Cover the Field

Snapshot

Students play with the idea of decomposing rectangles by trying to "cover the field"—a large array—with smaller rectangles they create by rolling dice. Students must think flexibly about what rectangles they make and how they fit them into their field.

Connection to CCSS
4.NBT.5
4.OA.1
4.OA.4

Agenda

Activity	Time	Description/Prompt	Materials
Launch	10 min	Remind students of the work we've done with decomposing rectangles. Model game play and how to record equations for each turn.	Cover the Field Recording Sheet and three dice, to model the game
Play	30 min	Students play Cover the Field in partners, in which they roll dice, decide on the dimension of rectangles, and use those rectangles to cover an array as completely as they can.	• Four dice per partnership • Cover the Field game board, one per student • Cover the Field Recording Sheet, half sheet per student • Rulers (optional)
Discuss	10+ min	Discuss the strategies students developed and how students made decisions about how to use their dice rolls to create rectangle dimensions.	

To the Teacher

The focus of this game is to build on the decomposing that students have begun with rectangles. Now students must think flexibly about how to create rectangles that best fit the available space on their grid. We have written the game rules with the idea that students will sum two of the dice to create one dimension of the rectangle and sum the other two dice for the other dimension. For instance, if a player rolls 5, 3, 2, and 1, the following rectangles are possible:

$$(5 + 3) \times (2 + 1) = 8 \times 3 = 24$$
$$(5 + 2) \times (3 + 1) = 7 \times 4 = 28$$
$$(3 + 2) \times (5 + 1) = 5 \times 6 = 30$$

Students will need to record their equations, and we recommend that they record them as we have here. This is a good opportunity to introduce the use of parentheses. One adaptation that will make the game both more challenging and flexible is to offer the option for students to find either the sum or the difference between two dice to make one dimension of the rectangle. This would mean, for example, that if a player rolled 5, 3, 2, and 1, they could make the rectangles listed earlier, or they could make the following additional rectangles:

$$(5 - 3) \times (2 + 1) = 2 \times 3 = 6$$
$$(5 - 2) \times (3 + 1) = 3 \times 4 = 12$$
$$(3 - 2) \times (5 + 1) = 1 \times 6 = 6$$
$$(5 - 3) \times (2 - 1) = 2 \times 1 = 2$$
$$(5 - 2) \times (3 - 1) = 3 \times 2 = 6$$
$$(3 - 2) \times (5 - 1) = 1 \times 4 = 4$$

Note that these smaller rectangles come in handy as the game board becomes filled and smaller spaces become hard to fill. You might choose to play the original version of this game on the first day and then offer this adaptation on a second day. You will need to use the Challenge Recording Sheet and show students how to put the operation symbol of their choice (+ or −) in the empty parentheses. If you do use this variation, you will want to discuss with students how playing with subtraction changed how they thought about their decisions and how the games ended.

Activity

Launch

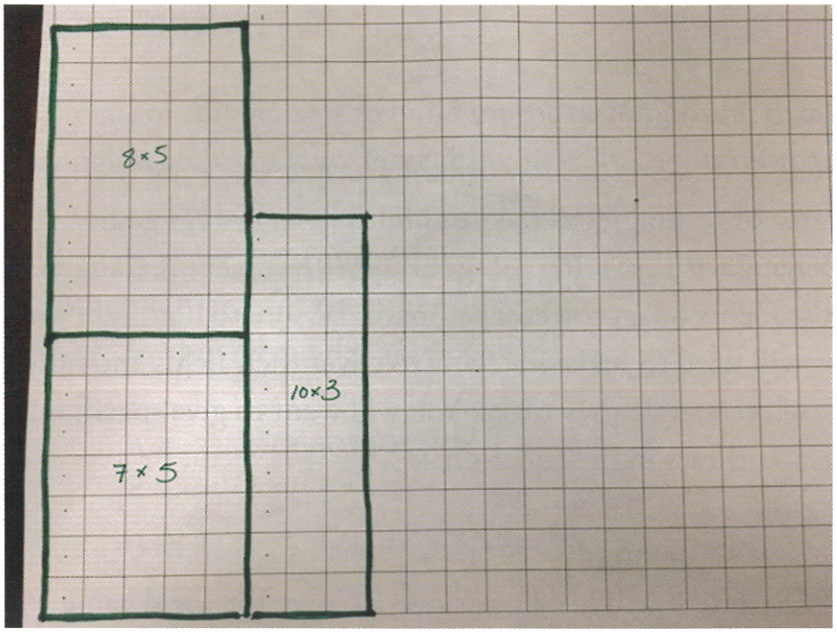
Launch this game by reminding students of the work they have been doing to think flexibly about finding the area of rectangles as ways to multiply. In today's game, Cover the Field, we'll be playing with covering a large array with smaller rectangles. Model the game play with students on a projector or board. Be sure to highlight for students the decisions they will need to make in trying to cover their fields and how to record an equation for each rectangle they make. You will want to give specific attention to how to use the parentheses in the equation.

Play

To play Cover the Field, each student will need a partner, a Cover the Field game board, and a recording sheet. The partnership will need four (six-sided) dice. The goal of the game is to cover your field as completely as you can.

Game Directions

- Players take turns. On your turn, roll the four dice.
- Use the values shown on the four dice to come up with the length and width of the rectangle you want to make. You must choose how to make two pairs of dice add together to become each side of the rectangle.
  - For instance, if you roll 6, 4, 3, and 1, you might choose to sum $4 + 3$ to get a side of 7 and $6 + 1$ to get a side of 7. Your rectangle would then be 7×7. Or you could sum $3 + 6$ to get a side of 9 and $4 + 1$ to get a side of 5. Your rectangle would then be 9×5.
  - You need to think about what rectangles you can make and which would be most useful in covering your field.
- Once you decide on the rectangle you want to make with your dice, draw your rectangle on your field in any place you want. You may not overlap with any existing rectangle. You may not break up your rectangle into smaller pieces.



- Label and record. Label the dimensions of your rectangle on your field. Record the equation you created to find the dimension and area of your rectangle on the recording sheet.
- Game play ends when one player rolls the four dice and cannot make any rectangle that will fit on their field.
- To determine the winner, find the total area of the field you have covered. How many squares did you cover? The player who covers the greatest area wins.

Discuss

Gather students together to discuss the following questions:

- How did you decide how to use your dice to make a rectangle? What were you thinking about?
- How did your decisions change from the beginning of the game to the end of the game?
- If you wanted to make the biggest rectangle you could, how would you use your dice?
- If you wanted to make the smallest rectangle you could, how would you use your dice?
- What made this game challenging for you? How did you handle that challenge?

- How was this like our work with visualizing multiplication? How was it different?

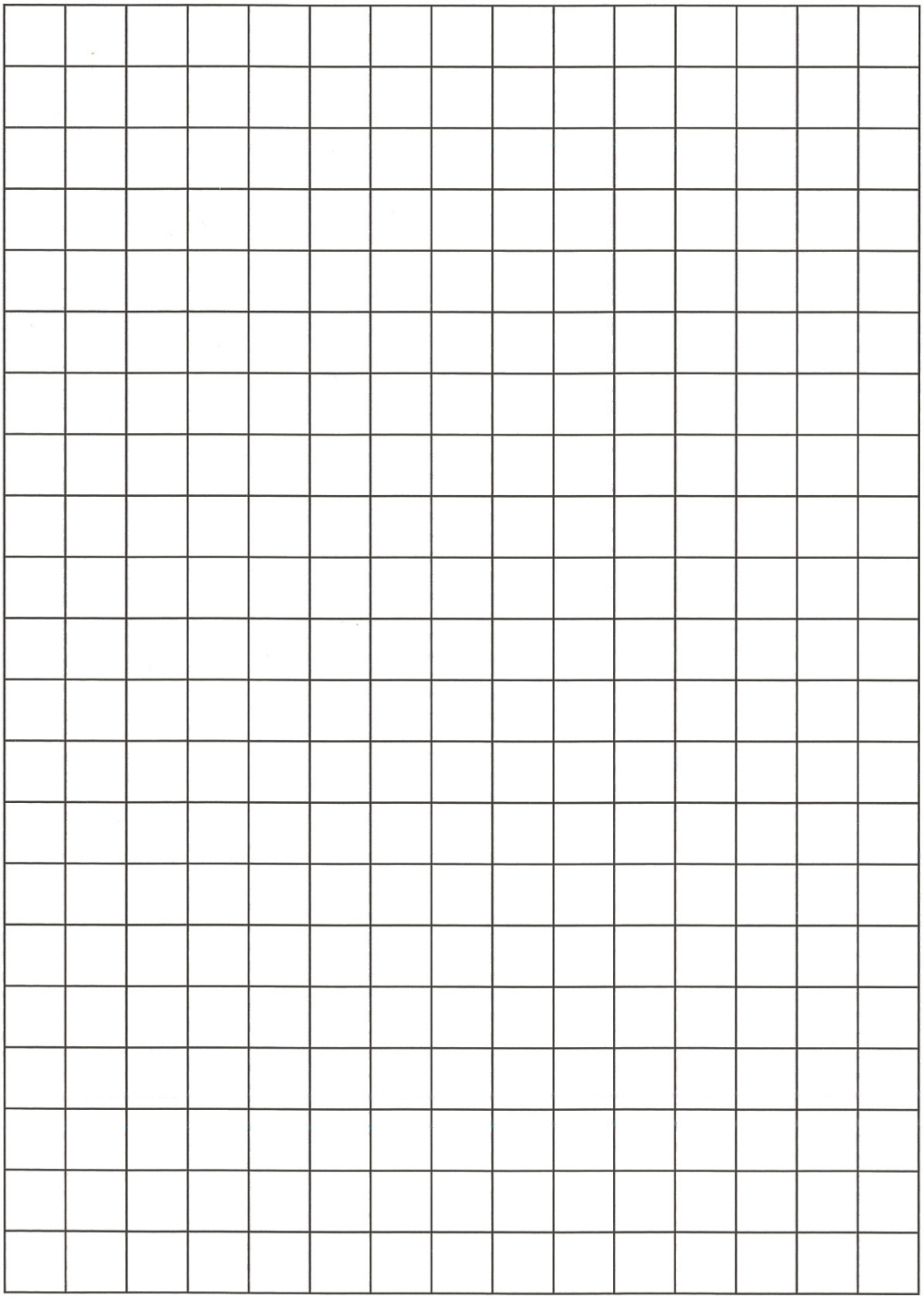
Look-Fors

- **Are students considering the different ways they might use the dice?** Some students might automatically pair and add the dice without considering all their options. Encourage students to look at the different rectangles they might make in order to decide which is the best strategic choice for their field.
- **Are students placing the rectangles strategically?** Are they considering what orientation makes the most strategic sense? Some students might get stuck thinking that the longer dimension must be horizontal, but they can orient the rectangle either way. Encourage students to think flexibly about the commutative property: $4 \times 11 = 11 \times 4$.
- **Are students thinking about ways to maximize and minimize rectangular areas?** At the beginning of the game, making large rectangles makes sense. Are students trying to make the largest they can? How are they thinking about that? Near the end of the game, when spaces get small, making small rectangles may make more sense. How are students thinking about using the dice to make a small rectangle?
- **How are students finding the total area covered?** Students might sum the rectangles or sum the results from the equations. Others might find the uncovered area and subtract.

Reflect

What advice would you give to someone who was going to play this game?

Cover the Field



Cover the Field Recording Sheet

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Cover the Field Challenge Recording Sheet

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