<table>
<tr><td>Teaching Point:</td><td>Multiply a Fraction by Whole Number – Model with Area Model</td></tr>
<tr><td>Big Ideas:</td><td>• Place value is essential in multiplication and division. Use place value to help you determine reasonable answers.
• Multiplying a factor by a number greater than one will get a product bigger than that factor. Multiplying a factor by a number equal to one will get a product the same as that factor. Multiplying a factor by a number less than one will get a product less than that factor.
• Fractions represent a numerator divided by a denominator.
• You can find equivalent fractions and keep the quotient unchanged (this is called maintaining the value of the quotient).</td></tr>
<tr><td>Standards Addressed:</td><td>5.NF.4 Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.
b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.</td></tr>
<tr><td>Materials Needed:</td><td>• Chart paper and/or doc cam
• Student copies of PST, application and exit ticket
• Lesson key (for reference). It is recommended to make your own teacher key to internalize the lesson
• Optional grid paper for application if needed</td></tr>
<tr><td>Lesson Outline:</td><td>8 – PST
20 min – discussion and takeaways
15 – application problems
7 min – exit ticket</td></tr>
<tr><td>Vocabulary</td><td><table>
<tr><td>Dividend</td><td>A value divided by another value to get a quotient</td></tr>
<tr><td>Divisor</td><td>A value by which another value is divided</td></tr>
<tr><td>Quotient</td><td>The value resulting from the division of one value by another</td></tr>
<tr><td>Fraction</td><td>Part of a whole in which the numerator is divided by the denominator</td></tr>
<tr><td>Area Model</td><td>A visual representation of the area of a rectangle that can be used to solve multiplication or division problems.</td></tr>
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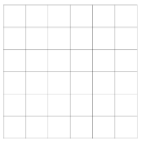
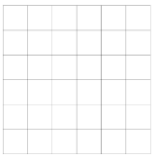
PST

A. Use the grid below to model a rectangle with a width of 3 square units and a length of 4 square units. Then, find the area of the rectangle.



B. Use the grid below to model a rectangle with a width of $\frac{1}{2}$ square unit and a length of 4 square units. Then, find the area of the rectangle.



What we want students to get from this problem: Here, students determine how to use what they know about area models to make an area model for a whole number times a fraction. This model is helpful for visualizing why multiplying by a fraction makes the product smaller than the other factor (scaling). It is also important to establish this model before we multiply fractions by fractions in the next few concepts.

Today's Takeaway: Area models represent multiplication. When one side length is a fraction, that side is less than one square unit.

Work time on PST (8 min.):

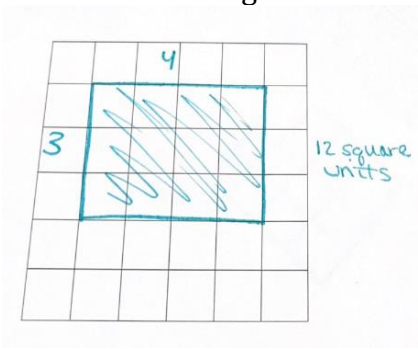
- Routine: PSTs are intended to be focused, independent work unless otherwise noted. Teachers can use the discussion toolkit to plan for the discussion during this time and note misconceptions. Students should engage in the struggle and attempt to work for the whole time - rereading the problem or trying another model or strategy if they finish early. Teachers should only intervene if students have a misconception that needs to be addressed to access the problem (noted in the discussion planner).
- This may be a tricky PST for students! If the majority of the class is stuck after a few minutes, ask: If each unit on the grid is one whole square unit, how you could represent half a square unit as the side of the rectangle?

Discussion (20 min)

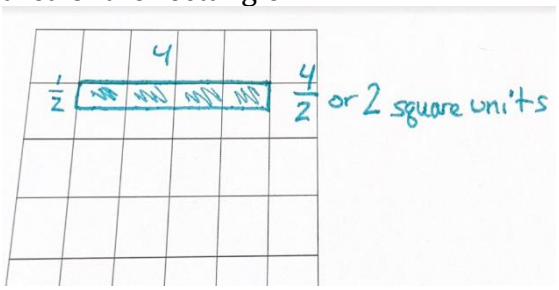
The following notes are a suggested discussion flow based on what we expect students to do to solve this problem. You may need to adjust or supplement based on the work that students produce during the PST. Each discussion is meant to be student focused with students sharing their thinking with the class. The suggested questions can be posed to the student sharing or to the class as the student shares. To have as many students engaged in the thinking as possible, pose many questions to the class while the student is sharing. Turn and talks can be very effective to get lots of students involved.

PST:	**Discussion Flow and Key Questions**
a. Use the grid below to model a rectangle with a width of 3 square units and a	<u>Unpack the PST:</u>

length of 4 square units. Then, find the area of the rectangle.



b. Use the grid below to model a rectangle with a width of $\frac{1}{2}$ square unit and a length of 4 square units. Then, find the area of the rectangle.



- Ask: **Why do area models represent multiplication? If students don't know, talk through it!**
  - *Area is the amount of flat space in a shape. We measure it in square units.*
  - *Area models use the factors as the length and the width (or dimensions) The product is the total number of square units that fill up the shape. When we see this in a grid, we can clearly see the equal groups that represent multiplication.*

Discuss part A:

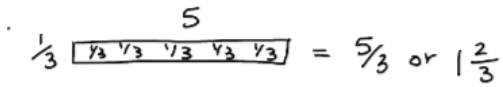
- Show student work: **3 by 4 rectangle**
  - **Show a student area model that matches the story.**
  - Ask: **How does this area model represent the number sentence 3 x 4?**
    - *The model has a length of 4 units and a width of 3 units.*
    - *It also shows 3 rows/equal groups of 4 or 4 rows/equal groups of 3.*
  - *Note the connection to "of" for multiplication with whole numbers! 3 groups of 4! We say it with whole number multiplication, too!
- Ask: **What is the area of the rectangle?**
  - *12 square units. The product of 3 x 4.*
- **Let's think about our rules about how one factor scales the other factor: How does 3 x 4 = 12 relate to our rules? Students can reference their notes.**
  - *Multiplying 3 by 4 makes 3 get bigger and multiplying 4 by 3 makes 4 get bigger.*
    - *If $b > 1$, then $a \times b > a$ or if $a > 1$, then $a \times b > b$.*

Discuss part B:

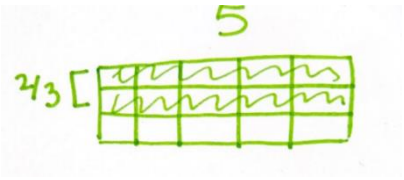
- Show student work: **$\frac{1}{2}$ by 4 rectangle**
  - **If no one drew the correct model, work through this questioning to create the model as a class!**

	○ Ask: **How is the multiplication expression ¼ x 4 different from the expression 3 x 4?** ▪ *We're finding half a group of four instead of 3 whole groups of 4.* ○ Ask: **If one of the dimensions of the rectangle is half of a square unit, how can we represent that in a model? (If a student did this, have them lead on this explanation instead of guiding it).** ▪ *We have to cut one square unit in half to show that side length.* ○ Ask: **What would the dimensions of the rectangle be if we didn't cut the unit in half?** ▪ *It would be 4 x 1.* ▪ **Outline the 4 x 1 rectangle so students can see both the 4 x 1 and the 4 x ½.** ▪ Follow up: **What would the area of a 4 by 1 rectangle be?** • *4! We know when you multiply anything by one, it doesn't change the value.* ○ Ask: **What can you predict about the product of 4 x ½ without telling the answer?** ▪ *It should be less than 4 and greater than ½.* ○ Ask: **What is the area of this 4 by ½ rectangle? Give students a moment to revise their work now that we've established what the area model looks like. Have a student share their thinking.** ▪ *It would be two! We can see this in the model because we see 4 half units, which makes 2 whole units.* ▪ *Spend time here to make sure students really see that there are 4 groups, but each are only ½ of a unit, which is why the answer gets smaller than 4.* Summarize and take notes!

- **Let's practice this by making another model in our notes! Let's try modeling a rectangle that has a length of 5 units and a width of $\frac{1}{3}$ unit with an area model. Work through the model together.**
  - Students can either model on grid paper or by simply labeling both side lengths on an open area model.



- Write the number sentence that matches the model as well: $\frac{1}{3} \times 5 = \frac{5}{3}$ or $1\frac{2}{3}$
- <u>Ask:</u> **What if the width was $\frac{2}{3}$ of a unit instead of $\frac{1}{3}$?**



- Notice how this model shows both 2/3 of 5 and 5 groups of 2/3!
- <u>Takeaway:</u> **Area models represent multiplication. When one side length is a fraction, that side is less than one square unit.**

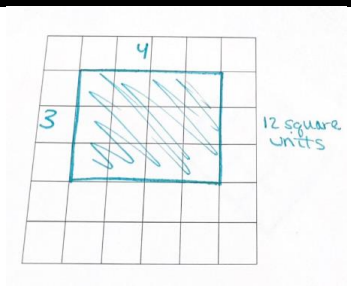
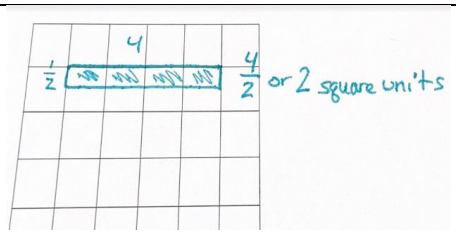
Application (15 min):

- Routine: After the discussion, keep all students together to start the application problems. Release students to finish application problems independently when they are demonstrating understanding.

Exit Ticket (7 min)

- Routine to reinforce: Exit tickets should be attempted by all students, even if they have not finished the application work. Exit ticket time should be silent, focused, and independent to collect real data on student understanding of the concept.
- Use the exit tickets to determine which students need a quick conference before the next lesson or to note students with larger misconceptions.

Discussion Toolkit

Strategy	Looks like	Student Names
Student who models 4 x 3 on the grid accurately.		
Student who finds the area to be 12 square units.		
Student who models 4 x ½ accurately.		
Student who finds the correct product of 2 or $\frac{4}{2}$		

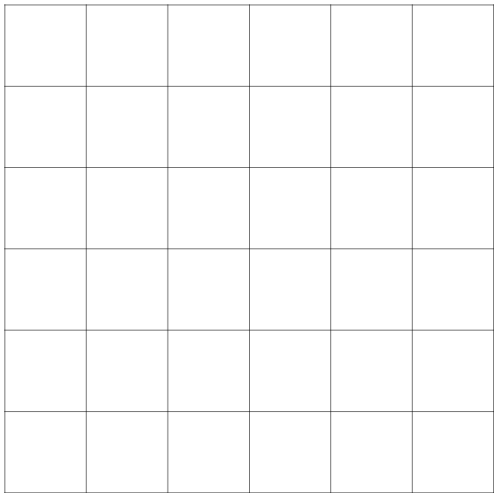
Misconception	Student Names
Students who do not make the 4 by 3 rectangle correctly (intervene)	
Students who do not find the correct product and multiply 4 x 2 or in some other way	
Students who have the correct product, but not the correct model.	

Small Group Planner: Today is the first day of area models with fractional side lengths. Note students who are struggling that may need support during the following days. If anyone really struggled with part A, prioritize them for support during application today.

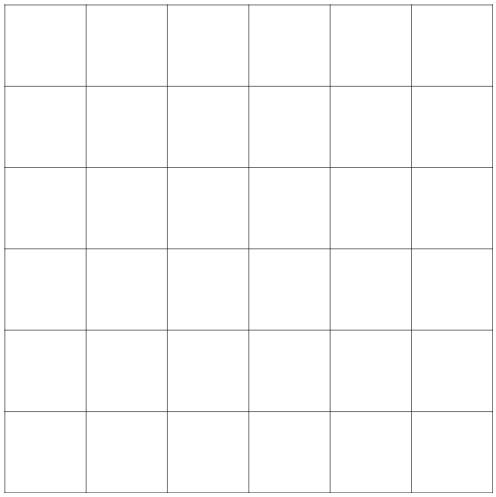
Student Names	Focus

Name: _____ Problem-Solving Task

A. Use the grid below to model a rectangle with a width of 3 square units and a length of 4 square units. Then, find the area of the rectangle.



B. Use the grid below to model a rectangle with a width of $\frac{1}{2}$ square unit and a length of 4 square units. Then, find the area of the rectangle.



Name _____ Application Problems:

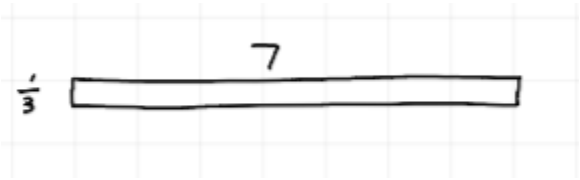
1) Find the area of each rectangle using an area model. The dimensions are given below. You may either sketch your model or use the grid paper provided.

   a. $\frac{1}{2}$ by 6

   b. 5 by $\frac{4}{5}$

   c. $\frac{3}{4}$ by 8

2) Use the area model to answer the questions that follow.



a. What expression can be used to find the area of the rectangle show?

b. Find the area of the rectangle.

c. How does the area model prove that multiplying by a fraction less than one scales the other factor down?

3) A rectangular carpet has a length of 12 yards and a width of $\frac{2}{3}$ yard. How many square yards does the carpet cover? Show or explain your thinking below.

Name _____ **Exit Ticket**

A play area has a width of $\frac{4}{5}$ meter and a length of 10 meters.

a. Will the area of the of the play area be greater or less than 10 square meters? How do you know?

b. How many square meters does the play area take up? Model with an area model and solve below.

Name _____ Lifework

Today's takeaway: Area models represent multiplication. When one side length is a fraction, that side is less than one square unit.

1) Model the expression with an area model and solve for the product: $\frac{1}{5} \times 3$

2) Model the expression with an area model and solve for the product: $\frac{3}{5} \times 3$

Math Review:

3) What number is $\frac{1}{10}$ of 4,567?

Represent the problem above with a multiplication equation: