square inch and a square centimeter, as these are units of measure that they will encounter frequently.

Provide students with a square inch tile and a square centimeter tile. Have them trace along the sides of each while stating the side length. Form rectangles from 2 square-inch tiles or 2 square-centimeter tiles. Then have students state the area of each. It may be helpful for students to find benchmarks in the classroom that are about the size of a square inch or a square centimeter.

COMMON ERRORS

Error Students count the number of unit squares incorrectly.

Example Students may find that the area of the figure in Try This! is 21 square centimeters.

Springboard to Learning Tell students that when they count the unit squares, it may be helpful to number the squares as they count them or to place a check in each square.

3 EXPLAIN

Share and Show MATH BOARD

The first problem connects to the learning model. Have students use the MathBoard to explain their thinking. Use the checked exercises for **Quick Check**.

Quick Check RtI

If a student misses the checked exercises

Then **Differentiate Instruction** with

- Reteach 11.5
- Personal Math Trainer 3.MD.C.5b, 3.MD.C.6
- RtI Tier 1 Activity (online)

Math Talk Use **Math Talk** to focus on students' understanding of finding area.

- **Why is it important to include a label with an area measurement?** Possible answer: The size of the unit used to measure can vary. The label lets you know what size unit was used to measure the area.

On Your Own

If students complete the checked exercises correctly, they may continue with the On Your Own section.

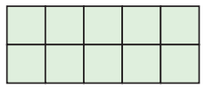
Allow students time to complete Exercises 4 and 5 on their own. If students are having difficulty finding the correct answer, make sure that they are not missing or double-counting unit squares.

MP6 Attend to precision. Have students consider finding the area of the board using square-inch tiles. Ask students if they would use more or fewer unit squares if they were measuring in square feet. fewer; because feet are a greater unit of measurement than inches

Name _____

Share and Show MATH BOARD

1. Count to find the area of the figure. Each unit square is 1 square centimeter.



Think: Are there any gaps? Are there any overlaps?

There are 10 unit squares in the figure.

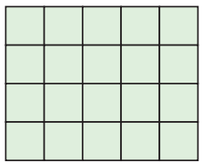
So, the area is 10 square centimeters.

Math Talk MATHEMATICAL PRACTICES 2

Use Reasoning How can you use square centimeters to find the area of different figures?

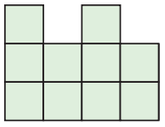
Count to find the area of the figure.
Each unit square is 1 square centimeter.

2.



Area = 20 square centimeters

3.



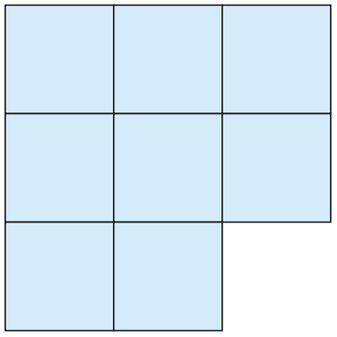
Possible explanation: you can count the number of square centimeters to find the area of each figure.

Area = 10 square centimeters

On Your Own

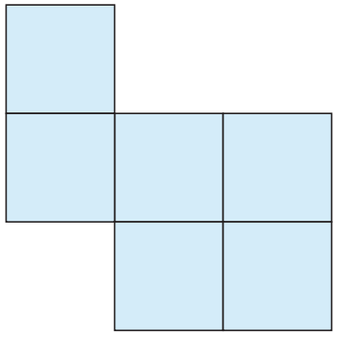
Count to find the area of the figure.
Each unit square is 1 square inch.

4.



Area = 8 square inches

5.



Area = 6 square inches

PROBLEM TYPE SITUATIONS

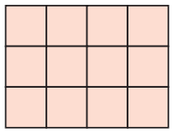
Addition and Subtraction

Put Together/Take Apart • Addend Unknown
Exercise: 9

Compare • Difference Unknown
Exercise: 7

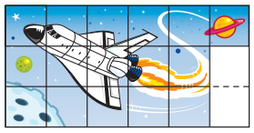
Problem Solving • Applications

6. MATHEMATICAL PRACTICE 4 **Use a Diagram** Danny is placing tiles on the floor of an office lobby. Each tile is 1 square meter. The diagram shows the lobby. What is the area of the lobby?



12 square meters

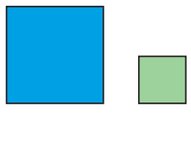
7. GO DEEPER Angie is painting a space shuttle mural on a wall. Each section is one square foot. The diagram shows the unfinished mural. How many more square feet has Angie painted than NOT painted on her mural?



14 more square feet

8. THINK SMARTER You measure the area of a table top with blue unit squares and green unit squares. Which unit square will give you a greater number of square units for area? **Explain.**

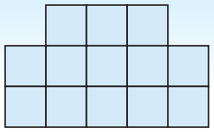
Rectangle *A*



the green unit square; possible explanation:

the blue square units are larger than the green square units, so it takes fewer blue square units than green square units to cover the figure.

9. THINK SMARTER How many squares need to be added to this figure so that it has the same area as a square with a side length of 5 units?



12 squares

DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™

Differentiated Centers Kit

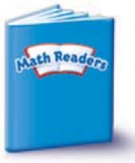
Activities

Figure It Out

Students complete blue Activity Card 18 by identifying two-dimensional figures by their attributes.

Literature

The Class Party



Students read about using perimeter to find how much wood is needed to make picture frames.

4 ELABORATE

Problem Solving • Applications

Common Core MATHEMATICAL PRACTICES

MP4 Model with mathematics. Exercises 6 and 7 ask students to find area using square meters and square feet. You might want to discuss the relative sizes of these units to develop students' understanding of their sizes.

THINK SMARTER

Exercise 8 checks students' understanding of unit size when measuring area. Suggest students look at the blue and green tiles to help with the comparison.

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

THINK SMARTER

Students should recognize that this problem requires more than one step. Students first will need to find the area of a square with a side length of 5 units. Then they should count unit squares to find the area of the given figure and subtract to find the number of unit squares needed. Students who give answers of 13 or 25 likely did not understand the problem and gave either the area of the figure or the area of the square.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students rephrase the directions to answer the Essential Question.

How can you find the area of a plane figure?

I can estimate the area by guessing about how many square units are needed to cover the figure. I can find the area by using tiles, making sure there are no gaps or overlaps, and counting the number of square units covering the figure.

Math Journal WRITE Math

Explain how to find the area of a figure using square tiles.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.

Name _____

Practice and Homework
Lesson 11.5

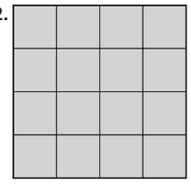
Measure Area

COMMON CORE STANDARDS—
3.MD.C.5b, 3.MD.C.6 *Geometric measurement: understand concepts of area and relate area to multiplication and to addition.*

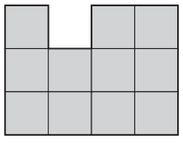
Count to find the area of the shape.
Each unit square is 1 square centimeter.

1. 

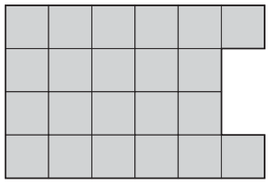
Area = 14 square centimeters

2. 

Area = 16 square centimeters

3. 

Area = 11 square centimeters

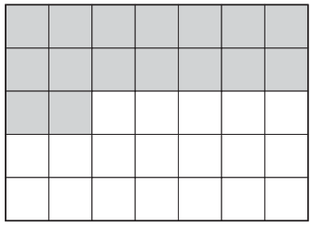
4. 

Area = 22 square centimeters

Problem Solving Real World

Alan is painting his deck gray. Use the diagram at the right for 5. Each unit square is 1 square meter.

Alan's Deck



5. What is the area of the deck that Alan has already painted gray?

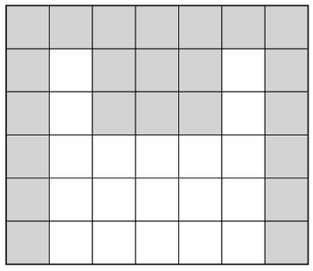
16 square meters

6. WRITE Math Explain how to find the area of a figure using square tiles.

Possible explanation: to find the area, just count the number of square tiles. The number of tiles is the area of the figure.

Lesson Check (3.MD.C.5b, 3.MD.C.6)

Each unit square in the diagram is 1 square foot.



1. How many square feet are shaded?

23 square feet

2. What is the area that has NOT been shaded?

19 square feet

Spiral Review (3.OA.A.3, 3.NF.A.1, 3.NF.A.3b, 3.MD.A.2)

3. Sonya buys 6 packages of rolls. There are 6 rolls in each package. How many rolls does Sonya buy?

36 rolls

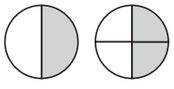
4. Charlie mixed 6 liters of juice with 2 liters of soda to make fruit punch. How many liters of fruit punch did Charlie make?

8 liters

5. What fraction of the circle is shaded?

$\frac{2}{3}$

6. Use the model on the right to name a fraction that is equivalent to $\frac{1}{2}$.



$\frac{2}{4}$

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

LESSON 11.6 | Progress to Algebra

Use Area Models

FOCUS | COHERENCE | RIGOR

LESSON AT A GLANCE

F C R Focus:

Common Core State Standards

3.MD.C.7 Relate area to the operations of multiplication and addition.

3.MD.C.7a Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths.

Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.5b, 3.MD.C.6, 3.MD.C.7b, 3.OA.A.3, 3.OA.C.7, 3.NBT.A.2

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.) **MP1** Make sense of problems and persevere in solving them. **MP3** Construct viable arguments and critique the reasoning of others. **MP6** Attend to precision. **MP8** Look for and express regularity in repeated reasoning.

F C R Coherence:

Standards Across the Grades

Before	Grade 3	After
2.G.A.2	3.MD.C.7	4.MD.A.3
	3.MD.C.7a	

F C R Rigor:

Level 1: Understand Concepts.....*Share and Show* (✓ Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Relate area to addition and multiplication by using area models.

Language Objective

Student pairs discuss and develop a clear reason to explain why you can multiply to find the area of a rectangle.

Materials

MathBoard

F C R For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

Progress to Algebra
Why Teach This

This is the first lesson in which students multiply to find the area of a figure. In Chapter 3, students learned how to find total amounts first by counting, then by using repeated addition, and last by multiplying. They will take this same approach to finding the area of rectangles.

This lesson provides the foundation for students to learn how to multiply in order to find areas of a variety of shapes. It also lays the groundwork for finding areas using formulas, which students will learn in later courses.

Professional Development Videos

GO DIGITAL

- iSE Interactive Student Edition
- Personal Math Trainer
- Math on the Spot Video
- iTools: Geometry
- HMH Mega Math

Daily Routines

Common Core

Problem of the Day 11.6

There are some new cars and motorcycles parked in front of a car dealership. There are a total of 20 wheels. If there are 4 cars, how many motorcycles are there?

2 motorcycles

Vocabulary

GO DIGITAL
- Interactive Student Edition
- Multimedia eGlossary

Fluency Builder

Common Core Fluency Standard 3.NBT.A.2

Materials Digit Cards (see *eTeacher Resources*)

Add 2-Digit and 3-Digit Numbers Have students work in pairs. Give each pair of students a set of digit cards, but exclude the 0 card. First, have both students draw two cards to create a 2-digit number. Students should add the 2-digit numbers formed by the cards. Then, have one student draw three cards and the other draw two cards. Add the 2- and 3-digit numbers formed by the cards. Last, have each student draw three cards and add the 3-digit numbers formed. Be sure students check each other's work.

Pages 106–107 in *Strategies and Practice for Skills and Facts Fluency* provide additional fluency support for this lesson.

1 ENGAGE

with the Interactive Student Edition

Essential Question

Why can you multiply to find the area of a rectangle?

Making Connections

Invite students to tell you what they know about painting a space.

Ask students if they have ever helped paint an area or room. For students who answer yes, ask what they painted and about how much paint they used.

Learning Activity

What is the problem the students are trying to solve? Connect the story to the problem.

- **How long is the parking space?** 7 yards
- **How wide is the parking space?** 3 yards
- **What is the problem asking you to find?** the area of the parking space

Literacy and Mathematics

Choose one or more of the following activities.

- Point out to students that *equa-* in *equation* is similar to the word *equal*. Have students explain how the words *equal* and *equation* are related.
- Have students evaluate whether or not they think the problem provides enough information to be solved, explaining why.

2 EXPLORE

Progress to Algebra

3.MD.C.7 Relate area to the operations of multiplication and addition.
3.MD.C.7a Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths.

Unlock the Problem

Real World

Common Core MATHEMATICAL PRACTICES

Have students read the problem.

One Way

MP5 Use appropriate tools strategically. Remind students that they must count each unit square exactly once in order to find the correct area.

Other Ways

MP4 Model with mathematics.

- **What do you notice about the number of unit squares in each row of Cristina's garden?** The same number of unit squares are in each row.
- **How can you use addition to find a total amount for a problem involving equal groups?** I can use repeated addition to add equal groups.
- **How is this shape like an array?** The shape has rows with the same number of unit squares in each row.
- **How can you use multiplication to find the total number of unit squares in an array?** I can multiply the number of unit squares in each row by the number of rows.

Math Talk

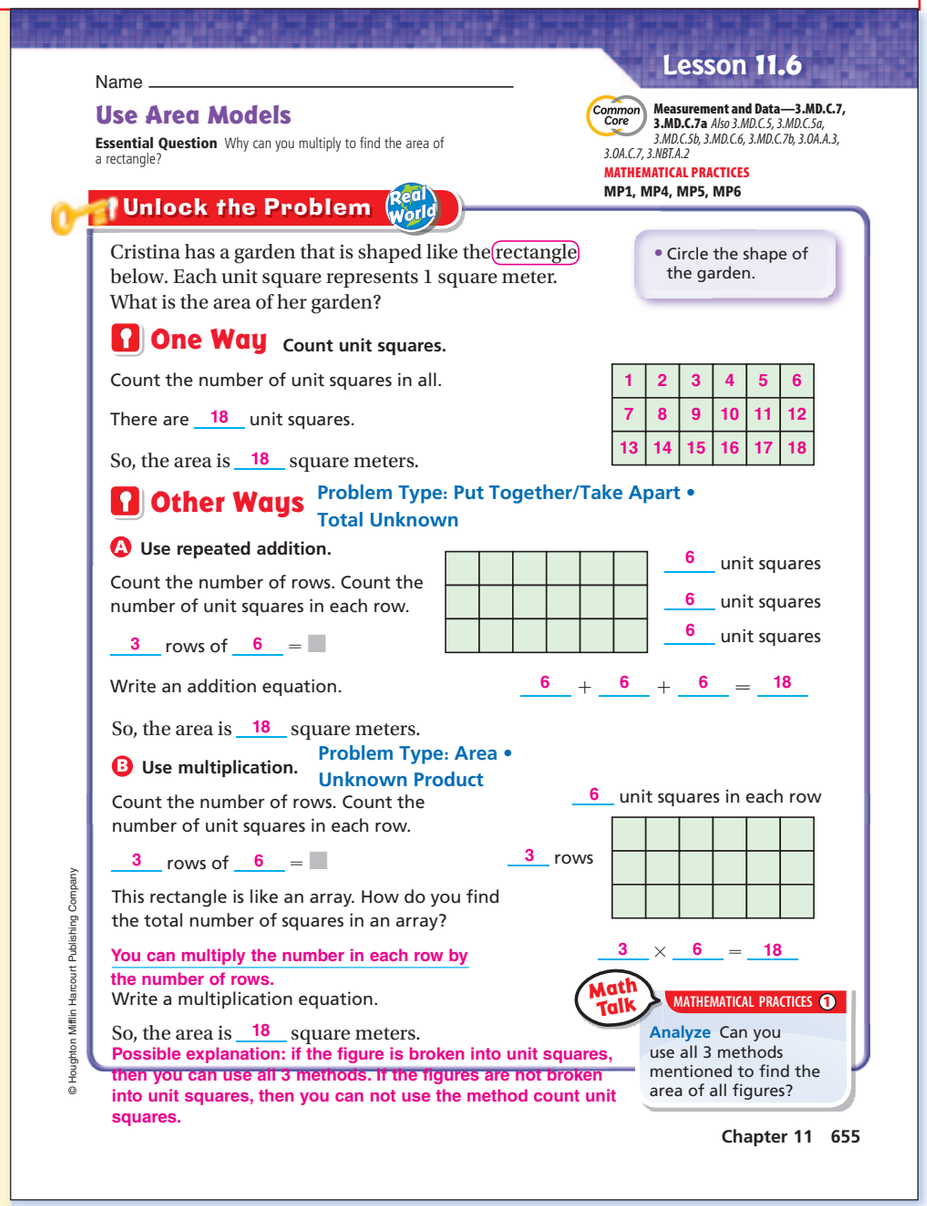
Use **Math Talk** to deepen students' understandings of when all 3 methods can be used to find the area.

ELL Strategy:

Identify Relationships

Students build understanding of how to measure area by connecting it to drawing an array for multiplication.

- Have students draw a rectangle on a sheet of grid paper and ask them to discuss with a partner how this rectangle looks like an array for multiplication.
- Model how to count, shade and label rows.
- Have students shade unit squares in each row, one by one. Ask how many unit squares there are in each row.
- Have students find the area of their rectangles. Ask how they found the area. Answers will vary.



Name _____

Lesson 11.6

Use Area Models

Essential Question Why can you multiply to find the area of a rectangle?

Common Core **Measurement and Data—3.MD.C.7, 3.MD.C.7a** *Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.5b, 3.MD.C.6, 3.MD.C.7b, 3.OA.A.3, 3.OA.C.7, 3.NBT.A.2*
MATHEMATICAL PRACTICES
MP1, MP4, MP5, MP6

Unlock the Problem

Real World

Cristina has a garden that is shaped like the rectangle below. Each unit square represents 1 square meter. What is the area of her garden?

- Circle the shape of the garden.

One Way Count unit squares.

Count the number of unit squares in all.

There are 18 unit squares.

So, the area is 18 square meters.

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Other Ways Problem Type: Put Together/Take Apart • Total Unknown

A Use repeated addition.

Count the number of rows. Count the number of unit squares in each row.

3 rows of 6 = ■

6 unit squares
6 unit squares
6 unit squares

Write an addition equation. 6 + 6 + 6 = 18

So, the area is 18 square meters.

B Use multiplication. Problem Type: Area • Unknown Product

Count the number of rows. Count the number of unit squares in each row.

3 rows of 6 = ■

6 unit squares in each row
3 rows

This rectangle is like an array. How do you find the total number of squares in an array?

You can multiply the number in each row by the number of rows.

Write a multiplication equation. 3 × 6 = 18

So, the area is 18 square meters.

Possible explanation: if the figure is broken into unit squares, then you can use all 3 methods. If the figures are not broken into unit squares, then you can not use the method count unit squares.

Math Talk MATHEMATICAL PRACTICES 1

Analyze Can you use all 3 methods mentioned to find the area of all figures?

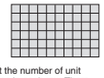
Reteach 11.6

RtI

Name _____ Lesson 11.6 Reteach

Use Area Models

Use multiplication to find the area of the figure. Each unit square is 1 square meter.



Step 1 Count the number of rows. There are 6 rows.

Step 2 Count the number of unit squares in each row. There are 10 unit squares.

Step 3 Multiply the number of rows by the number in each row to find the area.

number of rows × number in each row = area
6 × 10 = 60

So, the area of the figure is 60 square meters.

Find the area of the figure. Each unit square is 1 square meter.

1. 
27 square meters

2. 
35 square meters

Enrich 11.6

Differentiated Instruction

Name _____ Lesson 11.6 Enrich

Area Riddles

Use the clues to solve the riddle. You may use grid paper to draw the figure.

1. My sides are all the same length. My area is 9 square meters. What is the length of one of my sides?
3 meters

2. I am a square. One of my sides is 9 feet long. What is my area?
81 square feet

3. I am a rectangle. One of my sides is 8 centimeters long. Another side is 6 centimeters long. What is my area?
48 square centimeters

4. I am a rectangle. Two of my sides are each 7 inches long. My area is 28 square inches. What is the length of each of my other two sides?
4 inches

5. I am a rectangle. Each of my shorter sides measure 5 meters. My area is 45 square meters. What is the length of each of my longer sides?
9 meters

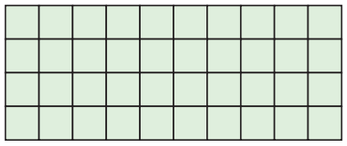
6. I am a square. My area is 64 square feet. What is the length of one of my sides?
8 feet

7. Write Math How did you find the answer in Exercise 4?
Possible answer: I found what number, when multiplied by 7, equals 28: 4

8. **Stretch Your Thinking** Suppose you know that a figure is a rectangle and its area is 8 square meters. What are all the different whole-number side lengths the rectangle could have?
1 and 8 meters or 2 and 4 meters

Try This! Problem Type: Area • Unknown Product

Find the area of the figure.
Each unit square is 1 square foot.



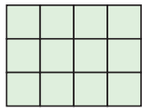
Think: There are 4 rows of 10 unit squares.

4 × 10 = 40

So, the area is 40 square feet.

Share and Show MATH BOARD

1. Look at the figure.



3 rows of 4 = ■

Add. 4 + 4 + 4 = 12

Multiply. 3 × 4 = 12

What is the area of the figure?

12 square units

Math Talk

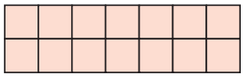
MATHEMATICAL PRACTICES 6

Compare Which method do you prefer using?

Possible explanation: I prefer using multiplication because it is quicker than counting or using repeated addition.

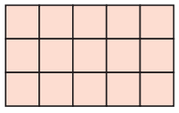
Find the area of the figure.
Each unit square is 1 square foot.

2.



14 square feet

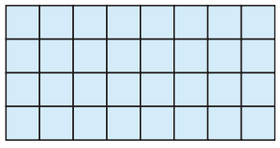
3.



15 square feet

Find the area of the figure.
Each unit square is 1 square meter.

4.



32 square meters

5.

27 square meters

Advanced Learners

Visual / Spatial
Individuals

Materials ruler or measuring tape

- Have students estimate the area of several objects in the classroom using two different units of measurement. Suggest the following:

  computer screen: square inches, square centimeters; doorway: square feet, square meters; classroom floor: square yards, square meters

- Have students measure the object to the nearest whole unit using a ruler or measuring tape. Then have students find the area using multiplication.
- Have students repeat the activity using an object of their own.

Try This!

- **Why can you use multiplication to find the area of a rectangle?** I can use multiplication because rectangles covered by unit squares are like arrays. They have rows of unit squares with the same number of unit squares in each row.
- **Can you use multiplication to find the area of any figure? Explain.** No; other figures may not have equal rows.

If students suggest finding the area of figures that are not rectangles by breaking them apart, tell them this method is used in later lessons.

Math Talk Use the **Math Talk** to discuss the different methods.

- **What is a benefit of knowing more than one way to find the area?** Possible answer: You can use one method to find the area and another to check your answer.

3 EXPLAIN

Share and Show MATH BOARD

The first problem connects to the learning model.

Use the checked exercises for **Quick Check**.

Quick Check RtI

If a student misses the checked exercises

Then **Differentiate Instruction** with

- Reteach 11.6
- Personal Math Trainer 3.MD.C.7, 3.MD.C.7a
- RtI Tier 1 Activity (online)

COMMON ERRORS

Error Students count the number of unit squares in each row incorrectly.

Example Students may say the area of the figure in Try This! is 36 square feet.

Springboard to Learning Tell students that when they count the unit squares, it may be helpful to double-check the number of unit squares that they counted.

On Your Own

If students complete the checked exercises correctly, they may continue with the On Your Own section.

Allow students time to complete Exercises 6–9 on their own. If students are having difficulty finding the correct answer using one method, suggest that they try using a different method.

MP2 Reason abstractly and quantitatively. Extend Exercise 8 by asking students if a rectangle that has an area of 40 square meters is larger than, smaller than, or the same size as a rectangle that has an area of 40 square feet. Ask them to explain their answers. Larger, because 1 square meter is larger than 1 square foot, so 40 square meters would be larger than 40 square feet.

MP4 Model with mathematics. Exercise 10 requires students to understand the concept of area in order to draw rectangles of their own. The problem requires students to start with the area to find appropriate side lengths. Since students have not learned multiplication facts for 12, encourage them to write an addition equation if they draw a rectangle that is 2 units by 12 units.

Additional Example

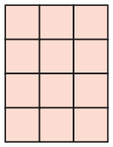
Area • Unknown Product

- **Jason is installing tile in an office. The area of each tile is 1 square foot. The office is 8 feet long and 10 feet wide. What is the area of the office? How many tiles does Jason need?** 80 square feet 80 tiles

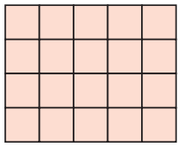
Name _____

On Your Own

Find the area of the figure.
Each unit square is 1 square foot.

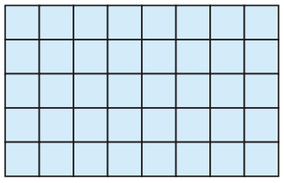
6. 

12 square feet

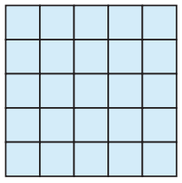
7. 

20 square feet

Find the area of the figure.
Each unit square is 1 square meter.

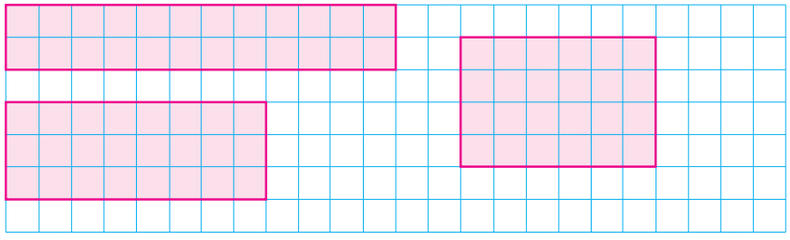
8. 

40 square meters

9. 

25 square meters

10. MATHEMATICAL PRACTICE 4 **Use Diagrams** Draw and shade three rectangles with an area of 24 square units. Then write an addition or multiplication equation for each.



Possible equations: 12 + 12 = 24 square units; 3 × 8 = 24 square units;
4 × 6 = 24 square units

PROBLEM TYPE SITUATION

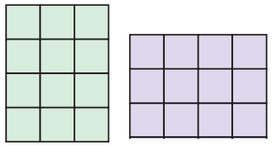
Multiplication and Division

Area • Unknown Product
Exercise: 11

Common Core MATHEMATICAL PRACTICES COMMUNICATE • PERSEVERE • CONSTRUCT ARGUMENTS

Problem Solving • Applications Real World

11. GO DEEPER Compare the areas of the two rugs at the right. Each unit square represents 1 square foot. Which rug has the greater area? Explain.



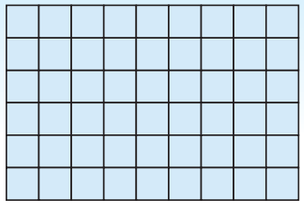
Areas are the same. Possible explanation: the green rug has 4 rows of 3 or 4 × 3 = 12 square feet; the purple rug has 3 rows of 4 or 3 × 4 = 12 square feet.

12. THINK SMARTER A tile company tiled a wall using square tiles. A mural is painted in the center. The drawing shows the design. The area of each tile used is 1 square foot.

Write a problem that can be solved by using the drawing. Then solve your problem.

Possible problem: A wall is tiled using yellow tiles and hand-painted tiles. How many more square feet of yellow tiles were used than square feet of hand-painted tiles?; 2 more square feet

13. THINK SMARTER Colleen drew this rectangle. Select the equation that can be used to find the area of the rectangle. Mark all that apply.



- ● $9 \times 6 = n$
- ● $9 + 9 + 9 + 9 + 9 + 9 = n$
- Ⓒ $9 + 6 = n$
- ● $6 \times 9 = n$
- Ⓔ $6 + 6 + 6 + 6 + 6 + 6 = n$

DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™

Differentiated Centers Kit

Activities
Jump to 9

Students complete blue Activity Card 6 by measuring and then adding lengths.

Activities
Hurray for Arrays!

Students complete blue Activity Card 15 by using arrays to model multiplication facts.

4 ELABORATE

Problem Solving • Applications Real World

Common Core MATHEMATICAL PRACTICES

GO DEEPER

For Exercise 11, be sure students find the area of each rug and not just compare the areas visually.

THINK SMARTER

Exercise 12 has students write and solve their own problems. Be sure that students explain the method they used in their solution.

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

THINK SMARTER

This item assesses whether students can represent an area model with addition or multiplication equations. Students should understand that area can be found by multiplying the number of columns and rows in the model or by adding the number of squares in each row or column the correct number of times.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students work in pairs to discuss and develop a clear reason to answer the Essential Question.

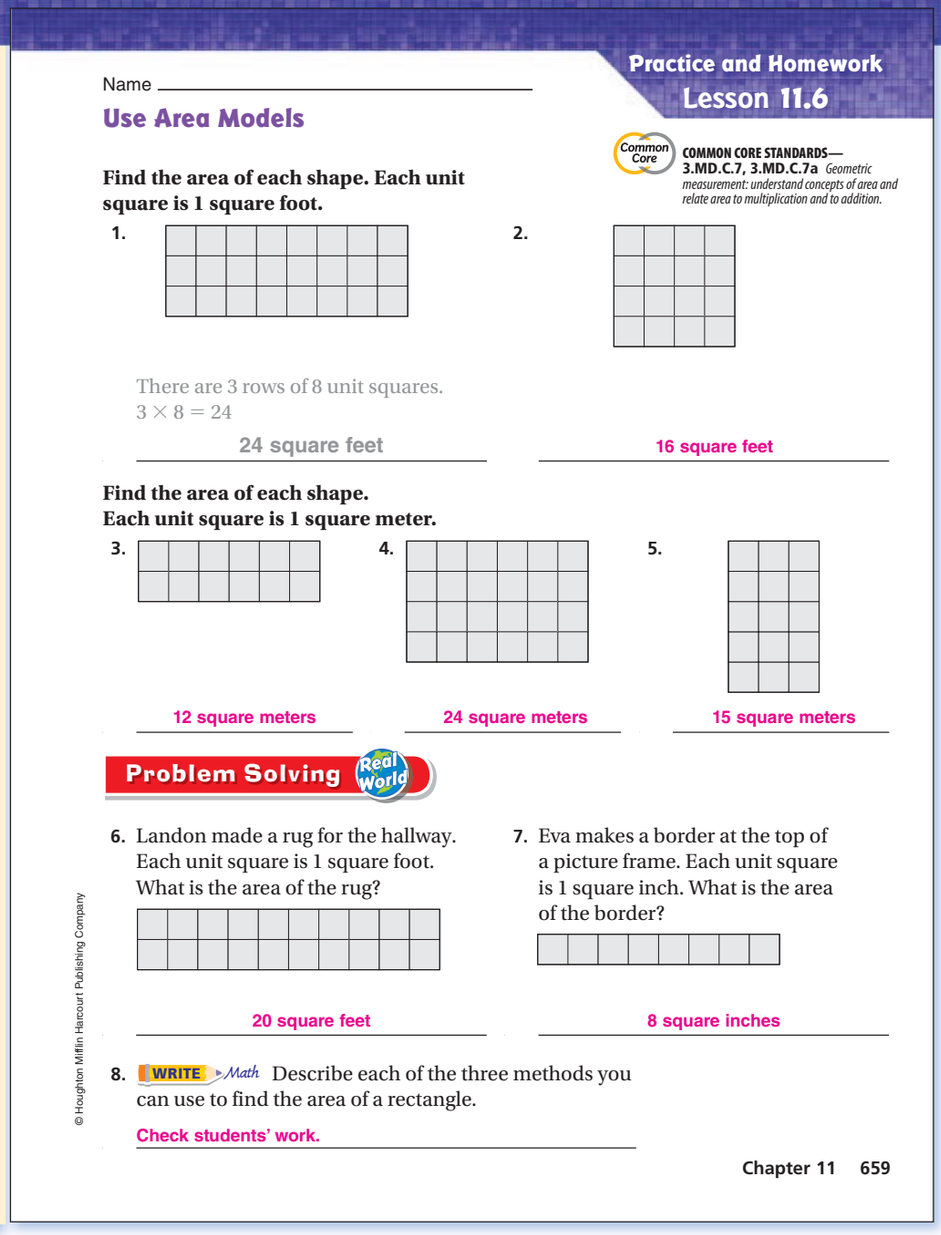
Why can you multiply to find the area of a rectangle? A rectangle covered by unit squares is like an array. It has rows of unit squares with an equal number of unit squares in each row. So I can use multiplication to find the area of a rectangle just like I can use an array to solve a multiplication problem.

Math Journal WRITE Math

Describe each of the three methods you can use to find the area of a rectangle.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.



Practice and Homework
Lesson 11.6

Name _____

Use Area Models

Common Core COMMON CORE STANDARDS—3.MD.C.7, 3.MD.C.7a *Geometric measurement: understand concepts of area and relate area to multiplication and to addition.*

Find the area of each shape. Each unit square is 1 square foot.

1.

2.

There are 3 rows of 8 unit squares.
$3 \times 8 = 24$

24 square feet

16 square feet

Find the area of each shape.
Each unit square is 1 square meter.

3.

4.

5.

12 square meters

24 square meters

15 square meters

Problem Solving Real World

6. Landon made a rug for the hallway. Each unit square is 1 square foot. What is the area of the rug?

20 square feet

7. Eva makes a border at the top of a picture frame. Each unit square is 1 square inch. What is the area of the border?

8 square inches

8. WRITE Math Describe each of the three methods you can use to find the area of a rectangle.

Check students' work.

Common Core PROFESSIONAL DEVELOPMENT

Mathematical Practices in Your Classroom

CCSS.Math.Practice.MP8 Look for and express regularity in repeated reasoning.

In Chapter 3, students learned how to find a total amount first by counting. They transitioned from counting to using equal groups and repeated addition to find a total amount. They then learned how repeated addition is related to multiplication and learned how to multiply to find a product.

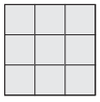
Students use this same reasoning to find the area of rectangles using counting, repeated addition, and multiplication.

Ask students the following to connect finding total amounts to finding the area of a rectangle:

- **How is counting equal groups similar to finding the area of a rectangle? How is it different?** Similarities: I can count to find both a total amount and the area of a rectangle. Differences: When I count equal groups, there may be space between each object in the group. When I count unit squares, there is not space between each unit square.
- **How is using repeated addition to find a total amount like using repeated addition to find the area of a rectangle?** I can use repeated addition to find area like I do to find a total amount. I find the number of groups (or rows) and how many objects (or unit squares) are in each group (or row), and then I add.
- **How is using an array to find a product like using multiplication to find the area of a rectangle?** Finding a product using an array is like finding the area of a rectangle using multiplication. Rectangles are like arrays and involve rows with the same number of unit squares.

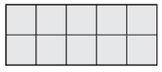
Lesson Check (3.MD.C.7, 3.MD.C.7a)

1. The entrance to an office has a tiled floor. Each square tile is 1 square meter. What is the area of the floor?



9 square meters

2. Ms. Burns buys a new rug. Each unit square is 1 square foot. What is the area of the rug?



10 square feet

Spiral Review (3.OA.A.4, 3.NF.A.3d, 3.MD.A.1, 3.MD.D.8)

3. Compare the fractions. Write <, >, or =.

$\frac{1}{3}$ < $\frac{2}{3}$

4. Claire bought 6 packs of baseball cards. Each pack had the same number of cards. If Claire bought 48 baseball cards in all, how many cards were in each pack?

8 cards

5. Austin left for school at 7:35 A.M. He arrived at school 15 minutes later. What time did Austin arrive at school?

7:50 A.M.

6. Wyatt's room is a rectangle with a perimeter of 40 feet. The width of the room is 8 feet. What is the length of the room?

12 feet

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

Monitoring Common Core Success

Maintaining Focus on the Major Work

In Grade 3, the major work includes understanding concepts of area and relating area to multiplication and addition (3.MD.C). In Lessons 11.1–11.3, students develop an understanding of perimeter, which is necessary to distinguish linear and area measures. In Lessons 11.4 and 11.5, students connect area to addition by partitioning shapes into individual square units and adding to find the area. In Lesson 11.6, students explore how both addition and multiplication can be used to calculate area.

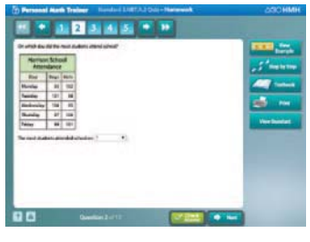
Connecting Content Across Domains and Clusters

In Lessons 11.1–11.3, students recognize perimeter as an attribute of plane figures (3.MD.D). In Lessons 11.4 and 11.5, students develop concepts of area (3.MD.C), which is necessary to distinguish linear and area measures (3.MD.D). The models used throughout the lessons highlight the similarities and differences between these measures, using unit squares, addition, and multiplication to find each measure. Students' work using addition and multiplication draws on their skills in using operations to solve problems (3.OA.D).

Building Fluency

In Grade 3, Standard 3.NBT.A.2 requires students to add and subtract fluently within 1,000. Students work heavily within 3.NBT.A.2 when adding linear units of perimeter or square units of area. By continuing to apply addition to other areas of mathematics, such as geometry, students improve their abilities in adding whole numbers and recognizing situations in which addition may be used to solve problems.

The *Personal Math Trainer*'s standards quizzes allow for targeted practice to help build fluency. Use *Personal Math Trainer*: Standards Quiz 3.NBT.A.2 to strengthen students' mastery of applying addition to problems.



LESSON 11.7 | Progress to Algebra

Problem Solving • Areas of Rectangles

FOCUS | COHERENCE | RIGOR

LESSON AT A GLANCE

F C R Focus:

Common Core State Standards

3.MD.C.7b Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning.

Also 3.OA.A.3, 3.OA.C.7, 3.OA.D.9

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.)
MP1 Make sense of problems and persevere in solving them. **MP2** Reason abstractly and quantitatively. **MP6** Attend to precision. **MP7** Look for and make use of structure.

F C R Coherence:

Standards Across the Grades

Before	Grade 3	After
2.G.A.2	3.MD.C.7b	4.MD.A.3

F C R Rigor:

Level 1: Understand Concepts.....*Share and Show* (Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Solve area problems using the strategy *find a pattern.*

Language Objective

Student pairs write up a recommendation for using the strategy *find a pattern* to solve area problems.

Materials

MathBoard

F C R For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

MP1 Make sense of problems and persevere in solving them.

In this lesson, students are presented with real-world, multistep problems. Students practice making and implementing a plan, including using the strategy *find a pattern*, to solve these problems.

Students must identify what information they need to find and what information is given. They must also be able to identify how to use the given information. This process of carefully identifying knowns and unknowns and implementing a plan will be crucial to students' success throughout their mathematical education.

Professional Development Videos

GO DIGITAL

- Interactive Student Edition
- Personal Math Trainer
- Math on the Spot Video
- *i*Tools: Geometry

Daily Routines

Common Core

Problem of the Day 11.7

A ticket to a play for an adult costs $9. A ticket for a child costs $7. How much does it cost to buy 2 adult tickets and 3 child tickets?

$39

Vocabulary

GO DIGITAL
- Interactive Student Edition
- Multimedia eGlossary

Fluency Builder

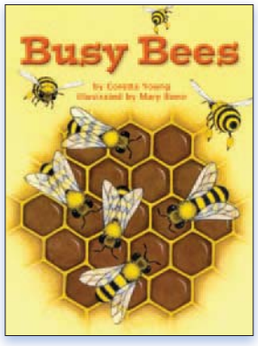
Common Core Fluency Standard 3.OA.C.7

Mental Math Provide students with the following expressions to review division. Either read the expressions aloud or write them on the board.

8 ÷ 2 4	16 ÷ 2 8
20 ÷ 10 2	27 ÷ 3 9
25 ÷ 5 5	24 ÷ 4 6

Pages 104–105 in *Strategies and Practice for Skills and Facts Fluency* provide additional fluency support for this lesson.

Literature Connections



Busy Bees

From the Grab-and-Go™ Differentiated Centers Kit

Students read about the hexagon patterns in honeycombs and other patterns in nature.

1 ENGAGE

with the Interactive Student Edition

Essential Question

How can you use the strategy *find a pattern* to solve area problems?

Making Connections

Invite students to tell you what they know about area.

What information do you need to know to find the area of a rectangle? length and width **How do you find the area of a rectangle?** Multiply length times width.

Learning Activity

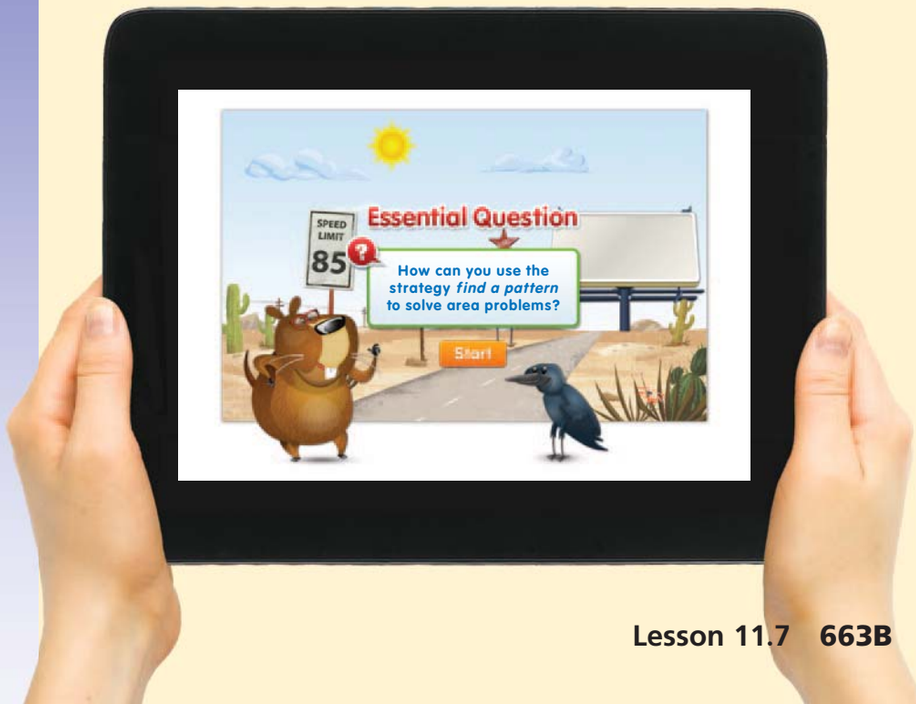
What is the problem the students are trying to solve? Connect the story to the problem.

- **What problem are you being asked to solve?** the area of the new rest stop
- **What are the measurements of the old rest stop?** 5 yards long and 3 yards wide
- **How are the measurements of the new rest stop changing?** The width will be doubled.

Literacy and Mathematics

Choose one or more of the following activities.

- Have students write a letter to the county council in which they either support or oppose the enlargement of the rest stop. Have students share their letters with the class.
- Have students list how the area of the new rest stop would change if the area of the old rest stop measured 5 yards wide and 3 yards long.



2 EXPLORE

Unlock the Problem

Common Core MATHEMATICAL PRACTICES

This problem uses patterns to help students make generalizations about what happens to the area of a figure when one of its dimensions is changed.

- **About how much bigger does Building *B* look than Building *A*?** *B* is about twice as big as *A*.
- **What about Buildings *C* and *D*?** *D* looks about twice as big as *C*.

Have students fill in the table.

- **What do you notice about the length and width of Buildings *A* and *B*?** The width doubles, but the length stays the same.
- **What do you notice about the area of Buildings *A* and *B*?** The area of Building *B* is double the area of Building *A*.
- **What pattern do you see in the length, width, and area of Buildings *C* and *D*?** the same pattern as Buildings *A* and *B*: the length stays the same, the width and area of Building *D* is double that of Building *C*.
- **How does the area change if the length stays the same and the width doubles?** The area doubles.

MP2 Reason abstractly and quantitatively.

- **How would the area change if both the length and the width were doubled?** The area would be 4 times the original area.

MP8 Look for and express regularity in repeated reasoning. Ask students to predict what would happen to the area if the length stayed the same, but the width tripled. The area would triple.

ELL Strategy: Restate

By restating the definition in a tangible way using tiles, students can understand the term *doubling*.

- **Have students make a rectangle using a total of 6 tiles in 2 rows of 3 tiles each.**
- **Have students double the area by adding 3 tiles to the end of each row.**
- **Tell students the length of each row *doubled*. Ask students what happened to the area of the rectangle.** The area doubled.
- **Continue with other examples.**

Progress to Algebra

3.MD.C.7b Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning.

Name _____

PROBLEM SOLVING Lesson 11.7

Problem Solving • Area of Rectangles

Essential Question How can you use the strategy *find a pattern* to solve area problems?

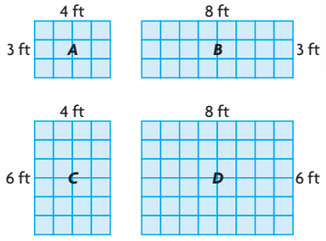
Common Core **Measurement and Data—3.MD.C.7b** *Also 3.OA.A.3, 3.OA.C.7, 3.OA.D.9*

MATHEMATICAL PRACTICES MP1, MP2, MP7

Unlock the Problem

Mr. Koi wants to build storage buildings, so he drew plans for the buildings. He wants to know how the areas of the buildings are related. How does the area change from the area of Building *A* to the area of Building *B*? How does the area change from the area of Building *C* to the area of Building *D*?

Use the graphic organizer to help you solve the problem.



Read the Problem

What do I need to find?	What information do I need to use?	How will I use the information?
I need to find how the areas will change from *A* to *B* and from **C** to **D**.	I need to use the **length** and **width** of each building to find its area.	I will record the areas in a table. Then I will look for a pattern to see how the **areas** will change.

Solve the Problem

I will complete the table to find patterns to solve the problem.

	Length	Width	Area		Length	Width	Area
Building *A*	3 ft	**4 ft**	**12 sq ft**	Building *C*	**6 ft**	4 ft	**24 sq ft**
Building *B*	3 ft	**8 ft**	**24 sq ft**	Building *D*	**6 ft**	8 ft	**48 sq ft**

I see that the lengths will be the same and the widths will be doubled.

The areas will change from **12 sq ft** to **24 sq ft** and from **24 sq ft** to **48 sq ft**.

So, when the lengths are the same and the widths are doubled,

the areas will be **doubled**.

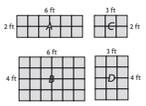
Reteach 11.7

RtI

Name _____ Lesson 11.7 Reteach

Problem Solving • Area of Rectangles

Mrs. Wilson wants to plant a garden, so she drew plans for some sample gardens. She wants to know how the areas of the gardens are related. How will the areas of Gardens A and B change? How will the areas of Gardens C and D change?



Use the graphic organizer to help you solve the problem.

Read the Problem

What do I need to find?	What information do I need to use?	How will I use the information?
I need to know how the areas will change from **C** to **D**.	I need to use the **length** and **width** of each garden to find its area.	I will record the areas in a table. Then I will look for a pattern to see how the **areas** will change.

Solve the Problem

	Length	Width	Area		Length	Width	Area
Garden A	2 ft	6 ft	12 sq ft	Garden C	2 ft	3 ft	6 sq ft
Garden B	4 ft	6 ft	24 sq ft	Garden D	4 ft	3 ft	12 sq ft

From the table, I see that the lengths will be doubled and the widths will be the same.
The areas in square feet will change from **12** to **24** and from **6** to **12**
So, the area will be **doubled**

Solve.

1. Mrs. Rios made a flower garden that is 8 feet long and 2 feet wide. She made a vegetable garden that is 4 feet long and 2 feet wide. How do the areas change?
The area of the flower garden is double the area of the vegetable garden.

Chapter Resources 11-17 Reteach

Enrich 11.7

Differentiated Instruction

Name _____ Lesson 11.7 Enrich

Find the Missing Information

Use the given information to find the missing information in the problem. Write the missing information. Then solve the problem.

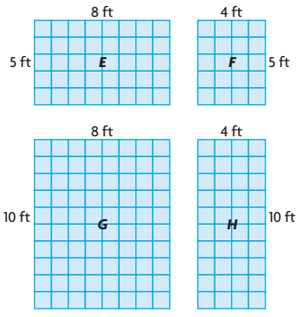
1. Kelly builds a dog run that is 3 feet wide and has an area of 12 square feet. The length of the dog run is **4** feet. Kelly's brother builds another dog run that is also 3 feet wide, but its area is double that of Kelly's dog run. What is the length of Kelly's brother's dog run?
8 feet
2. Mrs. Thompson builds a vegetable garden that is 10 meters long and has an area of 40 square meters. The width of the vegetable garden is **4** meters. She also builds an herb garden that has the same width, but its area is half that of her vegetable garden. What is the length of Mrs. Thompson's herb garden?
5 meters
3. Duane builds a square snow fort that is 4 feet long on each side. The area of his snow fort is **16** square feet. He then builds a second snow fort that has an area that is double the area of his first snow fort. What could the length and width of Duane's second snow fort be?
Possible answer: 4 feet wide and 8 feet long
4. Write Math How did you find the length of Kelly's dog run in Exercise 1?
Possible answer: you multiply length and width to find area, so I used 3 × ■ = 12 to find that the length is 4 feet.

Chapter Resources 11-18 Enrich

Try Another Problem

Mr. Koi is building more storage buildings. He wants to know how the areas of the buildings are related. How does the area change from the area of Building *E* to the area of Building *F*? How does the area change from the area of Building *G* to the area of Building *H*?

Use the graphic organizer to help you solve the problem.



Read the Problem

What do I need to find?
I need to find how the areas will change from *E* to *F* and from *G* to *H*.

What information do I need to use?
I need to use the length and width of each building to find its area.

How will I use the information?
I will record the areas in a table. Then I will look for a pattern to see how the areas will change.

Solve the Problem

I will complete the table to find patterns to solve the problem.

	Length	Width	Area		Length	Width	Area
Building *E*	5 ft	8 ft	40 sq ft	Building *G*	10 ft	8 ft	80 sq ft
Building *F*	5 ft	4 ft	20 sq ft	Building *H*	10 ft	4 ft	40 sq ft

The lengths will be the same and the widths will be halved. The areas will change from 40 sq ft to 20 sq ft and from 80 sq ft to 40 sq ft. So, when the lengths are the same and the widths are halved, the areas will be halved.

- How did your table help you find a pattern?

Possible answer: the table helped me see the multiplication needed to find the area. Then I was able to more easily compare the areas to see how they change.

Possible answer: the area would be doubled twice, or 4 times greater.

Math Talk

MATHEMATICAL PRACTICES 2

Reason Abstractly
What if the length of both sides is doubled? How would the areas change?

Try Another Problem

This problem uses patterns to help students understand what happens to the area of a shape when one of its dimensions is halved.

Have students read the problem.

- **Which building is bigger, *E* or *F*?** *E*
- **About how much bigger does the building look?** *E* is about twice as big as *F*.
- **What about Buildings *G* and *H*?** *G* is about twice as big as *H*.
- **What do you predict will happen to the area of the buildings when the width is halved?** The area will be half the original area.

Have students fill out the table.

- **What pattern do you see in the length, width, and area of Buildings *E* and *F*? Buildings *G* and *H*?** The length stays the same, the width and area of the smaller buildings are half the width and area of the larger buildings.
- **How does the area change if the length stays the same and the width is halved?** The area is halved.

Math Talk Use **Math Talk** to focus students' understanding on the relationship between doubles and halves.

- **What if the length of one side is doubled and the length of the other side is halved? Explain how this would affect the area.** Doubling one side would double the area, but halving the other side would halve the area. So the area would stay the same.

You may suggest that students place completed Try Another Problem graphic organizers in their portfolios.

Advanced Learners

Visual / Spatial
Individuals

Materials paper

- Students should draw a rectangle and label the length 3 inches and the width 4 inches. Have students determine the effect on the area when the width is multiplied by 2, 3, and 4.
- Have students make a conjecture about the effect on the area when the width is multiplied by any number. Possible answer: when the width is multiplied by a number, the area is multiplied by that same number.

COMMON ERRORS

Error Students do not look at the entire table to make a generalization.

Example Students may conclude that the area of the figures decreases by 20 when the width is halved.

Springboard to Learning Explain to students that in order to find a pattern, they must use multiple examples, not just one. They need to examine what happens to each pair of buildings, not just the first pair, in order to find a pattern.

3 EXPLAIN

Share and Show MATH BOARD

The first problem connects to the learning model. Have students use the MathBoard to explain their thinking.

MP8 Look for and express regularity in repeated reasoning. After completing Exercise 1, have students make as many generalizations about side lengths and areas as possible.

Exercise 2 requires students to think conceptually about how a change in the length of a shape affects the area of the shape.

Use the checked exercises for Quick Check. Students should show their answers for the Quick Check on the MathBoard.

Quick Check RtI

If a student misses the checked exercises

Then Differentiate Instruction with

- Reteach 11.7
- Personal Math Trainer 3.MD.C.7b
- RtI Tier 1 Activity (online)

On Your Own

MP7 Look for and make use of structure. For Exercise 3, have students explain how they found the area of each pool.

Additional Example

Area • Unknown Factor

- **The length of the quilt Margot is making is 7 feet. The area of the quilt is 42 square feet. What is the width of the quilt?** 6 feet

Name _____

Share and Show MATH BOARD

Use the table for 1–2.

Swimming Pool Sizes			
Pool	Length (in feet)	Width (in feet)	Area (in square feet)
A	8	20	160
B	8	30	240
C	8	40	320
D	8	50	400

1. Many pools come in rectangular shapes. How do the areas of the swimming pools change when the widths change?

First, complete the table by finding the area of each pool.

Think: I can find the area by multiplying the length and the width.

Then, find a pattern of how the lengths change and how the widths change.

The length stays the same. The widths increase by 10 feet.

Last, describe a pattern of how the area changes.

The areas increase by 80 square feet.

2. What if the length of each pool was 16 feet? Explain how the areas would change.

Possible explanation: the areas would double.

On Your Own

3. MATHEMATICAL PRACTICE 7 **Look for a Pattern** If the length of each pool in the table is 20 feet, and the widths change from 5, to 6, to 7, and to 8 feet, describe the pattern of the areas.

Possible description: the areas increase by 20 square feet, from 100, to 120, to 140, and to 160 square feet.

PROBLEM TYPE SITUATIONS

Addition and Subtraction

Put Together/Take Apart • Total Unknown
Exercise: 5

Multiplication and Division

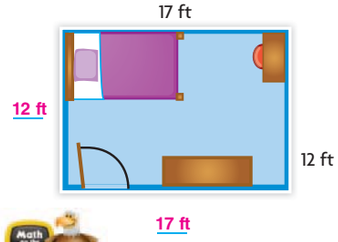
Area • Unknown Factor
Exercise: 4

4. MATHEMATICAL PRACTICE 1 **Analyze Relationships** Jacob has a rectangular garden with an area of 56 square feet. The length of the garden is 8 feet. What is the width of the garden?

7 feet

5. GO DEEPER A diagram of Paula's bedroom is at the right. Her bedroom is in the shape of a rectangle. Write the measurements for the other sides. What is the perimeter of the room? (Hint: The two pairs of opposite sides are equal lengths.)

58 feet



6. THINK SMARTER Elizabeth built a sandbox that is 4 feet long and 4 feet wide. She also built a flower garden that is 4 feet long and 6 feet wide and a vegetable garden that is 4 feet long and 8 feet wide. How do the areas change?

The area of the sandbox is 16 square feet. The area of the flower garden is 24 square feet. The area of the vegetable garden is 32 square feet. The areas increase by 8 square feet.

7. THINK SMARTER Find the pattern and complete the chart.

Total Area (in square feet)	50	60	70	80	90
Length (in feet)	10	10	10	10	10
Width (in feet)	5	6	7	8	9

How can you use the chart to find the length and width of a figure with an area of 100 square feet?

Possible answer: extend the chart to 100 square feet and continue the pattern: length 10 feet, width 10 feet. The figure is a square.

DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™ Differentiated Centers Kit

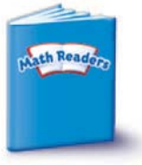
Activities

Hurray for Arrays!

Students complete blue Activity Card 15 by using arrays to model multiplication facts.

Literature

Busy Bees



Students read about the hexagon patterns in honeycombs and other patterns in nature.

4 ELABORATE

Common Core MATHEMATICAL PRACTICES

MP1 Make sense of problems and persevere in solving them.

- **What operation is the opposite of multiplication?** division **How can you use division to find the width?** Divide the area by the length.

GO DEEPER

Exercise 5 requires students to analyze the diagram and use what they know about perimeter to answer the question.

THINK SMARTER

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

THINK SMARTER

This item assesses how well students can relate length, width, and area of rectangles. Students must complete the chart by finding a pattern for changes in width and corresponding area and then use that pattern to determine the width of a rectangle with an area of 100 square feet.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students work in pairs to write up a recommendation to answer the Essential Question.

How can you use the strategy *find a pattern* to solve area problems? I can make a table to list the lengths and widths of rectangles and find their areas. Then I can examine the table to look for patterns in the lengths, widths, and areas.

Math Journal WRITE Math

Write and solve an area problem that illustrates how the use the *find a pattern* strategy.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.

Name _____

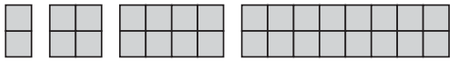
Practice and Homework
Lesson 11.7

Problem Solving • Area of Rectangles

COMMON CORE STANDARD—3.MD.C.7b
Geometric measurement: understand concepts of area and relate area to multiplication and to addition.

Use the information for 1–3.

An artist makes rectangular murals in different sizes. Below are the available sizes. Each unit square is 1 square meter.



1. Complete the table to find the area of each mural.

Mural	Length (in meters)	Width (in meters)	Area (in square meters)
A	2	1	2
B	2	2	4
C	2	4	8
D	2	8	16

2. Find and describe a pattern of how the length changes and how the width changes for murals A through D.

For each mural, the width doubles and the length stays the same.

3. How do the areas of the murals change when the width changes?

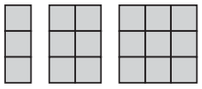
For each mural, the area doubles.

4. WRITE Math Write and solve an area problem that illustrates the use of the *find a pattern* strategy.

Check students' work.

Lesson Check (3.MD.C.7b)

1. Lauren drew the designs below. Each unit square is 1 square centimeter. If the pattern continues, what will be the area of the fourth figure?



12 square centimeters

2. Henry built one garden that is 3 feet wide and 3 feet long. He also built a garden that is 3 feet wide and 6 feet long, and a garden that is 3 feet wide and 9 feet long. How do the areas change?

The areas increase by 9 square feet.

Spiral Review (3.OA.A.3, 3.NBT.A.3, 3.NF.A.1, 3.MD.C.5b, 3.MD.C.6)

3. Joe, Jim, and Jack share 27 football cards equally. How many cards does each boy get?

9 cards

4. Nita uses $\frac{1}{3}$ of a carton of 12 eggs. How many eggs does she use?

4 eggs

5. Brenda made 8 necklaces. Each necklace has 10 large beads. How many large beads did Brenda use to make the necklaces?

80 large beads

6. Neal is tiling his kitchen floor. Each square tile is 1 square foot. Neal uses 6 rows of tiles with 9 tiles in each row. What is the area of the floor?

54 square feet

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

LESSON 11.8 | Progress to Algebra

Area of Combined Rectangles

FOCUS COHERENCE RIGOR

LESSON AT A GLANCE

F C R Focus:

Common Core State Standards

3.MD.C.7c Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and $b + c$ is the sum of $a \times b$ and $a \times c$. Use area models to represent the distributive property in mathematical reasoning.

3.MD.C.7d Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems.

Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.5b, 3.MD.C.7b, 3.OA.A.3, 3.OA.B.5, 3.OA.C.7, 3.NBT.A.2

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.)
MP1 Make sense of problems and persevere in solving them. **MP3** Construct viable arguments and critique the reasoning of others. **MP4** Model with mathematics. **MP6** Attend to precision. **MP7** Look for and make use of structure.

F C R Coherence:

Standards Across the Grades

Before	Grade 3	After
2.G.A.2	3.MD.C.7c	4.MD.A.3
	3.MD.C.7d	

F C R Rigor:

Level 1: Understand Concepts.....*Share and Show* (Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Apply the Distributive Property to area models and to find the area of combined rectangles.

Language Objective

Students demonstrate and describe to a partner how you can break apart a figure to find the area.

Materials

MathBoard, square tiles

F C R For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

MP7 Look for and make use of structure.

Being able to decompose a complicated figure into parts that are easier or more familiar to work with is an essential skill for geometry students. Also, recognizing that concepts, such as the Distributive Property, can be applied to geometry problems as well as numeric and algebraic problems will deepen students' understanding.

In this lesson, students are presented with figures that are made up of combined rectangles. Students will break the composite figure into smaller rectangles. They will find the area of each of the smaller rectangles and add them in order to find the total area of the combined figure. Students used this same concept to find products using the Distributive Property.

Professional Development Videos

GO DIGITAL

iSE Interactive Student Edition

Personal Math Trainer

Math on the Spot Video

Daily Routines

Common Core

Problem of the Day 11.8

Write an addition equation that is related to the multiplication equation $3 \times 5 = 15$.

$3 + 3 + 3 + 3 + 3 = 15$; $5 + 5 + 5 = 15$

Vocabulary

- Interactive Student Edition
- Multimedia eGlossary

Fluency Builder

Common Core Fluency Standard 3.OA.C.7

Multiplication Facts Write the following multiplication problems on the board. Have students practice their multiplication facts by solving each problem. Remind students that each multiplication problem represents a rectangle area problem.

6×3 18

9×4 36

2×7 14

7×9 63

9×8 72

5×4 20

6×8 48

8×3 24

Pages 62–63 in *Strategies and Practice for Skills and Facts Fluency* provide additional fluency support for this lesson.

1 ENGAGE

with the Interactive Student Edition

Essential Question

How can you break apart a figure to find the area?

Making Connections

Invite students to tell you what they know about square units.

How is a unit square related to a square unit? A unit square is a square with a side length of 1 unit. It has an area of 1 square unit. **What are examples of square units?** Possible answer: square inches or square feet

Learning Activity

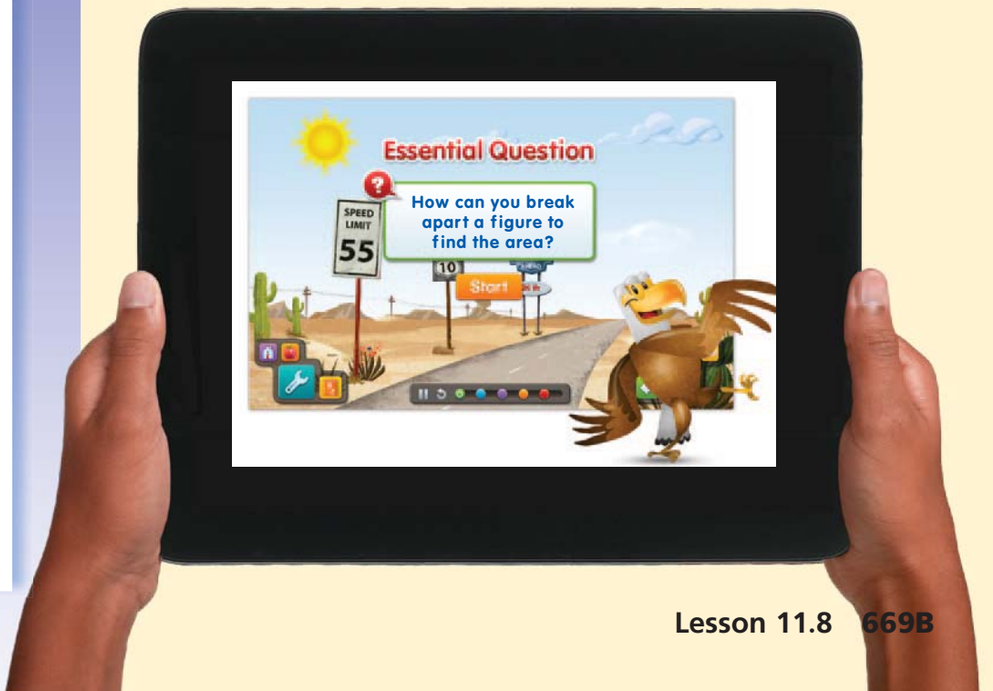
What is the problem the students are trying to solve? Connect the story to the problem.

- **What problem are you trying to solve?** Find the total area of the seat and the backrest.
- **What is going to be painted?** the seat and backrest of the bench
- **What is the size of the seat?** side lengths of 3 feet and 6 feet
- **What is the size of the backrest?** side lengths of 2 feet and 6 feet
- **What does the diagram of the bench look like in the problem?** It has several squares. Each unit square is 1 square foot.

Literacy and Mathematics

Choose one or more of the following activities:

- Have students construct a miniature bench using cardboard and tape. Have students brainstorm how they might find the total area of the seat and backrest of the bench they have created.
- Have students brainstorm real-world situations in which area might need to be found. Then have students write a short problem about one of the situations they came up with.



Progress to Algebra

3.MD.C.7c Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and $b + c$ is the sum of $a \times b$ and $a \times c$. Use area models to represent the distributive property in mathematical reasoning.
3.MD.C.7d Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems.

2 EXPLORE

Unlock the Problem

Real World Hands On

Common Core MATHEMATICAL PRACTICES

Have students read the problem. Remind them that they have used the Distributive Property and the break apart method using an array to find products.

Activity

MP2 Reason abstractly and quantitatively.

- **How did you decide where to place the vertical line to break apart the rectangle in Step 3?** Answers will vary. Possible answer: I decided to place the vertical line breaking apart the rectangle into two smaller rectangles.
- **Why do you add the areas of the two smaller rectangles in Step 5?** Each of the smaller areas represents only part of the whole area. Together, they make up the whole area.

MP4 Model with mathematics. Point out to students that some numbers may be easier to work with than others. Illustrate the connection between where they place the vertical line and the numbers they will need to add to find the area.

Math Talk Use **Math Talk** to help students recognize that the area of the original rectangle stays the same no matter how they choose to break it apart.

ELL Strategy:

Restate

Vocabulary in the break-apart strategy can be better understood when restated for students.

- Pair students with similar language levels.
- Draw a rectangle and restate the break apart strategy.
- Have students use sentence frames to discuss how they can break the rectangle apart to find the area. **When I break apart the rectangle using a vertical/horizontal line, it makes one shape that measures ____ by ____ and another shape that measures ____ by ____.**
- Have each pair of students draw a rectangle on grid paper and discuss it using the frames.

Name _____

Area of Combined Rectangles

Essential Question How can you break apart a figure to find the area?

Common Core **Measurement and Data—3.MD.C.7c, 3.MD.C.7d**
Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.5b, 3.MD.C.7b, 3.OA.A.3, 3.OA.B.5, 3.OA.C.7, 3.NBT.A.2

MATHEMATICAL PRACTICES
MP1, MP4, MP6

Unlock the Problem Real World Hands On

Anna's rug has side lengths of 4 feet and 9 feet. What is the area of Anna's rug?

See below.

Remember

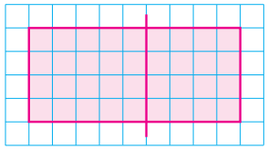
You can use the Distributive Property to break apart an array.

$3 \times 3 = 3 \times (2 + 1)$

Activity **Materials** ■ square tiles

STEP 1 Use square tiles to model 4×9.

STEP 2 Draw a rectangle on the grid paper to show your model.



Check students' drawings. Possible line is shown.

STEP 3 Draw a vertical line to break apart the model to make two smaller rectangles.

The side length 9 is broken into 5 plus 4.

STEP 4 Find the area of each of the two smaller rectangles.

Rectangle 1: 4 × 5 = 20

Rectangle 2: 4 × 4 = 16

Equations will vary. Possible equations are shown.

STEP 5 Add the products to find the total area.

20 + 16 = 36 square feet

STEP 6 Check your answer by counting the number of square feet.

36 square feet

So, the area of Anna's rug is 36 square feet.

Math Talk MATHEMATICAL PRACTICES 6

Compare Did you draw a line in the same place as your classmates? Explain why you found the same total area.

Possible explanation: no; we found the same total area because the total number of unit squares is the same no matter how we draw a line to break apart the model.

Problem Types: Area • Unknown Product, Put Together/Take Apart • Total Unknown

Reteach 11.8

RtI

Name _____ Lesson 11.8 Reteach

Area of Combined Rectangles

You can break apart a figure into rectangles to find the total area of the figure.

Step 1 Draw a line to break apart the figure into two rectangles.

Step 2 Count the number of unit squares in each rectangle.

Step 3 Add the number of unit squares in each rectangle to find the total area.

12 + 8 = 20 unit squares

So, the area of the figure is 20 square units.

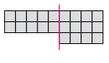
Draw a line to break apart the figure into rectangles. Find the area of the figure. Possible lines are shown.

1. 

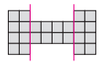
12 square units

2. 

10 square units

3. 

22 square units

4. 

24 square units

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Enrich 11.8

Differentiated Instruction

Name _____ Lesson 11.8 Enrich

Area of a Dream Bedroom

Draw a diagram of your dream bedroom. Include in the drawing a sleeping area, a closet, a bathroom, and a study area. Label each area.
One square unit is equal to 1 square foot.

Check students' drawings.

Use your drawing to solve the problems.

1. What is the total area of the sleeping area and the study area?
Answers will vary.

2. What is the total area of the closet and the bathroom?
Answers will vary.

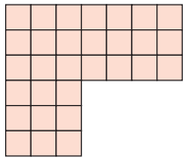
3. What is the total area of the bedroom, except for the bathroom?
Answers will vary.

4. What is the total area of the bedroom you drew on the grid?
Answers will vary.

5. Write Math How did you find the answer to Exercise 4?
Possible answer: I used my answer in Exercise 3 and then added the area of the bathroom to the answer to find the total area.

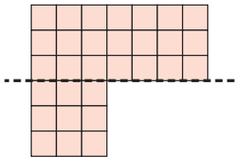
Chapter Resources © Houghton Mifflin Harcourt Publishing Company 11-20 Enrich

CONNECT Using the Distributive Property, you found that you could break apart a rectangle into smaller rectangles, and add the area of each smaller rectangle to find the total area. See below.



How can you break apart this figure into rectangles to find its area? Possible equations are given.

One Way Use a horizontal line.



STEP 1 Write a multiplication equation for each rectangle.

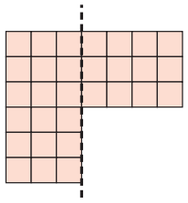
Rectangle 1: 3 × 7 = 21

Rectangle 2: 3 × 3 = 9

STEP 2 Add the products to find the total area.

21 + 9 = 30 square units

Another Way Use a vertical line.



STEP 1 Write a multiplication equation for each rectangle.

Rectangle 1: 6 × 3 = 18

Rectangle 2: 3 × 4 = 12

STEP 2 Add the products to find the total area.

18 + 12 = 30 square units

So, the area is 30 square units.

See below.

Math Talk

MATHEMATICAL PRACTICES 1

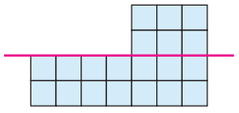
Evaluate How can you check your answer?

Share and Show MATH BOARD

1. Draw a line to break apart the figure into rectangles. Find the total area of the figure.

Think: I can draw vertical or horizontal lines to break apart the figure to make rectangles.

Possible line is shown.
Possible equations are given.



Rectangle 1: 2 × 7 = 14

Rectangle 2: 2 × 3 = 6

14 + 6 = 20 square units

Math Talk: Possible explanation: I can count all the unit squares to find the total number of square units.

Problem Types: Area • Unknown Product, Put Together/Take Apart • Total Unknown

Advanced Learners

Visual / Spatial
Individuals

Materials 1-Centimeter Grid Paper (see *eTeacher Resources*)

- Ask students to find the areas of the figures below using only multiplication.

Figure *A*: 21 square units;

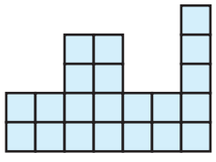


Figure *A*

Figure *B*: 21 square units

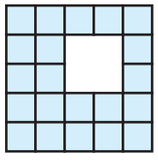


Figure *B*

- Have students draw another figure on grid paper with the same area that is made up of at least 4 rectangles.
- Ask students to exchange drawings and find the area of the figure.

Connect

Discuss with students that they will break apart figures that are not rectangles by finding smaller rectangles within the figure. There may be more than one way to do this.

One Way

Have students break the figure apart using a horizontal line.

- **How did you decide where to place the horizontal line?** I looked to see how I could break the figure into two separate rectangles.
- **If you had drawn the line in another place, how would you find the area?** Possible answer: if I placed the horizontal line anywhere else, I would have to either count or draw a second line to find the area.

Another Way

Have students break the figure apart using a vertical line.

- **How is using a vertical line to break the figure apart like using a horizontal line?** In both cases, I try to break the figure into two separate rectangles.

Math Talk Use **Math Talk** to discuss how students can break apart combined rectangles in different ways to check their work.

3 EXPLAIN

Share and Show MATH BOARD

The first problem connects to the learning model. Have students use the MathBoard to explain their thinking.

COMMON ERRORS

Error Students forget to add the areas of the smaller figures together.

Example Students may conclude that the area of the figure in One Way is 21 square units.

Springboard to Learning Tell students that they may want to write the areas of the smaller rectangles they find within the original figure to remind them to add to find the total.

Use the checked exercises for **Quick Check**. Students should show their answers for the Quick Check on the MathBoard.

Quick Check

If a student misses the checked exercises

Then **Differentiate Instruction** with

- Reteach 11.8
- Personal Math Trainer 3.MD.C.7c, 3.MD.C.7d
- RtI Tier 1 Activity (online)

On Your Own

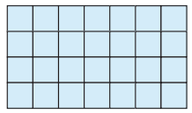
GO DEEPER

Exercise 7 requires students to analyze the shape to determine how to break it apart. They will need to break the shape into three separate rectangles.

MP4 Model with mathematics. Extend Exercise 7 by asking students to find the answer by drawing a different line or lines. Have students explain their answers. Answers will vary. Possible answer: I used one horizontal line to break the shape into three rectangles that have areas of 6, 18, and 6. The total area is 6 + 18 + 6 = 30 square units.

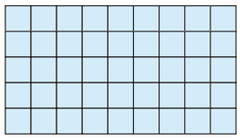
Name _____

Use the Distributive Property to find the area. Show your multiplication and addition equations. Equations will vary. Possible equations are given.

2. 

4 × 5 = 20; 4 × 2 = 8; 20 + 8 = 28

28 square units

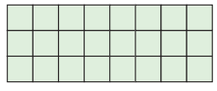
3. 

5 × 5 = 25; 5 × 4 = 20; 25 + 20 = 45

45 square units

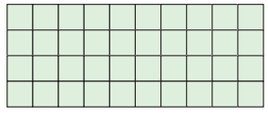
On Your Own

Use the Distributive Property to find the area. Show your multiplication and addition equations. Equations will vary. Possible equations are given.

4. 

3 × 5 = 15; 3 × 3 = 9; 15 + 9 = 24

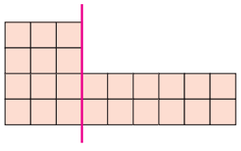
24 square units

5. 

2 × 10 = 20; 2 × 10 = 20; 20 + 20 = 40

40 square units

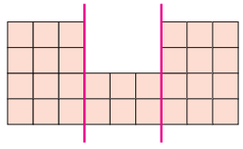
Draw a line to break apart the figure into rectangles. Find the area of the figure. Possible lines are shown. Possible equations are given.

6. 

Rectangle 1: 4 × 3 = 12

Rectangle 2: 2 × 6 = 12

12 + 12 = 24 square units

7. GO DEEPER 

Rectangle 1: 4 × 3 = 12

Rectangle 2: 2 × 3 = 6

Rectangle 3: 4 × 3 = 12

12 + 6 + 12 = 30 square units

PROBLEM TYPE SITUATIONS

Addition and Subtraction

Put Together/Take Apart • Total Unknown
Exercises: 8, 9, 12

Compare • Difference Unknown
Exercise: 12

Multiplication and Division

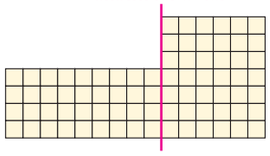
Area • Unknown Product
Exercises: 8, 9, 12

Common Core MATHEMATICAL PRACTICES ANALYZE • LOOK FOR STRUCTURE • PRECISION

Problem Solving • Applications

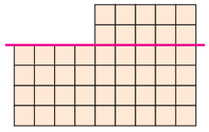
Possible lines are shown for 8–10.

8. GO DEEPER A model of Ms. Lee's classroom is at the right. Each unit square is 1 square foot. Draw a line to break apart the figure into rectangles. What are the areas of the two rectangles? What is the total area of Ms. Lee's classroom?



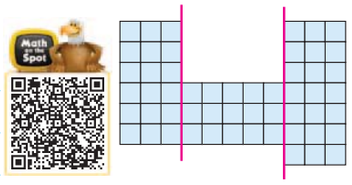
36 square feet; 42 square feet; 78 square feet

9. David has a rectangular bedroom with a rectangular closet. Each unit square is 1 square foot. Draw a line to break apart the figure into rectangles. What is the total area of David's bedroom?



46 square feet

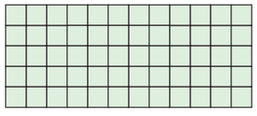
10. THINK SMARTER **Explain** how to break apart the figure to find its area.



1 unit square = 1 square meter

Possible explanation: I drew two vertical lines, breaking the figure into three rectangles. Rectangle 1: $6 \times 3 = 18$; Rectangle 2: $3 \times 5 = 15$; Rectangle 3: $7 \times 3 = 21$. Then, I added each area to find the total area: $18 + 15 + 21 = 54$; the area is 54 square meters.

11. MATHEMATICAL PRACTICE 4 **Interpret a Result** Use the Distributive Property to find the area of the figure at the right. Write your multiplication and addition equations.



1 unit square = 1 square centimeter

60 square centimeters; Equations will vary. Possible equations: $5 \times 10 = 50$; $5 \times 2 = 10$; $50 + 10 = 60$

Personal Math Trainer

12. THINK SMARTER+ Pete drew a diagram of his backyard on grid paper. Each unit square is 1 square meter. The area surrounding the patio is grass.

How much more of the backyard is grass than patio? Show your work.

22 more square meters

DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™

Differentiated Centers Kit

Activities
Classification Act

Students complete orange Activity Card 18 by classifying two-dimensional shapes based on their attributes.

Activities
Hurray for Arrays!

Students complete blue Activity Card 15 by using arrays to model multiplication facts.

4 ELABORATE

Problem Solving • Applications

Common Core MATHEMATICAL PRACTICES

THINK SMARTER

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

MP4 Model with mathematics. Exercise 11 requires students to use higher order thinking skills because they have not yet learned how to multiply with 12.

THINK SMARTER+ **Personal Math Trainer**

Be sure to assign this problem to students in the Personal Math Trainer. It features a video to help them model and answer the problem. For this multi-step problem, students first find the area of the grass part of the diagram by breaking the figure down into three rectangles. Then they should find the area of the patio and subtract the two numbers to find the difference in areas. Students who give answers of 4 or 30 likely did not understand the problem and gave either the area of the patio or the area of the entire backyard.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students work with a partner to demonstrate and describe the answer to the Essential Question.

How can you break apart a figure to find the area? I can break apart a figure into rectangles, find the area of the rectangles, and then add the areas to find the total area of the original figure.

Math Journal WRITE Math

Draw a figure that is not a rectangle and find its area. Use grid paper and show each step.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.

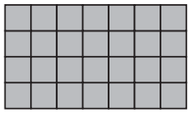
Name _____

Area of Combined Rectangles

Common Core **COMMON CORE STANDARDS—3.MD.C.7c, 3.MD.C.7d** *Geometric measurement: understand concepts of area and relate area to multiplication and to addition.*

Possible equations are given.

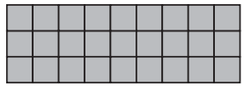
Use the Distributive Property to find the area. Show your multiplication and addition equations.

1. 

$4 \times 2 = 8; 4 \times 5 = 20$

$8 + 20 = 28$

28 square units

2. 

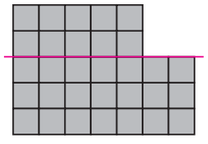
$3 \times 4 = 12; 3 \times 5 = 15$

$12 + 15 = 27$

27 square units

Draw a line to break apart the shape into rectangles. Find the area of the shape.

Possible lines are shown.
Possible equations are given.

3. 

Rectangle 1: 2 × 5 = 10

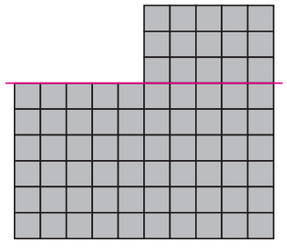
Rectangle 2: 3 × 7 = 21

10 + 21 = 31 square units

Problem Solving Real World

Possible line is shown.

A diagram of Frank's room is at right. Each unit square is 1 square foot.



4. Draw a line to divide the shape of Frank's room into rectangles.

5. What is the total area of Frank's room?

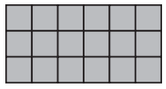
75 square feet

6. WRITE Math Draw a figure that is not a rectangle and find its area. Use grid paper and show each step.

Check students' work.

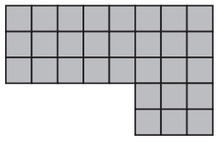
Lesson Check (3.MD.C.7c, 3.MD.C.7d)

1. The diagram shows Ben's backyard. Each unit square is 1 square yard. What is the area of Ben's backyard?



18 square yards

2. The diagram shows a room in an art gallery. Each unit square is 1 square meter. What is the area of the room?



30 square meters

Spiral Review (3.OA.B.6, 3.NF.A.1, 3.MD.B.4, 3.MD.D.8)

3. Naomi needs to solve $28 \div 7 = \square$. What related multiplication fact can she use to find the unknown number?

$4 \times 7 = 28$ or $7 \times 4 = 28$

4. Karen drew a triangle with side lengths 3 centimeters, 4 centimeters, and 5 centimeters. What is the perimeter of the triangle?

12 centimeters

5. The rectangle is divided into equal parts. What is the name of the equal parts?

fourths

6. Use an inch ruler. To the nearest half inch, how long is this line segment?

2 inches

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

LESSON 11.9

Same Perimeter, Different Areas

FOCUS COHERENCE RIGOR

LESSON AT A GLANCE

F C R Focus:

Common Core State Standards

3.MD.D.8 Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.5b, 3.MD.C.7b, 3.OA.A.3, 3.OA.C.7, 3.NBT.A.2

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.)
MP1 Make sense of problems and persevere in solving them.
MP3 Construct viable arguments and critique the reasoning of others.
MP4 Model with mathematics. **MP7** Look for and make use of structure.

F C R Coherence:

Standards Across the Grades

Before	Grade 3	After
2.MD.B.5	3.MD.D.8	4.MD.A.3

F C R Rigor:

Level 1: Understand Concepts.....*Share and Show* (Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Compare areas of rectangles that have the same perimeter.

Language Objective

Students each share with their partner the reasons you can use area to compare rectangles with the same perimeter.

Materials

MathBoard, square tiles

F C R For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

Teaching for Depth

In this lesson, students explore and compare rectangles that have the same perimeter but different areas. Empirically, they find that the rectangle with the greatest area is a square.

If time permits, you may wish to have students make all possible whole-unit rectangles that have a perimeter of 12 units and find the area of each. Encourage students to organize their data in a table that shows the length, width, perimeter, and area of each rectangle and look for patterns.

Students should observe that the "skinnier" rectangles have less area, while the "fatter" rectangles have more area. Of the rectangles with a perimeter of 12, the one that is 3 units long and 3 units wide (the square) has the greatest area.

Professional Development Videos

GO DIGITAL

- Interactive Student Edition
- Personal Math Trainer
- Math on the Spot Video
- Animated Math Models
- iTools: Geometry
- HMH Mega Math

Daily Routines

Common Core

Problem of the Day 11.9

What is the side length of a square that has a perimeter of 20 inches?

5 inches

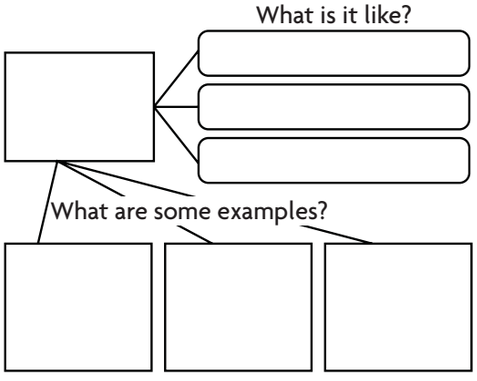
Vocabulary

GO DIGITAL
- Interactive Student Edition
- Multimedia eGlossary

Vocabulary Builder

Materials Word Definition Map (see *eTeacher Resources*)

Word Definitions Have students complete a word definition map for the word *area*. Encourage them to draw information and examples from the lesson. Ask them to use the vocabulary word.



1 ENGAGE

with the Interactive Student Edition

Essential Question

How can you use area to compare rectangles with the same perimeter?

Making Connections

Ask students to tell what they know about area and perimeter.

What is perimeter? the distance around a figure **How do you find the area of a figure?** Count the number of unit squares needed to cover the figure **Think about a rectangular garden. Which would you use to find the amount of fence needed to go around the garden?** perimeter

Learning Activity

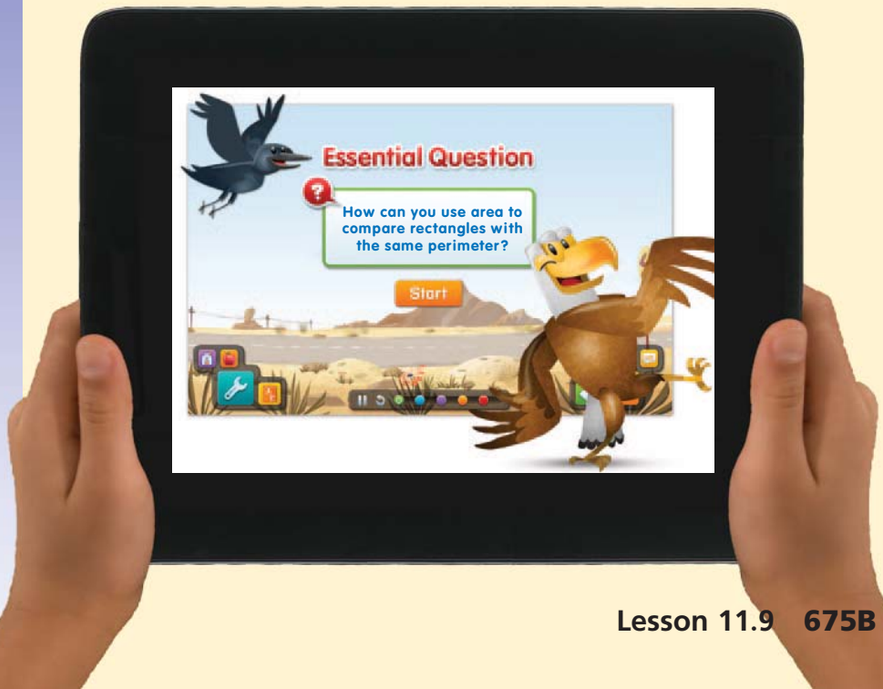
What is the problem the students are trying to solve? Connect the story to the problem. Ask the following questions.

- **What is the perimeter of the blanket?** 20 feet
- **What is the area of the blanket?** 24 square feet
- **What problem are you being asked to solve?** if another blanket with the same perimeter can have a greater area

Literacy and Mathematics

View the lesson opener with the students. Then, choose one or more of the following activities:

- Have small groups of students make a poster that includes a chart and drawings showing rectangles with a perimeter of 24 units. Have students identify the rectangles with the greatest and least area. Have students share their examples with the class.
- Have students draw a square on grid paper and then draw a rectangle with the same perimeter. Talk about what they notice about the areas of the two figures.



2 EXPLORE

Unlock the Problem

Common Core MATHEMATICAL PRACTICES

Activity

MP4 Model with mathematics. Discuss possible combinations of lengths and widths that will produce a rectangle with a perimeter of 12 feet. Then find the area of each combination.

- **Which of the sandboxes has equal side lengths? What figure is that sandbox?** Possible answer: Sandbox 3 has equal side lengths. It is a square.
- **Is it possible for Toby to make a rectangular sandbox that has a perimeter of 12 feet and an area of 12 square feet? Explain.** No; all of the possible rectangles that have a perimeter of 12 feet have areas that are not 12 square feet.
- **Suppose Toby wanted to make a sandbox with a perimeter of 16 square feet. What are the possible side lengths for the sandbox?** 1 ft by 7 ft; 2 ft by 6 ft; 3 ft by 5 ft; 4 ft by 4 ft
- **What areas will those sandboxes have?** 7 sq ft; 12 sq ft; 15 sq ft; 16 sq ft, respectively

MP7 Look for and make use of structure.

- **What type of figure is the sandbox with the greatest area?** The sandbox with the greatest area is a square.

ELL Strategy: Restate

By restating in a real life context, students build understanding of the terms *area* and *perimeter*.

- Restate how to find the *area* and *perimeter* using a number sentence and diagram.
  side × side = area
  side + side + side + side = perimeter
- In pairs, have students find the *area* and *perimeter* of a real-world rectangular shape such as a desk.
- Compare and contrast *perimeter* and *area*. Use sentence frames.
- ***Area* and *perimeter* are different because _____. However, they are similar because they ____.**

Common Core **3.MD.D.8** Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Name _____

Lesson 11.9

Same Perimeter, Different Areas

Essential Question How can you use area to compare rectangles with the same perimeter?

Common Core **Measurement and Data—3.MD.D.8** *Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.5b, 3.MD.C.7b, 3.OA.A.3, 3.OA.C.7, 3.NBT.A.2*

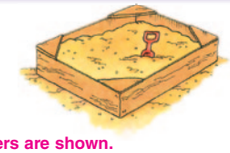
MATHEMATICAL PRACTICES MP2, MP3, MP4, MP6

Unlock the Problem

Toby has 12 feet of boards to put around a rectangular sandbox. How long should he make each side so that the area of the sandbox is as large as possible?

- What is the greatest perimeter Toby can make for his sandbox?
  12 feet

See below.

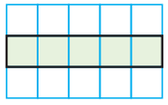


Activity

Materials ■ square tiles

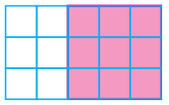
Use square tiles to make all the rectangles you can that have a perimeter of 12 units. Draw and label the sandboxes. Then find the area of each. Possible answers are shown.

Sandbox 1: 1 ft by 5 ft



Sandbox 2: 2 ft by 4 ft

Sandbox 3: 3 ft by 3 ft



Find the perimeter and area of each rectangle.

	Perimeter	Area
Sandbox 1	5 + 1 + 5 + 1 = 12 feet	1 × 5 = 5 square feet
Sandbox 2	4 + 2 + 4 + 2 = 12 feet	2 × 4 = 8 square feet
Sandbox 3	3 + 3 + 3 + 3 = 12 feet	3 × 3 = 9 square feet

The area of Sandbox 3 is the greatest.

So, Toby should build a sandbox that is 3 feet wide and 3 feet long.

Math Talk MATHEMATICAL PRACTICES 6

Compare How are the sandboxes alike? How are the sandboxes different?

Possible answer: all three rectangles have a perimeter of 12 feet. They have different side lengths and different areas.

Problem Types: Put Together/Take Apart • Both Addends Unknown, Area • Unknown Product

Reteach 11.9

RtI

Name _____ Lesson 11.9 Reteach

Same Perimeter, Different Areas

You can use perimeter and area to compare rectangles.

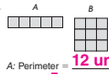
Compare the perimeters of Rectangle *A* and Rectangle *B*.

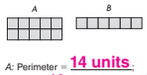
Find the number of units around each rectangle.
Rectangle *A*: 3 + 2 + 3 + 2 = 10 units
Rectangle *B*: 4 + 1 + 4 + 1 = 10 units
Compare: 10 units = 10 units
So, Rectangle *A* has the same perimeter as Rectangle *B*.

Compare the areas of Rectangle *A* and Rectangle *B*.

Find the number of unit squares needed to cover each rectangle.
Rectangle *A*: 2 rows of 3 = 2 × 3, or 6 square units
Rectangle *B*: 1 row of 4 = 1 × 4, or 4 square units
Compare: 6 square units > 4 square units
So, Rectangle *A* has a greater area than Rectangle *B*.

Find the perimeter and the area. Tell which rectangle has a greater area.

1. 
A: Perimeter = 12 units, Area = 5 square units
B: Perimeter = 12 units, Area = 9 square units
Rectangle *B* has a greater area.

2. 
A: Perimeter = 14 units, Area = 10 square units
B: Perimeter = 14 units, Area = 6 square units
Rectangle *A* has a greater area.

Chapter Resources © Houghton Mifflin Harcourt Publishing Company 11-21 Reteach

Enrich 11.9

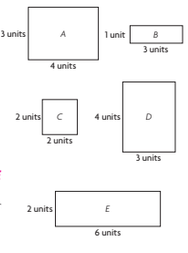
Differentiated Instruction

Name _____ Lesson 11.9 Enrich

Area and Perimeter Match-Up

Read the description. Write the letter of any figure that matches the description. More than one figure may match a description.

Description	Figures
1. a rectangle with a perimeter of 16 units Figure *E*	
2. a four-sided figure with an area of 4 square units Figure *C*	
3. a four-sided figure with an area of 12 square units Figure *A*, Figure *D*, Figure *E*	
4. a four-sided figure with a perimeter of 8 units Figure *B*, Figure *C*	



5. **Stretch Your Thinking** A four-sided figure is made from 24 unit squares. Using whole numbers, what is the smallest possible perimeter? Using whole numbers, what are the side lengths of the rectangle with the smallest perimeter?
The smallest perimeter is 20 units; the side lengths are 4 units, 6 units, 4 units, and 6 units.

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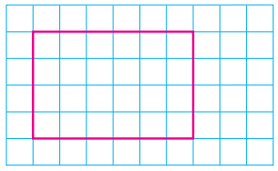
Examples

Examples Draw rectangles with the same perimeter and different areas.

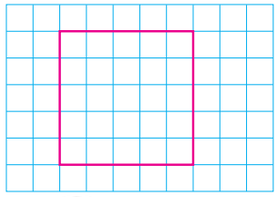
Possible drawing shown.

A Draw a rectangle that has a perimeter of 20 units and an area of 24 square units.
Possible answer given.
The sides of the rectangle measure
4 units and 6 units.



B Draw a rectangle that has a perimeter of 20 units and an area of 25 square units.

The sides of the rectangle measure
5 units and 5 units.



Possible explanation: both rectangles have a perimeter of 20 units. The area of the square for Example *B* is greater than the area of the rectangle for Example *A*.

Math Talk

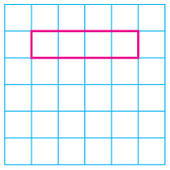
MATHEMATICAL PRACTICES 3

Compare Representations
Explain how the perimeters of Example *A* and Example *B* are related. Explain how the areas are related.

Share and Show MATH BOARD

1. The perimeter of the rectangle at the right is 10 units. The area is 6 square units.

2. Draw a rectangle that has the same perimeter as the rectangle in Exercise 1 but with a different area. Possible drawing shown.



3. The area of the rectangle in Exercise 2 is 4 square units.

4. Which rectangle has the greater area?
the rectangle in Exercise 1

5. If you were given a rectangle with a certain perimeter, how would you draw it so that it has the greatest area? Possible answer:
I would try to make a square, or as close to a square as I could.

Math Talk

MATHEMATICAL PRACTICES 6

Explain how you knew what the rectangle for Exercise 5 would look like.

Math Talk: Possible explanation: I noticed in the Activities and Examples that the rectangle that looked most like a square had the greatest area.

Examples

- **How did you choose the side lengths for Examples A and B?** Possible answer: since the area can be found by multiplying the number of unit squares in each row by the number of rows, I thought of numbers that when multiplied would give a product of 24 for Example A and 25 for Example B.
- **Can you use other side lengths for Example B? Explain.** No; there is only one rectangle that has a perimeter of 20 units and an area of 25 square units.

Math Talk Use **Math Talk** to focus on students' understanding of comparing areas and perimeters.

3 EXPLAIN

Share and Show MATH BOARD

The first problem connects to the learning model. Have students use the MathBoard to explain their thinking.

Math Talk Use **Math Talk** to focus on students' understanding of how to draw a rectangle with the greatest area given its perimeter.

- **A rectangle has a perimeter of 24 inches. How can you find the side length of a square with this perimeter? Explain.** Possible answer: Divide the perimeter by 4, because each side of a square is the same length and perimeter is the sum of the side lengths.

Advanced Learners

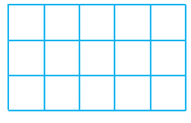
Visual / Logical
Partners

Materials 1-Centimeter Grid Paper (see *eTeacher Resources*)

- Have students draw a rectangle that is 3 units by 8 units on grid paper and then find the perimeter and area. They should label it as Rectangle *A*. Perimeter is 22 units. Area is 24 square units.
- **Draw another rectangle that is 5 units by 6 units, and then find the perimeter and area. Label it as Rectangle *B*.** Perimeter is 22 units. Area is 30 square units.
- **Use $<$, $>$, or $=$ to compare the perimeters and areas of Rectangles *A* and *B*.** Perimeter is $22 = 22$; Area is $24 < 30$
- **Draw two other rectangles that have the same perimeter as Rectangle *A*, and label them as Rectangles *C* and *D*. Order the rectangles from least area to the greatest area.** Check students' work.

COMMON ERRORS

Error Students may confuse area with perimeter.



Example

Area $= 3 + 5 + 3 + 5$
$= 16$ square units

Springboard to Learning Have students write the definition of each word and draw a picture that demonstrates the meaning.

Use the checked exercises for **Quick Check**. Students should show their answers for the Quick Check on the MathBoard.

Quick Check RtI

If a student misses the checked exercises

Then **Differentiate Instruction** with

- Reteach 11.9
- Personal Math Trainer 3.MD.D.8
- RtI Tier 1 Activity (online)

On Your Own

If students complete the checked exercises, they may continue with the On Your Own section.

MP6 Attend to precision. Exercise 9 requires students to write a question in which 32 square feet is the answer.

MP2 Reason abstractly and quantitatively.

- **What if you had a non-square rectangle and a square with the same perimeter? Which figure would have the greater area? Give an example to justify your reasoning.** the square; Possible explanation: for Exercise 7, the square has a larger area than the non-square rectangle.

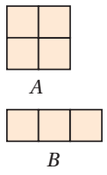
Additional Example

Put Together/Take Apart • Both Addends Unknown; Area • Unknown Product

- **Felicity has 18 inches of ribbon to put around some rectangular picture frames. The frames all have whole-inch sides. List all the sizes of picture frames she could put 18 inches of ribbon around. Which picture frame will have the greatest area?** 1 inch and 8 inch sides; 2 inch and 7 inch sides; 3 inch and 6 inch sides; 4 inch and 5 inch sides; the picture frame with the greatest area is the one with 4 inch and 5 inch sides.

Name _____

Find the perimeter and the area. Tell which rectangle has a greater area.

6. 

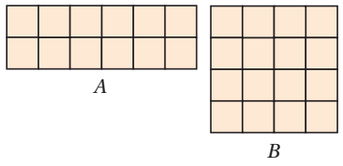
A: Perimeter = 8 units ; Area = 4 square units

B: Perimeter = 8 units ; Area = 3 square units

Rectangle A has a greater area.

On Your Own

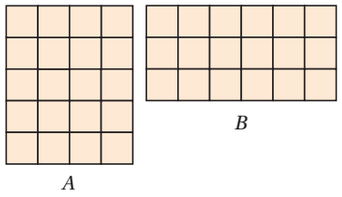
Find the perimeter and the area. Tell which rectangle has a greater area.

7. 

A: Perimeter = 16 units ;
Area = 12 square units

B: Perimeter = 16 units ;
Area = 16 square units

Rectangle B has a greater area.

8. 

A: Perimeter = 18 units ;
Area = 20 square units

B: Perimeter = 18 units ;
Area = 18 square units

Rectangle A has a greater area.

9. MATHEMATICAL PRACTICE 6 **Use Math Vocabulary** Todd's flower garden is 4 feet wide and 8 feet long. If the answer is 32 square feet, what is the question?

Possible question: What is the area of Todd's garden?

PROBLEM TYPE SITUATIONS

Addition and Subtraction

Put Together/Take Apart • Total Unknown
Exercises: 10, 11

Multiplication and Division

Area • Unknown Product
Exercises: 10, 11

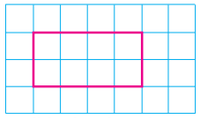
Common Core MATHEMATICAL PRACTICES MODEL • REASON • MAKE SENSE

Problem Solving • Applications

10. THINK SMARTER Draw a rectangle with the same perimeter as Rectangle *C*, but with a smaller area. What is the area?

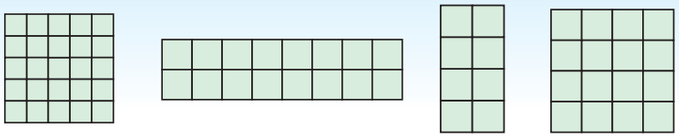
Area = Areas will vary.

C



Possible drawing shown.

11. THINK SMARTER Which figure has a perimeter of 20 units and an area of 16 square units?



Ⓐ ● Ⓒ Ⓓ

Connect to Reading

Cause and Effect

Sometimes one action has an effect on another action. The *cause* is the reason something happens. The *effect* is the result.

12. GO DEEPER Sam wanted to print a digital photo that is 3 inches wide and 5 inches long. What if Sam accidentally printed a photo that is 4 inches wide and 6 inches long?

Sam can make a table to understand cause and effect.

Cause	Effect
The wrong size photo was printed.	Each side of the photo is a greater length.

Use the information and the strategy to solve the problems.

a. What effect did the mistake have on the perimeter of the photo?

Possible answer: the perimeter increased by 4 inches.

b. What effect did the mistake have on the area of the photo?

Possible answer: the area increased by 9 square inches.

DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™

Differentiated Centers Kit

Activities
Jump to 9

Students complete blue Activity Card 6 by measuring and then adding lengths.

Activities
Perimeter Parade

Students complete orange Activity Card 10 by finding the perimeter of pattern blocks.

Literature
James' Frames

Students read about using perimeter to find how much wood is needed to make picture frames.

4 ELABORATE

Problem Solving • Applications

Common Core MATHEMATICAL PRACTICES

THINK SMARTER

Exercise 10 requires students to use higher order thinking skills to draw a different rectangle with the same perimeter, but a smaller area.

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

THINK SMARTER

This item assesses whether students can distinguish between rectangles that have the same perimeter, but different areas. Students who incorrectly select A or D are meeting just one condition of the problem. Have those students first find the area of each rectangle and then find the perimeter of each, looking for a rectangle with both the given perimeter and area.

Connect to Reading

Have students think about cause and effect in literature being studied in class. Use cause and effect to understand how changing lengths and widths affects perimeters and areas.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students work with a partner to answer the Essential Question.

How can you use area to compare rectangles with the same perimeter? Possible answer: I can create different rectangles with the same perimeter. Then I can calculate the areas to see how they change.

Math Journal WRITE Math

Draw three examples of rectangles that have the same perimeter, but different areas. Note which of the areas is greatest and which is least.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.

Name _____

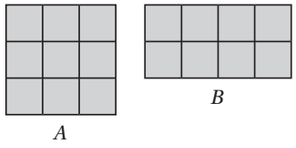
Practice and Homework
Lesson 11.4

Same Perimeter, Different Areas

Common Core **COMMON CORE STANDARD—3.MD.D.8**
Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

Find the perimeter and the area.
Tell which rectangle has a greater area.

1.

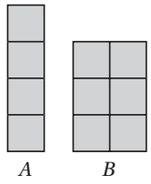


A: Perimeter = 12 units;
Area = 9 square units

B: Perimeter = 12 units;
Area = 8 square units

Rectangle *A* has a greater area.

2.



A: Perimeter = 10 units;
Area = 4 square units

B: Perimeter = 10 units;
Area = 6 square units

Rectangle *B* has a greater area.

Problem Solving Real World

3. Tara's and Jody's bedrooms are shaped like rectangles. Tara's bedroom is 9 feet long and 8 feet wide. Jody's bedroom is 7 feet long and 10 feet wide. Whose bedroom has the greater area? **Explain.**

Tara's; $9 \times 8 = 72$ and $7 \times 10 = 70$; $72 > 70$

4. WRITE Math Draw three examples of rectangles that have the same perimeter, but different areas. Note which of the areas is greatest and which is the least.

Check students' work.

Extend the Math Activity

Display the table for Perimeter and Area on the board for students to copy and complete.

In this Activity, students can apply the understanding of cause and effect as presented on page 678.

Investigate

Materials 1-Inch Grid Paper (see *eTeacher Resources*)

- Draw a rectangle on grid paper that has a length of 6 units and a width of 2 units. Record the perimeter and area in the table on the right.
- For Rectangle 2, multiply the length and width by 2. Record the length and width in the table. Record the perimeter and area in the table for Rectangle 2.
- Divide the length and width of Rectangle 1 by 2. Record this length and width in the table for Rectangle 3. Record the perimeter and area in the table for Rectangle 3.

Perimeter and Area

	Length (in units)	Width (in units)	Perimeter (in units)	Area (in square units)
Rectangle 1	6	2	16	12
Rectangle 2	12	4	32	48
Rectangle 3	3	1	8	3

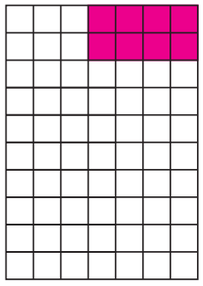
Summarize

- **What happened to the perimeter and area when the sides were doubled?** The perimeter was multiplied by 2; the area was multiplied by 4.
- **What happened to the perimeter and area when the sides were divided by 2?** The perimeter was divided by 2; the area was divided by 4.

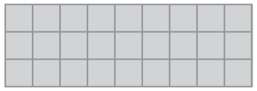
Lesson Check (3.MD.D.8)

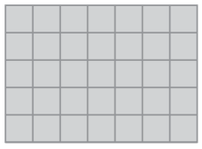
1. Draw a rectangle that has a perimeter of 12 units and an area of 8 square units.

Possible drawing:



2. Find the perimeter and the area. Tell which rectangle has the greater area.

A 

B 

A: Perimeter = 24 units

Area = 27 square units

B: Perimeter = 24 units

Area = 35 square units

Rectangle B has a greater area.

Spiral Review (3.MD.C.7, 3.MD.C.7a, 3.MD.D.8)

3. Kerrie covers a table with 8 rows of square tiles. There are 7 tiles in each row. What is the area that Kerrie covers in square units?

56 square units

4. Von has a rectangular workroom with a perimeter of 26 feet. The length of the workroom is 6 feet. What is the width of Von's workroom?

7 feet

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

LESSON 11.10

Same Area, Different Perimeters

FOCUS COHERENCE RIGOR

LESSON AT A GLANCE

F C R Focus:

Common Core State Standards

3.MD.D.8 Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.5b, 3.MD.C.7b, 3.OA.A.3, 3.OA.C.7, 3.NBT.A.2

MATHEMATICAL PRACTICES (See *Mathematical Practices in GO Math!* in the *Planning Guide* for full text.) **MP2** Reason abstractly and quantitatively. **MP3** Construct viable arguments and critique the reasoning of others. **MP4** Model with mathematics.

F C R Coherence:

Standards Across the Grades

Before	Grade 3	After
2.MD.B.5	3.MD.D.8	4.MD.A.3

F C R Rigor:

Level 1: Understand Concepts.....*Share and Show* (Checked Items)
Level 2: Procedural Skills and Fluency.....*On Your Own, Practice and Homework*
Level 3: Applications.....*Think Smarter and Go Deeper*

Learning Objective

Compare perimeters of rectangles that have the same area.

Language Objective

Student pairs explain how to use perimeter to compare rectangles with the same area.

Materials

MathBoard, square tiles

F C R For more about how *GO Math!* fosters **Coherence** within the Content Standards and Mathematical Progressions for this chapter, see page 623J.

About the Math

Professional Development

Teaching for Depth

In this lesson, students compare rectangles that have the same area but different perimeters. They will see that rectangles with two side lengths of 1 unit have the greatest perimeter of rectangles with the same area.

It may be interesting for your advanced students to know that when the perimeters are the same and the areas are different, the rectangle with two side lengths of 1 unit will minimize the area, while the rectangle that is closest to, or is, a square will maximize the area.

The opposite is true for rectangles with the same area but different perimeters. The rectangle with two side lengths of 1 unit will maximize the perimeter, while the rectangle that is closest to, or is, a square will minimize the perimeter.

Professional Development Videos

GO DIGITAL

- Interactive Student Edition
- Personal Math Trainer
- Math on the Spot Video
- Animated Math Models
- *i*Tools: Geometry
- HMH Mega Math

Daily Routines

Common Core

Problem of the Day 11.10

Jason plants a flower garden according to the table below. How many snapdragons does Jason plant?

Flower	Planted in
Tulip	2 rows of 6
Snapdragon	4 rows of 4
Lily	5 rows of 3
Iris	6 rows of 4

16 snapdragons

Vocabulary

GO DIGITAL
- Interactive Student Edition
- Multimedia eGlossary

Fluency Builder

Common Core Fluency Standard 3.OA.C.7

Mental Math Students should recall their multiplication facts. Practice multiplication facts with 4 and 7.

4×1 4	7×1 7
4×2 8	7×2 14
4×3 12	7×3 21
4×4 16	7×4 28
4×5 20	7×5 35
4×6 24	7×6 42
4×7 28	7×7 49
4×8 32	7×8 56
4×9 36	7×9 63

1 ENGAGE

with the Interactive Student Edition

Essential Question

How can you use perimeter to compare rectangles with the same area?

Making Connections

Invite students to tell what they know about area and draw different rectangles with the same area. Provide students with grid paper.

On the grid paper, draw a rectangle that is 6 units long and 1 unit wide. Check students' drawings. **How do you find the area of the rectangle you drew?** Count the squares inside the rectangle **Outline another rectangle with an area of 6 square units.** Check student's drawings.

Learning Activity

What is the problem the students are trying to solve? Connect the story to the problem. Ask the following questions.

- **What is the length of each log?** 1 unit
- **What is the area of the game field?** 12 square units
- **What problem are you being asked to solve?** the least number of logs the family could use to make the game field

Literacy and Mathematics

View the lesson opener with the students. Then, choose one or more of the following activities:

- Have students write a creative story about finding rectangles with the same area but different perimeters.
- Have students draw a square on grid paper and then draw a rectangle with the same area. Talk about what they notice about the perimeters of the two figures.

2 EXPLORE

Unlock the Problem

Common Core MATHEMATICAL PRACTICES

Activity

MP4 Model with mathematics. Have students find the possible rectangles that have an area of 16 square meters.

- **What are all the pairs of numbers that you can multiply together to get a product of 16?** 1 and 16, 2 and 8, 4 and 4
- **Look at the rectangle with the least perimeter. How do its side lengths compare to the side lengths of other rectangles?** Possible answer: all 4 side lengths are the same. Other rectangles have side lengths that are not the same.
- **Look at the rectangle with the greatest perimeter. How do its side lengths compare to the side lengths of other rectangles?** Possible answer: the rectangle has one side length of 1 and one side length that is greater than any of the side lengths of other rectangles.

Math Talk Use **Math Talk** to focus on the process used to find the lengths and widths of the rectangles.

MP7 Look for and make use of structure.

- **What happens to the perimeters as the lengths and the widths of the rectangles get closer to each other in value?** The perimeters decrease.

ELL Strategy:
Develop Meanings

Students enhance their comprehension of the terms *area* and *perimeter* by describing in words or drawing what they have learned.

- Ask students to draw 3 rectangles: one that is 3 by 4, one that is 2 by 5, and one that is 6 by 2. Label the rectangles *A*, *B*, and *C*.
- Develop the meanings of perimeter and area by discussing the shapes.
- **The ___ and __ shapes have the same perimeter.** *A* and *B* **The ___ and ___ shapes have the same area because _____.** *A* and *C*; the product of both sets of side lengths is 12.

Common Core **3.MD.D.8** Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Name _____

Same Area, Different Perimeters

Essential Question How can you use perimeter to compare rectangles with the same area?

Common Core **Measurement and Data—3.MD.D.8** *Also 3.MD.C.5, 3.MD.C.5a, 3.MD.C.5b, 3.MD.C.7b, 3.OA.A.3, 3.OA.C.7, 3.NBT.A.2*
MATHEMATICAL PRACTICES **MP2, MP3, MP4, MP6**

Unlock the Problem

Marcy is making a rectangular pen to hold her rabbits. The area of the pen should be 16 square meters with side lengths that are whole numbers. What is the least amount of fencing she needs?

See below.

- What does the least amount of fencing represent?

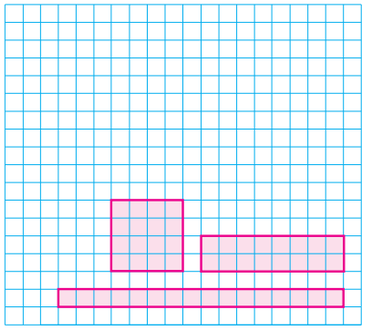
perimeter

Activity

Materials ■ square tiles

Use 16 square tiles to make rectangles. Make as many different rectangles as you can with 16 tiles. Record the rectangles on the grid, write the multiplication equation for the area shown by the rectangle, and find the perimeter of each rectangle.

Check students' drawings. Possible equations given.



Math Talk MATHEMATICAL PRACTICES 4

Model Mathematics How did you determine what rectangles to draw?

Area: 1 × 16 = 16 square meters Perimeter: 34 meters

Area: 2 × 8 = 16 square meters Perimeter: 20 meters

Area: 4 × 4 = 16 square meters Perimeter: 16 meters

To use the least amount of fencing, Marcy should make a rectangular pen with side lengths of 4 meters and 4 meters.

So, 16 meters is the least amount of fencing Marcy needs.

Possible answer: I started with a side length of 1 and increased the side by 1 unit until I found rectangles with an area of 16 square meters.

Problem Types: Area • Both Factors Unknown, Put Together/Take Apart • Total Unknown

Reteach 11.10

RtI

Name _____ Lesson 11.10 Reteach

Same Area, Different Perimeters

Find the perimeter and area of Rectangles *A* and *B*. Tell which rectangle has a greater perimeter.

Step 1 Find the area of each rectangle. You can multiply the number of unit squares in each row by the number of rows.

Rectangle *A*: 2 × 6 = 12 square units

Rectangle *B*: 3 × 4 = 12 square units

Step 2 Find the perimeter of each rectangle. You can add the sides.

Rectangle *A*: 6 + 2 + 6 + 2 = 16 units

Rectangle *B*: 4 + 3 + 4 + 3 = 14 units

Step 3 Compare the perimeters. 16 units > 14 units.

So, Rectangle *A* has a greater perimeter.

Find the perimeter and the area. Tell which rectangle has a greater perimeter.

1. *A*: Area = 6 square units; Perimeter = 10 units
   B: Area = 6 square units; Perimeter = 14 units
   Rectangle *B* has a greater perimeter.

2. *A*: Area = 16 square units; Perimeter = 20 units
   B: Area = 16 square units; Perimeter = 16 units
   Rectangle *A* has a greater perimeter.

Chapter Resources 11-23 Reteach

Enrich 11.10

Differentiated Instruction

Name _____ Lesson 11.10 Enrich

Area and Perimeter Comparisons

Find the length and width of 4 different rectangles such that each rectangle has an area of 24 square units. Write the length and width of each rectangle in the table. Then find the perimeter of each rectangle and record it in the table.

Order of answers and length and width in table may vary. Possible answers are given.

Rectangles with an area of 24 square units			
	Length	Width	Perimeter
Rectangle *A*	1 unit	24 units	50 units
Rectangle *B*	2 units	12 units	28 units
Rectangle *C*	3 units	8 units	22 units
Rectangle *D*	4 units	6 units	20 units

Use the table to answer the question.

1. Brian wants to build the rectangle that has the least perimeter. Which rectangle should he build?
   Rectangle *D*

2. Luke has 25 units of fencing. Which is the largest rectangle for which he can use the fencing?
   Rectangle *C*

3. Can Li build a square with an area of 24 square units, such that the side lengths are whole units? **Explain.**
   No. Possible explanations: there is no whole number that, when multiplied by itself, has the product 24.

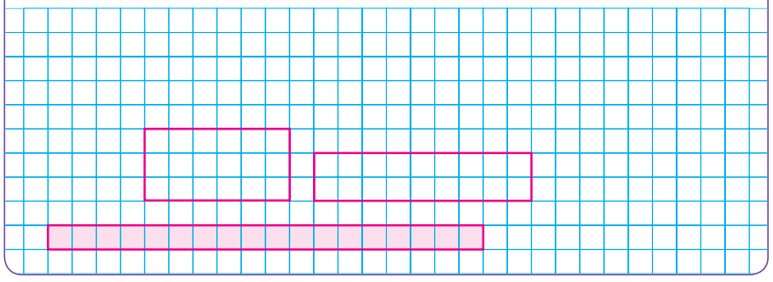
4. Ginger has 50 units of yarn. She wants to use all of the yarn as a border for one or more rectangles. Which rectangle(s) can Ginger build?
   Possible answer: Rectangle *A* or Rectangles *B* and *C*

Chapter Resources 11-24 Enrich

Try This!

Draw three rectangles that have an area of 18 square units on the grid. Find the perimeter of each rectangle. Shade the rectangle that has the greatest perimeter.

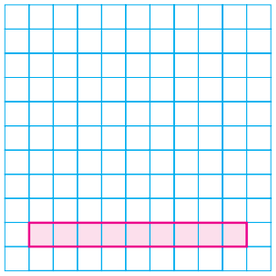
Check students' drawings. Possible drawings shown.



Share and Show MATH BOARD

1. The area of the rectangle at the right is **9** square units. The perimeter is **12** units.

2. Draw a rectangle that has the same area as the rectangle in Exercise 1 but with a different perimeter. **Possible drawing shown.**



3. The perimeter of the rectangle in Exercise 2 is **20** units.

4. Which rectangle has the greater perimeter?

the rectangle in Exercise 2

5. If you were given a rectangle with a certain area, how would you draw it so that it had the greatest perimeter? **Possible answer:**

I would make a rectangle with a side length of 1 unit.

Yes; possible explanation: we both drew a rectangle that has 1 row of 9 squares.

Math Talk

MATHEMATICAL PRACTICES 3

Compare Representations

Did you and your classmate draw the same rectangle for Exercise 2?

Advanced Learners

Visual / Spacial

Individuals

Materials 1-Centimeter Grid Paper (see *eTeacher Resources*)

- Have students draw a rectangle that is 3 units by 8 units on grid paper and then find the perimeter and area. They should label it as Rectangle *A*. Perimeter is 22 units. Area is 24 square units.
- **Draw another rectangle that is 2 units by 12 units, and then find the perimeter and area. Label it as Rectangle *B*.** Perimeter is 28 units. Area is 24 square units.
- **Draw two other rectangles that have the same area as Rectangle *A*, and label them as Rectangles *C* and *D*. Order the rectangles from least perimeter to greatest perimeter.** Check students' work.
- Repeat with rectangles that have an area of 18 square units, and then with 36 square units. Ask students to look for a pattern.

Try This!

Discuss with students that there are different ways to find rectangles with an area of 18 square units. Students can either use the strategy *predict and test* or they can find and use factor pairs.

- **How did you find all of the rectangles with an area of 18 square units?** Answers will vary. Possible answer: I started with a length of 1 unit, then I tried a length of 2 units, and then I kept going until I found three rectangles.
- **Compare the length and width of the rectangle with the greatest perimeter with the lengths and widths of the other rectangles.** Answers will vary. Possible answers: the length is 1, which is less than the other lengths, but the width is greater than the other widths. They are farther apart in value than the other lengths and widths.

3 EXPLAIN

Share and Show MATH BOARD

The first problem connects to the learning model. Have students use the MathBoard to explain their thinking.

Math Talk Use **Math Talk** to help students recognize that there are a limited number of rectangles that can be drawn with an area of 9 square units.

- **Can a rectangle with whole number side lengths have an area of 9 square units and a side length of 2 units? Explain.** No, 2 does not divide evenly into 9.

COMMON ERRORS

Error Students confuse perimeter and area.

Example Students asked to draw a rectangle with an area of 10 square units drew the rectangle below.

Springboard to Learning Tell students that they may want to count unit squares in order to check that their rectangles have the correct area.

Use the checked exercises for **Quick Check**. Students should show their answers for the Quick Check on the MathBoard.

Quick Check

If a student misses the checked exercises

Then **Differentiate Instruction** with

- Reteach 11.10
- Personal Math Trainer 3.MD.D.8
- RtI Tier 1 Activity (online)

On Your Own

If students complete the checked exercises correctly, they may continue with the On Your Own section.

THINK SMARTER

MP2 Reason abstractly and quantitatively. Exercise 9 requires students to analyze the dimensions of a shape abstractly in order to answer the question.

Math on the Spot Video Tutor

Use this video to help students model and solve this type of *Think Smarter* problem.

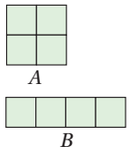
GO DIGITAL **Math on the Spot** videos are in the Interactive Student Edition and at *www.thinkcentral.com*.

MP7 Look for and make use of structure.

- **Assume that you have several rectangles with the same area. One is a square, and one has a length of 1 unit. Which has the greatest perimeter? Which has the least perimeter?** The square has the least perimeter. The rectangle with a length of 1 unit has the greatest perimeter.

Name _____

Find the perimeter and the area. Tell which rectangle has a greater perimeter.

6. 

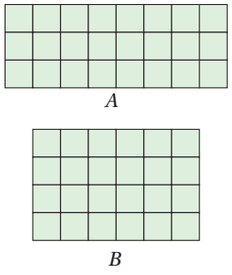
A: Area = 4 square units; Perimeter = 8 units

B: Area = 4 square units; Perimeter = 10 units

Rectangle B has a greater perimeter.

On Your Own

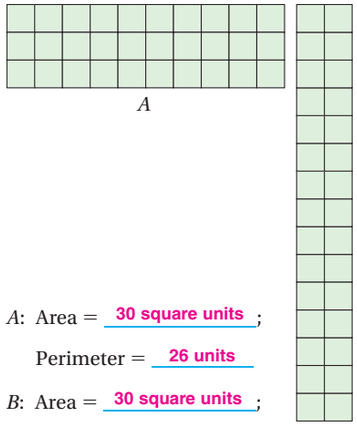
Find the perimeter and the area. Tell which rectangle has a greater perimeter.

7. 

A: Area = 24 square units;
Perimeter = 22 units

B: Area = 24 square units;
Perimeter = 20 units

Rectangle A has a greater perimeter.

8. 

A: Area = 30 square units;
Perimeter = 26 units

B: Area = 30 square units;
Perimeter = 34 units

Rectangle B has a greater perimeter.

9. THINK SMARTER **Sense or Nonsense?** Dora says that of all the possible rectangles with the same area, the rectangle with the largest perimeter will have two side lengths that are 1 unit. Does her statement make sense? Explain.

Yes; possible explanation: this will make the other two side lengths as large as possible.

PROBLEM TYPE SITUATIONS

Addition and Subtraction

Put Together/Take Apart • Total Unknown
Exercises: 10, 11

Multiplication and Division

Area • Both Factors Unknown
Exercises: 10, 11

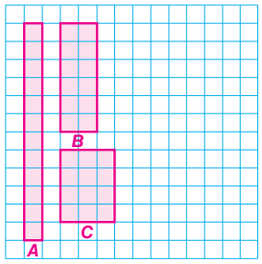
MATHEMATICAL PRACTICES COMMUNICATE • PERSEVERE • CONSTRUCT ARGUMENTS

Unlock the Problem

10. Roberto has 12 tiles. Each tile is 1 square inch. He will arrange them into a rectangle and glue 1-inch stones around the edge. How can Roberto arrange the tiles so that he uses the least number of stones?

a. MATHEMATICAL PRACTICE 6 **Explain a Method** How will you use what you know about area and perimeter to help you solve the problem? I will find the possible rectangles that have an area of 12 square inches. Then I will compare the perimeters of each possible rectangle.

b. GO DEEPER Draw possible rectangles to solve the problem, and label them *A*, *B*, and *C*.
Letters will vary for each rectangle. Check students' drawings and sentences.



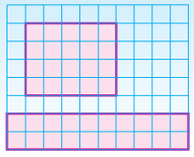
c. So, Roberto should arrange the tiles like Rectangle C.

11. THINK SMARTER Draw 2 different rectangles with an area of 20 square units. What is the perimeter of each rectangle you drew?

Area = 20 square units

Perimeter = 18 units

Perimeter = 24 units



Possible answer is shown.

DIFFERENTIATED INSTRUCTION INDEPENDENT ACTIVITIES

Grab-and-Go!™

Differentiated Centers Kit

Activities
Jump to 9

Students complete blue Activity Card 6 by measuring and then adding lengths.

Activities
Perimeter Parade

Students complete orange Activity Card 10 by finding the perimeter of pattern blocks.

Literature
James' Frames

Students read about using perimeter to find how much wood is needed to make picture frames.

4 ELABORATE

Unlock the Problem

Common Core MATHEMATICAL PRACTICES

Have students read Exercise 10. The exercise walks students through the steps required to solve any problem.

MP3 Attend to precision. Students must identify what they know and how to use what they know in order to find a solution.

GO DEEPER

Students need to draw rectangles with areas of 12 square units. Suggest they think of the factors of 12 to help them determine possible lengths and widths.

THINK SMARTER

Students should recognize that rectangles having the same area can have different perimeters, and use this understanding to correctly draw two rectangles with the same area and different perimeters. Students who have difficulty in drawing 2 different rectangles with the same area, may not fully understand the concept of linear units and square units.

5 EVALUATE Formative Assessment

Essential Question

Using the Language Objective

Reflect Have students work in pairs to give an explanation to answer the Essential Question.

How can you use perimeter to compare rectangles with the same area? I can create different rectangles with the same area. Then I can calculate the perimeters to see how they change.

Math Journal WRITE Math

Draw two rectangles with different perimeters but the same area.

Practice and Homework

Use the Practice and Homework pages to provide students with more practice of the concepts and skills presented in this lesson. Students master their understanding as they complete practice items and then challenge their critical thinking skills with Problem Solving. Use the Write Math section to determine student's understanding of content for this lesson. Encourage students to use their Math Journals to record their answers.

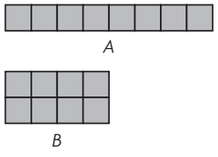
Name _____

Practice and Homework
Lesson 11.10

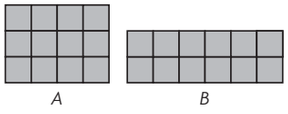
Same Area, Different Perimeters

Common Core **COMMON CORE STANDARD—3.MD.D.8**
Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

Find the perimeter and the area. Tell which rectangle has a greater perimeter.

1. 

A: Area = 8 square units;
Perimeter = 18 units
B: Area = 8 square units;
Perimeter = 12 units
Rectangle A has a greater perimeter.

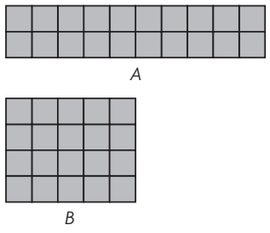
2. 

A: Area = 12 square units;
Perimeter = 14 units
B: Area = 12 square units;
Perimeter = 16 units
Rectangle B has a greater perimeter.

Problem Solving Real World

Use the tile designs for 3–4.

Beth's Tile Designs



3. Compare the areas of Design A and Design B.
The areas are the same, 20 square units.

4. Compare the perimeters. Which design has the greater perimeter?
Design A

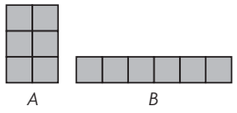
5. WRITE Math Draw two rectangles with different perimeters but the same area.
Check students' work.

Common Core PROFESSIONAL DEVELOPMENT Math Talk in Action

Teacher:	Look at the rectangles in Exercise 2. How did you find the perimeters of each rectangle?
Sarah:	I counted the units around each shape.
Teacher:	How did you find the areas?
Ray:	I counted the unit squares inside each rectangle.
Marco:	I multiplied the length by the width.
Teacher:	That's great. You can use either way to find the area of these rectangles. Let's look at the length and width of each rectangle. What are the length and width of Rectangle *A*?
Sarah:	The length is 3 units and the width is 4 units.
Teacher:	How about Rectangle *B*?
Sarah:	The length is 2 units and the width is 6 units.
Teacher:	Which rectangle has the greater perimeter?
Ray:	Rectangle *B*.
Teacher:	Can anyone think of a rectangle with an area of 12 square units that has a greater perimeter than Rectangle *B*?
Marco:	A rectangle that has a length of 1 unit and a width of 12 units would have a perimeter greater than Rectangle *B*.
Teacher:	That's right, Marco. Great job. How did you know?
Marco:	If rectangles have the same area, the rectangle with two side lengths of 1 unit will have the greatest perimeter.
Teacher:	That's a great generalization.

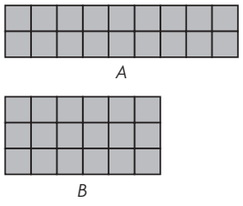
Lesson Check (3.MD.D.8)

1. Jake drew two rectangles. Which rectangle has the greater perimeter?



Rectangle *B*

2. Alyssa drew two rectangles. Which rectangle has the greater perimeter?



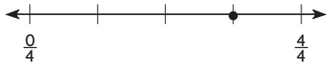
Rectangle *A*

Spiral Review (3.OA.D.8, 3.NF.A.2a, 3.NF.A.2b, 3.NF.A.3b)

3. Marsha was asked to find the value of $8 - 3 \times 2$. She wrote a wrong answer. What is the correct answer?

2

4. What fraction names the point on the number line?



$\frac{3}{4}$

5. Kyle drew three line segments with these lengths: $\frac{2}{4}$ inch, $\frac{2}{3}$ inch, and $\frac{2}{6}$ inch. List the fractions in order from least to greatest.

$\frac{2}{6}, \frac{2}{4}, \frac{2}{3}$

6. On Monday, $\frac{3}{8}$ inch of snow fell. On Tuesday, $\frac{5}{8}$ inch of snow fell. Write a statement that correctly compares the snow amounts.

$\frac{3}{8} < \frac{5}{8}$ or $\frac{5}{8} > \frac{3}{8}$

Continue concepts and skills practice with Lesson Check. Use Spiral Review to engage students in previously taught concepts and to promote content retention. Common Core standards are correlated to each section.

Monitoring Common Core Success

Maintaining Focus on the Major Work

In Grade 3, the major work includes understanding concepts of area and relating area to multiplication and addition (3.MD.C). In Lesson 11.7, students use models to explore how changes in length and width affect area. In Lesson 11.8, they use the fact that area is additive in order to find the areas of combined rectangles. Finally, in Lessons 11.9 and 11.10, students examine how changes in perimeter and area are related.

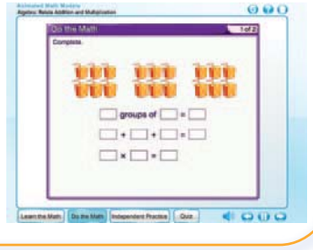
Connecting Content Across Domains and Clusters

In Lessons 11.7 and 11.8, students focus on understanding area by exploring how changes in dimensions affect area and by recognizing area as additive (3.MD.C). This work connects to their work using multiplication to represent problems (3.OA.A) as they use multiplication to find the areas of rectangles. In Lesson 11.8, students also use their skills with the four operations (3.OA.C), deciding how to use multiplication and addition to find the area of combined rectangles. Lessons 11.9 and 11.10 focus on understanding how area and perimeter are related (3.MD.C). Students continue to use their skills in representing problems (3.OA.A) and using multiplication and addition to solve problems (3.OA.C).

Building Fluency

In Grade 3, Standard 3.OA.C.7 requires students to multiply fluently within 100. By using multiplication to solve various area problems, students build an even greater fluency in multiplication. By continuing to apply multiplication to other areas of mathematics, such as geometry, students improve their abilities at multiplying whole numbers and recognizing situations in which multiplication may be used to solve problems.

Build fluency with *Animated Math Models*' use of pictorial representation of concepts and skills. Use *Animated Math Models*: Skill 10—Algebra: Relate Addition and Multiplication to strengthen students' mastery of multiplication.



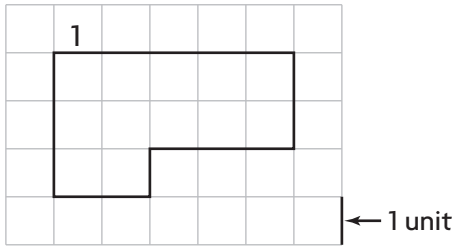
Name _____

Model Perimeter

Perimeter is the distance around a figure.

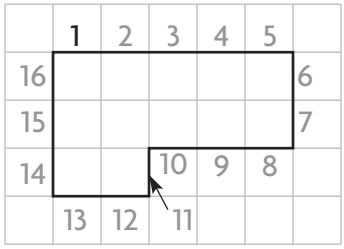
Find the perimeter of the figure.

Step 1 Choose a unit to begin counting and label it 1.



Step 2 Count each unit around the figure to find the perimeter.

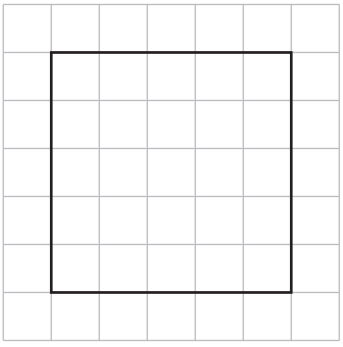
16 units



So, the perimeter of the figure is **16** units.

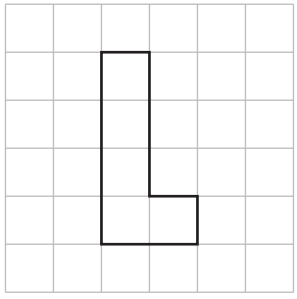
Find the perimeter of the figure. Each unit is 1 centimeter.

1.



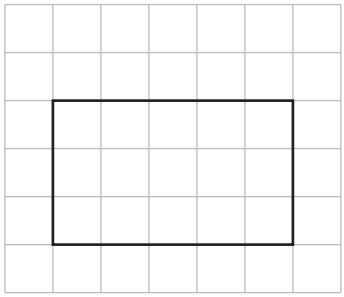
_____ centimeters

2.



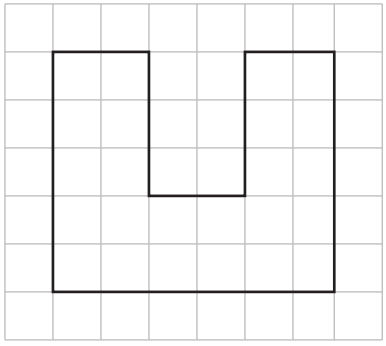
_____ centimeters

3.



_____ centimeters

4.



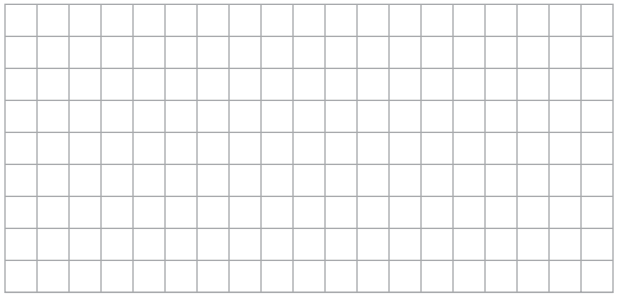
_____ centimeters

Name _____

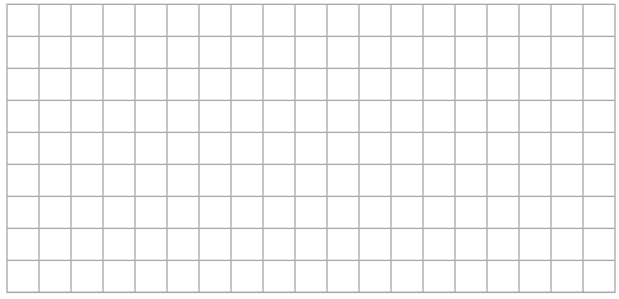
Draw Your Perimeter

Use the grid to draw two different figures that have the given perimeter.

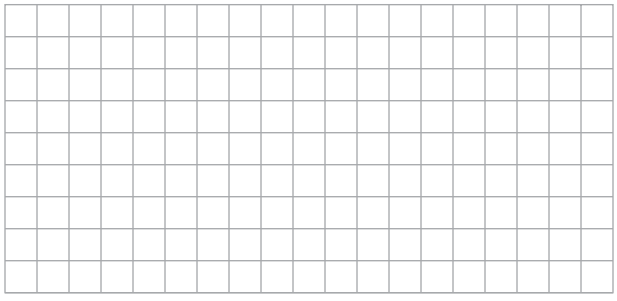
1. 16 units



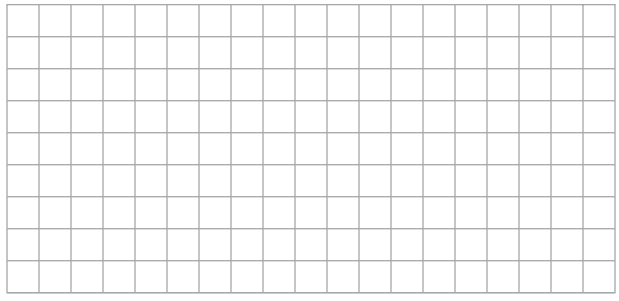
2. 24 units



3. 28 units



4. 30 units



5. Write Math Eduardo drew a figure that had a perimeter of 20 units. The length of each side was 5 units. What figure could Eduardo have drawn? **Explain**.

_____

_____

_____

Name _____

Find Perimeter

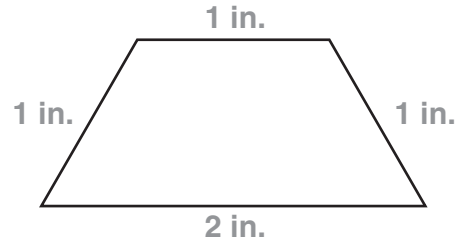
Kelsey wants to know the perimeter of the figure below. She can use an inch ruler to find the perimeter.

Step 1 Choose one side of the figure to measure. Place the zero mark of the ruler on the end of the side. Measure to the nearest inch. Write the length.

Step 2 Use the ruler to measure the other three sides. Write the lengths.

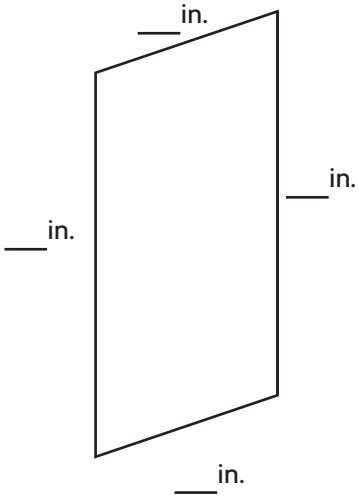
Step 3 Add the lengths of all the sides.
$1 + 1 + 2 + 1 = 5$

So, the perimeter of the figure is 5 inches.



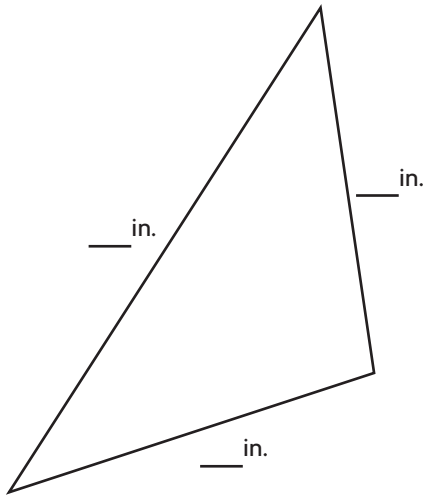
Use an inch ruler to find the perimeter.

1.



_____ inches

2.



_____ inches

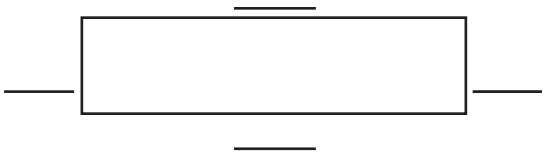
Name _____

Find My Perimeter

Measure each side to the nearest $\frac{1}{2}$ inch.

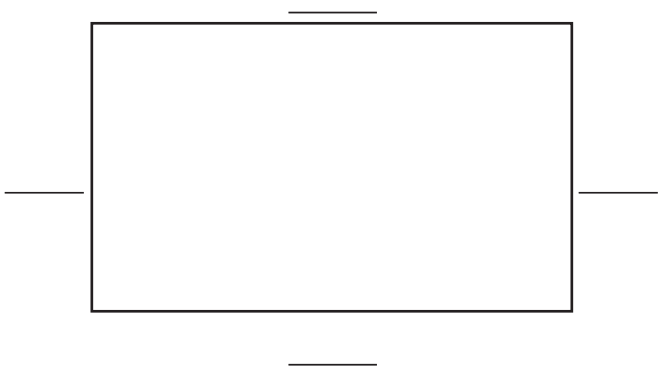
Then find the perimeter of each figure.
(Hint: $\frac{1}{2} + \frac{1}{2} = 1$).

1.



_____ in. + _____ in. + _____ in. + _____ in. = _____ inches

2.



_____ in. + _____ in. + _____ in. + _____ in. = _____ inches

3. Write Math **Explain** how you added the measurements in Exercise 2 to find the perimeter.

_____

_____

_____

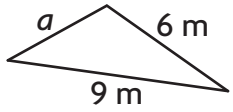
_____

Name _____

Algebra • Find Unknown Side Lengths

An unknown side length is a side that does not have its length labeled with a number. Instead the side is labeled with a symbol or letter, such as *a*.

The perimeter of the figure is 20 meters. Find the length of side *a*.



Think: There is only one unknown side length.

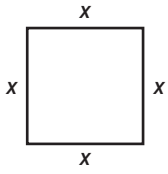
Step 1 Add the *known* side lengths.
$6 + 9 = 15$

Step 2 Subtract the sum of the known side lengths from the perimeter.
$20 - 15 = 5$

Step 3 Add to check your work.
$6 + 9 + 5 = 20$ ✓

So, the unknown side length, *a*, is 5 meters.

The perimeter of the square is 12 feet. What is the length of each side of the square?



Think: A square has four sides of equal length.

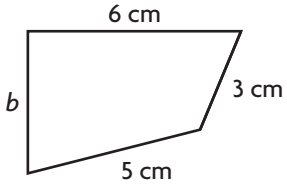
Step 1 Divide the perimeter by the number of sides.
$12 \div 4 = 3$

Step 2 Multiply to check your work.
$4 \times 3 = 12$ ✓

So, the length of each side, *x*, is 3 feet.

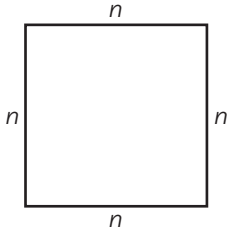
Find the unknown side lengths.

1. Perimeter = 18 centimeters



$b =$ _____ centimeters

2. Perimeter = 20 yards



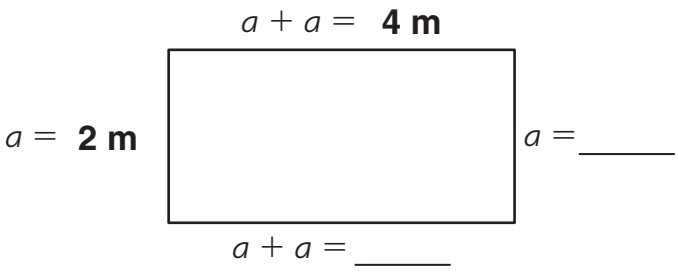
$n =$ _____ yards

Name _____

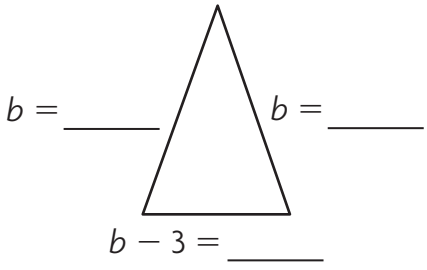
Perimeter Reasoning

Find and label the length of each unknown side.

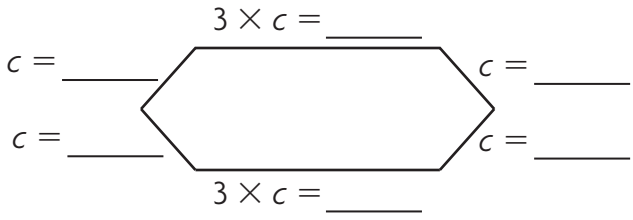
1. Perimeter = 12 meters



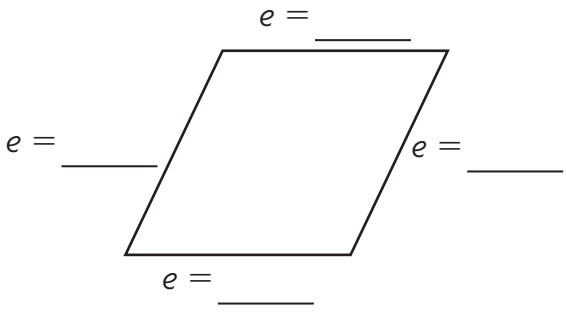
2. Perimeter = 24 feet



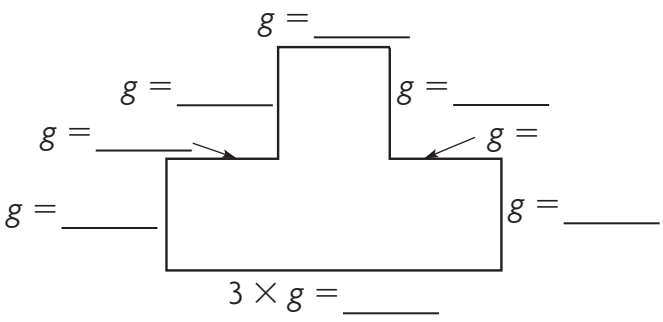
3. Perimeter = 30 meters



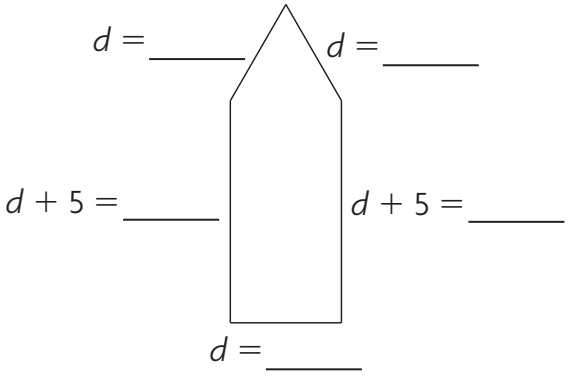
4. Perimeter = 48 yards



5. Perimeter = 10 feet



6. Perimeter = 35 yards

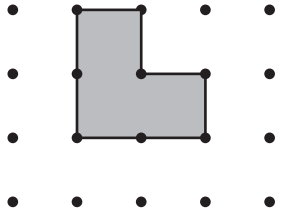


Name _____

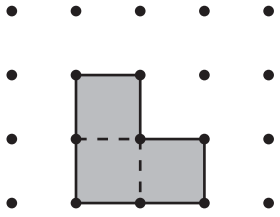
Understand Area

A unit square is a square with a side length of 1 unit. Area is the measure of the number of unit squares needed to cover a surface. A square unit is used to measure area.

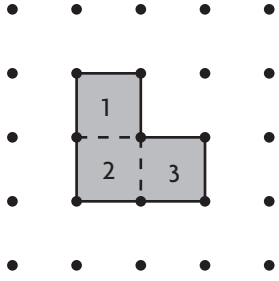
What is the area of the figure?



Step 1 Draw lines to show each unit square in the figure.



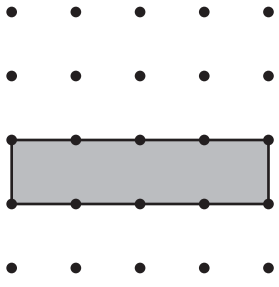
Step 2 Count the number of unit squares to find the area.



The area of the figure is **3** square units.

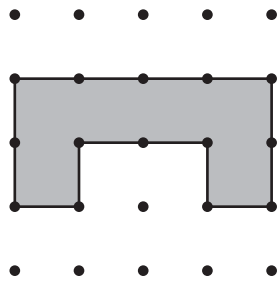
Count to find the area of the figure.

1.



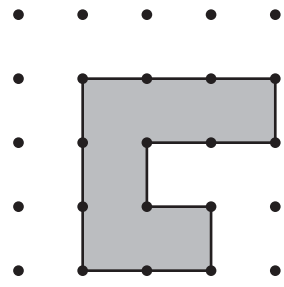
Area = ___ square units

2.



Area = ___ square units

3.



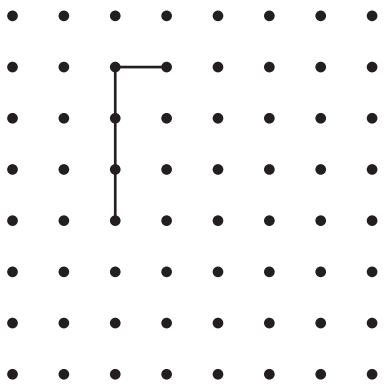
Area = ___ square units

Name _____

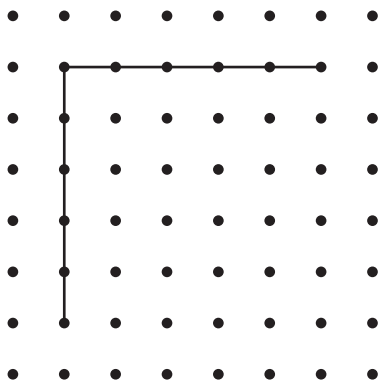
Connect the Dots to Show the Area

On each piece of dot paper below, a figure has been started. Use the area to complete the figure by connecting the dots. Connect the dots to complete the figure with the given area.

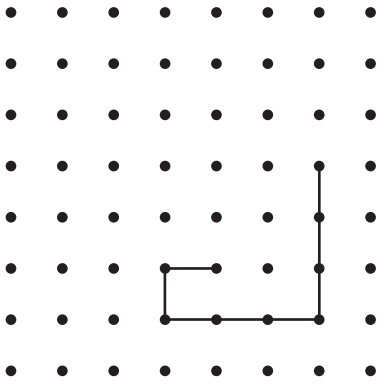
1. Area = 11 square units



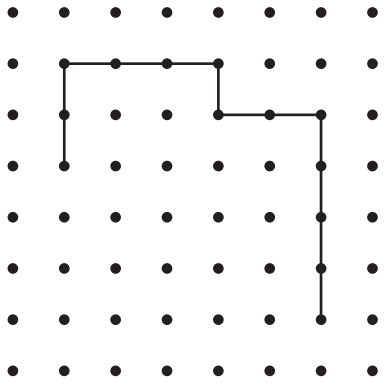
2. Area = 15 square units



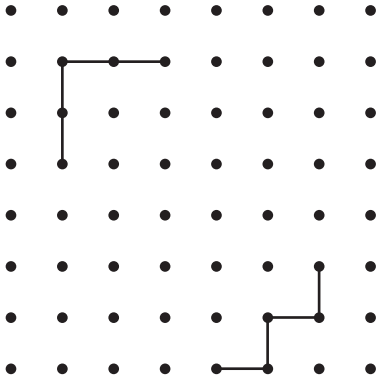
3. Area = 16 square units



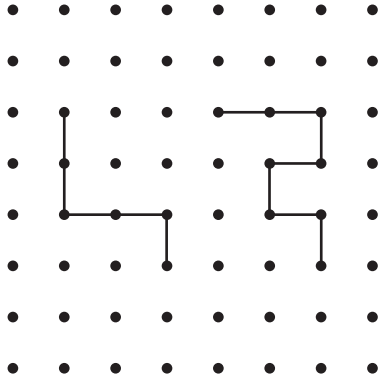
4. Area = 11 square units



5. Area = 13 square units



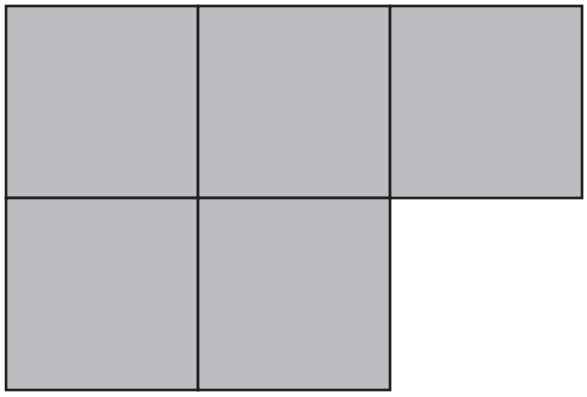
6. Area = 11 square units



Name _____

Measure Area

Find the area of the figure. Each unit square is 1 square inch.



Think: How many unit squares are needed to cover this flat surface?

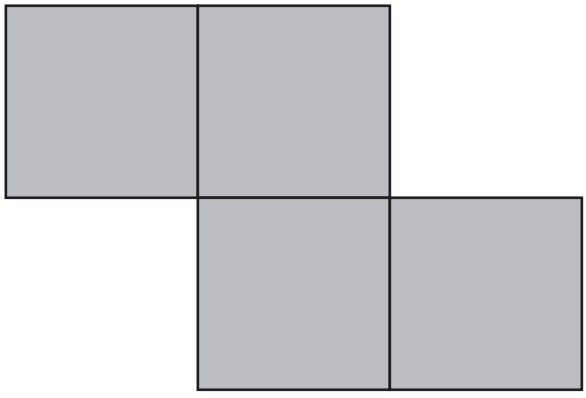
Step 1 Use 1-inch square tiles. Cover the surface of the figure with the tiles. Make sure there are no gaps (space between the tiles). Do not overlap the tiles.

Step 2 Count the tiles you used.
5 tiles are needed to cover the figure.

So, the area of the figure is 5 square inches.

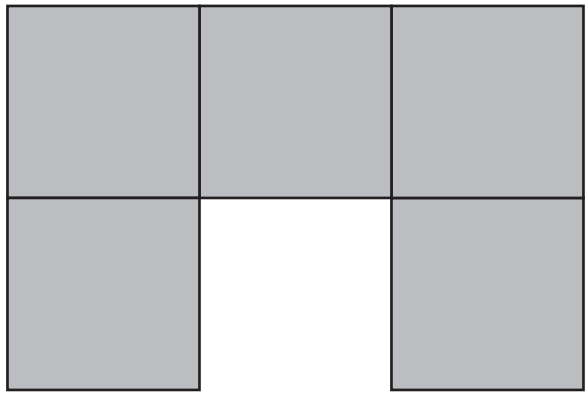
Count to find the area of the figure. Each square is 1 square inch.

1.



Area = _____ square inches

2.



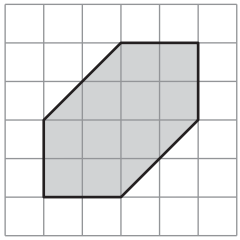
Area = _____ square inches

Name _____

Find Area

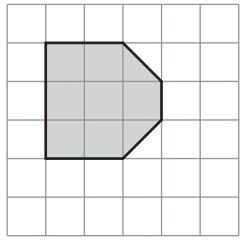
Find the area of each figure.
1 unit square is 1 square centimeter. (Hint: two half-unit squares make one unit square.)

1.



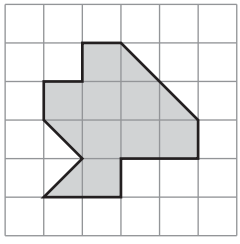
Area = _____ square centimeters

2.



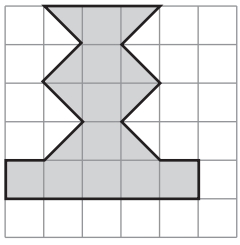
Area = _____ square centimeters

3.



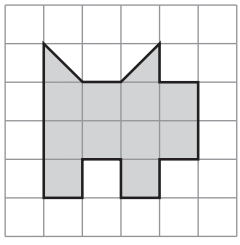
Area = _____ square centimeters

4.



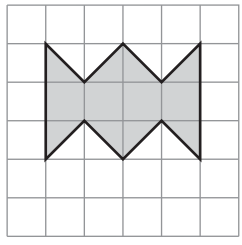
Area = _____ square centimeters

5.



Area = _____ square centimeters

6.



Area = _____ square centimeters

7. Write Math How did you find the area in Exercise 6?

_____

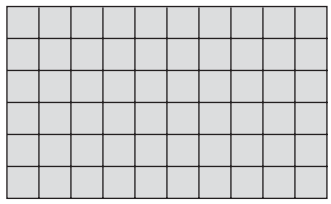
_____

_____

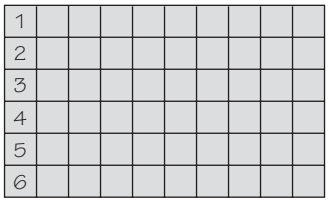
Name _____

Use Area Models

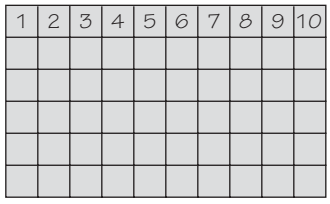
Use multiplication to find the area of the figure. Each unit square is 1 square meter.



Step 1 Count the number of rows. There are **6** rows.



Step 2 Count the number of unit squares in each row. There are **10** unit squares.



Step 3 Multiply the number of rows by the number in each row to find the area.

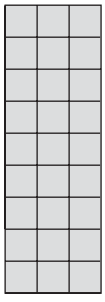
number of rows $\times$ number in each row $=$ area

$6 \times 10 = 60$

So, the area of the figure is **60** square meters.

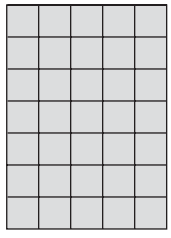
Find the area of the figure. Each unit square is 1 square meter.

1.



_____

2.



_____

Name _____

Area Riddles

Use the clues to solve the riddle.
You may use grid paper to draw the figure.

1. My sides are all the same length. My area is 9 square meters. What is the length of one of my sides?

_____

2. I am a square. One of my sides is 9 feet long. What is my area?

_____

3. I am a rectangle. One of my sides is 8 centimeters long. Another side is 6 centimeters long. What is my area?

_____

4. I am a rectangle. Two of my sides are each 7 inches long. My area is 28 square inches. What is the length of each of my other two sides?

_____

5. I am a rectangle. Each of my shorter sides measure 5 meters. My area is 45 square meters. What is the length of each of my longer sides?

_____

6. I am a square. My area is 64 square feet. What is the length of one of my sides?

_____

7. Write Math How did you find the answer in Exercise 4?

_____

_____

_____

_____

8. **Stretch Your Thinking** Suppose you know that a figure is a rectangle and its area is 8 square meters. What are all the different whole-number side lengths the rectangle could have?

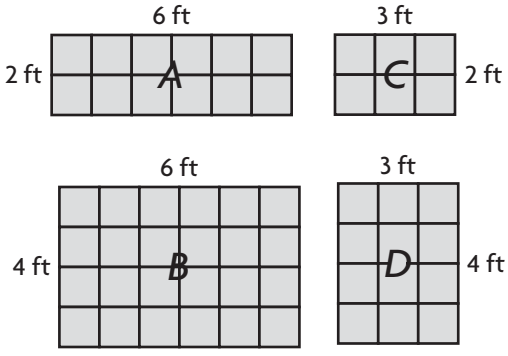
_____

_____

Name _____

Problem Solving • Area of Rectangles

Mrs. Wilson wants to plant a garden, so she drew plans for some sample gardens. She wants to know how the areas of the gardens are related. How will the areas of Gardens A and B change? How will the areas of Gardens C and D change?



Use the graphic organizer to help you solve the problem.

Read the Problem

What do I need to find?	What information do I need to use?	How will I use the information?
I need to know how the areas will change from *A* to *B* and from C to D.	I need to use the length and width of each garden to find its area.	I will record the areas in a table. Then I will look for a pattern to see how the areas will change.

Solve the Problem

	Length	Width	Area		Length	Width	Area
Garden A	2 ft	6 ft	12 sq ft	Garden C	2 ft	3 ft	6 sq ft
Garden B	4 ft	6 ft	24 sq ft	Garden D	4 ft	3 ft	12 sq ft

From the table, I see that the lengths will be doubled and the widths will be the same.
The areas in square feet will change from 12 to 24 and from 6 to 12.
So, the area will be doubled.

Solve.

1. Mrs. Rios made a flower garden that is 8 feet long and 2 feet wide. She made a vegetable garden that is 4 feet long and 2 feet wide. How do the areas change?

_____

_____

Name _____

Find the Missing Information

Use the given information to find the missing information in the problem. Write the missing information. Then solve the problem.

1. Kelly builds a dog run that is 3 feet wide and has an area of 12 square feet. The length of the dog run is _____ feet. Kelly's brother builds another dog run that is also 3 feet wide, but its area is double that of Kelly's dog run. What is the length of Kelly's brother's dog run?

   _____ feet

2. Mrs. Thompson builds a vegetable garden that is 10 meters long and has an area of 40 square meters.

   The width of the vegetable garden is _____ meters. She also builds an herb garden that has the same width, but its area is half that of her vegetable garden. What is the length of Mrs. Thompson's herb garden?

   _____ meters

3. Duane builds a square snow fort that is 4 feet long on each side. The area of his snow fort is _____ square feet. He then builds a second snow fort that has an area that is double the area of his first snow fort. What could the length and width of Duane's second snow fort be?

   _____

4. Write Math How did you find the length of Kelly's dog run in Exercise 1?

   _____

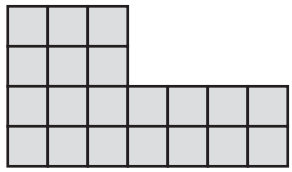
   _____

   _____

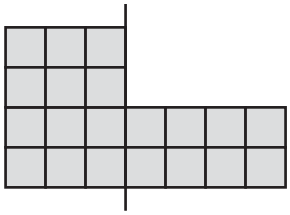
Name _____

Area of Combined Rectangles

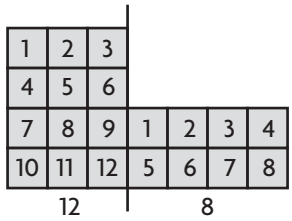
You can break apart a figure into rectangles to find the total area of the figure.



Step 1 Draw a line to break apart the figure into two rectangles.



Step 2 Count the number of unit squares in each rectangle.



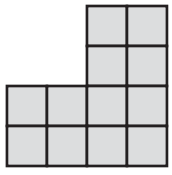
Step 3 Add the number of unit squares in each rectangle to find the total area.

$12 + 8 = 20$ unit squares

So, the area of the figure is **20** square units.

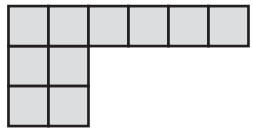
Draw a line to break apart the figure into rectangles. Find the area of the figure.

1.



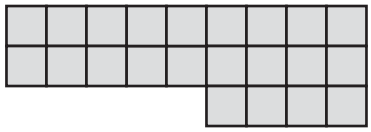
_____

2.



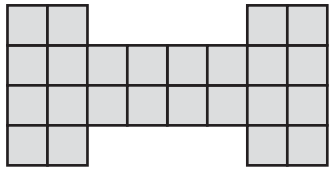
_____

3.



_____

4.



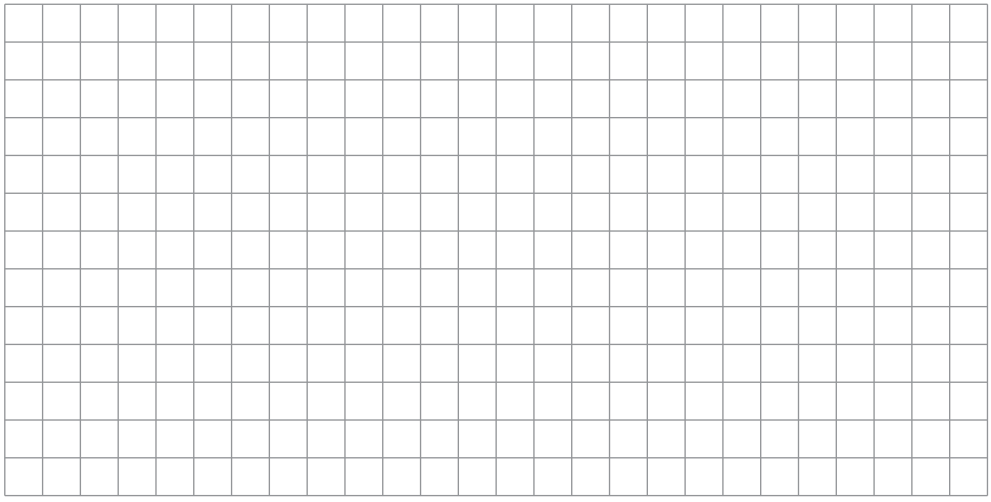
_____

Name _____

Area of a Dream Bedroom

Draw a diagram of your dream bedroom. Include in the drawing a sleeping area, a closet, a bathroom, and a study area. Label each area.

One square unit is equal to 1 square foot.



Use your drawing to solve the problems.

1. What is the total area of the sleeping area and the study area?

_____

2. What is the total area of the closet and the bathroom?

_____

3. What is the total area of the bedroom, except for the bathroom?

_____

4. What is the total area of the bedroom you drew on the grid?

_____

5. Write Math How did you find the answer to Exercise 4?

_____

_____

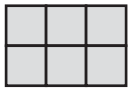
_____

Same Perimeter, Different Areas

You can use perimeter and area to compare rectangles.

Compare the perimeters of Rectangle *A* and Rectangle *B*.

A



B

Find the number of units around each rectangle.

Rectangle *A*: $3 + 2 + 3 + 2 = 10$ units

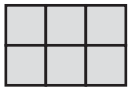
Rectangle *B*: $4 + 1 + 4 + 1 = 10$ units

Compare: 10 units $=$ 10 units

So, Rectangle *A* has the same perimeter as Rectangle *B*.

Compare the areas of Rectangle *A* and Rectangle *B*.

A



B

Find the number of unit squares needed to cover each rectangle.

Rectangle *A*: 2 rows of 3 $= 2 \times 3$, or 6 square units

Rectangle *B*: 1 row of 4 $= 1 \times 4$, or 4 square units

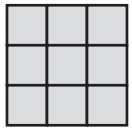
Compare: 6 square units $>$ 4 square units

So, Rectangle *A* has a greater area than Rectangle *B*.

Find the perimeter and the area. Tell which rectangle has a greater area.

1. *A*

B



A: Perimeter $=$ _____;

Area $=$ _____

B: Perimeter $=$ _____;

Area $=$ _____

Rectangle ____ has a greater area.

2. *A*

B

A: Perimeter $=$ _____;

Area $=$ _____

B: Perimeter $=$ _____;

Area $=$ _____

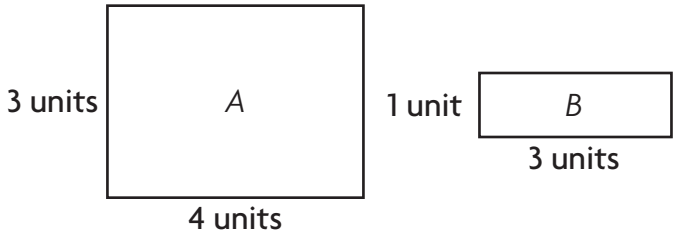
Rectangle ____ has a greater area.

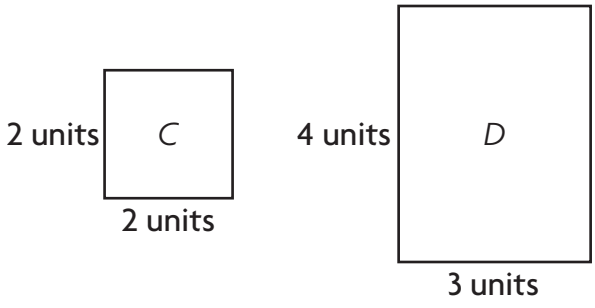
Name _____

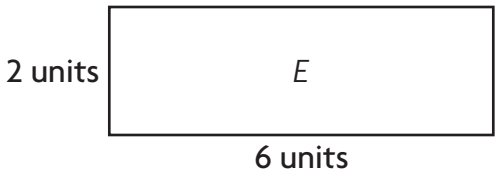
Area and Perimeter Match-Up

Read the description. Write the letter of any figure that matches the description. More than one figure may match a description.

Description	Figures
1. a rectangle with a perimeter of 16 units _____	
2. a four-sided figure with an area of 4 square units _____	
3. a four-sided figure with an area of 12 square units _____	
4. a four-sided figure with a perimeter of 8 units _____	







5. Stretch Your Thinking A four-sided figure is made from 24 unit squares. Using whole numbers, what is the smallest possible perimeter? Using whole numbers, what are the side lengths of the rectangle with the smallest perimeter?

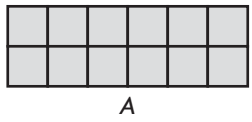
_____

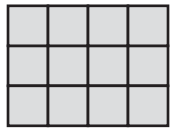
_____

Name _____

Same Area, Different Perimeters

Find the perimeter and area of Rectangles *A* and *B*. Tell which rectangle has a greater perimeter.





Step 1 Find the area of each rectangle. You can multiply the number of unit squares in each row by the number of rows.

Rectangle *A*: $2 \times 6 = 12$ square units

Rectangle *B*: $3 \times 4 = 12$ square units

Step 2 Find the perimeter of each rectangle. You can add the sides.

Rectangle *A*: $6 + 2 + 6 + 2 = 16$ units

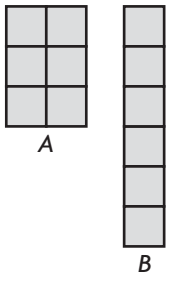
Rectangle *B*: $4 + 3 + 4 + 3 = 14$ units

Step 3 Compare the perimeters. 16 units > 14 units.

So, Rectangle ***A*** has a greater perimeter.

Find the perimeter and the area. Tell which rectangle has a greater perimeter.

1.



A: Area = _____;

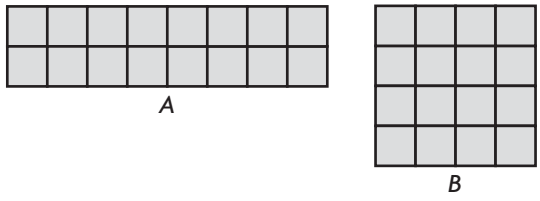
Perimeter = _____

B: Area = _____;

Perimeter = _____

Rectangle ____ has a greater perimeter.

2.



A: Area = _____,

Perimeter = _____

B: Area = _____,

Perimeter = _____

Rectangle ____ has a greater perimeter.

Name _____

Area and Perimeter Comparisons

Find the length and width of 4 different rectangles such that each rectangle has an area of 24 square units. Write the length and width of each rectangle in the table. Then find the perimeter of each rectangle and record it in the table.

Rectangles with an area of 24 square units			
	Length	**Width**	**Perimeter**
Rectangle *A*			
Rectangle *B*			
Rectangle *C*			
Rectangle *D*			

Use the table to answer the question.

1. Brian wants to build the rectangle that has the least perimeter. Which rectangle should he build?

_____

2. Luke has 25 units of fencing. Which is the largest rectangle for which he can use the fencing?

_____

3. Can Li build a square with an area of 24 square units, such that the side lengths are whole units? **Explain**.

_____

_____

_____

_____

4. Ginger has 50 units of yarn. She wants to use all of the yarn as a border for one or more rectangles. Which rectangle(s) can Ginger build?

_____

_____

_____