Notes for the Teacher

Students use a rectangular array model of multiplication to develop skip counting and "adding on" strategies for learning the multiplication facts from 2 × 2 through 11 × 10. Students are asked to find the total number of rooms in a building when given the number of rooms per floor and the number of floors. Students construct a rectangular array as a visual model of the building to visualize and solve each problem. As they progress, students develop strategies for finding the products. The activity ends with a multiplication "marathon" to assess students' progress.

Objectives:

- Students will use a rectangular array model to explore multiplication.
- Students will develop strategies for computing up to 11 x 10.

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.OA1, 3, 5, 7, 9

Grade Range: Grades 3–4

Introduce:

Open **Construct a Building--Multiplication Array Model.gsp,** and distribute the worksheet. Use a projector to show sketch page "Practice." Explain that students can construct a building by dragging the right and top handles to change the number of rooms per floor and the number of floors, respectively.

Say, "Let's construct a building that has 5 rooms per floor and has 7 floors." Demonstrate how to use the **Arrow** tool to drag the horizontal handle to show 5 rooms per floor. Then drag the vertical handle up, but initially stop at 2 floors. Ask what the gray 10 in the top right square represents. (the total number of rooms) Tell students that they can use the gray numbers to skip count to find the total number of rooms in a building. Ask, "By what number can we skip count as we create the building with 7 floors? Explain." (Possible answer: by 5s since there are 5 rooms on each floor)

Have students skip count with you as you drag the vertical handle to create 7 floors. (5, 10, 15, 20, 25, 30, 35) Ask, "How many total rooms are in a building with 7 floors?" (35 rooms) Ask, "What multiplication problem can we write to represent the total number of rooms in this building?" There are two possible answers: 5 × 7 = 35 or 7 × 5 = 35.

Press the *Show Pictures* button with the **Arrow** tool to show each room in the building represented as a picture. Press the *Show Blocks* button to return to the blocks. (Note: The *Show Pictures* option is fun, but may not be well suited for students who are just learning about multiplication.)

Now go to sketch page "Level 1." Explain that in this game, students are challenged to find the total number of rooms in a building. Follow these steps to show students how to play:

1. Choose the number of rooms per floor. Use the **Arrow** tool to highlight the number in the *Rooms for next game* edit box and enter a new number using the computer keyboard.

2. Press either *New Ordered Game* or *New Random Game*. (The New Ordered Game option presents the problems in order from $2 \times n$ through $11 \times n$, where n is the number of rooms per floor. The New Random Game option presents the same 10 problems, but in a random order. Students can solve problems beyond $11 \times n$, but their score won't go beyond 100.)

3. Construct a building to represent each problem visually. Use the **Arrow** tool to drag the handles to construct a building with the number of floors and the number of rooms per floor stated in the problem. (As students develop their multiplication skills, they can choose to skip this step.)

4. Answer the problem. A problem appears with a numerical keypad. Use the **Arrow** tool to enter an answer in the keypad. For example, to enter 12, click 1 and then 2. The back arrow deletes the last digit entered and C clears the entire number.

5. Check the answer by pressing the *Check Answer* button. If the answer is not correct, students can still enter a new number without penalty. (The score is not computed until the *New Problem* button is pressed.)

6. After getting the correct answer, use the **Arrow** tool to press the *New Problem* button. Each correct answer scores 10 points.

7. If students are especially confident of their answer, they can press *New Problem* without either constructing a building or pressing *Check Answer*.

Demonstrate how to answer several problems, or have volunteers come to the computer or electronic whiteboard to answer the problems. Be sure students understand how to play the game before you send them off to the computers on their own.

Explore:

Assign students to partners and send them in pairs to the computers. Have students open **Construct a Building--Multiplication Array Model.gsp** and go to page "Practice." Give students time to explore how to construct an array if they haven't done so before.

Then have students go to pages "Level 1" and "Level 2" and play as many games as time allows. (You may wish to play the games over several days.) Explain that the games on Level 2 are similar to Level 1, but Level 2 does not provide the gray skip-counting numbers when constructing the array. Students should record the results of each game and their scores on their worksheet.

As you circulate, observe students as they work. What strategies do students use to answer the problems? Are students constructing arrays and counting each block to find the total? Do students skip count by the number of rooms per floor or by the number of floors to find the total? Do students use repeated addition? Do students answer the problem without constructing the array? Ask students to explain their thinking; it will give you insight to their understanding (or misunderstanding) of multiplication.

Make sure students understand how to record the results of each game played and the score for each game on the worksheet.

Discuss:

Call students together to discuss and summarize what they've learned. Discuss the different strategies that students used to find the total number of rooms. Here are some possible student strategies:

- *We constructed buildings and counted each room one by one to find the total.*
- *In a building with 4 rooms on each of 7 floors, we added 4 + 4 + 4 + 4 + 4 + 4 + 4 = 28.*
- *For ordered games, we used an 'adding on' strategy. For example, if a building with 7 rooms on each of 8 floors had 56 rooms, then we knew that a building with 7 rooms on each of 9 floors had 56 + 7 = 63 rooms.*
- *We skip counted by the number of rooms per floor to find the total.*
- *We skip counted, too, but we skipped counted by the number of floors if it was an easier number. For example, when there were 7 rooms on 5 floors, we skipped counted by 5s seven times to get 35 rooms because it was easier than skipped counting by 7s five times.*

- *We looked for multiplication facts we knew. For example, we constructed a building with 6 rooms on each of 8 floors. We knew 5 rooms on 8 floors is 8 × 5 = 40, and then we added the 8 rooms in the last column to get 48.*
- *We thought of large buildings as a collection of smaller buildings. We found the total number of rooms in each of the smaller buildings and then added them together. For example, for a building 8 floors high with 4 rooms on each floor, we broke it into two smaller buildings of 4 floors each with 4 rooms on each floor. We found 4 × 4 = 16 twice to get 16 + 16 = 32.*
- *We thought of the related multiplication fact and solved it. For example, a building of 6 rooms on each of 6 floors is 6 × 6 = 36. We noticed that when the number of rooms and floors were the same, the array was a square!*

You can extend the discussion by having students look at their worksheets to identify buildings that have the same number of total rooms. For example, ask, "How many different buildings did you find that have a total of 12 rooms?" Write all the results on the board in a table:

Rooms on each floor	Floors	Total rooms
2	6	12
3	4	12
4	3	12
6	2	12

Discuss how 2, 3, 4, and 6 are all factors of 12, and present the Commutative Property of Multiplication: 2 × 6 is the same as 6 × 2.

When time allows, have students open **Construct a Building Marathon--Multiplication Array Model.gsp** and play games on sketch pages "Level 1," "Level 2," and "Level 3" on their own. On page "Level 1," the 25 problems are presented randomly and are chosen from 2 × 2 up to 8 × 5. Students are awarded 4 points for each correct answer with a maximum score of 100. On page "Level 2," the 50 random problems are chosen from 2 × 2 up to 10 × 6 and are worth 2 points each. Then on page "Level 3," the 100 random problems are chosen from 2 × 2 up to 11 × 10 and are worth 1 point each. Have students play these games to practice their multiplication facts. Be sure students record their answers on their worksheets. Later you can use the completed worksheets to have students find patterns in the multiplication tables.

Related Activities:

- *Fill a Box with Chocolate—Skip Counting Techniques*

- *Bug Multiplication—Multiplication as Scaling*
- *Multiplication Strategies—Multipliers 6 Through 12*
- *Bunny Times*

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