Notes for the Teacher

Students use an array model to find products of two-digit multiplication problems up to 50 × 50. Students split arrays into as many as four smaller arrays that represent "friendly" facts—facts whose products they already know. Students then add the partial products to find the product of the original two-digit multiplication problem.

Objectives:

- Students will use a rectangular array model to explore two-digit multiplication problems up to 20 × 20.
- Students will see the relationship between a multiplication problem represented in numerical form and the same problem represented with an array.
- Students will develop and use strategies for splitting a rectangular array into smaller arrays in which the partial products are easier to calculate mentally.

Common Core Mathematical Practices: (1) Make sense of problems and persevere in solving them; (2) Reason abstractly and quantitatively; (3) Construct viable arguments and critique the reasoning of others; (5) Use appropriate tools strategically; (7) Look for and make use of structure.

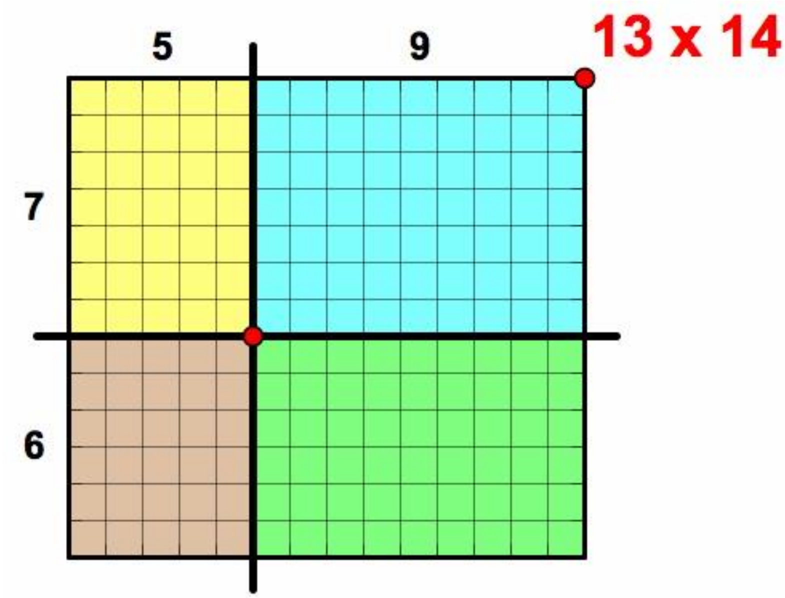
Common Core State Content Standards: : 3.OA5; 4.NBT5

Grade Range: Grades 3–4

Introduce:

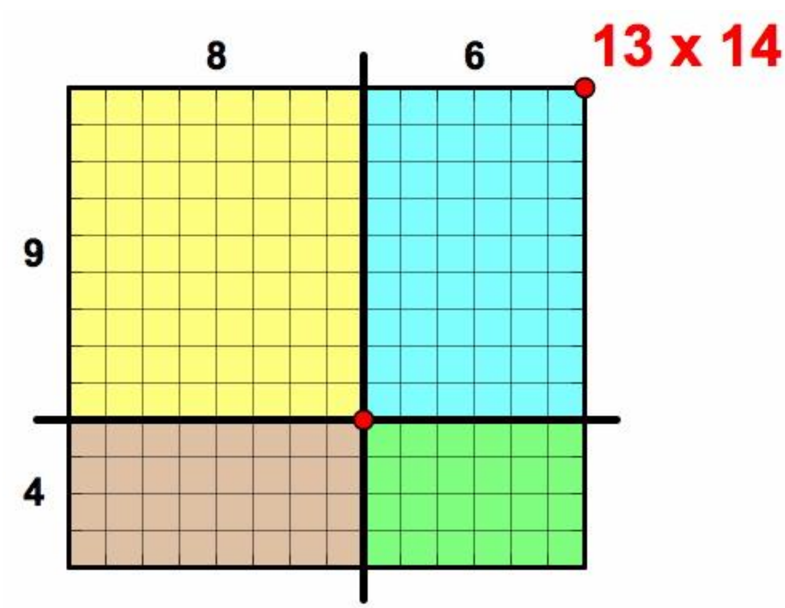
Open **Two-Digit Multiplication--Using an Array Model.gsp,** and distribute the worksheet. Use a projector to show page "Array One." Ask students to explain why the large array shown represents 13 × 14. (It has 13 rows and 14 columns; the total number of squares in the array represents the product) For this activity, the first number in each multiplication statement is the number of rows and the second number is the number of columns. Establish this convention with students when discussing the arrays so everyone understands what is being described. Then have students identify the four smaller arrays that make up the 14 × 13 array. (4 × 6, 4 × 8, 9 × 6, 9 × 8)

Now use the **Arrow** tool to drag the red point in the interior of the 13 × 14 array so that the horizontal and vertical dividers split 14 and 13 into different quantities, such as 5 + 9 and 7 + 6.

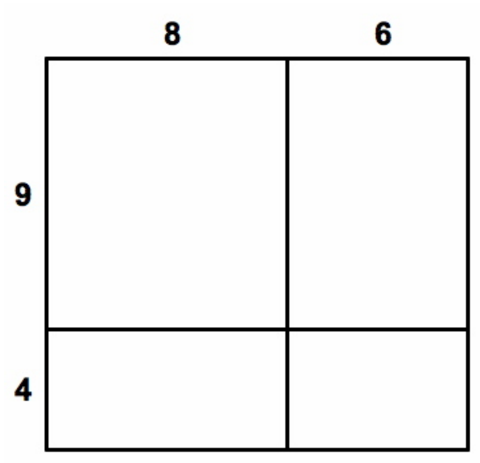


Ask, “What smaller arrays are formed now?” (7 × 5, 7 × 9, 6 × 5, and 6 × 9) “Does the larger array still represent 13 × 14? Explain.” (Yes, the larger array still has 13 rows and 14 columns.) Drag the interior red point a few more times, each time asking students to identify the dimensions of the four smaller arrays formed and to tell whether the larger array still represents 13 × 14. Ask, “Why do the larger array always represent 13 × 14?” Students should state that the dividers split 13 and 14 into different quantities but the larger array always represents 13 × 14 because it always has 13 rows and 14 columns. Its overall size does not change.

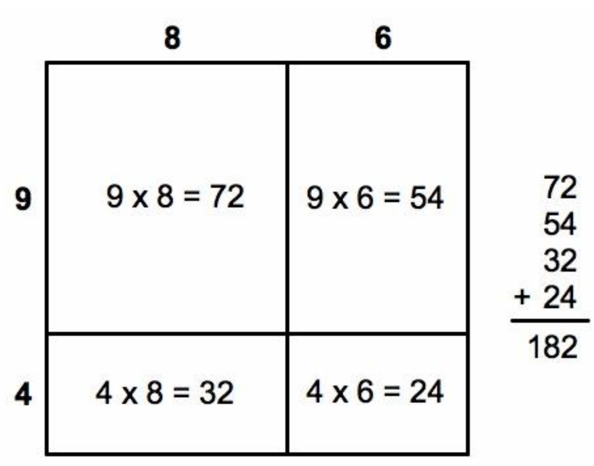
Now use the **Arrow** tool to drag the interior red point so that the 13 × 14 array is divided as shown.



Draw a simple visual representation of the split array on the board without grid lines. Ask, “How can we use this split array to find 13 × 14?”

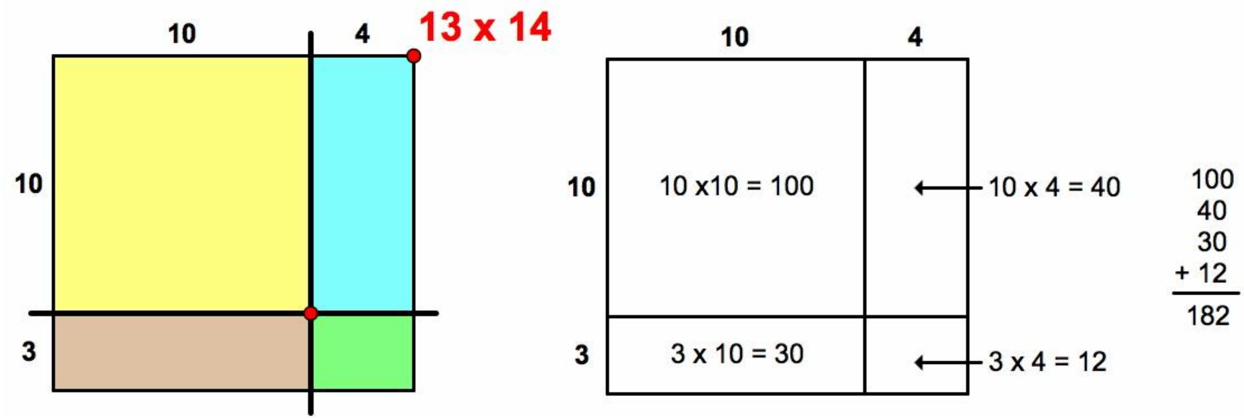


Help students see that they can add the products of the smaller arrays (the partial products) to find 13 × 14. Have students identify the four smaller arrays that represent “friendly” facts that the class already knows. Ask, “Which multiplication facts do the four smaller arrays represent?” (9 × 8, 9 × 6, 4 × 8, and 4 × 6) Have students find the products of these four multiplication facts. Write these products in the grid and then find their sum.



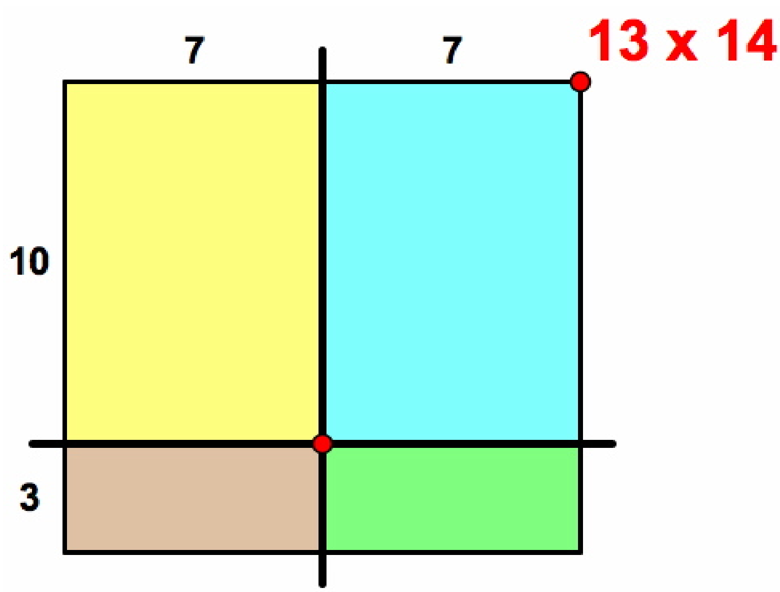
Ask, “So what is 13 × 14?” (182) Say, “It was helpful to split the 13 × 14 array into smaller arrays representing facts we already know, but it still required some work to add all the products together. I wonder if there is another way to split 13 and 14 so that the addition is easier.” Have volunteers suggest different splits and try them to see if the partial products are easier to add.

A student will likely suggest 10 + 3 for 13 and 10 + 4 for 14. Work through the solution with the class and note that the answer is still 182.



Ask, "Why are these products easier to add?" (because three of them are multiples of 10)

Finally, explore the split shown below, which is also a convenient way to split 13 × 14 into easy-to-add partial products.



Explore:

Assign students to partners and send them in pairs to the computers. Have students open **Two-Digit Multiplication--Using an Array Model.gsp** and go to page "Array One." Ask students to use the rectangular array model to find the products of two-digit multiplication problems. Make sure students understand how to record the results on the worksheet. Explain that students should sketch their solutions in the rectangles given by writing the equation for each partial product and then finding the sums of the partial products.

As you circulate, observe students as they work. How are they splitting up the larger array? Are students identifying numbers that are easier for them to multiply? Are they finding numbers that create partial products that are easier for them to add?

For students who have difficulty determining the dimensions of the four smaller arrays, suggest that they press the *Show Remaining Dimensions* button. Doing so displays dimensions along the right edge and bottom edge of the array. Suggest to students that they press the *Hide Grid* button if they do not need the grid lines. As an alternative to the grid lines, students can view tick marks by the pressing the *Show Tick Marks* button.

Discuss:

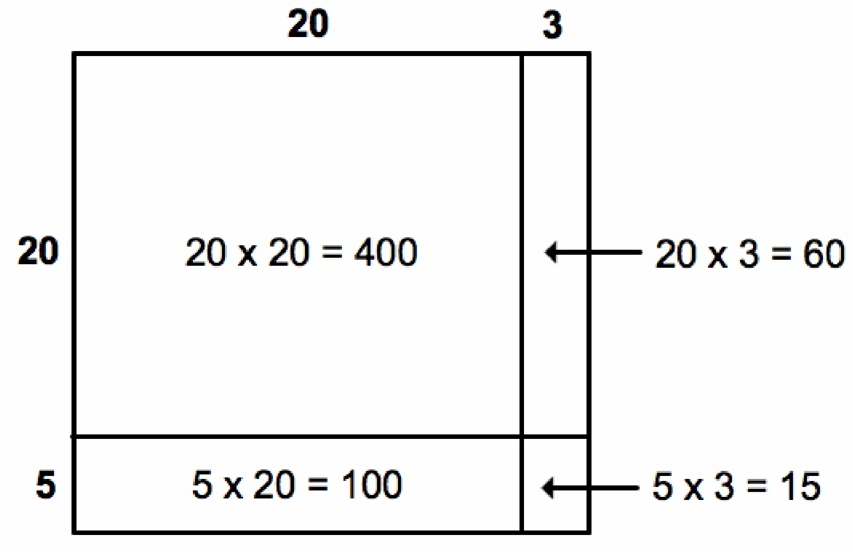
Call students together to discuss their solutions. Ask, "What strategy did you use to break the larger array into smaller arrays that were easier to work with?" A sample student reply may be, "By splitting the factors into tens and ones, it was easier to find and add the products. I could find the partial products in my head because three of them were always multiples of 10."

Ask students to solve a few two-digit multiplication problems without using Sketchpad. Ask, "How would you find the product of 17 × 18?" A student may say, "I can split 17 into 10 + 7 and 18 into 10 + 8, so I'm finding 10 × 10, 10 × 8, 7 × 10, and 7 × 8. That is 100 + 80 + 70 + 56, or 306." Continue with a few more problems, having students explain their reasoning for each problem.

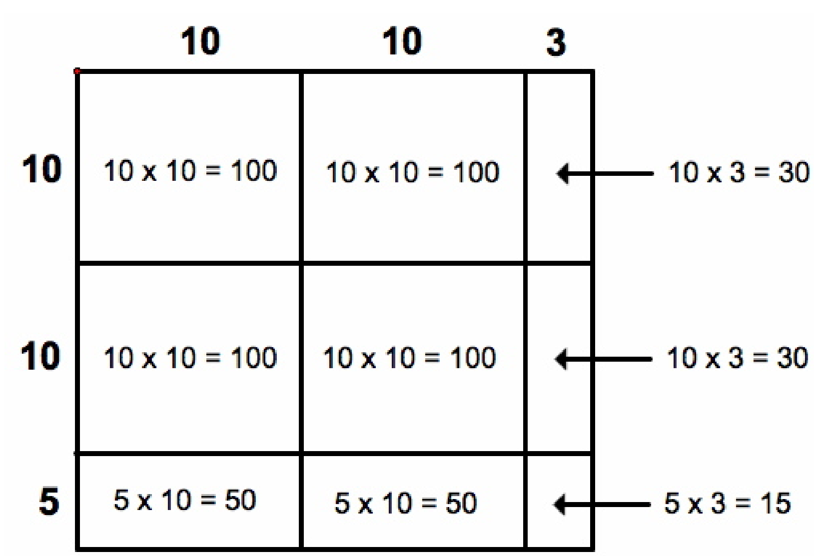
Go to page "Array Two." On this page, the grid lines in the array are more closely spaced, and you can view problems up to 50 × 50 (For the largest arrays, you'll need to increase the size of the Sketchpad window.)

Have students try 25 × 23. Ask, "How would you find this product?" Encourage students to draw a sketch on the board to help. Some sample solutions might include the following:

- *I split 25 into 20 + 5 and 23 into 20 + 3. Then I found 20 × 20, 20 × 3, 5 × 20, and 5 × 3 or 400 + 60 + 100 + 15 = 575.*



- *I used six smaller arrays. I split 25 into 10 + 10 + 5 and 23 into 10 + 10 + 3. That gave me the partial products 10 × 10 = 100, 10 × 10 = 100, 10 × 3 = 30, 10 × 10 = 100, 10 × 10 = 100, 10 × 3 = 30, 5 × 10 = 50, 5 × 10 = 50, 5 × 3 = 15. Hmmm, that adds up to 100, 200, 300, 400, 500, 560, 575.*



Related Activities:

- *Two-Digit Multiplication, Part One—Using Base Ten Blocks*
- *Two-Digit Multiplication, Part Two—Using Base Ten Blocks*
- *Bunny Times*

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