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Framing Rectangles
Grade 6-8

Introduction
In this activity students explore the relationship between the area of a rectangle and the number of squares that make up a border around it. This activity provides students an opportunity to explore the operations of addition and multiplication, and area and perimeter. Students will work to find patterns as they organize data and look for ways to record their observations. This activity makes space for young mathematicians to count, describe shapes, explore ideas, build with square tiles, investigate conjectures, analyze patterns, organize findings, add and takeaway square tiles, and create visuals to explain and justify their thinking.

Agenda

Activity	Time	Description	Materials
Mindset Message	5 min	Play the mindset video	Mindset Video
Square tiles play-time (Optional)	10-15 min	Give students time to cut out the square tiles and/or play with the tiles.	Square paper tiles, Framing Rectangles Handouts (pg 6 and 7) attached, or a square tile manipulative
Framing Rectangles	45 min	1. Create a rectangle with a border that has double the number of square tiles as the area. Find as many rectangles that work as you can. Draw each of your rectangles on grid paper. 2. Create a rectangle with a border that has the same number of square tiles as the rectangle's area. Find as many rectangles that work as you can. Draw each of your rectangles on grid paper.	• Square paper tiles, Framing Rectangles Handout (pg and 7), or a square tile manipulative • Framing Rectangles Challenge Handout on pg 5 (Optional) • Graph/grid paper or Math journals • Poster paper
Debrief Mindset Message	5 min	Debrief the mindset messages for this activity.	Math journal (Optional)

Activity

You might consider giving students time to cut out the square tiles and/or play with the tiles before you start the activity. Encourage them to build anything of their choice. After some time to build, invite a couple of volunteers to share what they have created.

Give students the task sheet and square tiles. We have provided a template so you can cut them out of paper in case you don't have the plastic square tile. As students work in groups to discover which rectangular arrays have square tiles that satisfy the conditions they will look for patterns and explore area versus perimeter and how the border number is related to these values.

Give groups enough time to explore each challenge until they feel like they have exhausted their thinking. Encourage them to think deeply by being a skeptic and insist they find multiple examples that confirm their thinking.

As groups are working, a question that might come up during this challenge is, "Are a 2x3 rectangle and a 3x2 rectangle the same rectangle?" The prompt for the challenges leaves it open for students to interpret. This is also something you all can decide on as a maths community. You might pull together the class to have a short conversation about whether or not you all think a 2x3 and a 3x2 counts as one rectangle or two.

At some point you may want to introduce how mathematicians use a table to organize their findings. Tables help us to see patterns. In our work with middle school students we found it helpful to let them work for a while so we can observe how they are coming along with their own organization. If needed we introduce a table where students can help fill in the information they have found. We encourage cells to be filled with all the different answers they may have found. Mistakes are wonderful. We don't say whether any entries are right or wrong, we let the class figure it out. Having more than one answer in the cell of a table brings on a great conversation!

Here's an example of a table you might use. We have included only a few rows and columns to give you an idea.

Area	Dimensions of case 1	# in the border	Dimensions of case 2	# in the border	Dimensions of case 3	# in the border
1	1 x 1					
2	2 x 1					
3	3 x 1					
4	4 x 1		2 x 2			
5	5 x 1					
6	6 x 1		2 x 3			
7	7 x 1					
8	8 x 1		2 x 4			
9	9 x 1				3 x 3	
10	10 x 1		2 x 5			
11	1 1x 1					
12	1 2x 1		2 x 6		3 x 4	
...						

When starting each discussion you might want to use a format similar to a dot/number talk by inviting students to share their answers and then share strategies. Something powerful about this format is accepting and discussing every answer students' offer. When students are sharing strategies encourage them to describe their thinking visually.

During the discussion(s), give time for students to think deeply about each other's reasons and justification. If after the sharing of strategies there are still different answers, ask students if this is the kind of problem that has one answer or multiple answers. Then have them share what they think and together decide if they think they should agree or if they are okay with multiple answers.

Ask students to reflect on the video they watched and of the value of struggles they went through, or mistakes they made. If they struggled or made mistakes in this lesson, point out to students that their brains have grown and new pathways have formed!

Extensions
- If you have a border with 14 square tiles, what could be the dimensions of the rectangle? Is there only one rectangle with a border of 14 square tiles?
- How would you describe the relationship between the number of squares in the center and border?
- Make up a problem similar to this that you would want to explore.

Materials
- Square paper tiles (Framing Rectangles Handouts, pg 6 and 7) or Square tile manipulatives
- Poster paper
- Graph/grid paper
- Math Journal
- Framing Rectangles Challenge Handout pg 5 (optional)

Framing Rectangles
Challenge Handout

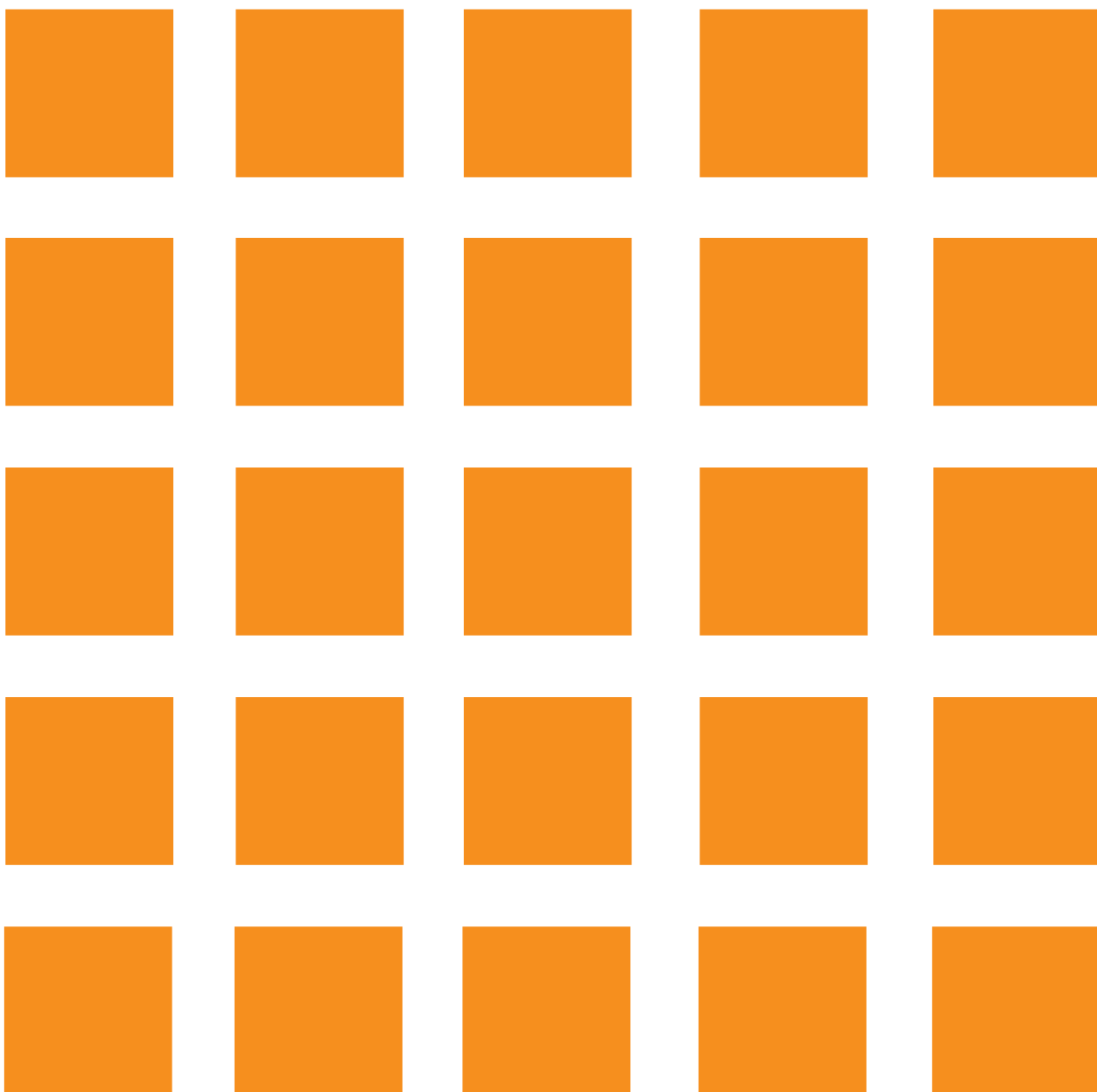Work collaboratively with your group to explore each rectangle challenge.

Challenge 1: Create a rectangle with a border that has twice the number of square tiles than the area. Find as many rectangles that work as you can. Record each of your rectangles.

Challenge 2: Create a rectangle with a border that has the same number of square tiles as the rectangle's area. Find as many rectangles that work as you can. Record each of your rectangles.

Framing Rectangles
Handout

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Handout