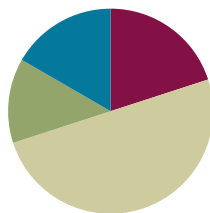# Lesson 7

Objective: Interpret area models to form rectangular arrays.

Suggested Lesson Structure

- ■ Fluency Practice   (12 minutes)
- ■ Application Problem   (8 minutes)
- ■ Concept Development   (30 minutes)
- ■ Student Debrief   (10 minutes)
-   **Total Time**   **(60 minutes)**

Fluency Practice (12 minutes)

- ▪ Group Counting **3.OA.1**   (4 minutes)
- ▪ Draw Rectangles **3.MD.5**   (4 minutes)
- ▪ Draw Rectangular Arrays **3.MD.5**   (4 minutes)

Group Counting (4 minutes)

Note: Group counting reviews interpreting multiplication as repeated addition.

Instruct students to count forward and backward, occasionally changing the direction of the count.

- ▪ Sixes to 60
- ▪ Sevens to 70
- ▪ Eights to 80
- ▪ Nines to 90

Draw Rectangles (4 minutes)

Materials: (S) Grid paper

Note: This fluency activity reviews drawing a rectangle from a known area. Show student work that is correct but looks different (e.g., a 6 × 2 unit rectangle juxtaposed with a 4 × 3 unit rectangle).

- T: Draw a rectangle that has an area of 6 square units.
- S: (Draw a 6-square unit rectangle.)

Continue with the following possible sequence: 10 square units, 12 square units, 16 square units, 24 square units, and 35 square units.

Draw Rectangular Arrays (4 minutes)

Materials: (S) Grid paper

Note: This fluency activity reviews finding area using side lengths.

- T: Draw a 4 × 2 rectangular array using the squares on your grid paper.
- T: How many square units are in your array?
- S: 8 square units.

Continue with the following possible sequence of rectangular arrays: 6 × 2, 4 × 3, 6 × 3, 9 × 2, 6 × 4, and 3 × 8.

Application Problem (8 minutes)

Lori wants to replace the square tiles on her wall. The square tiles are sold in boxes of 8 square tiles. Lori buys 6 boxes of tiles. Does she have enough to replace all of the tiles, including the tiles under the painting? Explain your answer.
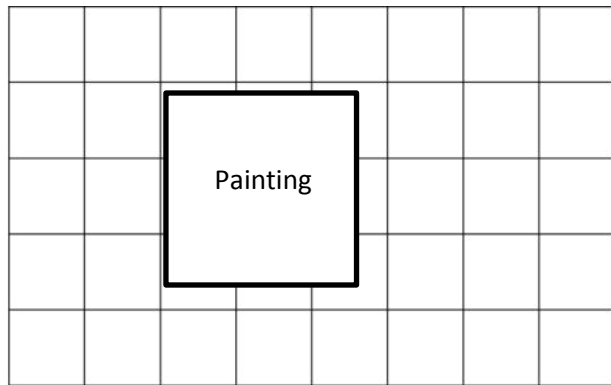
8 × 6 = 48

She bought 48 square tiles.

5 × 8 = 40

The area of the wall is 40 square tiles.

Painting

Yes, Lori will have enough tiles because she only needs 40 tiles, but she bought 48 tiles.

Note: This problem reviews multi-step word problems in the context of using square tiles to measure area. It also reviews finding the area of an incomplete array from Lesson 6.

Concept Development (30 minutes)

Materials: (T) Meter stick, 12-inch ruler, pad of square sticky notes (S) 1 set of square centimeter and square inch tiles per pair (from Lesson 2), personal white board, ruler, area model (Template)

**Part 1: Explore the relationship between units and area.**

- T: One partner will use square inches, and the other will use square centimeters. Work together to decide how to arrange your tiles to make the same shape rectangle. Then, create that rectangle with your pieces.
- S: (Decide on a rectangle and represent it using square inches and square centimeters.)

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T: You and your partner each made the same shape rectangle. Is the area also the same?

S: We used the same number of pieces, but my pieces are smaller than yours. They are square centimeters, and look, my shape takes up less space on the table. → The area of the shape with square inches is bigger because inches are bigger than centimeters.

T: Turn your personal white board horizontally and write the area of your rectangle.

S: (Write either 12 square inches or 12 square centimeters.)

T: (Draw 1 square meter on the board.) This is 1 square meter. Suppose you used 12 square meter tiles to make your rectangle instead. Would this rectangle have a bigger area or a smaller area compared to your original rectangle?

MP.6 S: It would be much larger!

T: (Draw 1 square foot on the board.) How would your rectangle compare if you made it from 12 square feet?

S: It would be bigger than 12 square inches or centimeters but smaller than 12 square meters.

T: (Hold up a pad of square sticky notes.) How about if you had used 12 sticky notes?

S: Still bigger than 12 square inches or centimeters but smaller than 12 square feet or meters.

T: Why is it important to label the unit when you are talking about area?

S: Because how much area there is changes if the unit is small or big. → If you do not know the unit, then you do not really know what the area means. → It is just like with length. Twelve of a shorter unit is shorter than 12 of a longer unit.

Part 2: Relate area to multiplication to draw rectangular arrays.

T: Let us draw a rectangular array with an area of 18 square centimeters. How might we find the side lengths?

S: We could use our tiles to make the array and see. → If you multiply side lengths, you get area, so we can think about what numbers you can multiply to make 18.

T: Work with your partner to make a list of multiplication facts that equal 18.

S: (Possible list is as follows: 1×18, 18×1, 2×9, 9×2, 3×6, and 6×3.)

T: Let us draw a 3 cm by 6 cm rectangular array. Use a ruler to measure the side lengths on your personal white board. Mark each centimeter with a point and connect the points to draw the square centimeters.

T: After drawing your squares, check your work by skip-counting the rows to find the total number of tiles you drew.

S: (Draw, label, and skip-count tiles in array.)

T: Turn your personal white board so that it is vertical. Does the rectangle still have the same area?

S: Yes.

T: However, the side lengths switched places. Tell your partner how you know the area is the same.

S: The side lengths didn't change; they just moved. → It is the commutative property. We learned before that you can turn an array and it does not change how much is in it. The rows just turn into columns and columns turn into rows.
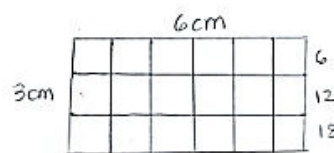
Part 3: Interpret area models to find area.

T: The grid you drew inside of your 3 cm by 6 cm rectangle shows a picture of all the tiles that make up the area. Carefully erase the grid lines in your rectangle. (Pause.) The empty rectangle with labeled side lengths left is called an **area model**. How can you find the total area just using the labeled side lengths?

S: I can multiply! → I can multiply the side lengths, 3 cm and 6 cm, to get the area, 18 square cm.

T: (Project or draw the area model on the right.)
     What is the total area of my pictured rectangle?

S: 18 square cm.

T: Tell your partner how you figured out the area.

S: It is easy. One side length is 18 and the other is 1. $18 \times 1 = 18$.
     The labels tell you the unit is centimeters, so the area is square centimeters.
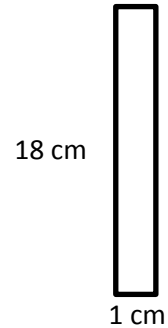
T: (Pass out the area model template.) Slip the area model into your personal white board. Use your ruler to measure the side lengths of one of the squares on the grid. (Allow students time to measure.) What unit makes up this grid?

S: Square inches!

T: The side lengths of this area model are not labeled. Let us draw a grid inside it to help find the side lengths. Earlier, we drew a grid inside a rectangle by marking each unit with a point and using a ruler to connect the points. Do we need to draw points on the area model to draw a grid inside of it?

S: No, we can just use the grid lines. → No, the lines on the grid can act as points because the area model is lined up with the grid.

T: Use your ruler and the lines on the grid to draw squares inside of the area model. (Allow students time to work.) What size are the units inside the area model?

S: Square inches. → They are square inches because we used the square inch grid paper to help draw the squares.

T: Find and label the side lengths, and then write an equation to find the area.

S: (Label the side lengths as 4 in and 2 in, and write $2 \times 4 = 8$ or $4 \times 2 = 8$.)

T: What is the area?

S: 8 square inches!

18 cm

1 cm

Area Model Template
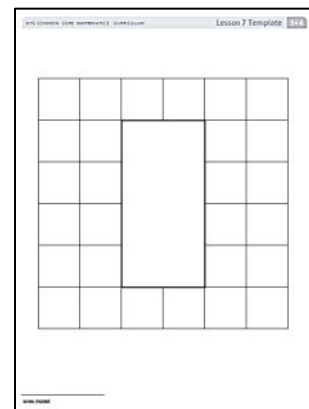
Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students should solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Interpret area models to form rectangular arrays.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.

Any combination of the questions below may be used to lead the discussion.

- What was your strategy for finding the total number of squares in Problem 2(c)?
- Invite students who drew arrays that demonstrate commutativity for Problem 4(a) (possibly 4 × 6 and 6 × 4) to share their work. Guide students to articulate understanding that commutativity still applies in the context of area.
- For Problem 4(b), most students answered that Mrs. Barnes' array probably had 24 squares. Is there another answer that makes sense? (For example, 12, 48, 72.)
- Compare the **area model** to the array. How are they the same and different? (Guide discussion to include the commutativity of both models.)

> **NOTES ON MULTIPLE MEANS FOR ACTION AND EXPRESSION:**
>
> Consider offering the following adaptations to the Problem Set:
>
> - Prompt students to approach Rectangle E first. Offer practice with 1 by *n* rectangles to build fluency and confidence.
> - Remove side lengths to encourage closer investigation.
> - Challenge students to devise an alternate method for finding the area of Benjamin's bedroom floor.

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students' understanding of the concepts that were presented in today's lesson and planning more effectively for future lessons. The questions may be read aloud to the students.

Name _____   Date _____

1. Use a straight edge to draw a grid of equal size squares within the rectangle. Find and label the side lengths. Then, multiply the side lengths to find the area.
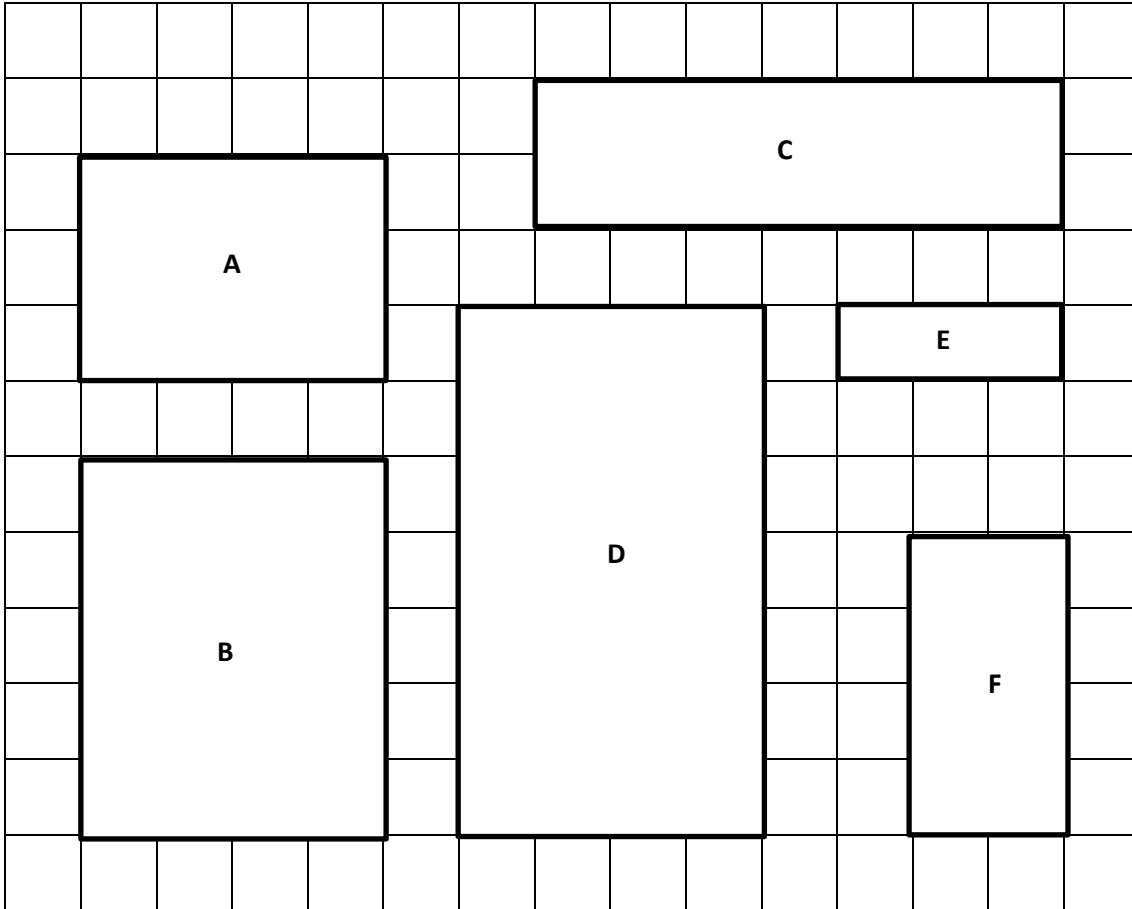
a. Area A:

_____ units × _____ units = _____ square units

b. Area B:

_____ units × _____ units = _____ square units

c. Area C:

_____ units × _____ units = _____ square units

d. Area D:

_____ units × _____ units = _____ square units

e. Area E:

_____ unit × _____ units = _____ square units

f. Area F:

_____ units × _____ units = _____ square units

2. The area of Benjamin's bedroom floor is shown on the grid to the right. Each ☐ represents 1 square foot. How many total square feet is Benjamin's floor?
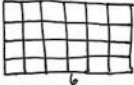
    a. Label the side lengths.

    b. Use a straight edge to draw a grid of equal size squares within the rectangle.

    c. Find the total number of squares.

    Benjamin's
    Bedroom Floor
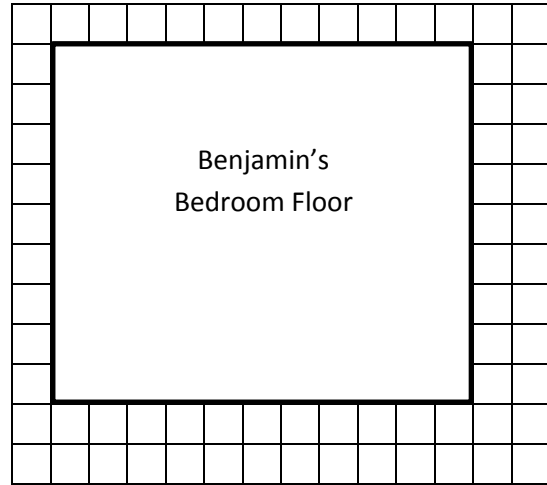
3. Mrs. Young's art class needs to create a mural that covers exactly 35 square feet. Mrs. Young marks the area for the mural as shown on the grid. Each ☐ represents 1 square foot. Did she mark the area correctly? Explain your answer.

    Mural
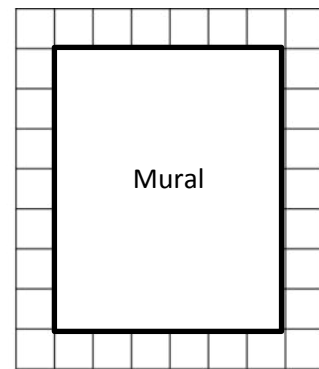
4. Mrs. Barnes draws a rectangular array. Mila skip-counts by fours and Jorge skip-counts by sixes to find the total number of square units in the array. When they give their answers, Mrs. Barnes says that they are both right.

    a. Use pictures, numbers, and words to explain how Mila and Jorge can both be right.

    b. How many square units might Mrs. Barnes' array have had?

Name _____   Date _____

1. Label the side lengths of Rectangle A on the grid below. Use a straight edge to draw a grid of equal size squares within Rectangle A. Find the total area of Rectangle A.
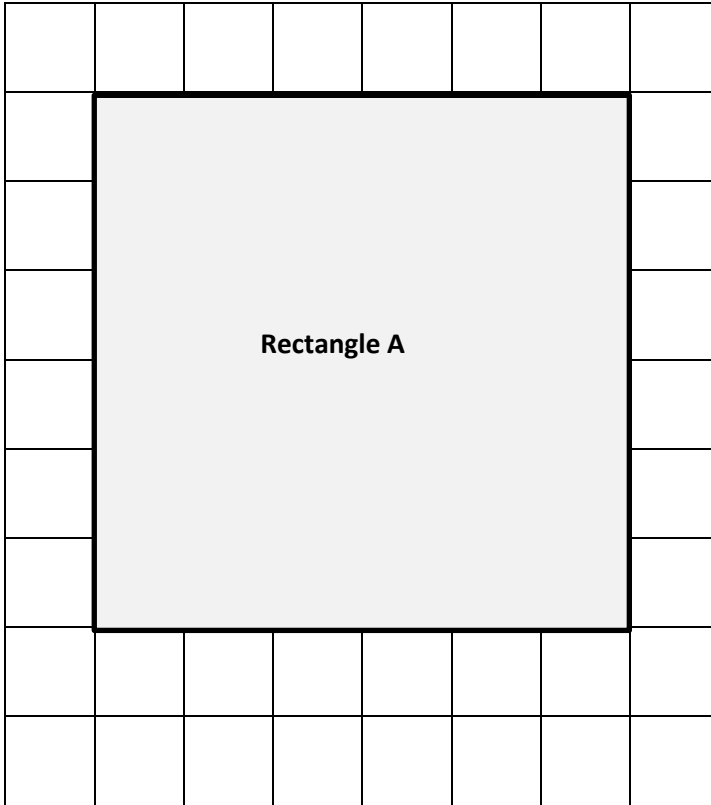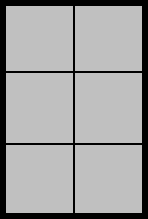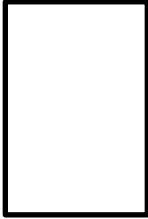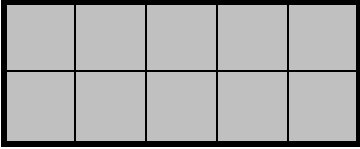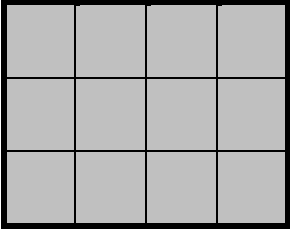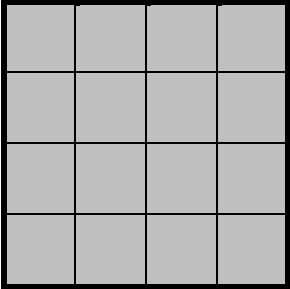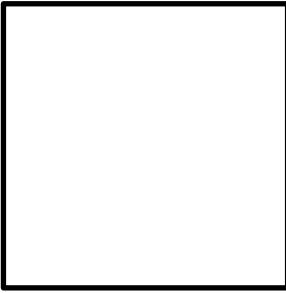
Rectangle A

Area: _____ square units

2. Mark makes a rectangle with 36 square centimeter tiles. Gia makes a rectangle with 36 square inch tiles. Whose rectangle has a bigger area? Explain your answer.

Name _____   Date _____

1. Find the area of each rectangular array. Label the side lengths of the matching area model, and write a multiplication equation for each area model.

Rectangular Arrays	**Area Models**
a. _____ square units	3 units (rectangle) 2 units 3 units × _____ units = _____ square units
b. _____ square units	_____ units × _____ units = _____ square units
c. _____ square units	_____ units × _____ units = _____ square units
d. _____ square units	_____ units × _____ units = _____ square units

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2. Jillian arranges square pattern blocks into a 7 by 4 array. Draw Jillian's array on the the grid below. How many square units are in Jillian's rectangular array?
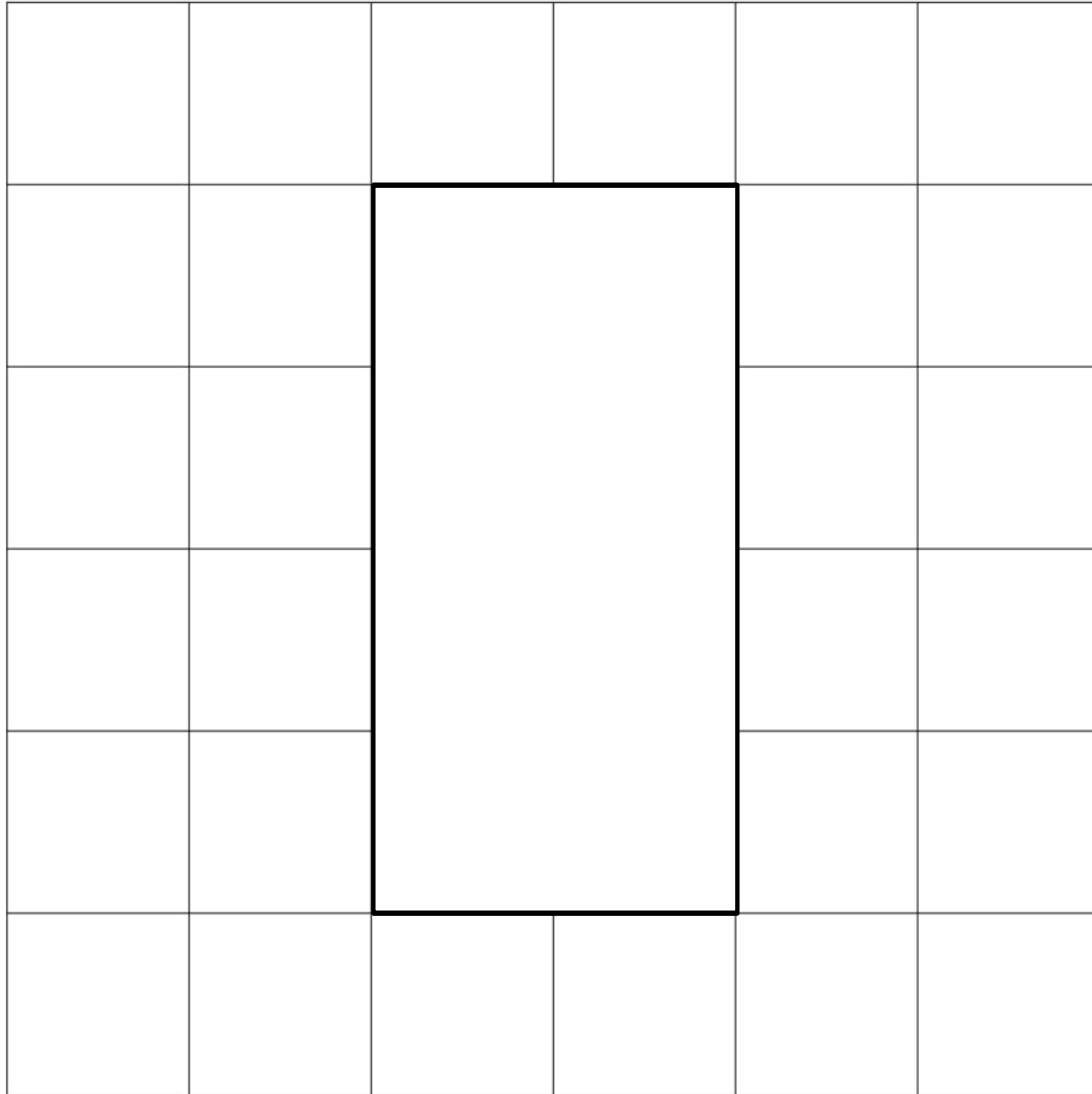
    a.
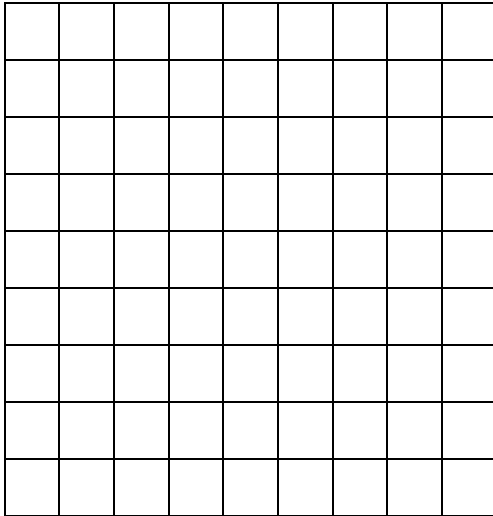
    b. Label the side lengths of Jillian's array from Part (a) on the rectangle below. Then, write a multiplication sentence to represent the area of the rectangle.
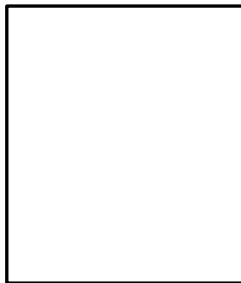
3. Fiona draws a 24 square centimeter rectangle. Gregory draws a 24 square inch rectangle. Whose rectangle is larger in area? How do you know?

area model