Core Knowledge® MATHEMATICS

Area and Multiplication

Student Workbook

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Area and Multiplication

Table of Contents

Area and Multiplication

Teacher Guide

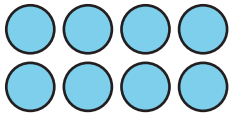
Core Knowledge Mathematics™

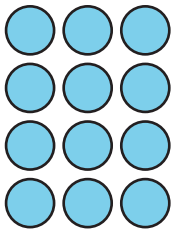
Lesson 1: What is Area?

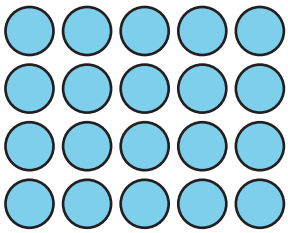
- Let's compare the size of shapes.

Warm-up: How Many Do You See: Arrays

How many do you see? How do you see them?

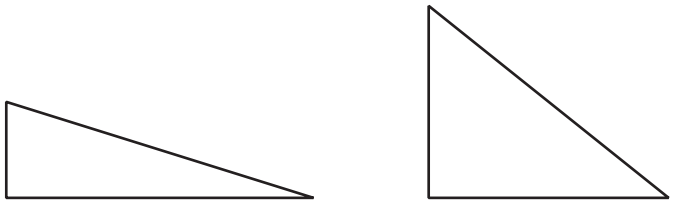






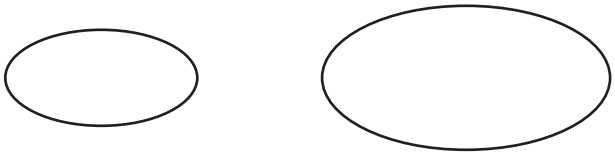
1.1: Compare Shapes

1. Here are two triangles. Which triangle is larger?



2. In each pair of shapes, which shape is larger? Be prepared to explain your reasoning.

   a.



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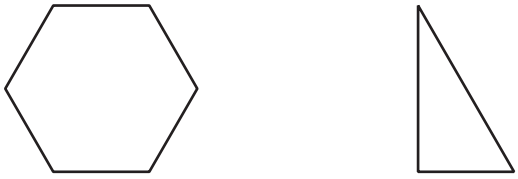
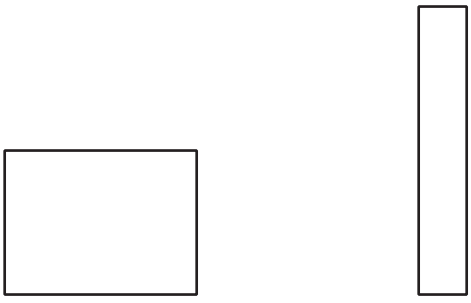


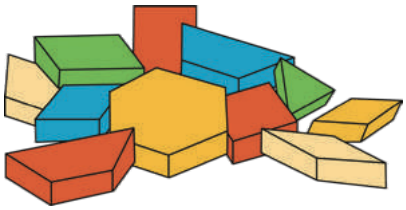
   c.



1.2: Pattern Blocks to Compare Shapes

Your teacher will give you handouts with some shapes on them.

Use pattern blocks to decide which shape covers the most space. Be ready to explain your reasoning.



Lesson 2: How Do We Measure Area?

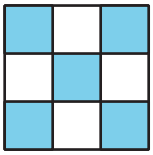
- Let's use square tiles to measure area.

Warm-up: Which One Doesn't Belong: Shapes with Squares

Which one doesn't belong?

A

B



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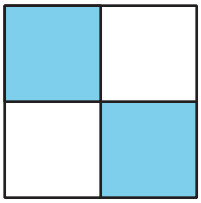

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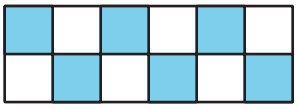
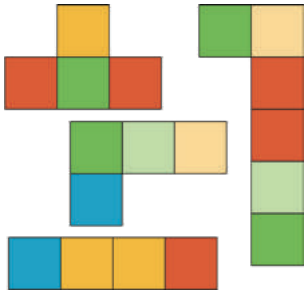


2.1: Create and Compare

1. Take a handful of square tiles.
2. Create a shape from the tiles.
3. As a group, order the shapes from smallest to largest.



2.2: Use Square Tiles to Measure Area

Your teacher will give you handouts with some figures on them.

Use square tiles to find the area of each figure. Record your answers here. Be prepared to explain your reasoning.

1. Area: _____ square units

2. Area: _____ square units

3. Area: _____ square units

4. Area: _____ square units

5. Area: _____ square units

6. Area: _____ square units

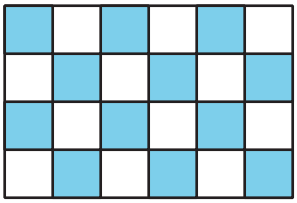
Lesson 3: Tile Rectangles

- Let’s count square tiles.

Warm-up: Which One Doesn’t Belong: Tiles

Which one doesn't belong?

A



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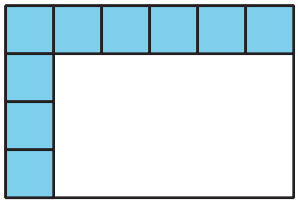

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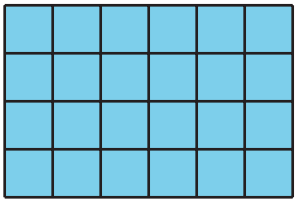

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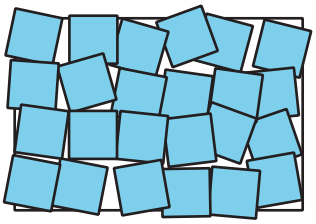
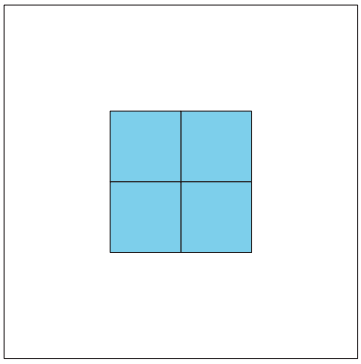


3.1: Time to Tile

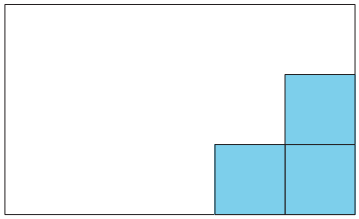
Your teacher will give you square tiles and a handout showing rectangles and squares.

1. Describe or show how to use the square tiles to measure the area of each rectangle. You can place square tiles on the handout where squares are already shown. You can also move the tiles, if needed.

   a.



   b.



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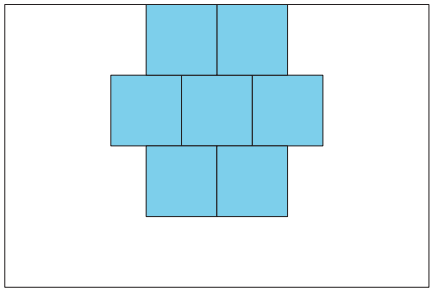
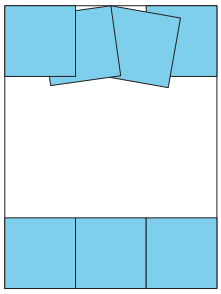


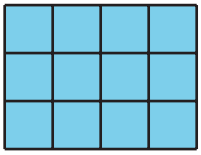
d.

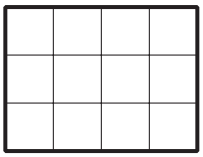


2. Describe how to use square tiles to find the area of any rectangle.

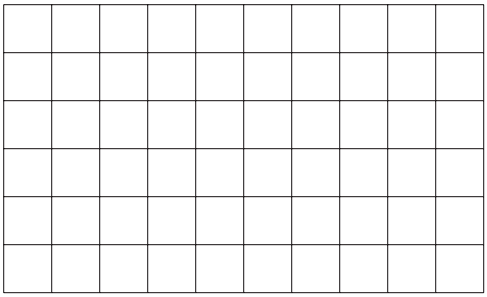
3.2: Card Sort: Rectangles

What do you notice? What do you wonder?



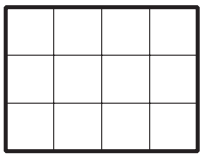


Draw a rectangle with an area of 8 square units on the grid.

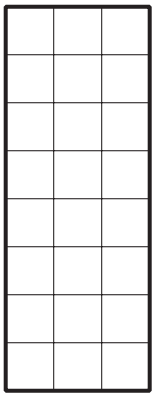


Your teacher will give you a set of cards that show rectangles. Sort the cards into categories of your choosing. Be prepared to explain your categories.

1. **A**



B



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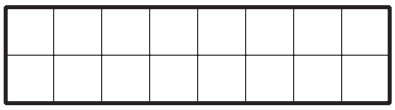

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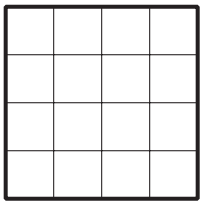
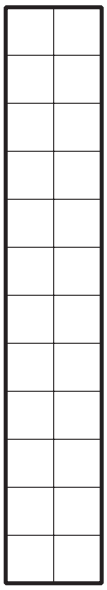
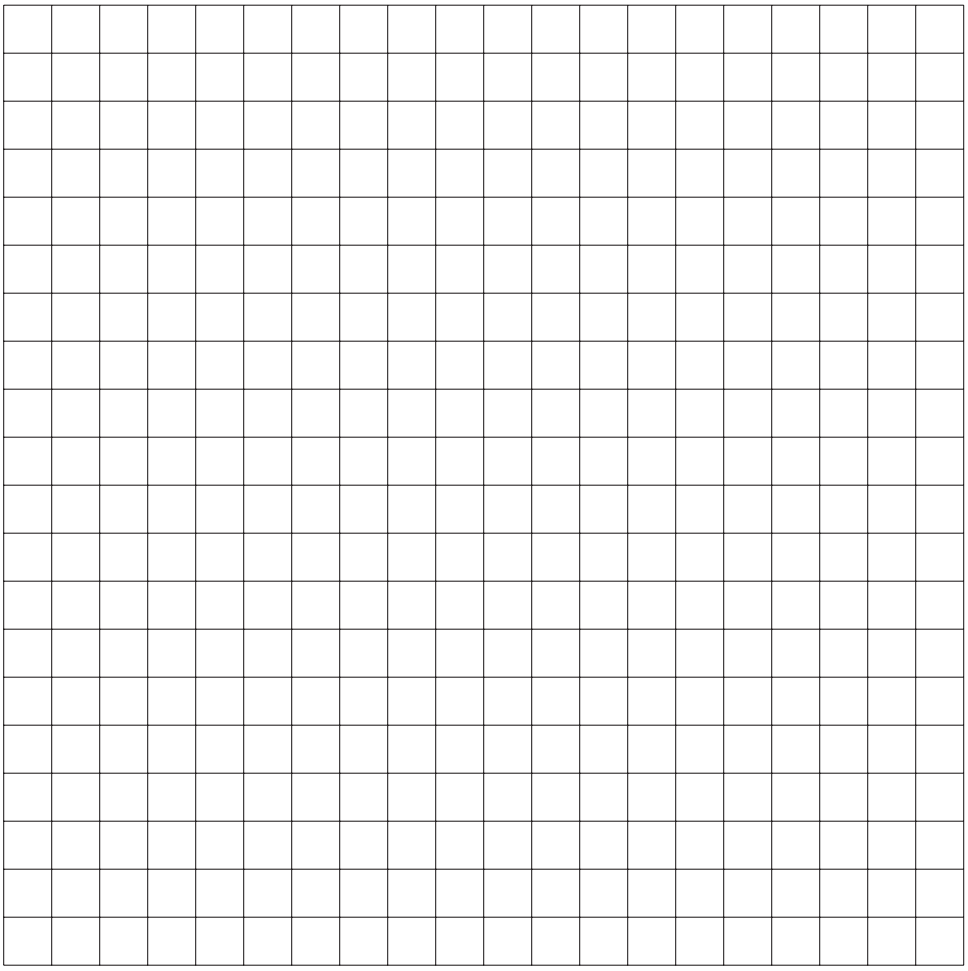


F



2. Create a rectangle that would fit in each group.



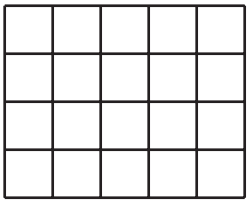
Lesson 4: Area of Rectangles

- Let's find the area of more rectangles.

Warm-up: Which One Doesn't Belong: Area and Arrays

Which one doesn't belong?

A



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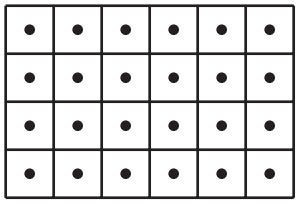
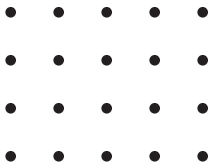


C



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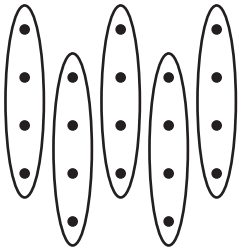


4.1: What Did I Create?

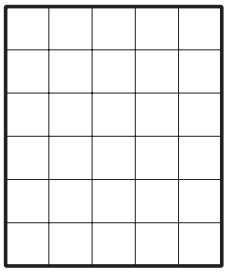
1. Can you and your partner draw the same rectangle without looking at each other's drawing?
    - Partner A: Draw a rectangle on one of the grids provided. Describe it to your partner without telling them the total number of squares.
    - Partner B: Draw the rectangle your partner describes to you.
2. Place your two rectangles next to each other. Discuss: What is the same? What is different?
3. Switch roles and repeat.

4.2: Find the Area

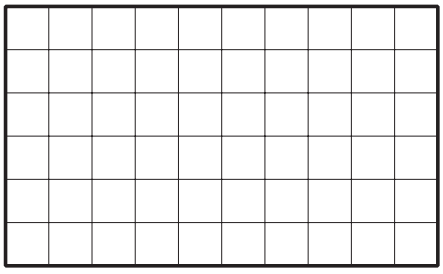
Find the area of each rectangle and include the units. Explain or show your reasoning.

1.

2.



3.



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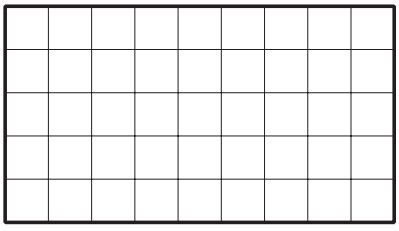
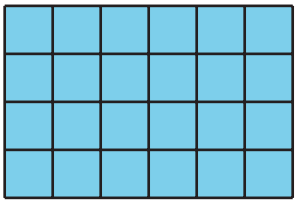
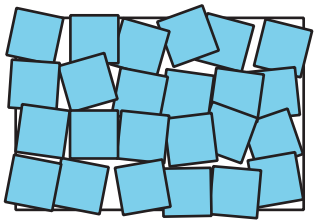


Section Summary

Section Summary
In this section, we learned that **area** is the amount of space covered by a shape.

We saw that we can count squares to measure area. When we tile a shape, we need to make sure that the squares are covering the whole shape without gaps or overlaps.





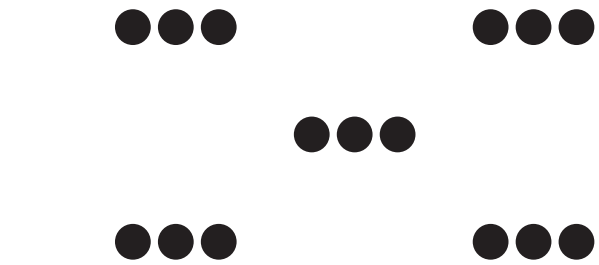
Area is measured in square units. The area of the tiled rectangle here is 24 square units.

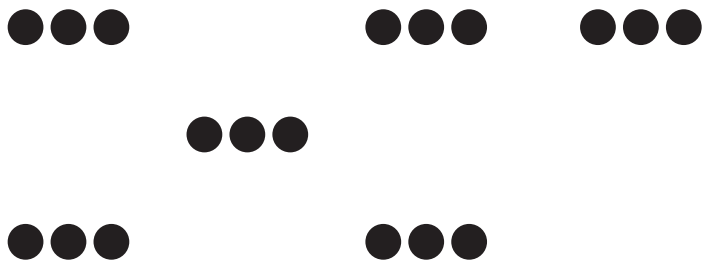
Lesson 5: Represent Products as Areas

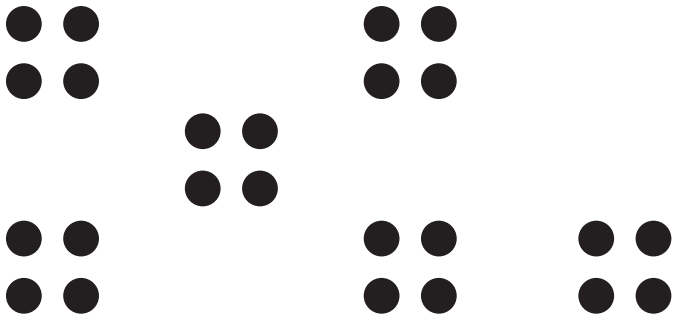
- Let's connect multiplication expressions to area.

Warm-up: How Many Do You See: One More

How many do you see? How do you see them?







5.1: Match Expressions and Areas

Your teacher has posted images of rectangles around the room. Match each expression with a rectangle that can represent it. Be prepared to explain your reasoning.

1. 9×5

2. 8×2

3. 7×10

4. 3×3

5. 2×6

6. 8×4

7. 5×7

5.2: Create from Expressions

1. The numbers in each expression represent the number of rows (or columns) in a rectangle and how many squares are in each row (or column).

   On the grid, draw each rectangle, label it with the numbers, and find its area.

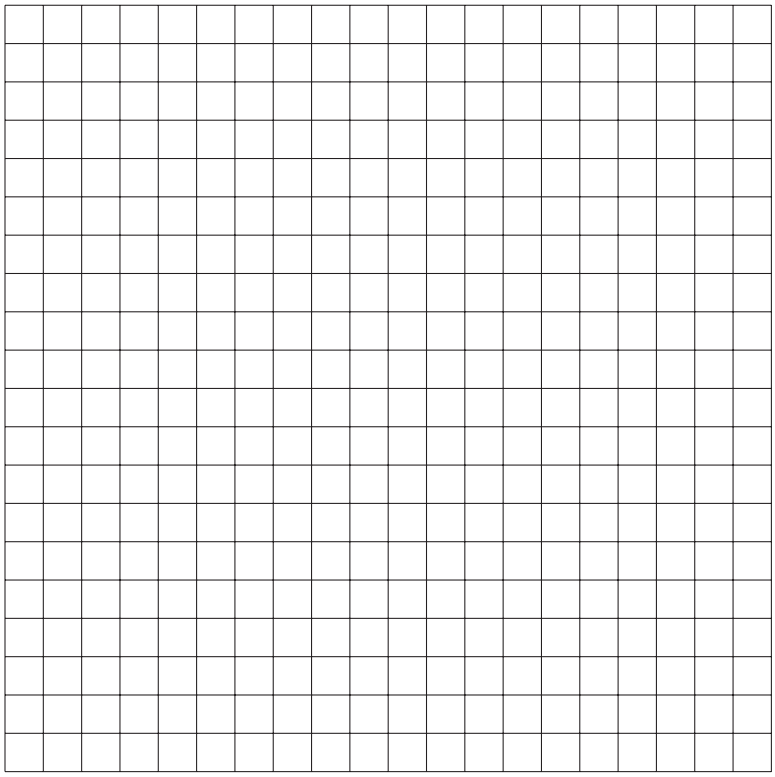
   a. 3×4

   b. 4×6

   c. 6×3

   d. 7×4

   e. 3×2



2. Explain why multiplying the numbers in each expression gives us the area of the rectangle.

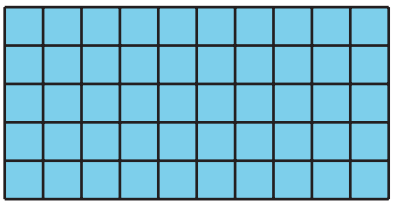
Lesson 6: Different Square Units (Part 1)

- Let's learn about different units we can use to measure area.

Warm-up: Notice and Wonder: Squares, Squares

What do you notice? What do you wonder?

A



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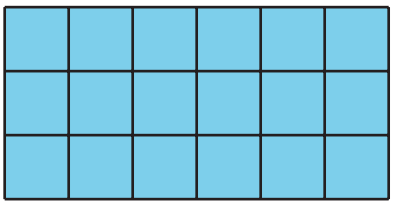

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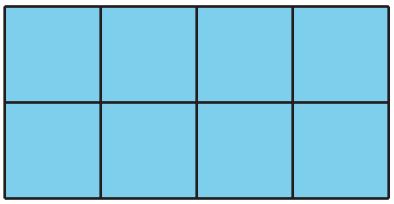

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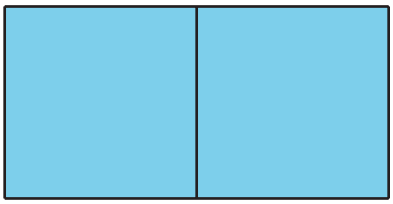


6.1: Same Rectangle, Different Units

Your teacher will give you two kinds of grid paper. Use them to create a rectangle for each expression.

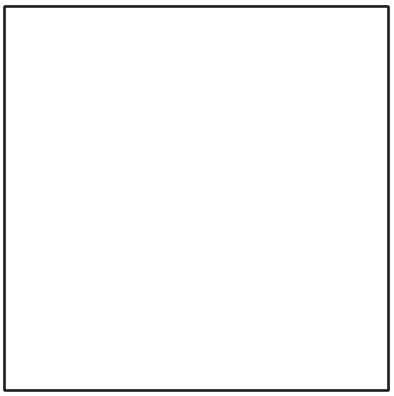
Partner 1: Use grid 1.

Partner 2: Use grid 2.

1. 2×5
2. 7×3
3. 6×8

6.2: What's the Area?

Estimate how many square centimeters and inches it will take to tile this square.



- square inches (estimate) _____
- square centimeters (estimate) _____

1. Use the inch grid and centimeter grid to find the area of the square
    - square inches _____
    - square centimeters _____
2. Write a multiplication expression that describes the rows and columns in the square and can tell us the area in each unit.
    - square inches _____
    - square centimeters _____

Lesson 7: Different Square Units (Part 2)

- Let's learn about larger square units.

Warm-up: Notice and Wonder: A Bigger Square

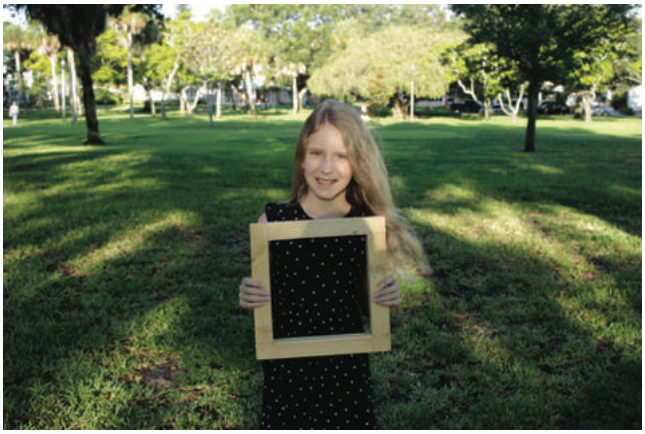
What do you notice? What do you wonder?

7.1: Square Feet and Square Meters

1. This is a square meter.

What kinds of areas would make sense to measure with square meters? Be ready to explain your reasoning.

2. This is a square foot.



What kinds of areas would make sense to measure with square feet? Be ready to explain your reasoning.

7.2: Which Square Unit?

1. For each area tell if you would use square centimeters, square inches, square feet, or square meters to measure it and why you chose that unit.

   a. The area of a baseball field

   b. The area of a cover of a book you're reading

   c. The area of our classroom

   d. The area of a piece of paper

   e. The area of the top of a table

   f. The area of the screen on a phone

2. Choose the area that best matches each item. Be ready to explain your reasoning.

- ○ About 9 square inches
- ○ About 3 square feet
- ○ About 55 square centimeters
- ○ About 55 square meters

a. A playing card

b. The floor of a classroom

c. A sticky note

d. The top of a student desk

7.3: Area Scavenger Hunt

Find some object or space that you would measure with square inches, square centimeters, square feet, and square yards.

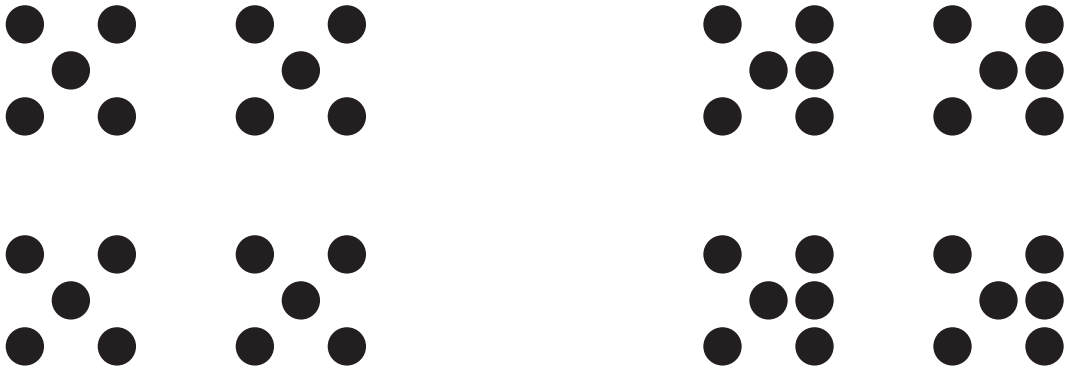
area	square unit and reasoning
Example: a piece of paper	*Example:* "I think it can fit about 8 inches across and 10 inches down, so square inches work well. It can be measured in square centimeters, too, but would just take a lot more squares. Square feet and square meters would be too large."

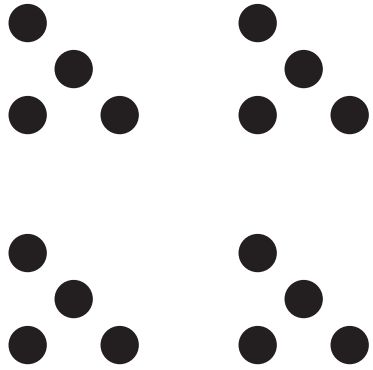
Lesson 8: Area of Rectangles Without a Grid

- Let's solve area problems without a grid.

Warm-up: How Many Do You See: One More, One Less

How many do you see? How do you see them?



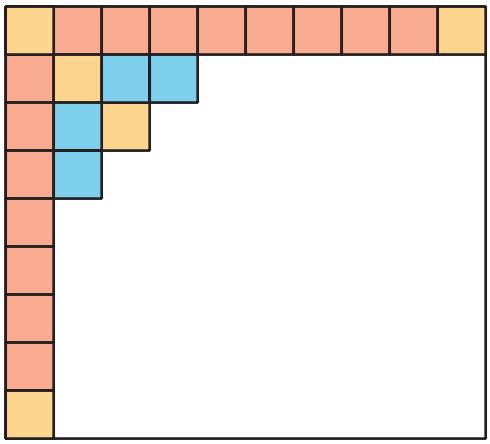


8.1: Partially Tiled

What do you notice? What do you wonder?

After learning about azulejos in Portugal, Elena is making her own tile artwork. This rectangle shows the project Elena is tiling. Each tile has a side length of 1 inch.

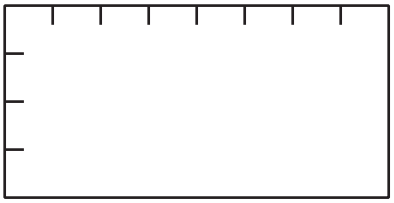
How many tiles are needed to tile the whole rectangle? Explain or show your reasoning.



8.2: No More Squares

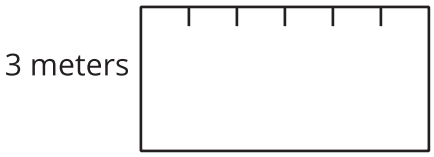
What is the area of the rectangle in square meters?

1. The tick marks on the sides of the rectangle are 1 meter apart.



What is the area of this rectangle in square meters?

2. The top side of this rectangle is marked off in meter lengths. The left side is labeled with the length in meters.



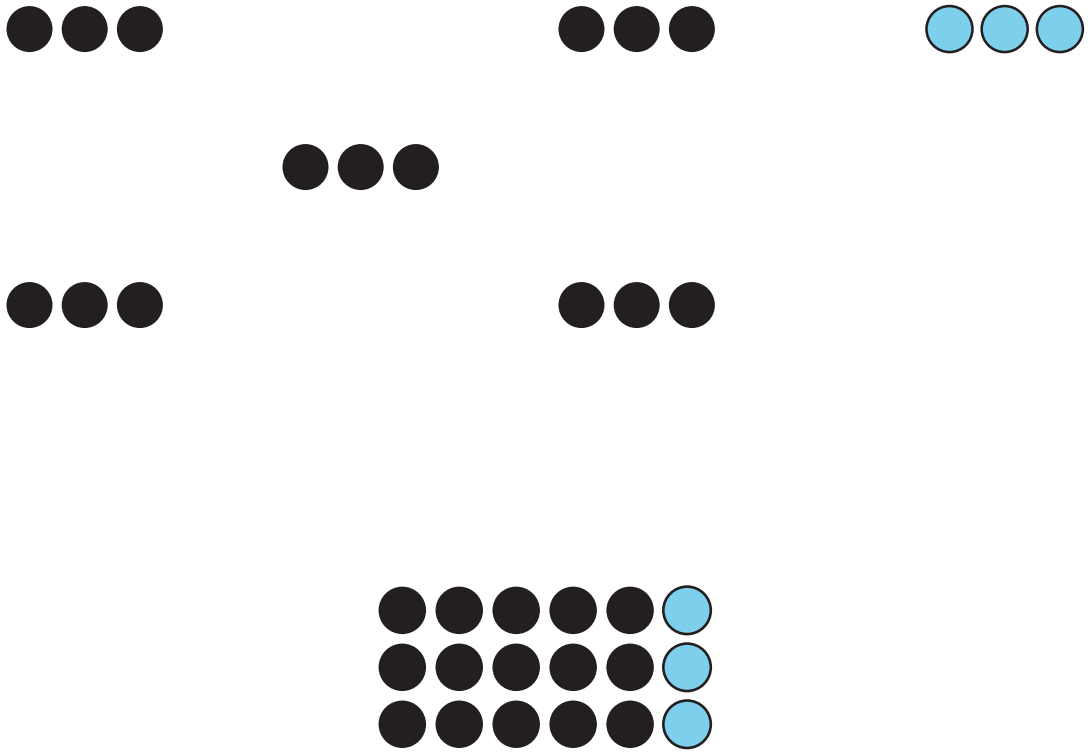
What is the area of this rectangle in square meters?

Lesson 9: Measure to Find the Area

- Let's measure the sides of rectangles and find the area.

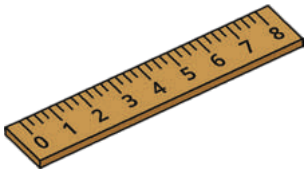
Warm-up: Notice and Wonder: Groups and Arrays

What do you notice? What do you wonder?

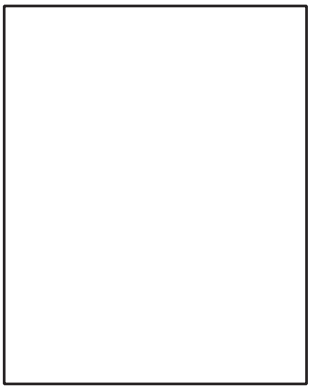


9.1: Measure to Find Area

Use a ruler to measure the rectangles. Then, calculate the area of the rectangles in square centimeters.

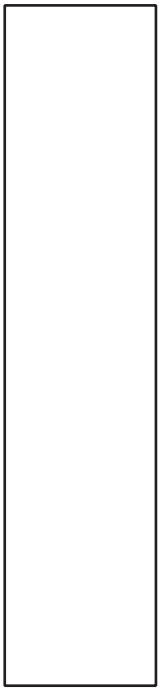


A



B

C



9.2: Create a Rectangle

Your teacher will give you some tape. Use it to create a rectangle with your assigned area.

- Area 1: 4 square feet
- Area 2: 6 square feet
- Area 3: 9 square feet
- Area 4: 10 square feet
- Area 5: 12 square feet
- Area 6: 16 square feet

Lesson 10: Solve Area Problems

- Let's solve area problems.

Warm-up: Number Talk: One More Group

Find the value of each expression mentally.

- 5×2

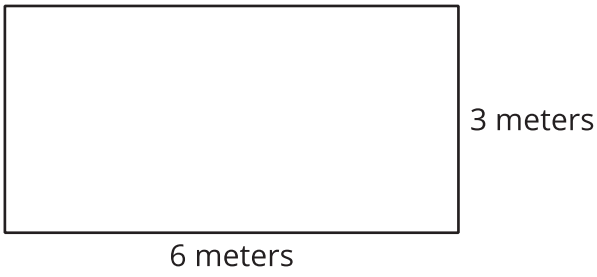
- 6×2

- 5×6

- 6×6

10.1: Paint a Wall

Noah is painting a wall in a community garden. The wall is shaped like a rectangle. A diagram of the wall is shown here.



Paint is sold in 3 different sizes:

- A small container will cover 3 square meters.
- A medium container will cover 10 square meters.
- A large container will cover 40 square meters.

What should Noah buy? Explain your reasoning.

10.2: Create a Garden

1. Elena is planning how to use her rectangular space in the community garden. She needs a space that is at least 20 square feet to fit her plants. She has enough soil for a garden that is 30 square feet. The space she has available has to be 3 feet on one side.

   What are the possible sizes for her garden?

Create a poster to show your thinking. Organize it so it can be followed by others.

2. As you look at the posters with your group:

   a. Describe how another group solved the problem in a different way than your group did.

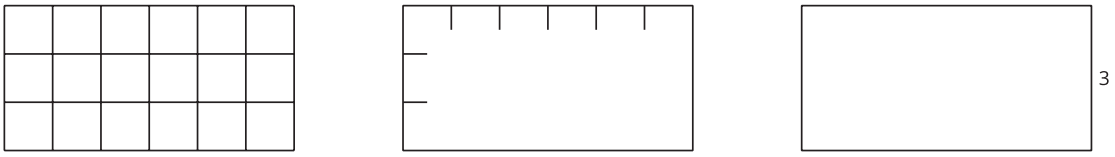
   b. Write three things you saw that helped you understand how other students solved the problem.

Section Summary

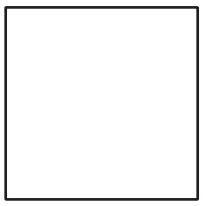
Section Summary

In this section, we learned how area is related to multiplication. We multiplied the side lengths of a rectangle to find its area.

$$6 \times 3 = 18$$



We also learned about how different square units are useful for measuring area in different situations and solved problems involving area.



square inch

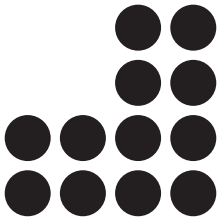
square meter

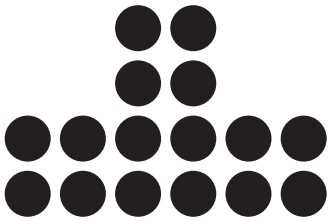
Lesson 11: Area and the Multiplication Table

- Let's explore area and the multiplication table.

Warm-up: How Many Do You See: Arrays that Grow

How many do you see? How do you see them?





11.1: Area and the Multiplication Table

What do you notice? What do you wonder?

×	1	2	3	4	5
1					
2					
3	3				
4					
5					

×	1	2	3	4	5
1					
2					
3		6			
4					
5					

×	1	2	3	4	5
1					
2					
3			9		
4					
5					

×	1	2	3	4	5
1					
2					
3				12	
4					
5					

1. Use the blank table to create your own rectangle.

   Start from the top left corner. Record the product that the rectangle represents. Be prepared to explain your reasoning.

×	1	2	3	4	5
1					
2					
3					
4					
5					

2. Use the following table to create a rectangle with an area of 24 square units. Start from the top left corner. Record the product that the rectangle represents. Be prepared to explain your reasoning.

×	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5									
6									
7									
8									
9									

11.2: Products in the Multiplication Table

What do you notice? What do you wonder?

×	1	2	3	4	5	6	7	8	9	10
1		2								
2	2	4	6	8	10					
3		6								
4		8								
5		10								
6										
7										
8										
9										
10										

1. Find as many other products in the table as you can. You may want to start with rows and columns that show products of 2, 5, and 10.

2. What patterns do you see in the row and column that show products of 5?

3. Write some equations that show one of the patterns that you see in the multiplication table. Explain or show your reasoning.

Lesson 12: Area and Addition

- Let's find the area of figures made up of rectangles.

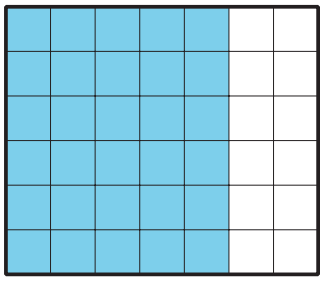
Warm-up: Number Talk: So Close

Find the value of each expression mentally.

- $9 + 6$
- $29 + 6$
- $59 + 6$
- $49 + 8$

12.1: Rectangles in Rectangles

1. This rectangle represents space in a community garden. The shaded part is covered with vegetables and the unshaded part is covered with flowers. Each square represents 1 square foot.

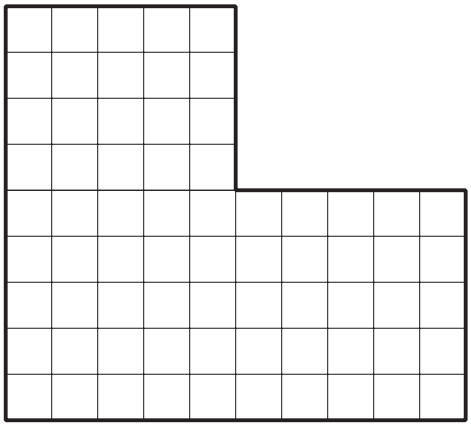


What is the area of the whole space?

2. Design your own garden. Find the area of each part of the garden and the area of the whole garden.

12.2: Find the Rectangles

What do you notice? What do you wonder?



Find the area of this figure. Explain or show your reasoning. Organize it so it can be followed by others.

Lesson 13: Find the Area of Figures

- Let's find the area of figures.

Warm-up: Number Talk: Extend Make a Ten

Find the value of each expression mentally.

- $109 + 4$

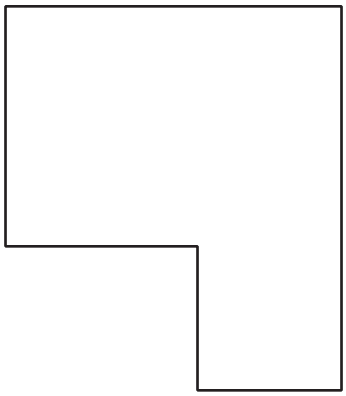
- $109 + 14$

- $209 + 34$

- $219 + 34$

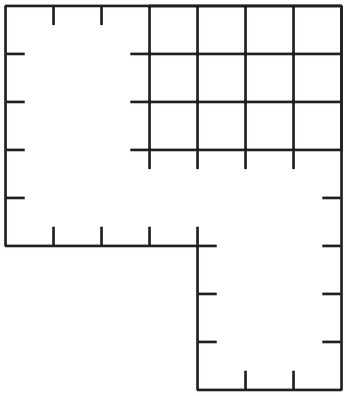
13.1: Bye-Bye Squares

What do you notice? What do you wonder?

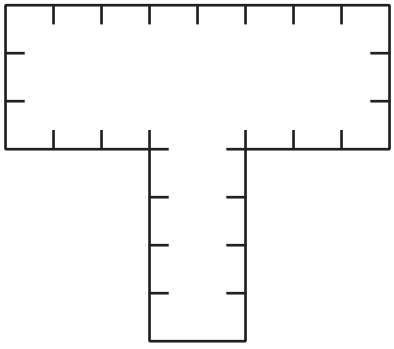


Find the area of each figure. Explain or show your reasoning.

1.

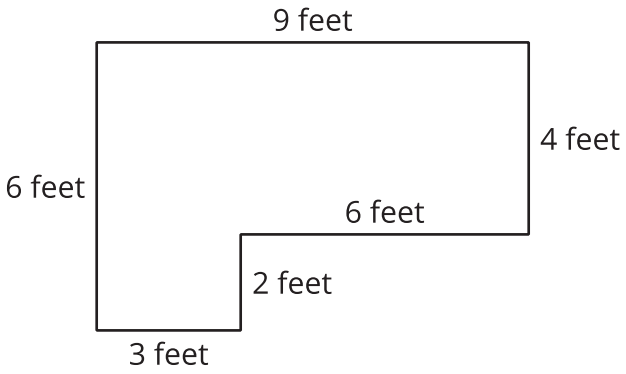


2.



13.2: How Many Pavers Do We Need?

Noah wants to use square pavers that are 1 square foot each to create a small patio in the community garden. A diagram of the patio is shown.



1. How many 1 square foot pavers will Noah need to cover the whole patio?

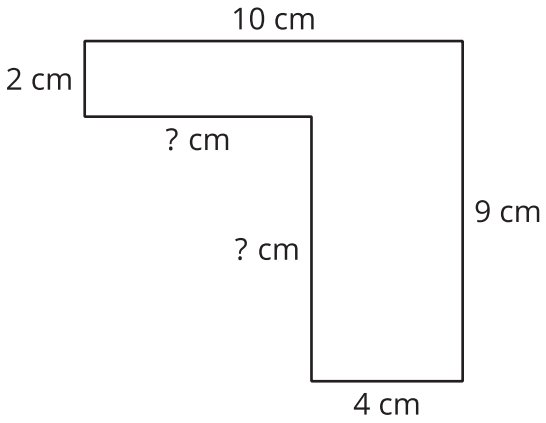
2. What is the area of the patio? Explain or show your reasoning.

Lesson 14: Find the Area of Figures with Missing Sides

- Let's find the area of figures with missing side lengths.

Warm-up: Notice and Wonder: Mystery Sides

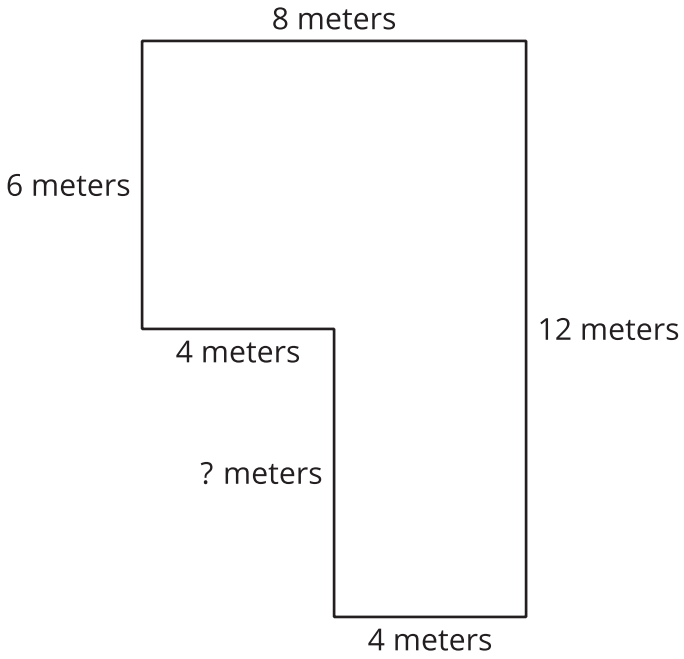
What do you notice? What do you wonder?



14.1: The Mystery Side

Tyler says that the missing side length is 5 meters because it looks longer than the sides that are 4 meters long.

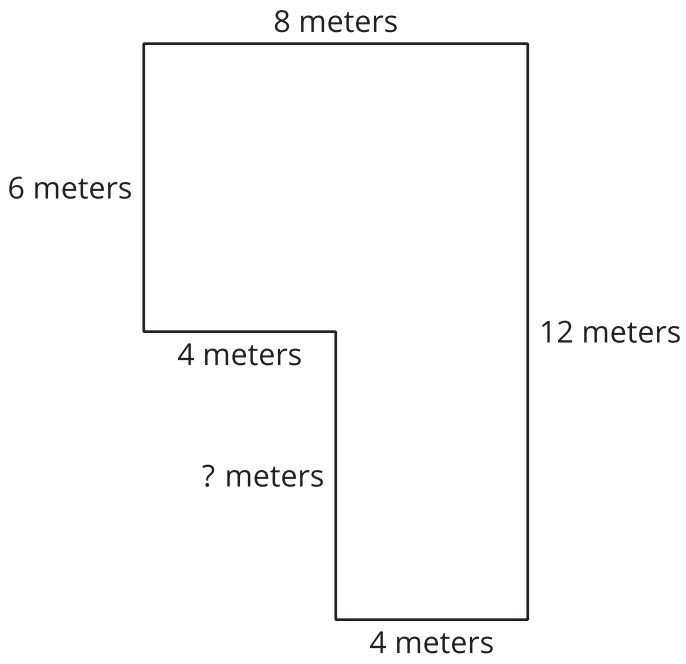
Do you agree or disagree? Be prepared to explain your reasoning.



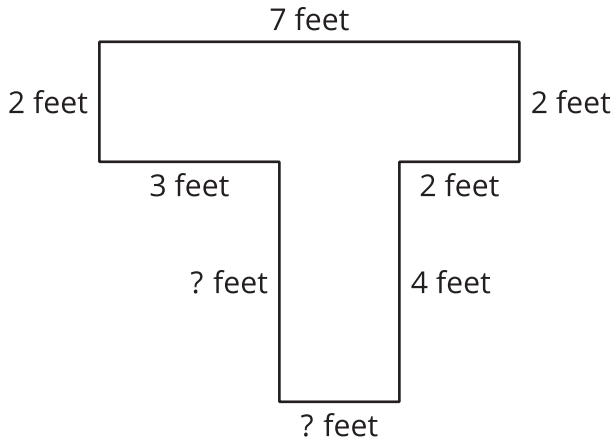
14.2: Practice with Mystery Sides

Find the area of each figure. Explain or show your reasoning.

A



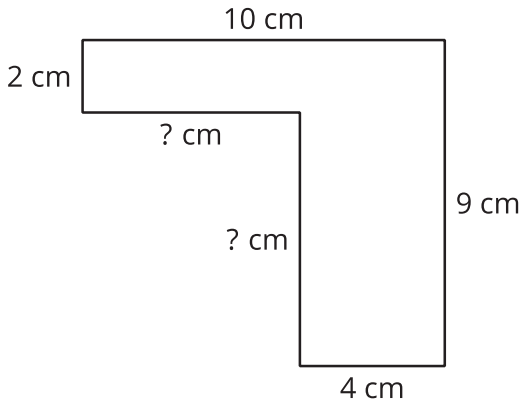
B



Section Summary

Section Summary
In this section, we found the area of figures that could be decomposed into rectangles. We added the area of each rectangle to find the area of the entire figure.

We also found missing side lengths by using what we know about opposite sides of rectangles.

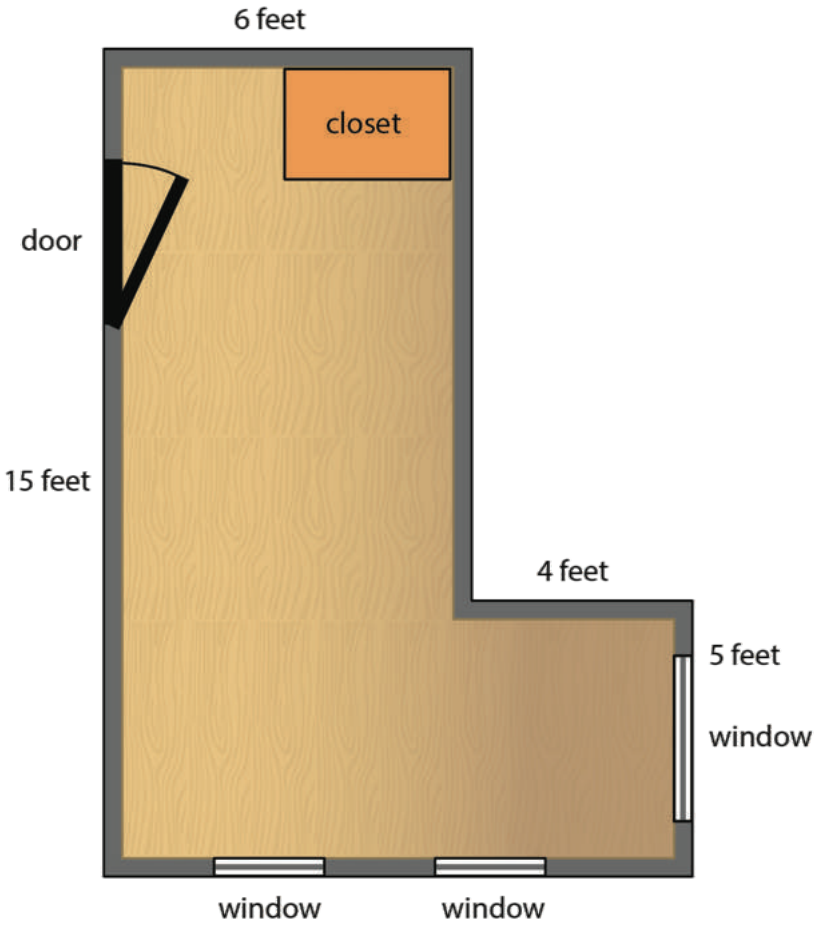


Lesson 15: New Room

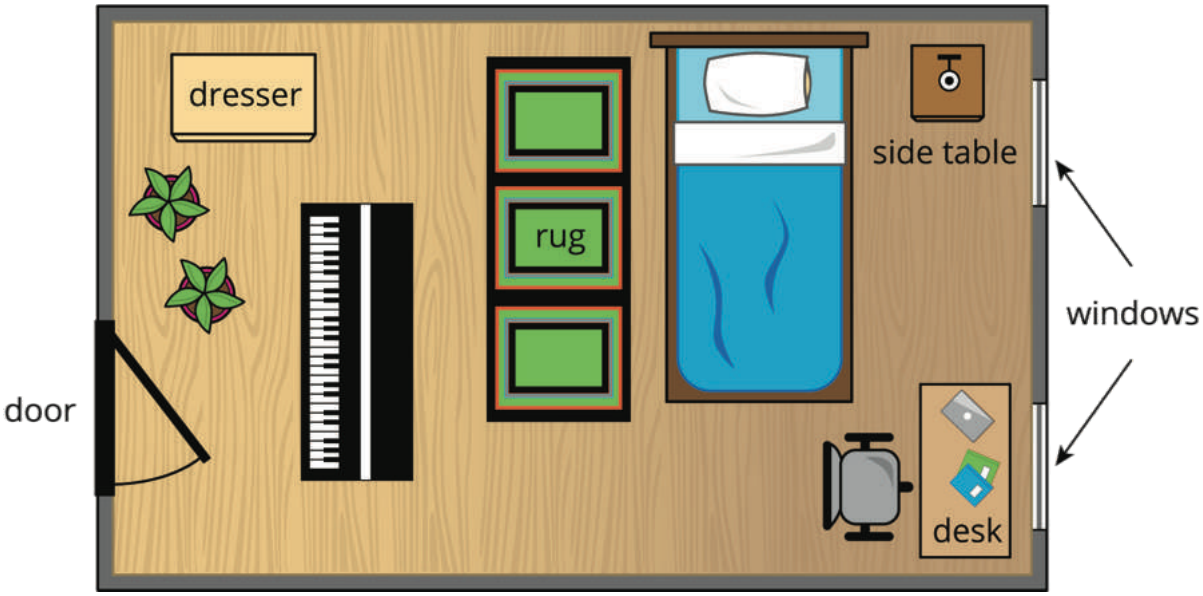
- Let's fit furniture into a room.

Warm-up: Notice and Wonder: Floor Plan

What do you notice? What do you wonder?



15.1: Floor Plans



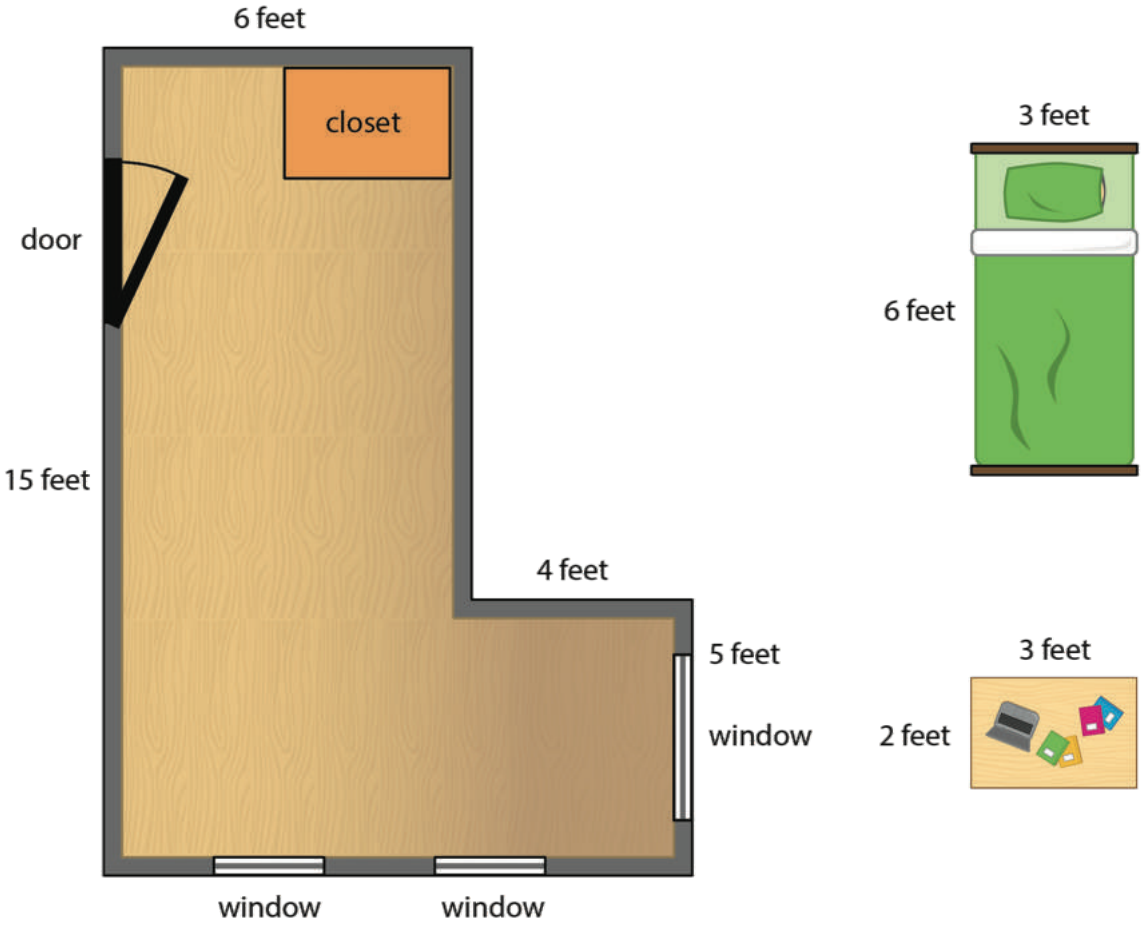
The image shows a design of a floor plan for a bedroom. Discuss with your partners:

1. What is one thing you like about the given design?

2. What is one thing you would change and why?

15.2: New Bed and Desk

This is a diagram of Tyler's new room, his desk, and his bed.



1. How should Tyler arrange his bed and desk in his new room?

2. What is the area of the room that is not covered with furniture?

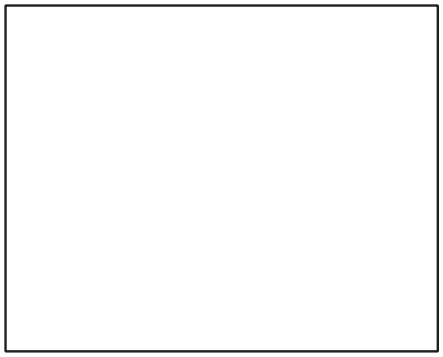
Create a poster to show your thinking. Organize it so it can be followed by others.

Section A: Practice Problems

1. **Pre-unit**

   a. Partition the rectangle into 4 equal rows and 5 equal columns.

   b. How many small squares are there in the rectangle?



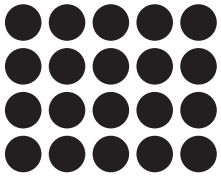
2. **Pre-unit**

   Is the number of dots in each image even or odd? Explain how you know.

   a.

   b.

   c.



3. **Pre-unit**

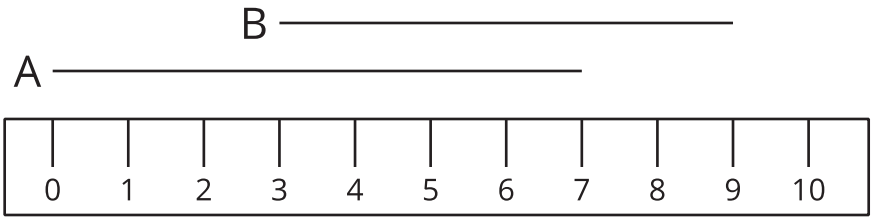
How many dots are in each array? Explain or show your reasoning.

a.

b.

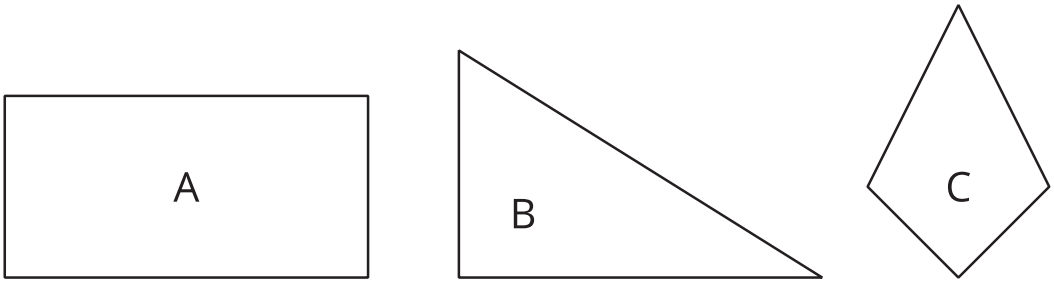
c.

4. **Pre-unit**



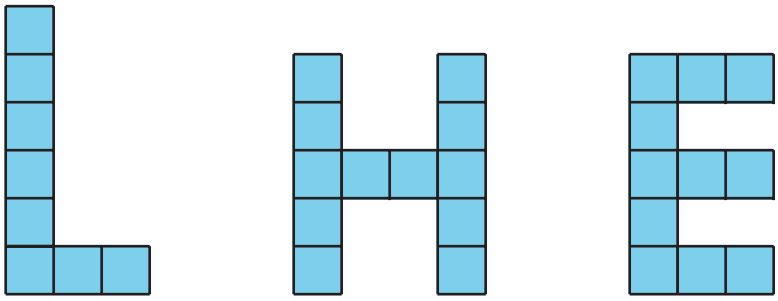
Use the centimeter ruler to find the lengths of the two line segments A and B. Explain your reasoning.

5. Which shape is the largest? Which shape is the smallest? Explain your reasoning. You may trace and cut out the shapes if it is helpful.



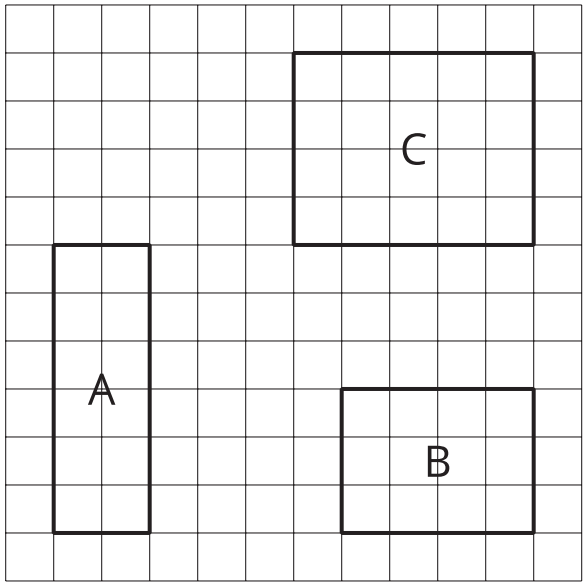
(From Unit 2, Lesson 1.)

6. Lin, Han, and Elena made letters from squares. Put the letters in order from least area to greatest area. Explain your reasoning.



(From Unit 2, Lesson 2.)

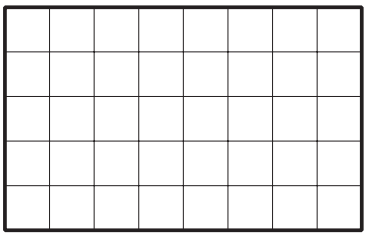
7. a. Find the area of each rectangle.



b. Can rectangles with different shapes have the same area? Explain your reasoning.

(From Unit 2, Lesson 3.)

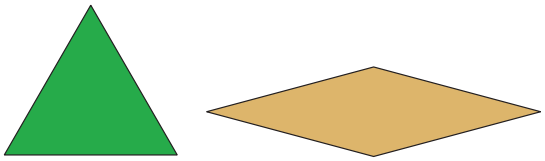
8. Find the area of the rectangle. Explain or show your reasoning.



(From Unit 2, Lesson 4.)

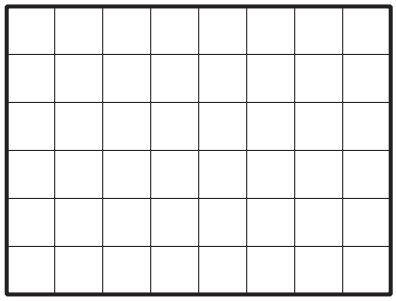
9. **Exploration**

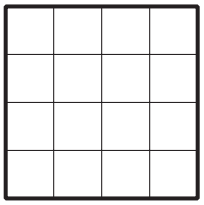
Which shape has greater area, a green triangle pattern block or a tan rhombus pattern block? Explain your reasoning.



10. **Exploration**

Here are two rectangles.





a. What is the area of the larger rectangle?

b. What is the area of 3 smaller rectangles?

c. Can you cover the first rectangle with 3 of the smaller rectangles without cutting them up? Explain or show your reasoning.

11. **Exploration**

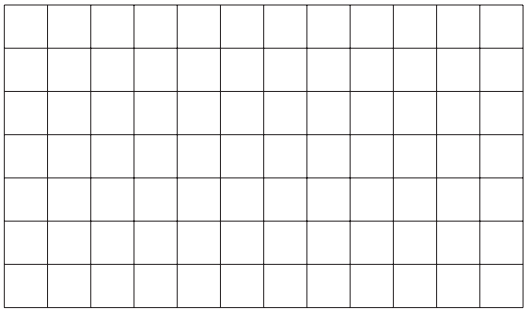
    a. How many different rectangles can you make with 36 square tiles? Describe or draw the rectangles.

    b. How are the rectangles the same? How are they different?

Section B: Practice Problems

1. a. Use the grid to create a rectangle whose area can be represented by 5×7.

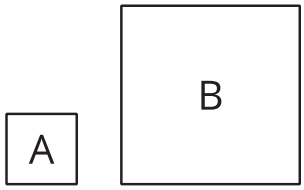
   b. How does your rectangle represent the expression 5×7?



(From Unit 2, Lesson 5.)

2. Here are two squares. One of the squares is a square centimeter and one of them is a square inch.

   Which square is a square centimeter? Which square is a square inch? Explain how you know.



(From Unit 2, Lesson 6.)

3. For each object, decide if you would use square centimeters, square inches, square feet, or square meters to measure its area. Explain your reasoning.

   a. a baseball field

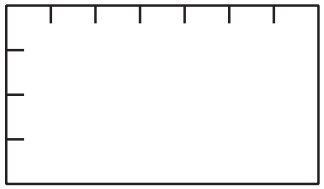
   b. a table top

   c. a cell phone screen

(From Unit 2, Lesson 7.)

4. The sides of the rectangle are marked in centimeters.

   What is the area of the rectangle? Explain your reasoning.



(From Unit 2, Lesson 8.)

5. a. Use your ruler to find the area of the rectangle in square centimeters.

b. Use your ruler to draw a rectangle whose area is 18 square centimeters.

(From Unit 2, Lesson 9.)

6. Tyler has 40 carpet squares that are 1 foot on each side. He wants to use all of them to make a rectangle-shaped carpet for his room.

   For the carpet to fit in the room, the longest side cannot be more than 12 feet. What side lengths could Tyler's rectangle have?

(From Unit 2, Lesson 10.)

7. a. Describe some patterns that you see for the numbers in the table.

×	1	2	3	4	5	6	7	8	9
1			3			6			9
2			6			12			18
3			9			18			27
4			12			24			36
5			15			30			45
6			18			36			54
7			21			42			63
8			24			48			72
9			27			54			81

b. Describe one of the patterns you saw using an equation.

(From Unit 2, Lesson 11.)

8. **Exploration**

a. Find a rectangle in your classroom or at home. Describe the rectangle.

b. Would you use square centimeters, square inches, square feet, or square meters to measure the area of the rectangle? Explain your reasoning.

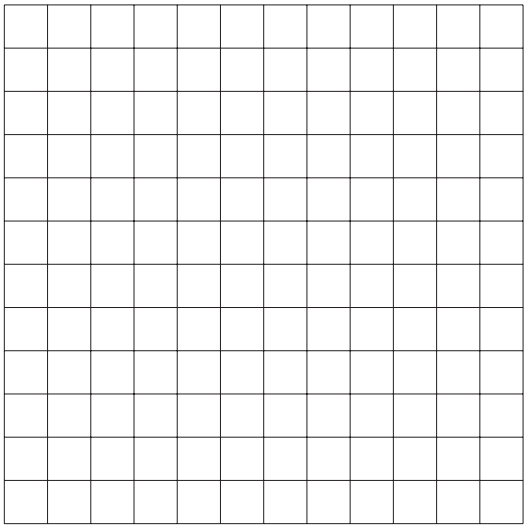
9. **Exploration**

What patterns do you notice in the three columns of the multiplication table?

×	1	2	3	4	5	6	7	8	9	10
1		2		4	5					
2		4		8	10					
3		6		12	15					
4		8		16	20					
5		10		20	25					
6		12		24	30					
7		14		28	35					
8		16		32	40					
9		18		36	45					
10		20		40	50					

10. **Exploration**

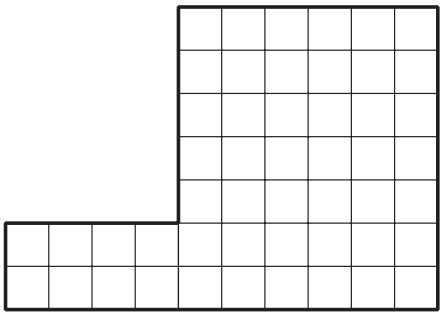
Mai picked a mystery number that is less than 30. She says that she can show 3 different rectangles on this grid whose area is the same as her mystery number.



What could be Mai's mystery number? Explain or show your reasoning.

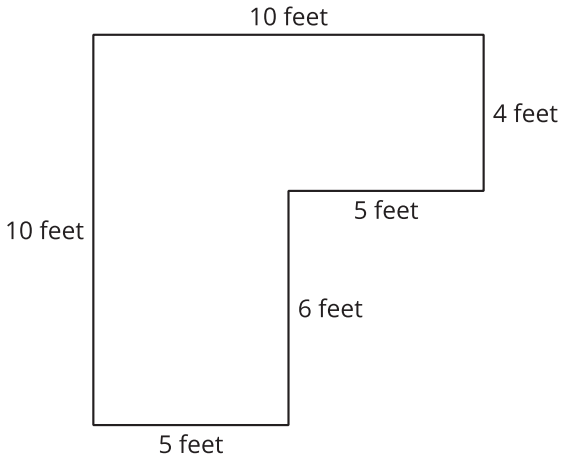
Section C: Practice Problems

1. What is the area of this figure in square units? Explain or show your reasoning.



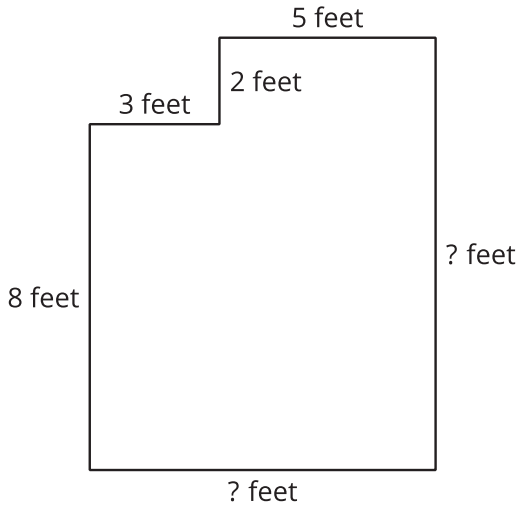
(From Unit 2, Lesson 12.)

2. Find the area of this figure. Explain or show your reasoning.



(From Unit 2, Lesson 13.)

3. Find the area of this figure. Explain or show your reasoning.

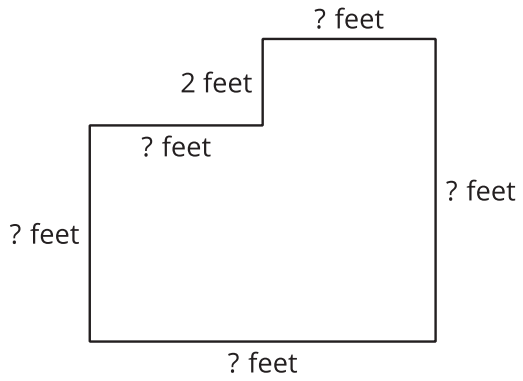


(From Unit 2, Lesson 14.)

4. **Exploration**

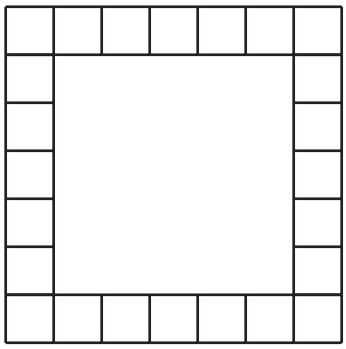
Lin says that she knows how to find the area of the figure. Diego says there is not enough information to find the area.

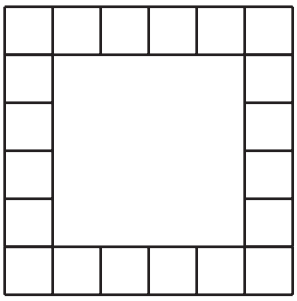
Do you agree with Lin or with Diego? Explain your reasoning.



5. **Exploration**

a. Each image shows part of a shape filled with squares.





For each image, which do you think is greater, the number of squares in the image or the number of squares missing in the middle?

b. Check whether or not your answers are correct.

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