Topic C

Rectangular Arrays as a Foundation for Multiplication and Division

2.OA.4, 2.G.2

Focus Standards:

2.OA.4 Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends.

2.G.2 Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.

Instructional Days: 7

Coherence -Links from: G1–M2 Introduction to Place Value Through Addition and Subtraction Within 20

-Links to: G2–M8 Time, Shapes, and Fractions as Equal Parts of Shapes

G3–M4 Multiplication and Area

Topic C naturally follows Topic B, where students composed and manipulated the rows and columns of an array. This topic is designed to deepen students’ understanding of spatial structuring as they build and partition rectangles with rows and columns of same-size squares.

In Lessons 10 and 11, students compose a rectangle by making tile arrays with no gaps or overlaps. They use their prior knowledge of making equal groups and the spatial relationship between rows and columns to construct rectangular arrays. In Lesson 10, given a number of tiles (up to 25) students are asked to create rectangular arrays that show equal rows or columns (up to 5 by 5). In Lesson 11, students build upon this understanding, manipulating a set of 12 square tiles to compose various rectangles (e.g., 1 column of 12, 2 rows of 6, and 3 rows of 4). As students share their rectangles, they are encouraged to ask themselves, “How can I construct this differently?” They use repeated addition to find the total number of squares, alternating flexibly between the number in each row and the number in each column as the unit.

Lesson 12 introduces the added complexity of composing a rectangle by using math drawings. Once students have arranged square tiles into a specified rectangular array without gaps or overlaps, they trace to construct the same rectangle by iterating the square unit much as they iterated a length unit in Module 2 to create a centimeter ruler. Next, students use the spatial reasoning developed so far in the module to draw the same rectangle without tracing, using their understanding of equal columns and equal rows.

After students compose rectangles, they decompose, or partition, them using tiles in Lesson 13. For example, when working with an array of 5 rows of 3 (and a total of 15), they see that if they remove a row of 3, they
have 4 rows of 3 (and a total of 12). Alternately, they see that instead of 3 columns of 5, they have 3 columns of 4.

In Lesson 14, students are encouraged to think flexibly as they use paper models to further develop their ability to visualize arrays. Students fold two congruent rectangular pieces of paper to create two 2-by-4 rectangular arrays composed of same-size squares. Next, they use scissors to cut the rectangle into 2 rows of 4 squares (first paper) and 4 columns of 2 squares (second paper). Then, students cut each row or column into individual square units. As a result, they see that just as a rectangle is composed of equal rows or columns, each row or column is composed of squares, or iterated units. Students now have 16 same-size squares and can create different rectangular arrays with them (e.g., 1 by 16, 2 by 8, and 4 by 4).

Lesson 15 moves toward more abstract reasoning as students use math drawings to partition rectangles. With colored pencils and grid paper, students shade in rows or columns and relate them to the repeated addition number sentence (e.g., 5 rows of 3 squares = 3 + 3 + 3 + 3 + 3, or 5 threes). Then, given a rectangle with one row or one column missing, students draw in the remaining squares to complete the array (shown on right) and find the total by relating their completed array to repeated addition.

In Lesson 16, students practice spatial structuring skills by working with grids and diagrams. They copy designs using same-size squares and triangles (half of the squares) as manipulatives. Students create their copies on paper with grid squares of the same size as the manipulative square. In order to successfully create these, they must pay careful attention to which grid square to color and how many spaces to leave. Students share designs with a partner, who then tries to copy the designs exactly (shown on right). Finally, students use grid paper to design a tessellation using a core square composed of a 3 by 3 array of same-size squares. They create designs by coloring the 9 squares and then iterating that core unit. This provides students with the opportunity to sharpen their spatial structuring skills, as they must count rows and columns to successfully create a quilt of their designs.
A Teaching Sequence Towards Mastery of Rectangular Arrays as a Foundation for Multiplication and Division

**Objective 1:** Use square tiles to compose a rectangle, and relate to the array model.
(Lessons 10–11)

**Objective 2:** Use math drawings to compose a rectangle with square tiles.
(Lesson 12)

**Objective 3:** Use square tiles to decompose a rectangle.
(Lesson 13)

**Objective 4:** Use scissors to partition a rectangle into same-size squares, and compose arrays with the squares.
(Lesson 14)

**Objective 5:** Use math drawings to partition a rectangle with square tiles, and relate to repeated addition.
(Lesson 15)

**Objective 6:** Use grid paper to create designs to develop spatial structuring.
(Lesson 16)
Lesson 10

Objective: Use square tiles to compose a rectangle, and relate to the array model.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problem (6 minutes)
- Concept Development (32 minutes)
- Student Debrief (10 minutes)
- Total Time (60 minutes)

Fluency Practice (12 minutes)

- Happy Counting by Tens: Crossing 100 2.NBT.2 (3 minutes)
- Sprint: Sums to the Teens 2.OA.2 (9 minutes)

Happy Counting by Tens: Crossing 100 (3 minutes)

Note: Students skip-count by tens as review of counting equal groups.

T: Let’s count by tens, starting at 270. Ready? (Point up rhythmically until a change is desired. Close hand to indicate a stopping point. Point down to count in the opposite direction. Continue, periodically changing direction.)

S: 270, 280, 290, 300, 310, 320, 330, 340. (Switch.) 330, 320, 310, 300, 290. (Switch.) 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420. (Switch.) 410, 400, 390, 380.

T: Excellent! Try it for 30 seconds with your partner, starting at 300. Partner A, you are the teacher today.

Sprint: Sums to the Teens (9 minutes)

Materials: (S) Sums to the Teens Sprint

Note: This Sprint gives practice in the grade level fluency goal of sums to 20.
Application Problem (6 minutes)

Note: The students have a chance to apply their understanding of arrays to a real world context.

Sandy’s toy telephone has buttons arranged in 3 columns and 4 rows.

a. Draw a picture of Sandy’s telephone.

b. Write a number sentence to show the total number of buttons on Sandy’s telephone.

Concept Development (32 minutes)

Materials: (S) Bag with 25 square tiles

Problem 1: Compose a rectangle with square tiles that has no gaps or overlaps.

T: Take out 10 tiles from your bag.
S: (Count out 10 tiles.)
T: Now put your tiles into 2 equal groups.
S: (Create arrays.)
T: How many rows did you make?
S: 2
T: How many tiles are in each row?
S: 5
T: What number sentence can we use to find the total for two rows of 5?
S: 5 + 5 = 10.
T: What do you notice about the shape of this array?
S: It has corners like an L. → Pairs of sides are the same length. → It’s a rectangle!
T: Using the same tiles, make 2 columns of 5, and again, leave no spaces between the columns to make a rectangle.
S: (Construct arrays.)
T: What number sentence can we use to find the total for 2 columns of 5? Turn and talk.
S: 5 + 5 = 10.
T: Are the number sentences and totals equal for both arrays?
Lesson 10: Use square tiles to compose a rectangle, and relate to the array model.

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

- Large foam floor tiles can be a tool to engage the class in a whole-group activity prior to giving the children small tiles to handle themselves.
- In the absence of tiles, square sticky notes can be a good substitute for this activity.

S: Yes!
T: How is that so? Talk to your partner.
S: It is the same rectangle, just turned on its side. It uses the same number of tiles. It doesn't matter whether you have 2 columns of 5 or 2 rows of 5, because you have 2 groups of 5. It's a rectangle, too.
T: Is this shape also a rectangle?
S: Yes!

Repeat the above process with 15 tiles (5 by 3) and 12 tiles (3 by 4).

**Problem 2: Compose a square from rows and columns.**

T: Let’s look at the array we just made (3 by 4). How can we change this rectangle from three columns of 4 to have the same number of rows and columns? Talk to your partner.

S: Change it to 3 groups of 3. Add another column. Take away one of the rows.

T: (Model taking away a row to make equal rows and columns.)
T: What do you notice about the shape of this array?
S: It’s a square. The columns and rows are equal. There are 3 rows and 3 columns.

T: Let’s see if we can make another square array. Talk to your partner about your thinking as you use all 25 tiles from your bag to create an array with equal rows and columns. (Circulate and offer hints to encourage all students to find the array.)

S: I am going to start by making a row of 5, because I know I can count to 25 by five’s. I will separate the tiles into groups until they are all equal.

T: What does your array look like?
S: Five rows of 5! Five columns and 5 rows! A square!

T: Now keep 16 tiles on your desk and put the rest in your bag.

T: Create an array with equal rows and columns.
S: (Create equal rows and columns.)
T: What strategies did you use to figure out how many rows and how many columns?
S: I started by creating groups of 2. Then I realized that if I made groups of 4, I would have 4 groups. I know that 4 + 4 + 4 + 4 = 16, so I made 4 rows of 4. I made two rows of eight and then saw it was a double of 2 rows of 4, so I just moved half the tiles down.
Lesson 10

Use square tiles to compose a rectangle, and relate to the array model.

T: So what do you know about making an array with equal rows and columns?

S: It’s like there have to be 5 groups with 5 objects in each one. → I know that if you have 4 rows, then there has to be 4 in each row. → I know that you need the same number of groups and the number in each group. → You need the same number of tiles in the rows as in the columns. → It’s a special rectangle, a square!

T: Turn and talk, could we make a square array with 10 tiles?

S: No, because you can’t make equal rows and columns. → Ten tiles can only be 2 rows of 5 or 1 row of 10. → Only certain numbers can make equal rows and columns.

Direct students to move on to the Problem Set.

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 solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Use square tiles to compose a rectangle, and relate to the array model.

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.

You may choose to use any combination of the questions below to lead the discussion.

- For Problems 1(a) and (b), share your rectangles with a partner and describe them using the words rows and columns. How do your rectangles match the repeated addition number sentences?
- For Problems 2(a) and (b), share your rectangles with a partner. How are rectangles composed of equal groups? How does your rectangle match your number sentence?
Lesson 10: Use square tiles to compose a rectangle, and relate to the array model.

- For Problem 3, explain to your partner how you arranged the tiles into a rectangle? How did making equal rows and columns help you to construct the rectangle?
- Squares are special rectangles that have the same number of rows and columns. In Problem 4, you changed a rectangle into a square by removing a column. Is there a different way to make a square from the array?
- What repeated addition sentence would we use to describe a square array with rows of 2? 3? 4? 5? What do you notice?
- Why don’t we relate triangles to an array model?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.

Note: In order to assess student understanding on today’s exit ticket, walk around and directly observe students as they work with the tiles. Take note of how students are building their arrays. Look for understanding of rows and columns as well as the importance of building with no gaps or spaces between the tiles.
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### Lesson 10: Use square tiles to compose a rectangle, and relate to the array model.

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Lesson 10 Problem Set

Name ____________________________ Date ______________

Use your square tiles to construct the following rectangles with no gaps or overlaps on your work mat. Write a repeated addition sentence to match each construction.

1.  
   a. Construct a rectangle with 2 rows of 3 tiles.

   ________________________________

   b. Construct a rectangle with 2 columns of 3 tiles.

   ________________________________

2.  
   a. Construct a rectangle with 5 rows of 2 tiles.

   ________________________________

   b. Construct a rectangle with 5 columns of 2 tiles.

   ________________________________
3.  
   a. **Construct a rectangle of 9 tiles so that the rows are the same size as the columns.**  
      
      ________________________________  

   b. **Construct a rectangle of 16 tiles that has equal rows and columns.**  
      
      ________________________________  

4.  
   a. **What shape is the array pictured below?** _________________________  

   ![Array Image](image)  

   b. **Redraw the above shape with one column removed in the space below.**  

   c. **What shape is the array now?** ________________________________
Use your square tiles to construct the following arrays with no gaps or overlaps on this sheet. Write a repeated addition sentence to match your construction.

1. 
   a. Construct a rectangle with 2 rows of 5 tiles.
   
   b. Write the repeated addition sentence: ____________________________

2. 
   a. Construct a rectangle with 5 columns of 2 tiles.
   
   b. Write the repeated addition sentence: ____________________________
Name ____________________________  Date ______________

Cut out the square tiles below and construct the following arrays with no gaps or overlaps. Write a repeated addition sentence to match each construction on the line.

1. a. Construct a rectangle with 2 rows of 4 tiles.
   __________________________

   b. Construct a rectangle with 2 columns of 4 tiles.
   __________________________

2. a. Construct a rectangle with 3 rows of 2 tiles.
   __________________________

   b. Construct a rectangle with 3 columns of 2 tiles.
   __________________________

3. a. Construct a rectangle using 10 tiles.
   __________________________

   b. Construct a rectangle using 12 tiles.
   __________________________
4.

a. What shape is the array pictured below? ________________________________.

b. Redraw the above shape with one more column in the space below.

c. What shape is the array now? ________________________________.

d. Draw a different array of tiles that is the same shape as 4(c).
Lesson 11

Objective: Use square tiles to compose a rectangle, and relate to the array model.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problem (6 minutes)
- Concept Development (32 minutes)
- Student Debrief (10 minutes)

Total Time (60 minutes)

Fluency Practice (12 minutes)

- Happy Counting by Tens: Crossing 100 2.NBT.2 (3 minutes)
- Sprint: Subtraction Crossing Ten 2.OA.2 (9 minutes)

Happy Counting by Tens: Crossing 100 (3 minutes)

Note: Students skip-count by tens as review of counting equal groups.

T: Let’s count by tens, starting at 360. Ready? (Point up rhythmically until a change is desired. Close hand to stop. Point down to count in the opposite direction.)


T: Excellent! Try it for 30 seconds with your partner, starting at 440. Partner B, you are the teacher today.

Sprint: Subtraction Crossing Ten (9 minutes)

Materials: (S) Subtraction Crossing Ten Sprint

Note: This Sprint gives practice in the grade level fluency of sums to 20.
**Application Problem (6 minutes)**

Ty bakes two pans of brownies. In the first pan he cuts 2 rows of 8. In the second pan he cuts 4 rows of 4.

Draw a picture of Ty's brownie pans.

a. Write a number sentence to show the total number of brownies in each pan.

b. How many brownies did Ty bake altogether? Write a number sentence and a statement to show your answer.

Note: This Application Problem gives students another real-world context for seeing arrays. Encourage them to see the rectangular shape of the rows and columns as you share student work samples.

**Concept Development (32 minutes)**

Materials: (T) 5 red inch tiles, 5 green inch tiles (S) Bag with 25 tiles, personal white board

Assign partners A and B, and call students to sit in a circle at the front of the room.

**Problem 1: Compose rectangles from one row of tiles and write addition sentences to match.**

T: (Show a row of 10 tiles, made with two colors as pictured.)

T: How many rows do you see?

S: 1.

T: How many tiles are in the row?

S: 10.

T: Is this array a rectangle?

S: Yes. It's long and skinny!

T: It is also an array. Tell me about its rows and columns.

S: Yes, it's 1 row of 10. → Yes, you could say 10 columns of 1.

T: How can we arrange these 10 tiles in a different way to form another rectangle? Turn and talk.

S: Move the green tiles so they are under the red tiles. → I know I can count by 2's to 10 so you can make columns of 2 instead of columns of 1. → You can break the row apart so there are two rows of 5.

T: Let's try that. (Move the green tiles to show 2 rows of 5 as pictured.)

T: Now how many rows do you see?
Lesson 11
Use square tiles to compose a rectangle, and relate to the array model.

Date: 11/20/13

NOTES ON MULTIPLE MEANS OF REPRESENTATION:
Point out arrays throughout the day. Use students lining up to walk down the hall, hopscotch grids, wall tile patterns, books on shelves, and more as examples. Engage students in observing these arrays all around them.

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:
Encourage students to play games that involve arrays, like Memory and Tic-Tac-Toe. This can also be a good home connection for families to connect with what students are learning in school.

S: 2!
T: How many in each row?
S: 5!
T: How many columns do you see?
S: 5!
T: How many in each column?

T: Turn and talk, what repeated addition sentences can we make to represent either the columns or rows of this rectangle?
S: 5 + 5 = 10. → 2 + 2 + 2 + 2 + 2 = 10.
T: Now, make a row of 14 tiles on your personal board.
S: (Create a row.)
T: Now, rearrange the tiles to make another array.
S: (Make arrays.)
T: How did you arrange the tiles to make the arrays?
S: I broke the row in half like we did with the row of 10 and slid one under the other. → I made 2 rows of 7 since 7 + 7 is 14. → It’s like the last rectangle; I used the doubles fact to make 2 rows of 7, which makes 14.
T: Add a number sentence underneath your rectangle.
T: What number sentence did you write?
S: I made columns of two. 2 + 2 + 2 + 2 + 2 + 2 + 2 = 14. → I broke the rectangle in half like we did with 10. → I moved half the array to the bottom row so I have 7 + 7 = 14.

Repeat the above process with 16 tiles.

Problem 2: Compose varied rectangles from a given number of tiles.

T: Turn and talk, is there another rectangle we can make using the same 16 tiles?
S: We can break it in half again and make 4 rows of 4. → We can make a square like we did yesterday.
T: Partner A, with the help of Partner B, make a new array.
T: How are your arrays similar and how are they different? Turn and talk.
S: They both have 16 tiles. → One has the same number of rows and columns and the other doesn’t. → You can turn an array with 4 rows of 4 on its side and it looks exactly the same. You can’t do that with 2 rows of 8.
T: Now, each partner count out 12 tiles and arrange them in a row.
Lesson 11

Lesson Objective: Use square tiles to compose a rectangle, and relate to the array model.

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.

You may choose to use any combination of the questions below to lead the discussion.

- Can we call the arrangement in Problem 1(a) an array? How can you describe it in terms of both rows and columns?
- For Problem 1, how is knowing how to make equal groups helpful in constructing a rectangle with 8 tiles? Explain how your number sentence matches your array.
- What strategy did you use in Problem 2 to construct a rectangle with 12 tiles? How are your two rectangles different? How are they the same?
Lesson 11

- How did your rows and columns change when you rearranged your tiles to create a new rectangle for Problem 3?
- For Problem 4, explain how you know that $3 + 3 = 2 + 2 + 2$?
- You constructed two rectangles with 10 tiles for Problem 5. Is it possible to do the same with 11 tiles? Why not?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 11: Use square tiles to compose a rectangle, and relate to the array model.

Lesson 11 Sprint
NYS COMMON CORE MATHEMATICS CURRICULUM

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Lesson 11: Use square tiles to compose a rectangle, and relate to the array model.

Date: 11/20/13

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Lesson 11 Problem Set

Use your square tiles to construct the following arrays with no gaps or overlaps on your work mat. Write a repeated addition sentence to match each construction.

1. a. Place 8 square tiles in a row.
   
   b. Construct an array with the 8 square tiles.
   
   c. Write a repeated addition sentence to match the new array.
      ____________________________

2. a. Construct an array with 12 squares.
   
   b. Write a repeated addition sentence to match the array.
      ____________________________
   
   c. Rearrange the 12 squares into a different array.
   
   d. Write a repeated addition sentence to match the new array.
      ____________________________
3. 
   a. Construct an array with 20 squares.
   
   b. Write a repeated addition sentence to match the array.
      ______________________________
   
   c. Rearrange the 20 squares into a different array.
   
   d. Write a repeated addition sentence to match the new array.
      ______________________________

4. Construct 2 arrays with 6 squares.
   
   a. 2 rows of _____ = _____
   
   b. 3 rows of _____ = 2 rows of _____

5. Construct 2 arrays with 10 squares.
   
   a. 2 rows of _____ = _____
   
   b. 5 rows of _____ = 2 rows of _____
Lesson 11 Exit Ticket

Name ___________________________________________  Date ________________

a. Construct an array with 12 square tiles.

b. Write a repeated addition sentence to match the new array.

________________________________________
Lesson 11: Use square tiles to compose a rectangle, and relate to the array model.

Name ________________________________ Date ________________

1. 
   a. Construct an array with 9 square tiles.
   b. Write a repeated addition sentence to match the new array.

   ________________________________

2. 
   a. Construct an array with 10 squares.
   b. Write a repeated addition sentence to match the array.

   ________________________________
   c. Rearrange the 10 squares into a different array.
   d. Write a repeated addition sentence to match the new array.

   ________________________________

Cut out each square tile and use to construct the arrays in Problems 1-4.
3.
   a. Construct an array with 12 squares.
   b. Write a repeated addition sentence to match the array.
      __________________________
   c. Rearrange the 12 squares into a different array.
   d. Write a repeated addition sentence to match the new array.
      __________________________

   a. 2 rows of _____ = _____
   b. 2 rows of _____ = 7 rows of _____
Lesson 12

Objective: Use math drawings to compose a rectangle with square tiles.

Suggested Lesson Structure

- Fluency Practice (10 minutes)
- Application Problem (6 minutes)
- Concept Development (34 minutes)
- Student Debrief (10 minutes)

Total Time (60 minutes)

Fluency Practice (10 minutes)

- Compensation 2.NBT.5 (5 minutes)
- Grade 2 Core Fluency Differentiated Practice Sets 2.OA.2 (5 minutes)

Compensation (5 minutes)

Note: This fluency drill reviews the mental math strategy of compensation. By making a multiple of 10, students solve a much simpler addition problem. Draw a number bond for the first problem on the board to help students visualize the decomposition.

T: (Write 42 + 19 = _____.) Let’s use a mental math strategy to add. How much more does 19 need to make the next ten?

S: 1 more.

T: Where can 19 get 1 more from?

S: From the 42!

T: Take 1 from 42 and give it to 19. Say the new number sentence, with the answer.

S: 41 + 20 = 61.

T: 37 + 19.

S: 36 + 20 = 56.

Continue with the following possible sequence: 29 + 23, 38 + 19, 32 + 19, 24 + 19, and 34 + 19.

Grade 2 Core Fluency Differentiated Practice Sets (5 minutes)

Materials: (S) Core Fluency Practice Sets

Note: During G2–M6–Topic C and for the remainder of the year, each day’s fluency includes an opportunity
for review and mastery of the sums and differences with totals through 20 by means of the Core Fluency Practice Sets or Sprints. Five options are provided in this lesson for the Core Fluency Practice Set, with Sheet A being the most simple to Sheet E being the most complex. Start all students on Sheet A.

Students complete as many problems as they can in 120 seconds. We recommend 100% accuracy and completion before moving to the next level. Collect any Practice Sets that have been completed within the 120 seconds and check the answers. The next time Core Fluency Practice Sets are used, students who have successfully completed their set can be provided with the next level. Keep a record of student progress.

Consider assigning early finishers a counting pattern and start number (e.g., count by fives from 195). Celebrate improvement as well as advancement. Students should be encouraged to compete with themselves rather than their peers. Discuss with students possible strategies to solve. Notify caring adults of each student’s progress.

Concept Development (34 minutes)

Materials: (T) 1 tile, plain white paper (S) 6 inch tiles, plain white paper

Note: For this lesson, students may convene in a circle on the floor with clipboards (or another hard work surface), or they may remain at their seats if there is a document camera or projector available.

Problem 1: Trace a unit square to draw an array.

T: Make an array with 2 rows of 3 on your paper using the tiles in your bag.
S: (Create a 2 by 3 array.)
T: To draw the same array, we can trace the tile 3 times to make a row and then trace to make another row underneath.
T: Remove the tiles from your paper. Using one tile, make a square in the very top left corner of your paper like I do.
T: We can use the edge of the paper as one of our lines to help keep the array straight.
S: (Draw first square as shown.)
T: What should we do next to create 2 rows of 3? Turn and talk.
S: Make another square in the top row. → Make a square underneath the first one to start the second row.
T: We could do it either way. For now, let’s finish the row of 3, just as we did when we were building arrays row by row. Add two more squares by tracing your tile as I do.
T: (Complete the first row as students do the same.)
Lesson 12:
Use math drawings to compose a rectangle with square tiles.

T: Turn and talk, what is our next step?
S: Add another row. Trace a tile on the bottom to start the second row.
T: Let’s try that. Add another square just below the first one. Do we need to trace the entire square?
S: No!
T: Why not?
S: The bottom line from the first square will be the top line of this square!
T: Draw what I draw. (Add the first square in the second row as pictured.)
T: How many more squares do we need to complete this array?
S: 2!
T: Add the last two squares as I do. (Complete the array as pictured.)
S: (Complete their arrays.)
T: This process reminds me of creating our rulers. How is it the same? Talk to your partner.
S: We are repeating a unit. → We are using a tool to help us make the spaces the same. → We are measuring using the mark and advance technique but going down, too!
T: I hear good observations. This time we are making a unit that is a square, before we were making a length unit.

Have students repeat the above process independently to create an array 2 units wide and 4 units long below the first array. This time the side of the paper will guide them. Then distribute another piece of paper.

Problem 2: Draw an array without the use of a tile.

T: This time, we will draw most of the array without the tile. To start, let’s make one square in the middle of the page. (Model tracing to make one square in the middle of the page as pictured.)
T: Let’s start with the top side of the next square. Tell me when to stop drawing. (Make the line as pictured above.)
S: Stop!
T: Is the length of the line about the same length as the first tile?
S: Yes!
T: Your turn. Draw that line on your paper.

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:
Model this process outdoors, drawing with sidewalk chalk on pavement around foam squares or a square piece of construction paper.
T: Let’s draw the bottom of the square. Again, say when to stop. (Add the line as pictured.)
S: Stop!
T: Is the bottom line the same length as the top line?
S: Yes!
T: Add that line to your drawing.
T: Let’s close the square by making a third line. (Add the last line of the square as pictured.)
T: Does the square I drew look pretty much the same as the square I traced?
S: Yes!
T: Now it’s your turn. Complete your square on your paper.
S: (Draw the line to close the square.)
T: How many more squares do we need in this row to make 1 row of 3?
S: 1!
T: Draw one more square the way we made the last one. Then hold your paper up with two hands for me to see.
T: (Check student work.)
T: Let’s start the second line together.
T: I will draw the line and you say when to stop. (Add another line to start the first square in the second row.)
S: Stop!
T: Is this line the same length as the side of the first square?
S: Yes!
T: Add that line to your drawing. (Circulate.)
S: (Draw.)
T: Work to draw 3 rows of 3 squares.
T: What shape did you end up making?
S: A square!
T: What shape had you made after making 2 rows of 3?
S: A rectangle!

Check student work before moving on. When students are ready have them finish the second row of the array independently. If more practice is needed, have them complete an array with 2 rows of 5, offering support when needed, otherwise move them directly to the Problem Set and then to the Application Problem.

**Problem Set (10 minutes)**

Note: Students will need 1 square tile for both the Problem Set and the Homework sheet.

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 solve these problems using the RDW approach used for Application Problems.

**Application Problem (6 minutes)**

Note: This Application Problem serves as a practice of the previous day’s lesson. The extension, however, invites students to apply understandings from today’s lesson as well. For this reason, it follows the Concept Development.

Lulu made a pan of brownies. She cut them into 3 rows and 3 columns.

- **a.** Draw a picture of Lulu’s brownies in the pan.
- **b.** Write a number sentence to show how many brownies Lulu has.
- **c.** Write a statement about Lulu’s brownies.

**Extension:** How should Lulu cut her brownies if she wants to serve 12 people? 16 people? 20 people?

**Student Debrief (10 minutes)**

**Lesson Objective:** Use math drawings to compose a rectangle with square tiles.

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.

You may choose to use any combination of the questions below to lead the discussion.

- For Problems 3(a) and (b), what was your first step in drawing a rectangle?
- Explain to your partner how to draw a rectangle with one square tile. Why was precision important today? How is this different from drawing an array with X’s?
Lesson 12: Use math drawings to compose a rectangle with square tiles.

- For Problems 1 and 2, discuss with your partner how the repeated addition number sentence relates to the number of units in each rectangle.
- What was challenging about drawing a rectangle without tracing the square tile in Problem 3? What did you need to be sure to do?
- How does drawing a rectangle support the idea of composing a larger unit from smaller units? Use the terms square, rows, and columns in your response.

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Use math drawings to compose a rectangle with square tiles.

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Lesson 12 Core Fluency Practice Set D

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Lesson 12: Use math drawings to compose a rectangle with square tiles.

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1. Draw without using a square tile to make an array with 2 rows of 5.

   2 rows of $5 = \underline{\hspace{2cm}}$
   
   $\underline{\hspace{1cm}} + \underline{\hspace{1cm}} = \underline{\hspace{2cm}}$

2. Draw without using a square tile to make an array with 4 columns of 3.

   4 columns of $3 = \underline{\hspace{2cm}}$
   
   $\underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} = \underline{\hspace{2cm}}$
3. Complete the following arrays without gaps or overlaps. The first tile has been drawn for you.

a. 3 rows of 4

```
  |
  |
  |
```

b. 5 columns of 3

```
  |
  |
  |
  |
  |
```

c. 5 columns of 4

```
  |
  |
  |
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```
1. Draw an array of 3 columns of 3 starting with the square below without gaps or overlaps.

\[
\begin{array}{|c|c|c|}
\hline
& & \\
\hline
& & \\
\hline
\end{array}
\]
Lesson 12 Homework

Name ___________________________________ Date ________________

1. Cut out and trace the square tile to draw an array with 2 rows of 4.

2 rows of 4 = ______

_____ + _____ = _____

2. Trace to make an array with 3 columns of 5.

3 columns of 5 = ______

_____ + _____ + _____ = _____
3. Complete the following arrays without gaps or overlaps. The first tile has been drawn for you.

a. 4 rows of 5

b. 5 columns of 2

c. 4 columns of 3
Lesson 13

Objective: Use square tiles to decompose a rectangle.

Suggested Lesson Structure

- Fluency Practice (10 minutes)
- Concept Development (33 minutes)
- Application Problem (7 minutes)
- Student Debrief (10 minutes)

Total Time (60 minutes)

Fluency Practice (10 minutes)

- Making the Next Ten to Add 2.OA.2, 2.NBT.5 (5 minutes)
- Grade 2 Core Fluency Differentiated Practice Sets 2.OA.2 (5 minutes)

Making the Next Ten to Add (5 minutes)

Note: This drill reviews making a ten to add.

S: 10 + 3.
T: Answer.
S: 13.

Continue with the following possible sequences:

19 + 4, 29 + 4, 29 + 14, 59 + 14  
9 + 6, 19 + 6, 19 + 16, 49 + 16  
8 + 3, 18 + 3, 18 + 13

8 + 5, 18 + 5, 18 + 15, 38 + 15  
7 + 6, 17 + 6, 17 + 16, 37 + 16  
7 + 4, 17 + 4, 67 + 4

Grade 2 Core Fluency Differentiated Practice Sets (5 minutes)

Materials: (S) Core Fluency Practice Sets from G2–M6–Lesson 12

Note: During G2–M6–Topic C and for the remainder of the year, each day’s fluency includes an opportunity for review and mastery of the sums and differences with totals through 20 by means of the Core Fluency Practice Sets or Sprints. The process is detailed and Practice Sets provided in G2–M6–Lesson 12.
**Concept Development (33 minutes)**

Materials: (S) Bag with 25 square tiles, personal white board with insert, ruler

For the following Concept Development, model the work for students using an overhead projector or document camera.

T: With your partner, use the tiles in your bag to construct a rectangle with 4 rows of 5 on your personal board. Tell your partner the total number of tiles in your rectangle and how you know.

T: (Model a rectangle with 4 rows of 5 using the overhead projector.)

S: There are 20 tiles because $5 + 5 + 5 + 5 = 20$. → 20 because $4 + 4 + 4 + 4 = 20$.

T: Write the number of rows and the number in each row as the whole in your number bond as I do. (Model writing 4 rows of 5 under the rectangle.)

S: (Write 4 rows of 5 as pictured.)

T: How can we decompose this rectangle into two equal parts? Turn and talk.

S: I know that $10 + 10$ makes 20, so we could put 10 on one side and 10 on the other. → If we split it down the center like how we spread out the rows of lima beans with a ruler, we can make it half and half. → Two equal parts would be 2 rows of 5 on one side and 2 rows of 5 on the other.

T: Use your ruler to break your rectangle into two equal parts as I do. (Model using the ruler to break the rectangle.)

T: (Circulate as students decompose rectangles as pictured.)

T: How many rows do you have in each part?

S: Two rows!

T: How many tiles in each row?

S: 5!

T: Write 2 rows of 5 for each part of your number bond.

T: (Model writing 2 rows of 5 in each part of the number bond.)
Lesson 13: Use square tiles to decompose a rectangle.

T: If $5 + 5 + 5 + 5$ represented the rectangle before we decomposed it, what number sentence can you use to describe each part?

S: $5 + 5 = 10$!

T: Write $5 + 5 = 10$ below the parts of the number bond. (Model writing the number sentences under each part.)

S: (Write number sentences.)

T: Tell your partner the two parts and the whole using a number sentence.

S: Two rows of 5 and 2 rows of 5 makes 4 rows of 5.

Repeat the process with 6 columns of 2, decomposing by columns rather than by rows.

T: With your partner, count out 16 tiles. Then construct a rectangle on your desk with 4 rows.

T: (Circulate as students work.)

T: How many rows did you make?

S: 4!

T: How many tiles are in each row?

S: 4!

T: Say the number sentence.

S: $4 + 4 + 4 + 4 = 16$!

T: What do 4 rows of 4 equal?

S: 16!

T: Take away a row.

T: Turn and talk, what is the new total for the rectangle and how do you know?

S: 12 because $4 + 4 + 4 = 12$. $\rightarrow$ 12 because $16 - 4 = 12$. $\rightarrow$ 3 fours is 12.

T: Remove one column.

T: How many tiles do you have now, and how do you know? Turn and talk.

S: Nine, because there are 3 rows of 3 and $3 + 3 + 3 = 9$. $\rightarrow$ I see 3 threes and that's 9. $\rightarrow$ Nine, because $12 - 3 = 9$.

Repeat the above process with a rectangle of 25 tiles.

Notes on Multiple Means of Action and Expression:
Some students will be able to express their arrays in multiplication number sentences and will be eager to show off their expertise. Encourage them to write both types of number sentences and share how they know with another student.
Lesson 13: Use square tiles to decompose a rectangle.

Date: 11/20/13

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 solve these problems using the RDW approach used for Application Problems.

Application Problem (7 minutes)

Note: This Application Problem provides an opportunity for students to apply understandings from this day’s lesson, so it follows the Concept Development. If necessary, provide manipulatives for students to use when solving the problem.

Ellie bakes a square pan of 9 lemon bars. Her brothers eat 1 row of her treats. Then her mom eats 1 column.

a. Draw a picture of Ellie’s lemon bars before any are eaten. Write a number sentence to show how to find the total.

b. Write an X on the bars that her brothers eat. Write a new number sentence to show how many are left.

c. Draw a line through the bars that her mom eats. Write a new number sentence to show how many are left.

d. How many bars are left? Write a statement.

Student Debrief (10 minutes)

Lesson Objective: Use square tiles to decompose a rectangle.

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.

You may choose to use any combination of the questions below to lead the discussion.

- How does your number bond show how you decomposed, or broke apart, your rectangle in Problem 1?
- In Problem 2, what do you notice is the same in the whole and parts of your number bond? (A unit of two.) How does your repeated addition sentence change without one row?
After completing Problem 3, defend how you know that a rectangle can be decomposed into smaller rectangles. Describe the two smaller rectangles that you found in 5 columns of 3. Use the terms rows, columns, units, and repeated addition.

What was your strategy for composing a rectangle with 12 squares for Problem 4? How many different possibilities are there?

For Problem 5, how is removing a row from a rectangle with 2 rows of 10 different from removing a row from 5 rows of 4? Which one will leave you with more squares?

For Problem 6, share with a partner all of the different ways that you could break apart a rectangle made up of 16 square tiles.

**Exit Ticket (3 minutes)**

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students' understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 13 Problem Set

Name ____________________________ Date ______________

Use your square tiles and work mat. Follow the instructions.

**Problem 1**

Step 1: Construct a rectangle with 4 columns of 3.
Step 2: Separate 2 columns of 3.
Step 3: Write a number bond to show the whole and two parts.

Step 4: Write a repeated addition sentence to match each part of the number bond.

**Problem 2**

Step 1: Construct a rectangle with 5 rows of 2.
Step 2: Separate 1 row of 2.
Step 3: Write a number bond to show the whole and two parts.

Step 4: Write a repeated addition sentence to match each part of the number bond.

**Problem 3**

Step 1: Construct a rectangle with 5 columns of 3.
Step 2: Separate 3 columns of 3.
Step 3: Write a number bond to show the whole and two parts.

Step 4: Write a repeated addition sentence to match each part of the number bond.
4. Use your square tiles to construct a rectangle with 12 squares with 3 rows.
   
   a. _____ rows of _____ = 12
   
   b. Remove 1 row. How many squares are there now? _____
   
   c. Remove 1 column from the new rectangle you made in 4(b). How many squares are there now? _____

5. Use your square tiles to construct a rectangle with 20 squares.
   
   a. _____ rows of _____ = _____
   
   b. Remove 1 row. How many squares are there now?
   
   c. Remove 1 column from the new rectangle you made in 5(b). How many squares are there now?

6. Use your square tiles to construct a rectangle with 16 squares.
   
   a. _____ rows of _____ = _____
   
   b. Remove 1 row. How many squares are there now?
   
   c. Remove 1 column from the new rectangle you made in 6(b). How many squares are there now?
Use your square tiles to complete the steps for each problem.

Step 1: Construct a rectangle with 3 columns of 4.
Step 2: Separate 2 columns of 4.
Step 3: Write a number bond to show the whole and two parts.

Step 4: Write a repeated addition sentence to match each part of the number bond.
Lesson 13 Homework

Name ___________________________________ Date _________________

Cut out and use your square tiles to complete the steps for each problem.

Problem 1
Step 1: Construct a rectangle with 5 rows of 2.
Step 2: Separate 2 rows of 2.
Step 3: Write a number bond to show the whole and two parts.

Step 4: Write a repeated addition sentence to match each part of your number bond.

Problem 2
Step 1: Construct a rectangle with 4 columns of 3.
Step 2: Separate 2 columns of 3.
Step 3: Write a number bond to show the whole and two parts.

Step 4: Write a repeated addition sentence to match each part of your number bond.
3. Use your square tiles to construct a rectangle with 9 squares with 3 rows.

   a. _____ rows of _____ = _____

   b. Remove 1 row. How many squares are there now? _____

   c. Remove 1 column from the new rectangle you made in 4(b). How many squares are there now? _____

4. Use your square tiles to construct a rectangle with 14 squares.

   a. _____ rows of _____ = _____

   b. Remove 1 row. How many squares are there now? _____

   c. Remove 1 column from the new rectangle you made in 5(b). How many squares are there now? _____
Use square tiles to decompose a rectangle.

Date: 11/20/13
Lesson 14

Objective: Use scissors to partition a rectangle into same-size squares, and compose arrays with the squares.

Suggested Lesson Structure

- Fluency Practice: 12 minutes
- Concept Development: 38 minutes
- Student Debrief: 10 minutes
- Total Time: 60 minutes

Fluency Practice (12 minutes)

- Sprint: Subtraction from Teens 2.OA.2 (8 minutes)
- Coin Drop 2.OA.2 (2 minutes)
- More and Less 2.NBT.5 (2 minutes)

Sprint: Subtraction from Teens (8 minutes)

Materials: (S) Subtraction from Teens Sprint

Note: Students practice subtraction from teens in order to gain mastery of the sums and differences within 20.

Coin Drop (2 minutes)

Materials: (T) 10 dimes, 10 pennies, metal or plastic can

Note: In this activity, students practice adding and subtracting ones and tens using coins, in preparation for G2–Module 7.

T: (Hold up a penny.) Name my coin.
S: A penny.
T: How much is it worth?
S: 1 cent.
T: Listen carefully as I drop coins in my can. Count along in your minds.

Drop in some pennies and ask how much money is in the can. Take out some pennies and show them. Ask how much money is still in the can. Continue adding and subtracting pennies for a minute or so. Then repeat the activity with dimes, then with dimes and pennies.
Lesson 14: Use scissors to partition a rectangle into same-size squares, and compose arrays with the squares.

Date: 11/20/13

More and Less (2 minutes)

Materials: (T) 10 dimes, 10 pennies

Note: In this activity, students practice adding and subtracting ones and tens using coins.

T: Let’s count by tens. (Move dimes to the side while counting.)
S: 10, 20, 30, 40, 50, 60.
T: How many dimes are shown?
S: 6 dimes.
T: What is the value of 6 dimes?
S: 60 cents.
T: What is 5 cents more? (Move 5 pennies.)
S: 65 cents.
T: Give the number sentence.
S: 60 cents + 5 cents = 65 cents.
T: What is 10 cents less? (Move one dime.)
S: 55 cents.
T: Give the number sentence.
S: 65 cents – 10 cents = 55 cents.

Repeat this line of questioning by starting with 7 dimes, removing 3 dimes, and asking for the number sentence. Continue by adding 3 pennies and asking for the number sentence, adding 4 dimes and asking for the number sentence, and so forth.

Concept Development (38 minutes)

Materials: (T) Lesson template for demonstration (S) Lesson template, Problem Set, scissors

In this lesson, the Problem Set is used during the Concept Development.

T: Today we’re going to use the Problem Set for our lesson! We’ll use the sentence frames to record our answers and to speak in complete sentences.

Pass out the template, Problem Set, and scissors. For each step of the instructions, model as students work along with you. Circulate to be sure students are following the steps accurately.

T: Cut Rectangle A into rows and complete Problem 1. Share your responses and thinking with your partner. (Allow students time to work and share.)
Lesson 14: Use scissors to partition a rectangle into same-size squares, and compose arrays with the squares.

Date: 11/20/13

T: Cut Rectangle B into columns and complete Problem 2. Share again.

T: Put both rectangles back together again. Move the columns of Rectangle B so they are sitting directly on top of the rows of Rectangle A with no gaps or overlaps. Talk to your partner about what you notice.

S: They both show the same amount, and they’re both the same size and shape. → I can see the same rectangle different ways: it’s 2 rows of 4, 4 columns of 2 or, 8 squares. → They’re both made up of rows and columns with the same total.

T: You’ve recognized that we can decompose the same rectangle into rows, columns or unit squares.

T: Take both your rows of 4 and cut them to show 4 twos instead of 2 fours.

T: (Demonstrate as necessary.) Put together your twos to form one long rectangle that has 8 columns of 2.

T: Imagine we were going to put 2 rows on top to make the exact same rectangle. Talk to your partner. Explain what those rectangles would be.

S: I see it would be 2 rows of 8. → We need 2 eights. → They would be 2 of the long skinny rectangles.

T: We can decompose this rectangle into 2 rows of 8 or 8 columns of 2.

T: Cut out all your squares from Rectangles A and B. How many squares do you have now?

S: 16!

T: Use your 16 squares to answer Problem 3.

T: To answer Problem 4, cut out your squares from Rectangles A, B, and C.

Circulate as students experiment with their squares to form their rectangles. Ask them questions about each rectangle to support their spatial structuring, such as, "How many rows do you see in this rectangle?" or, "How many columns?" This lesson’s intent is to give practice in seeing the same rectangle both as rows and columns. It is important for them to work with more tiles to increase the complexity of the work. Encourage them to see the array with 24 squares as a rectangle, rather than as many squares. Students who struggle can work with fewer squares.

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:
If you have students who miss lessons in the module and others who struggle to grasp the concept, ask the struggling students to explain the array concepts to the previously absent students. This will help the struggling students to clarify their thinking or discover what questions to ask in order to understand the concept better.
Student Debrief (10 minutes)

Lesson Objective: Use scissors to partition a rectangle into same-size squares, and compose arrays with the squares.

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. At the end of the Debrief today, review and clarify the directions for the Homework to check for student understanding.

You may choose to use any combination of the questions below to lead the discussion.

- What did we learn about our rectangles by first cutting them into rows and columns before cutting out each individual square?
- If you were to write a number sentence to describe the work we did in Problem 2, what would it look like? Why? How does this relate to the columns you cut out?
- For Problem 3, what was your strategy for composing a new rectangle? How did the rows and columns change?
- For Problem 4, what strategy did you use to compose a new rectangle with 24 squares?
- How many different possibilities can you think of for composing a rectangle with 24 squares? How many different number sentences? How do they match the rows and columns of your array?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
### Lesson 14 Sprint

**A**

**Subtract.**

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**# Correct _____**
Use scissors to partition a rectangle into same-size squares, and compose arrays with the squares.

### Lesson 14 Sprint

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</table>
Lesson 14 Problem Set

Name ___________________________ Date ________________

Cut out Rectangles A, B, and C, then cut according to directions. Answer each of the following using Rectangles A, B, and C.¹

1. Cut out each row of Rectangle A.
   a. Rectangle A has _____ rows.
   b. Each row has ______ squares.
   c. _____ rows of _____ = _____
   d. Rectangle A has ______ squares.

2. Cut out each column of Rectangle B.
   a. Rectangle B has _____ columns.
   b. Each column has ______ squares.
   c. _____ columns of _____ = _____
   d. Rectangle B has ______ squares.

¹ Note: This Problem Set is used with a template of three identical arrays measuring 2 inches by 3 inches, labeled as Rectangles A, B, and C.
3. Cut out each square from both Rectangles A and B.

   a. Construct a new rectangle using all 16 squares.
   
   b. My rectangle has ______ rows of ______.
   
   c. My rectangle also has______ columns of ______.
   
   d. Write two repeated addition sentences to match your rectangle.

4. Construct a new array using the 24 squares from Rectangles A, B, and C.

   a. My rectangle has ______ rows of ______.
   
   b. My rectangle also has______ columns of ______.
   
   c. Write two number repeated addition sentences to match your rectangle.

Extra time? Construct another array using the squares from Rectangles A, B, and C.

   a. My rectangle has______ rows of ______.
   
   b. My rectangle also has______ columns of ______.
   
   c. Write two repeated addition number sentences to match your rectangle.
1. With your tiles, show 1 rectangle with 12 squares. Complete the sentences below.

I see _____ rows of ____.

In the exact same rectangle, I see _____ columns of ____.
Lesson 14 Homework

Name ________________________________ Date ________________

1. Imagine that you have just cut this rectangle into rows.
   a. What do you see? Draw a picture.

   How many squares are in each row? _______

   b. Imagine that you have just cut this rectangle into columns. What do you see? Draw a picture.

   How many squares in each column? _______

2. Create another rectangle using the same number of squares.

   How many squares in each row? _______
   How many squares in each column? ______

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3. Imagine that you have just cut this rectangle into rows.
   a. What do you see? Draw a picture.

   How many squares are in each row? _______

   b. Imagine that you have just cut this rectangle into columns. What do you see?
   Draw a picture.

   How many squares in each column? _______

4. Create another rectangle using the same number of squares.

   How many squares in each row? _______
   How many squares in each column? _______
Lesson 14: Use scissors to partition a rectangle into same-size squares, and compose arrays with the squares.

Date: 11/20/13

6.C.66

Rectangle A

Rectangle B

Rectangle C
Lesson 15

Objective: Use math drawings to partition a rectangle with square tiles, and relate to repeated addition.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problem (6 minutes)
- Concept Development (32 minutes)
- Student Debrief (10 minutes)
- Total Time (60 minutes)

Fluency Practice (12 minutes)

- Sprint: Subtract Crossing the Ten 2.OA.2, 2.NBT.5 (8 minutes)
- Using the Nearest Ten to Subtract 2.NBT.5 (2 minutes)
- Subtract Common Units 2.NBT.5, 2.NBT.7 (2 minutes)

Sprint: Subtract Crossing the Ten (8 minutes)

Materials: (S) Subtract Crossing the Ten Sprint

Note: Students practice subtracting crossing the ten in preparation for the lesson and to gain mastery of the sums and differences within 20.

Using the Nearest Ten to Subtract (2 minutes)

Note: Reviewing the Grade 1 skill of counting up and down to 10 to subtract gives students a mental strategy to subtract fluently with larger numbers.

T: (Post 16 – 9 on the board.) Raise your hand when you know the answer to 16 – 9.
S: 7.
T: Break 16 apart into 10 and 6. (Write in the bond.) What is 10 – 9?
S: 1.
T: 1 + 6 is?
S: 7.

Continue with the following possible sequence: 15 – 9, 13 – 8, 15 – 7, 16 – 7, 12 – 9, 13 – 7, 23 – 7, 25 – 7,
Lesson 15: Use math drawings to partition a rectangle with square tiles, and relate to repeated addition.

Subtract Common Units (2 minutes)

Note: Reviewing this mental math fluency prepares students for understanding the importance of the subtraction algorithm and place value.

T: (Project 77.) Say the number in unit form.
S: 7 tens 7 ones.
T: (Write 77 – 22 = ____.) Say the subtraction sentence and answer in unit form.
S: 7 tens 7 ones – 2 tens 2 ones = 5 tens 5 ones.
T: Write the subtraction sentence on your personal boards.

Repeat the process for 88 – 33, 66 – 44, 266 – 44, 55 – 33, and 555 – 33.

Application Problem (6 minutes)

Rick is filling his muffin pan with batter. He fills 2 columns of 4. One column of 4 is empty. Draw to show the muffins and the empty column. Then write a repeated addition sentence to tell how many muffins Rick makes and how many muffin cups there are in the pan.

Note: This problem is intended for independent practice. Students apply learning from the previous day’s lesson (distinguishing units within units) to a familiar situation, which leads into today’s Concept Development, wherein students shade in given arrays.

Concept Development (32 minutes)

Materials: (T) Extra 6 by 8 grids for independent practice (S) Problem Set, crayons or colored pencils

Note: In this lesson, the Problem Set comprises the Concept Development. Circulate as students complete arrays, monitoring comprehension.

T: Remind me what we discovered yesterday when we worked with rectangles.

S: We can cut up a rectangle into rows and columns. → There are lots of small squares inside the rectangle. → I was thinking how it’s kind of like there are smaller numbers inside bigger numbers.

T: What an interesting connection! Yes, in all kinds of ways, smaller units combine to make larger units, and larger units can be decomposed into smaller units.

T: We’re going to use the Problem Set again for today’s lesson. Look at Problem 1. Tell your partner what you see.

S: A large rectangle. → A lot of small squares inside the large rectangle. → An array.
Lesson 15: Use math drawings to partition a rectangle with square tiles, and relate to repeated addition.

Date: 11/20/13

T: That’s all true. Problem 1 says shade, or color, in an array with 2 rows of 3. Are we going to color in the whole rectangle?
S: No!
T: Starting in the upper left corner, how many squares are we going to color in the first row?
S: 3 squares!
T: Let’s color that first row green. (Model as students do the same.)
T: What should we do next?
S: Color in another row of 3 under the first row.
T: Yes! Do that with me, this time using a different color. (Model as students do the same.)
T: Now tell your partner what you see.
S: I see 2 rows of 3. → I see 6 colored squares, 3 + 3. → I see 2 threes.
T: Ah! I like the way you related repeated addition to the array. There are 2 threes, so 3 + 3. Let’s write that on the line next to the array. (Write 3 + 3 = 6 as students do the same.)
T: Let’s do Problem 2. How many rows are we going to color?
S: 4 rows!
T: How many squares in each row do we need to color?
S: 3 squares!
T: Color in an array that shows 4 rows of 3. Use a different color for each row. (Model as students do the same.)
T: Now, write the repeated addition sentence for the array, and share what you wrote with your partner.
S: 3 + 3 + 3 + 3 = 12.
T: That’s right! Let’s read Problem 3: Shade in an array with 5 columns of 4. How many columns are we going to color?
S: 5 columns!
T: How many squares should we color in each column?
S: 4 squares!
T: All right, color in 5 columns of 4. Again, use a different color for each column. (Model as students do the same.)

Before moving on to the next activity, provide support to struggling students. Allow students who demonstrate proficiency to work independently with the following sequence on the extra grids without changing colors for each row or column: 5 rows of 5, 3 columns of 4, and an array of their choosing, writing a repeated addition sentence that represents each array.
T: Let’s try something different! Look at Problem 4. Draw one more column of 2 to make a new array.

T: Are we adding another row or another column?
S: Another column!
T: Draw another column of 2. (Model as students do the same.)
T: How many columns are there now?
S: 5 columns!
T: How many in each column?
S: 2!
T: Yes! Each column has a group, or unit, of two! How many twos are there altogether?
S: 5 twos!
T: What is a repeated addition sentence for the new array?
S: \(2 + 2 + 2 + 2 + 2 = 10\)
T: Excellent! Now, work with your partner to complete Problems 5 and 6. Be sure to read the directions carefully, and use your models to explain why your repeated addition sentences match.

Provide support for struggling students while students work independently.

**Student Debrief (10 minutes)**

**Lesson Objective:** Use math drawings to partition a rectangle with square tiles, and relate to repeated addition.

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.
Lesson 15: Use math drawings to partition a rectangle with square tiles, and relate to repeated addition.

You may choose to use any combination of the questions below to lead the discussion.

- In what way did your array change from Problem 1 to Problem 2? How did your number sentence change? How are the totals related?
- In Problem 3, each column is like a unit of how many? How does that relate to your number sentence?
- For Problem 4, if you were to continue adding columns of 2, would your new array look more like a train or a tower? If you wanted to increase the total number of tiles quickly, would you suggest adding more rows or columns? Why?
- Why couldn’t you draw another column of 2 in Problem 5? Given what you know about rectangles, what did you need to be sure to do? Explain how you know that your number sentence is correct by matching it to your drawing.
- How many squares are in your 2 new columns in Problem 6? Why? In what way does this array show that big units are made up of smaller units? (Use rows, columns, square, and rectangle in your response.)

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 15: Use math drawings to partition a rectangle with square tiles, and relate to repeated addition.

Date: 11/20/13

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### B

**Subtract.**

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<td>11 - 6 =</td>
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</table>
Lesson 15: Use math drawings to partition a rectangle with square tiles, and relate to repeated addition.

1. Shade in an array with 2 rows of 3.
   Write a repeated addition sentence for the array.

2. Shade in an array with 4 rows of 3.
   Write a repeated addition sentence for the array.

   Write a repeated addition sentence for the array.
4. Draw one more column of 2 to make a new array.

```
  ┌───┬───┐
  │   │   │
  └───┴───┘
```

Write a repeated addition sentence for the new array.

```
2 + 2 = 4
```

5. Draw one more row of 4 and then one more column to make a new array.

```
  ┌───┬───┬───┬───┐
  │   │   │   │   │
  └───┴───┴───┴───┘
```

Write a repeated addition sentence for the new array.

```
2 + 2 + 4 = 8
```

6. Draw one more row and then two more columns to make a new array.

```
  ┌───┬───┬───┬───┐
  │   │   │   │   │
  └───┴───┴───┴───┘
```

Write a repeated addition sentence for the new array.

```
2 + 2 + 4 + 4 = 12
```
1. Shade in an array with 3 rows of 5.

Write a repeated addition sentence for the array.

________________________
Name ________________________________ Date ________________

1. Shade in an array with 3 rows of 2.

Write a repeated addition sentence for the array.


Write a repeated addition sentence for the array.


Write a repeated addition sentence for the array.
4. Draw one more column of 2 to make a new array.

Write a repeated addition sentence for the new array.

5. Draw one more row of 3 and then one more column to make a new array.

Write a repeated addition sentence for the new array.

6. Draw one more row and then two more columns to make a new array.

Write a repeated addition sentence for the new array.
Lesson 16

Objective: Use grid paper to create designs to develop spatial structuring.

Suggested Lesson Structure

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency Practice</td>
<td>12 minutes</td>
</tr>
<tr>
<td>Application Problem</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Concept Development</td>
<td>33 minutes</td>
</tr>
<tr>
<td>Student Debrief</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Total Time</td>
<td>60 minutes</td>
</tr>
</tbody>
</table>

Fluency Practice (12 minutes)

- Get to 10, 20, or 30 2.OA.2 (4 minutes)
- Count by Ten or One with Dimes and Pennies 2.OA.2 (3 minutes)
- Grade 2 Core Fluency Differentiated Practice Sets 2.OA.2 (5 minutes)

Get to 10, 20, or 30 (4 minutes)

Materials: (S) 3 dimes and 10 pennies

Note: This activity uses dimes and pennies to help students become familiar with coins, while simultaneously providing practice with missing addends to ten(s).

For the first two minutes:

- Step 1: Lay out 0–10 pennies in 5-group formation and ask students to identify the amount shown (e.g., 9 cents).
- Step 2: Ask for the addition sentence to get to a dime (e.g., 9 cents + 1 cent = 1 dime).

For the next two minutes:

- Repeat Steps 1 and 2, then add a dime and ask students to identify the amount shown (e.g., 1 dime 9 cents + 1 cent = 2 dimes).

Count by Ten or One with Dimes and Pennies (3 minutes)

Materials: (T) 10 dimes and 10 pennies

Note: This activity uses dimes and pennies as abstract representations of tens and ones to help students become familiar with coins, while simultaneously providing practice with counting forward and back by ten or one.
Lesson 16

NYS COMMON CORE MATHEMATICS CURRICULUM

Lesson 16:

Use grid paper to create designs to develop spatial structuring.

Date: 11/20/13

6.C.80

First minute: Place and take away dimes in a 5-group formation as students count along by 10.

Second minute: Begin with 2 pennies. Ask how many ones there are. Instruct students to start at 2 and add and subtract 10 as you place and take away dimes.

Third minute: Begin with 2 dimes. Ask how many tens there are. Instruct students to begin at 20 and add and subtract 1 as you place and take away pennies.

Grade 2 Core Fluency Differentiated Practice Sets (5 minutes)

Materials: (S) Core Fluency Practice Sets from G2–M6–Lesson 12

Note: During G2–M6–Topic C and for the remainder of the year, each day’s fluency includes an opportunity for review and mastery of the sums and differences with totals through 20 by means of the Core Fluency Practice Sets or Sprints. Practice Sets, along with details about the process, are provided in G2–M6–Lesson 12.

Application Problem (5 minutes)

Rick is baking muffins again. He filled 3 columns of 3, and left one column of 3 empty. Color the pan to show what the muffin pan looked like. Write a repeated addition sentence to tell how many muffins he makes and how many muffin cups are in the whole pan.

Note: This problem is intended for independent practice of the previous day’s concept. Given an array with one column missing, students fill in the missing units to complete the array. Then, they find the total by relating the completed array to repeated addition.

Concept Development (33 minutes)

Materials: (T) Grid paper template, inch tiles (S) Problem Set, grid paper template, scissors, colored pencils or crayons, personal white board; 1 grid paper template on colored paper per four students

Note: The Problem Set will be completed during the course of the Concept Development today, rather than at the end.

In this lesson, students extend their earlier work of composing and decomposing rectangles using tiles. Here, they create tessellations, fitting their inch tiles together with no gaps or overlaps to make patterns that could, theoretically, extend indefinitely. This highly engaging activity serves the important purpose of further developing students’ spatial structuring ability, preparing them to work with area in Grade 3, while generating work well suited for classroom display.

T: We’ve used square tiles to put together and break apart rectangles, but did you know we can also use them to create designs?
Lesson 16: Use grid paper to create designs to develop spatial structuring.

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T: (Project grid paper.) Watch how I place my tiles. (Place tiles on top of grid to create the image at the top of the next page.)

T: Talk with your partner about the design. How can you describe it?

S: It goes red, white, red, white, red, white, red, white, red. \(\rightarrow\) It has 5 red squares and 4 empty spaces. \(\rightarrow\) It looks like an array, with 3 rows and 3 columns.

T: Good attention to detail, and I like the way you used math language! I can create the same design again by shading in this same pattern. (Shade in the identical design on the grid paper.)

Be sure students are seated in groups of four for this activity. Pass out one white grid paper template per student and one colored paper template for every four students. Instruct students to slide the white grid template into their personal boards, and have their dry erase markers ready. Instruct each student to cut off two rows of colored squares for themselves, and then pass the paper to the next person in the group.

T: Now it’s your turn to try! Cut out 5 individual squares from the colored grid paper. (Pause.)

T: Use the squares to copy my design on top of your board.

T: Then, carefully remove the squares and, with your marker, shade in the squares to create the design on your board.

Circulate to check for understanding as students recreate the design.

T: Now you get to create your own design! Listen and follow my directions carefully.

Problem 1: Create a design using 10 tiles.

T: Cut out 5 more squares from the colored sheet. (Pause.)

T: Now cut one square in half diagonally so that you have two triangles. (Pause.)

T: Use all of your 10 tiles to create a design on top of your grid. Then, use your marker to shade in your design on your white board.

T: Pay careful attention to which grid squares to color and how many spaces to leave.

T: When you’re finished, share your design with a partner.

T: (Allow students time to work and share.) Now, hold up your designs, so we can admire each other’s creative work!

Circulate to provide support as students work.

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

- Search online for tessellations to show their connection to artwork and patterns, including real life tessellations in quilts, historical mosaics, and tiling in buildings and homes, as well as many works by M.C. Escher.

- Offer students puzzles such as Perpetual Puzzles or other puzzles that use same-shaped pieces, and point out how they form tessellations.
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Problem 2: Create a design using 16 tiles.
   T: Cut out 6 more squares. (Allow students time to cut.)
   T: Cut 2 of those square tiles in half diagonally. (Allow students time to cut.)
   T: Now, create a new design with your tiles, then shade in your design on your board.

Problem 3: Share and check your partner’s work.
   T: Share your second design with your partner. Check each other’s copy to be sure it matches the tile design.
   T: Describe your partner’s design: How would you describe it as an array? How many tiles do you see in the second row? Do any columns look the same? (Allow students time to discuss their partner’s work.)
   T: Hold up those designs again, and look around! Oh, I see how they are becoming more intricate with more tiles and triangles!

Problem 4: Create a tessellation.
   T: Let’s look at my design again. (Project the original 5-tile design.)
   T: You noticed that this is a 3 by 3 array, made up of 3 rows and 3 columns, which is a total of 9 squares. I can also call it my core unit.
   T: Watch how I can make this pattern go on and on by repeating the core unit. (Place the next core unit.)
   T: Notice how the tiles touch but don’t overlap. I could keep going this way and cover the entire space of this page. Can you visualize how this paper would look if I repeated my design until the page was full?
   T: I continue my pattern right up to the edge of the grid, and when there are only two columns left, I imagine that it just keeps going on forever.
   T: Now you’re going to work in pairs.
   T: One partner, take the grid paper out of your board. You’ll be using your colored pencils for this activity.
   T: You and your partner will now create your own 3 by 3 design, which will be your core unit.
   T: Work together, starting in one corner of the paper, to create a pattern and color a design that covers a 3 by 3 area. Don’t forget to leave spaces!
   T: Then, repeat the core unit, copying that design over and over to fill your whole paper.
   T: Now, it’s your turn! Go ahead and get started!

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:
As a class project, create a mosaic from the tessellations your students create. If there is enough parental involvement, create a class quilt from the pattern.
Circulate as students work. Once all have finished, consider having a gallery walk if time permits, so that students can view each other’s tessellations.

T: What you and your partner just created is called a tessellation! Isn’t that a great word? Say it with me.
S: Tessellation!
T: So if what you just made is a tessellation, what do you think that word means?
S: It means making a pattern. → It means copying a small pattern over and over to cover a bigger space. → It means filling a bigger space with smaller shapes. → It means repeating a unit so it makes a big design.
T: Good reasoning! Tessellation is the word we use to describe how we can take certain shapes and use them like tiles!

Student Debrief (10 minutes)

Lesson Objective: Use grid paper to create designs to develop spatial structuring.

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.

You may choose to use any combination of the questions below to lead the discussion.

- For Problems 1–3, how is knowing how to build an array helpful in creating designs with the tiles?
- What was the most challenging part of today’s Problem Set? Why?
- What exciting new math vocabulary did we learn today? How would you describe a tessellation to a first-grader?
- How is making copies of a unit similar to something we have done before?
- Where do you see tessellations at school? At home? Outside?
- Why do you think we spent time creating designs and learning about tessellations today?
Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Use your square tiles and grid paper to complete the following.

Problem 1
a. Cut out 10 square tiles.
   b. Cut one of your square tiles in half diagonally.
   c. Create a design.
   d. Shade in your design on grid paper.

Problem 2
a. Use 16 square tiles.
   b. Cut two of your square tiles in half diagonally.
   c. Create a design.
   d. Shade in your design on grid paper.
   e. Share your second design with your partner.
   f. Check each other’s copy to be sure it matches the tile design.

Problem 3
a. Create a 3 by 3 design with your partner in the corner of a new piece of grid paper.
   b. With your partner, copy that design to fill the whole paper.
Name ____________________________ Date _____________

Use your square tiles and grid paper to complete the following.

a. Create a design with the paper tiles you used in the lesson.

b. Shade in your design on the grid paper.

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1. Shade to create a copy of the design on the empty grid.

   a. 

   b. 

   c.
2. Create two different designs.

3. Use colored pencils to create a design in the bolded square section. Create a tessellation by repeating the design throughout.
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