Mathematics: The Language of STEM
Using Models to Multiply Fractions
Ed Jarrett

CONTENT AND TASK DECISIONS

Grade Level(s): 5

Description of the Task: Given large sheets of bulletin board paper, students will use standard unit squares to determine the area(s) of the large sheets. Side lengths will be composed of whole numbers, fractions and mixed fractions.

This lesson is, in essence, from the NYS Common Core Mathematics Curriculum.
https://www.engageny.org/resource/grade-5-mathematics-module-5-topic-c-lesson-10

Indiana Mathematics Content Standard: *5.C.5 Use visual fraction models and numbers to multiply a fraction by a fraction or a whole number.*

Indiana Mathematics Process Standards:
PS.1: Students will persevere in fitting paper tiles to determine the area of the larger sheet. The sheets will progressively not "fit." Students will have to enlarge their construct to adapt.
PS.7: Students will find new relationships (partial products) that will enable greater fluidity.

Mathematics Content Goals: Given large sheets of bulletin board paper, students will use standard unit squares to determine the area(s) of the large sheets. Side lengths will be composed of whole numbers, fractions and mixed fractions. Students will use various drawn models to generalize their work. Additionally, the use of partial products will be encouraged and rehearsed.

Language Objectives: Students will write/draw/label correctly length, width and area. Students will verbally explain the solution to a problem involving partial products.

Materials:

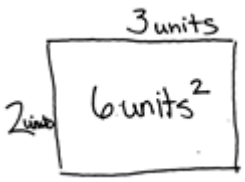
- Box of hamburger patty paper (used to separate hamburger patties - wax paper approximately 5.5 x 5.5 inches) These will be the "unit" tile.
- Large papers - one per group of the following dimensions (create template using the "unit" then trace/cut.)
- Rectangle A: 3 x 2 (three units long -bottom- by 2 units wide -tall) (one 'rectangle' per pair of students.)
- Rectangle B: 3 x 2 ½
- Rectangle C: 1 ½ x 5
- Rectangle D: 2 x 1 ¾
- Rectangle E: ¾ x 5

THE LESSON

Distribute Rectangle A to pairs of students. “We want to determine the area of this rectangle.” “What kind of units will be used to measure it?” (variety of systems; inches, centimeters..., ***square*** units.)
Introduce the use of (patty paper) tiles. “This will be our square unit. Starting in the upper left corner cover the rectangle with tiles leaving no spaces or overlaps, find the number of tiles that cover the rectangle.” Discuss the 6 square units.
Students should sketch what the tiling looks like, with teacher modeling. Drawing first the rectangle outline then the tiles “inside.”

Invite students to consider the lengths of the sides of the rectangle (2 and 3) and the area (6 square units).

“If we only had only a labeled sketch and not the tiles, would we still know the area? How?”



Create a chart on chart paper or board.

Rectangle	Length	Width	Area
A	3 units	2 units	6 units^2
B	3 units	$2\frac{1}{2}$ units	$7\frac{1}{2}$ units^2

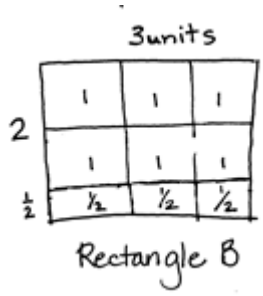
“Find rectangle B. How does it compare with rectangle A?” Explore: same length, larger width in B.

Students use tiles to find area. Folding tiles or overhanging rectangle B is necessary.

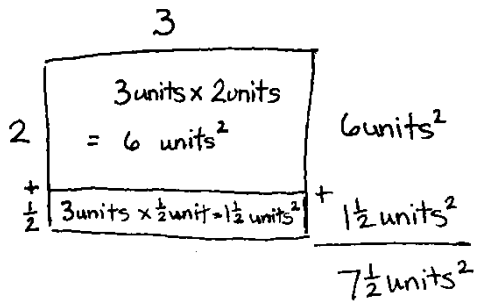
“What fraction of a tile do you need to cover this part of the rectangle? How do you know?

“What is the length? Width?”
“What is the area? How do you know?”

Students and teacher sketch and place information in the chart.



Sketch again, but without tiles.



Decompose the rectangle: "The length is still three units. What is the width?"
"Let's consider 2 ½ as 2 + ½."
"What is the area of the larger rectangle? 2x3=6. 6 square units."
"What is the area of the smaller rectangle? How do you know?"
Encourage students to reconstruct the parts to find the area of the whole.

Invite pairs to investigate rectangles C, D and E. The worksheet at the end of this lesson may be helpful.

Circulate as pairs work. Listen for helpful generalizations and misunderstandings. Allow for reliance on the concrete, tiles. Encourage students to demonstrate their understanding through their sketches.

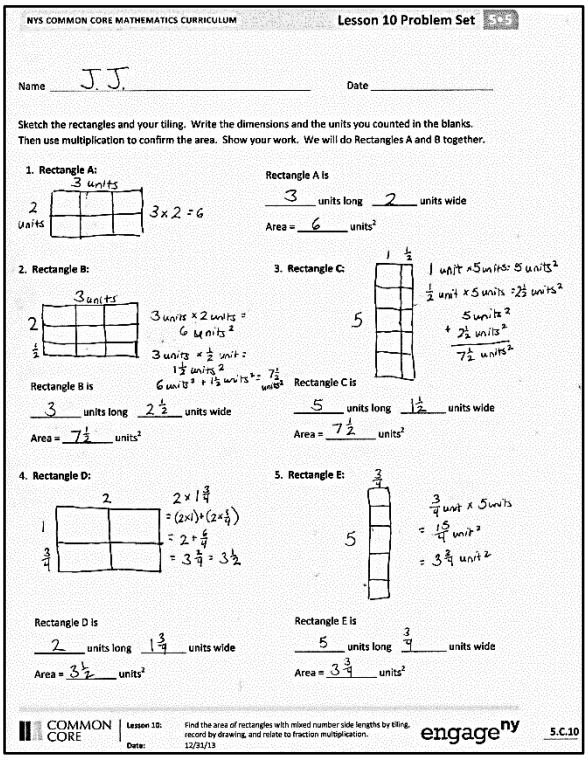
"What relationship did you notice between the areas of Rectangle C and Rectangle E? What accounts for this relationship?"

"How was Rectangle E different from the other rectangles you tiled? Describe how you tiled it."

"How did you determine the area of Rectangle E? Did you count the single units? Add repeatedly? Multiply the sides?"

"Could you place these rectangles in order of greatest to least area by using relationships among the dimensions but without actually performing the calculations? Why or why not?"

As students finish, invite them to pursue problems 6 and 7.



NYS COMMON CORE MATHEMATICS CURRICULUM — Lesson 10 Problem Set — 5•5

Name J. J. Date

Sketch the rectangles and your tiling. Write the dimensions and the units you counted in the blanks. Then use multiplication to confirm the area. Show your work. We will do Rectangles A and B together.

1. Rectangle A:

Rectangle A is

3 units long 2 units wide

Area = 6 units²

2. Rectangle B:

Rectangle B is

3 units long 2½ units wide

Area = 7½ units²

3. Rectangle C:

Rectangle C is

5 units long 1½ units wide

Area = 7½ units²

4. Rectangle D:

Rectangle D is

2 units long 1¾ units wide

Area = 3½ units²

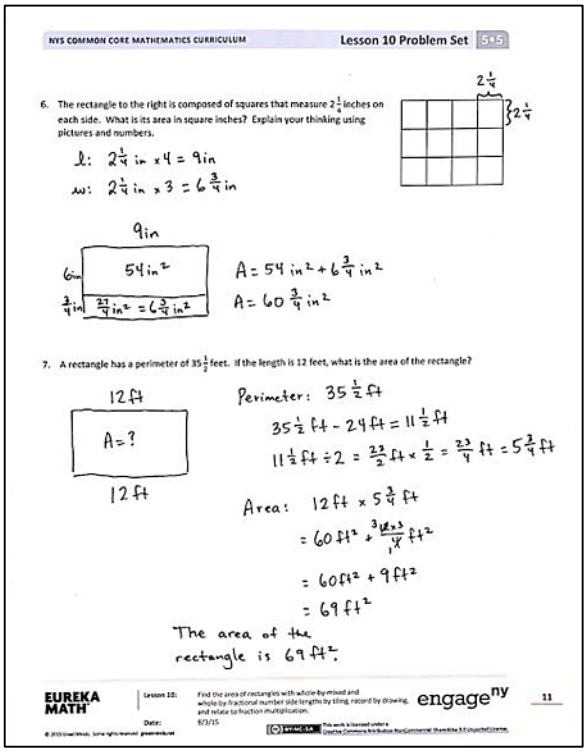
5. Rectangle E:

Rectangle E is

5 units long ¾ units wide

Area = 3¾ units²

COMMON CORE | Lesson 10: Date: | Find the area of rectangles with mixed number side lengths by tiling, record by drawing, and relate to fraction multiplication. 12/31/13 | engage^ny | 5.C.10



NYS COMMON CORE MATHEMATICS CURRICULUM — Lesson 10 Problem Set — 5•5

6. The rectangle to the right is composed of squares that measure $2\frac{1}{4}$ inches on each side. What is its area in square inches? Explain your thinking using pictures and numbers.

$2\frac{1}{4}$

$2\frac{1}{4}$

l: $2\frac{1}{4}$ in $\times 4 = 9$ in

w: $2\frac{1}{4}$ in $\times 3 = 6\frac{3}{4}$ in

9in

6in | 54in^2

$\frac{3}{4}$in | $\frac{27}{4}\text{in}^2 = 6\frac{3}{4}\text{in}^2$

$A = 54\text{in}^2 + 6\frac{3}{4}\text{in}^2$

$A = 60\frac{3}{4}\text{in}^2$

7. A rectangle has a perimeter of $35\frac{1}{2}$ feet. If the length is 12 feet, what is the area of the rectangle?

12ft

A=?

12ft

Perimeter: $35\frac{1}{2}$ ft

$35\frac{1}{2}\text{ft} - 24\text{ft} = 11\frac{1}{2}\text{ft}$

$11\frac{1}{2}\text{ft} \div 2 = \frac{23}{2}\text{ft} \times \frac{1}{2} = \frac{23}{4}\text{ft} = 5\frac{3}{4}\text{ft}$

Area: $12\text{ft} \times 5\frac{3}{4}\text{ft}$

$= 60\text{ft}^2 + \frac{3(4\times 3)}{1(4)}\text{ft}^2$

$= 60\text{ft}^2 + 9\text{ft}^2$

$= 69\text{ft}^2$

The area of the rectangle is 69ft^2.

EUREKA MATH — Lesson 10: Find the area of rectangles with whole-by-mixed and whole-by-fractional number side lengths by tiling, record by drawing, and relate to fraction multiplication. — Date: 8/3/15 — engage^ny — 11

Allow for student demonstration under document camera. Invite students to share solutions. Continue use of shared chart.

ASSESSMENT

Invite students to create their own expression for multiplying a mixed number times a whole number and solving it. The solution must be demonstrated with a labeled sketch. Invite students to share/explain their sample with peer (NOT their partner.)

Further, invite students to challenge a peer to solve their sample.

Name _____ **Date** _____

Sketch the rectangles and your tiling. Write the dimensions and the units you counted in the blanks. Then, use multiplication to confirm the area. Show your work. We will do Rectangles A and B together.

1. **Rectangle A:**

Rectangle A is

_____ units long _____ units wide

Area = _____ units^2

2. **Rectangle B:**

Rectangle B is

_____ units long _____ units wide

Area = _____ units^2

3. **Rectangle C:**

Rectangle C is

_____ units long _____ units wide

Area = _____ units^2

4.

4. **Rectangle D:**

Rectangle D is

_____ units long _____ units wide

Area = _____ units^2

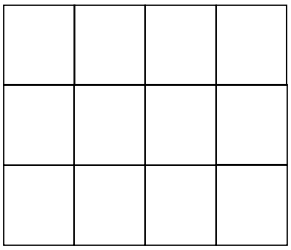
5. **Rectangle E:**

Rectangle E is

_____ units long _____ units wide

Area = _____ units^2

6. The rectangle to the right is composed of squares that measure $2\frac{1}{4}$ inches on each side. What is its area in square inches? Explain your thinking using pictures and numbers.



7. A rectangle has a perimeter of $35\frac{1}{2}$ feet. If the length is 12 feet, what is the area of the rectangle?