Rectangle Riddles

Common Core Standard:
Work with equal groups of objects to gain foundations for multiplication.
2.G.2 Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.

Additional/Supporting Standard(s):
Work with equal groups of objects to gain foundations for multiplication.
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.

Standards for Mathematical Practice:
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
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision

Student Outcomes:
• I can divide a rectangle into parts.
• I can count to find the total number of sections/part in the rectangle.
• I can divide rectangles into equal parts using rows or columns.
• I can write an equation to tell the total number of squares (or square-like sections) in a rectangle as a sum of equal addends.

Materials:
• color tiles, square tiles
• 1 inch grid paper or cm grid paper
• index cards

Advance Preparation:
• This standard is the beginning of connecting a geometric representation to multiplication and area. Students can draw arrangements using materials and then count the total number of blocks. The focus is on the geometric representation not multiplication. The concept of multiplication is introduced in grade 3.
• The tasks described in this lesson can occur over several mathematics sessions.

Directions:
1. As a class discuss what are the attributes of a rectangle. Observations from students might be:
   a. four straight lines
   b. four right angles or square corners. The children may need time to explore square corners (right angles).
c. 2 long sides and 2 short sides – This is a misconception that many students have. They do not recognize a square as a rectangle. As students refine their understanding of rectangles they should develop an understanding that a square is a rectangle.

2. As students tell attributes of a rectangle the teacher can show examples that match the verbal descriptions. For example, when a student says a rectangle has 4 straight sides the teacher could show the blue pattern block rhombus – it has 4 straight sides but is not a rectangle. Continue to show examples and have students refine their description of a rectangle.

3. Build a rectangle, 5 rows x 3 columns, with color tiles (square tiles) for the class to view. Ask students how this rectangle fits the attributes the class has developed.

4. Give each student about 20 color tiles (square tiles). Ask them to build a rectangle. They do not have to use all the tiles. Have them turn to a partner and explain why their shape is a rectangle.

5. As students share with a partner, the teacher listens to students’ descriptions.

6. After partners have shared with each other, the teacher has some student pairs share their rectangles with the class. As students share ask them how they know they made a rectangle.

7. Explain to the class that we have a specific way of describing these rectangles. We can describe them by rows and columns. Show a rectangle and demonstrate the rows and columns. Rows go across and columns go down. This rectangle has 3 rows and 4 columns. 

   \textit{When describing a rectangle we say the rows first and columns next.}

8. Have them look at the rectangle they made with a partner. Find out how many rows and columns are in your rectangle. The teacher listens to monitor student understanding of rows and columns.

9. Explain that they are going to solve rectangle riddles. They are going to build the rectangle described. Ask students to build a rectangle that has 2 rows and 4 columns.

10. Monitor student understanding. After most students have built the rectangle have someone share the answer. Some students may have built this rectangle, 4 rows and 2 columns.

11. Compare these two rectangles. They are congruent but have a different orientation. The 2\textsuperscript{nd} rectangle is not 2 rows and 4 columns.

12. Continue to have students build rectangles that you describe. Examples are:

   a. 6 rows and 3 columns
   b. 5 rows and 5 columns
   c. 4 rows and 4 columns
   d. 1 row and 6 columns
   e. 8 rows and 3 columns

13. After you feel students are beginning to understand this concept have them build a rectangle, without their partner seeing it, and describe it to the partner. Give them a folder or
something that hides what they are building. One partner builds a rectangle without the other partner seeing it. This partner describes the rectangle and the second partner builds the rectangle. Remove the barrier to see if the rectangles are congruent. The partners need to sit beside each other so they do not see a mirror image. Take turns describing the rectangles.

14. During a follow-up lesson have students build another rectangle described by the teacher. Example: have them build a rectangle with 2 columns and 5 rows. Explain that we can also describe this rectangle by writing an equation. This rectangle could be written as $2 + 2 + 2 + 2 + 2 = 10$. Ask them what the 2s represent (rows) and what the 10 represents (the total number of tiles). This applies to the Common Core Standard write an equation to express the total as a sum of equal addends.

15. Continue to describe other rectangles and have the students build them. Describe them using the vocabulary, rows and columns, and then have students tell an equation that represents the rectangle.

16. During another lesson have students create rectangle riddles. Give students an index card. Fold the card in half. On the outside “cover” students write a description of a rectangle. On the inside of the folded index card (or a piece of paper) draw a picture of the rectangle.

17. Example: On the outside of the card the students writes: My rectangle has 2 rows and 6 columns. It is $2 + 2 + 2 + 2 + 2 + 2 = ____$. When the card is opened the student sees:

18. The attached blackline master, “Making More Rectangles” can be used in centers.

Questions to Pose:

Before:

- What do you know about rectangles?
- What is a right angle/square corner?
- How many sides does a rectangle have?
- Where do we have rectangles in our classroom?

During Partner Work

- How do you know this is a rectangle?
- Show me the right angles (square corners).
- How many tiles did you use to make the rectangle?
- Could you make a different rectangle with the same number of tiles? Show me.

After:

- Describe your rectangle. If the student does not use rows and columns ask how many rows and then how many columns are in the rectangle.
- How could you write an equation to describe this rectangle?
Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students count the rows and then start counting the columns on the second column. Students have already counted the first row and do not understand that the first corner tile is also in the first column.</td>
<td>Build a rectangle and describe it to the students. As you describe it trace each row and each column with your hand. Students can do the same. Ask them what they notice about the how we counted. Point out that the first tile is in the first row <strong>and</strong> also in the first column.</td>
</tr>
<tr>
<td>Students may have difficulty distinguishing between rows and columns.</td>
<td>Have students find columns in their environment to create a mental image that columns go up and down.</td>
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</tbody>
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Special Notes:
- Challenge: In a center have students make all the rectangles for 18, 24 or 36 tiles. When they think they have found all the rectangles for one of the numbers, draw them on grid paper, cut them out and make a poster of all the arrangements for that number of tiles. Extension: Student can choose a number of their own from 8 to 36 and see how many different rectangles they can make.
- Have a specific number of students an area in the room where they can sit. Have them sit according to your directions. example: 12 students Sit in 3 rows and 4 columns 15 students Sit in 5 rows and 3 columns.
- Students can record their rectangles on 1 inch grid paper or 1 cm grid paper. After drawing the rectangle they label the rectangle. For example this rectangle could be labeled as 2 rows and 6 columns. Students could also write $2 + 2 + 2 + 2 + 2 + 2 = 12$

Solutions: NA
## More Making Rectangles

**Materials:** square pattern blocks or colored square tiles

<table>
<thead>
<tr>
<th>Take some square tiles. Make a rectangle that has 3 rows and 2 columns. Record your rectangle on the grid paper. How many tiles did you use? ______</th>
<th>Take some square tiles. Make a rectangle that has 4 rows and 4 columns. Record your rectangle on the grid paper. How many tiles did you use? ______</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take some square tiles. Make a rectangle that has 5 rows and 3 columns. Record your rectangle on the grid paper. How many tiles did you use? ______</td>
<td>Take some square tiles. Make a rectangle that has 6 rows and 2 columns. Record your rectangle on the grid paper. How many tiles did you use? ______</td>
</tr>
<tr>
<td>Take 16 square tiles. Make as many different rectangles as you can. Record them on the grid paper. How many different rectangles did you make? ______</td>
<td>Take 20 square tiles. Make as many different rectangles as you can. Record them on the grid paper. How many different rectangles did you make? ______</td>
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