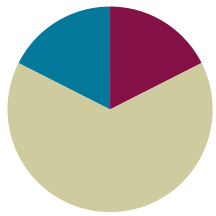
Lesson 15

Objective: Solve real world problems involving area of figures with fractional side lengths using visual models and/or equations.

Suggested Lesson Structure

Fluency Practice	(10 minutes)
Concept Development	(40 minutes)
Student Debrief	(10 minutes)
Total Time	**(60 minutes)**



Fluency Practice (10 minutes)

- Divide Whole Numbers by Unit Fractions and Unit Fractions by Whole Numbers **5.NF.7** (6 minutes)
- Quadrilaterals **3.G.1** (4 minutes)

Divide Whole Numbers by Unit Fractions and Unit Fractions by Whole Numbers (6 minutes)

Materials: (S) Personal white board

Note: This fluency activity reviews Module 4.

T: (Write $1 \div \frac{1}{2}$.) Say the division expression.

S: $1 \div \frac{1}{2}$.

T: How many halves are in 1?

S: 2.

T: (Write $1 \div \frac{1}{2} = 2$. Beneath it, write $2 \div \frac{1}{2}$.) How many halves are in 2?

S: 4.

T: (Write $2 \div \frac{1}{2} = 4$. Beneath it, write $3 \div \frac{1}{2}$.) How many halves are in 3?

S: 6.

T: (Write $3 \div \frac{1}{2} = 6$. Beneath it, write $7 \div \frac{1}{2}$.) On your personal white board, write the complete division sentence.

S: (Write $7 \div \frac{1}{2} = 14$.)

Continue with the following possible sequence: $1 \div \frac{1}{4}$, $2 \div \frac{1}{4}$, $9 \div \frac{1}{4}$, and $3 \div \frac{1}{5}$.

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T: (Write $\frac{1}{2} \div 2$.) Say the complete division sentence.

S: $\frac{1}{2} \div 2 = \frac{1}{4}$.

T: (Write $\frac{1}{2} \div 2 = \frac{1}{4}$. Beneath it, write $\frac{1}{2} \div 3$.) Say the complete division sentence.

S: $\frac{1}{2} \div 3 = \frac{1}{6}$.

T: (Write $\frac{1}{2} \div 3 = \frac{1}{6}$. Beneath it, write $\frac{1}{2} \div 4$.) Say the complete division sentence.

S: $\frac{1}{2} \div 4 = \frac{1}{8}$.

T: (Write $\frac{1}{2} \div 9 =$ ____.) On your personal white board, write the complete division sentence.

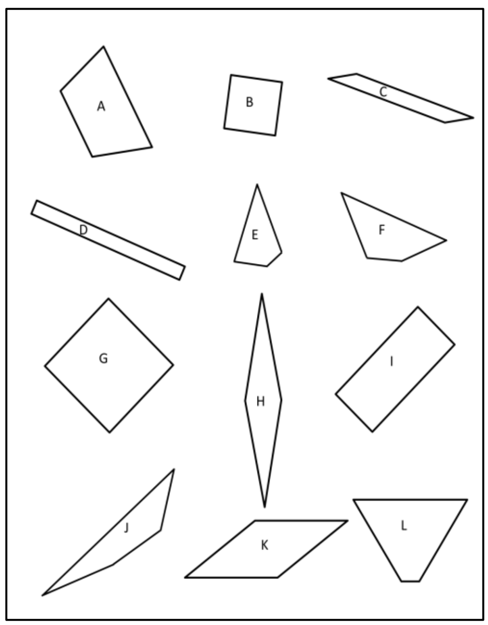
S: (Write $\frac{1}{2} \div 9 = \frac{1}{18}$.)

Continue with the following possible sequence: $\frac{1}{5} \div 2$, $\frac{1}{5} \div 3$, $\frac{1}{5} \div 5$, and $\frac{1}{8} \div 4$.

Quadrilaterals (4 minutes)

Materials: (T) Shape sheet (Template)

Note: This fluency activity reviews Grade 3 geometry concepts in anticipation of G5–Module 6 content. The sheet can be duplicated if preferred.



Attributes to Consider

Number of Sides

Length of Sides

Angle Measures

Shapes

Quadrilateral

Rhombus

Square

Rectangle

T: (Project the Shape sheet template and the list of attributes.) Take one minute to discuss the attributes of the shapes you see. You can use the list to support you.

S: Some have right angles. → All have straight sides. → They all have four sides. → B and G and maybe H and K have all equal sides. I'm not really sure.

T: If we wanted to verify whether the sides are equal, what could we do?

S: Measure with a ruler.

T: What about the angles? How could you verify that they're right angles?

S: I could compare it to something that I know is a right angle. → I could use a set square. → I could use a protractor to measure.

T: Now, look at the shape names. Determine which shapes might fall into each category. (Post the shape names.)

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S: B and G might be squares. → All of them are quadrilaterals. → H and K might be rhombuses. It's hard to know if their sides are equal. → D and I are rectangles. Oh yeah, and B and G are, too. → L and A look like trapezoids.

T: Which are quadrilaterals?

S: All of them.

T: Which shapes appear to be rectangles?

S: B, D, G, and I.

T: Which appear to have opposite sides of equal length but are not rectangles?

S: C, H, and K. → A and L have one pair of opposite sides that look the same.

T: Squares are rhombuses with right angles. Do you see any other shapes that might have four equal sides without right angles?

S: H and K.

Concept Development (40 minutes)

Materials: (S) Problem Set

Note: The Problem Set has been incorporated into and will be completed during the Concept Development. While there are only four problems, most are multi-step and will require time to solve.

Suggested Delivery of Instruction for Solving Lesson 15's Word Problems

1. Model the problem.

Have two pairs of students who can successfully model the problem work at the board while the others work independently or in pairs at their seats. Review the following questions before beginning the first problem:

- Can you draw something? This might be a tape diagram or an area model.
- What can you draw?
- What conclusions can you make from your drawing?

As students work, circulate. Reiterate the questions above. After two minutes, have the two pairs of students share only their labeled diagrams. For about one minute, have the demonstrating students receive and respond to feedback and questions from their peers.

2. Calculate to solve and write a statement.

Give everyone two minutes to finish working on that question, sharing his work and thinking with a peer. All students should write their equations and statements of the answer.

3. Assess the solution for reasonableness.

Give students one to two minutes to assess and explain the reasonableness of their solutions.

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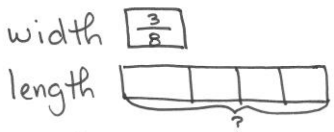
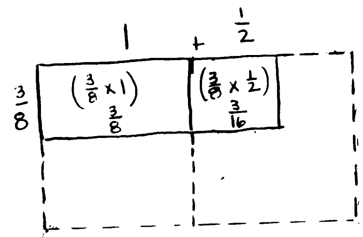
Problem 1

The length of a flowerbed is 4 times as long as its width. If the width is $\frac{3}{8}$ meter, what is the area?



length $= \frac{3}{8}$ m $\times 4 = \frac{12}{8}$ m $= \frac{3}{2}$ m

area $= \frac{3}{8}$ m $\times \frac{3}{2}$ m $= \frac{9}{16}$ m^2



$\frac{3}{8} + \frac{3}{16}$

$= \frac{6}{16} + \frac{3}{16} = \frac{9}{16}$

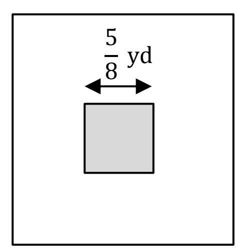
The flowerbed's area is $\frac{9}{16}$ m^2.

While this problem is quite simple to calculate, two complexities must be navigated. First, the length is not given. Second, the resulting area is less than a whole square meter. Once students have arrived at a solution, ask if their result makes sense and why. If students need support, discuss what this might look like if the flowerbed was tiled with 1-meter square tiles. The length of the bed necessitates that 2 whole tiles be used. (How is it that the area is less than 1?) Students might draw or represent the problem with concrete materials to explain their thinking. The folding for these units may prove challenging but worthwhile because these types of problems are often done procedurally by students rather than with a deep understanding of what their answer represents. As in Lesson 14, continue to have students explain their choice of strategy in terms of efficiency. As students share their approaches with the class, encourage those who had difficulty to ask how the presenters got started with their drawing and calculations. Also, encourage students to explain any false starts they experienced when solving and how and why their thinking changed.

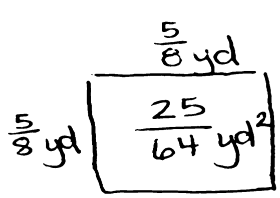
Problem 2

Mrs. Johnson grows herbs in square plots. Her basil plot measures $\frac{5}{8}$ yd on each side.

a. Find the total area of the basil plot.
b. Mrs. Johnson puts a fence around the basil. If the fence is 2 ft from the edge of the garden on each side, what is the perimeter of the fence?
c. What is the total area that the fence encloses?



a.



The total area of the basil plot is $\frac{25}{64}$ yd^2.

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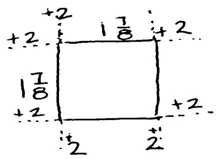
b. $\frac{5}{8}\text{ yd} = \frac{5}{8} \times 1\text{ yd}$

$= \frac{5}{8} \times 3\text{ ft}$

$= \frac{15}{8}\text{ ft}$

$= 1\frac{7}{8}\text{ ft}$



$1\frac{7}{8}\text{ ft} + 4\text{ ft} = 5\frac{7}{8}\text{ ft}$

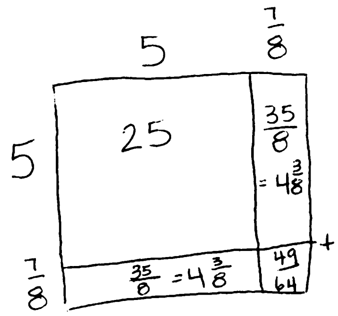
$5\frac{7}{8}\text{ ft} \times 4$

$= 20\frac{28}{8}\text{ ft}$

$= 23\frac{1}{2}\text{ ft}$

The perimeter of the fence is $23\frac{1}{2}$ ft.

c.



$29\frac{3}{8}$

$+\ 5\frac{9}{64}$

$34\frac{33}{64}$

The fenced area is $34\frac{33}{64}\text{ ft}^2$.

That's a little more than $34\frac{1}{2}\text{ ft}^2$.

$4\frac{3}{8} + \frac{49}{64}$

$= 4\frac{24}{64} + \frac{49}{64}$

$= 4\frac{73}{64}$

$= 5\frac{9}{64}$

$29\frac{24}{64} + 5\frac{9}{64}$

$= 34\frac{33}{64}$

As in Problem 1, the fraction multiplication involved in completing Part (a) is not rigorous. However, this problem offers an opportunity to explore the relationships of square yards to square feet and the importance of understanding the actual size of such units. The expression of the area as $\frac{25}{64}\text{ yd}^2$ may be conceptually challenging for students. They might be encouraged to relate this to a benchmark of 1 half or 1 third square yard (which is 3 square feet). Students might be asked to show what a tiling of this garden plot would look like.

It may even be helpful to use yardsticks to show the actual size of the herb plot. The area expressed as a bit more than 5 square feet may be surprising to the students. Help students make connections to the shading models of Module 4 and how the representation of the area model for the basil plot compares and contrasts to the representation of fraction multiplication. Part (b) offers a bit of complexity in that the dimensions of the garden are given in yards, yet the distance from the garden to the fence is given in feet. Part (c) requires that students use the fence measurements to find the total area enclosed by the fence. Multiple methods may be used to accomplish this.

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Problem 2 may be extended by having students convert the fence perimeter back into yards and the fenced area back into square yards. The understanding that $1\text{ yd}^2 = 9\text{ ft}^2$ makes this an interesting challenge.

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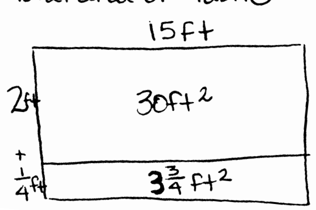
Problem 3

Janet bought 5 yards of fabric $2\frac{1}{4}$ feet wide to make curtains. She used $\frac{1}{3}$ of the fabric to make a long set of curtains and the rest to make 4 short sets.

a. Find the area of the fabric she used for the long set of curtains.
b. Find the area of the fabric she used for each of the short sets.

Total area of fabric



$= 33\frac{3}{4}\text{ ft}^2$

a. $33\frac{3}{4} \times \frac{1}{3}$

$= (33 \times \frac{1}{3}) + (\frac{3}{4} \times \frac{1}{3})$

$= 11 + \frac{1}{4}$

$= 11\frac{1}{4}\text{ ft}^2$

The area of the long curtain is $11\frac{1}{4}$ ft²

b. $33\frac{3}{4} - 11\frac{1}{4} = 22\frac{1}{2}$

$22\frac{1}{2} \times \frac{1}{4}$

$= (22 \times \frac{1}{4}) + (\frac{1}{2} \times \frac{1}{4})$

$= 5\frac{1}{2} + \frac{1}{8}$

$= 5\frac{5}{8}$

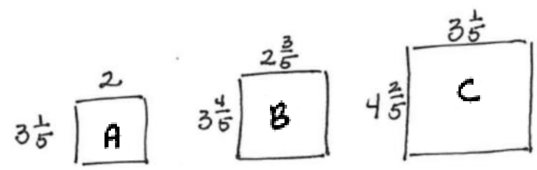
The area of each set of short curtains is $5\frac{5}{8}$ ft².

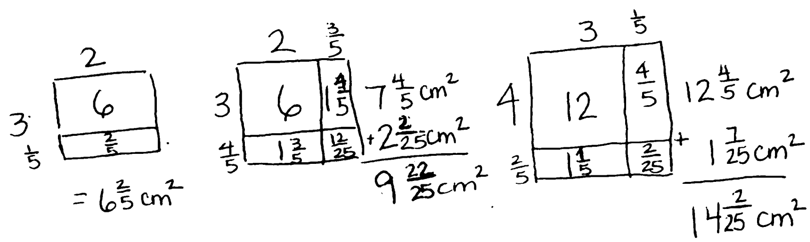
As in Problem 2, there are different units within a multi-step problem. After students have solved the problem, allow them to share whether they converted both measurements to feet or yards and the advantages and disadvantages of both. A discussion of the relationship of the square yards to the square feet may also be fruitful. Discuss the various strategies students may have used to find the fabric left for the shorter curtains.

Problem 4

Some wire is used to make 3 rectangles: A, B, and C. Rectangle B's dimensions are $\frac{3}{5}$ cm larger than Rectangle A's dimensions, and Rectangle C's dimensions are $\frac{3}{5}$ cm larger than Rectangle B's dimensions. Rectangle A is 2 cm by $3\frac{1}{5}$ cm.

a. What is the total area of all three rectangles?
b. If a 40 cm coil of wire was used to form the rectangles, how much wire is left?





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The complexity of this problem stems from students making sense of the way each rectangle increases in dimension. As always, encourage students to start by drawing each of the three rectangles. Since the denominators are easily expressed as hundredths, some students may use decimals to calculate these areas. Should this occur, help make the connection for other students to that learning from Module 4.

For Part (b), students must shift their thinking to the perimeter and use the outer dimensions of the rectangles to find the total amount of wire used. Again, students may use decimals for the calculations. Be sure to have students compare their decimal and fraction solutions with one another for equivalence and explain why they chose each type of fraction.

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Encourage students to look for patterns in the growth of the perimeters. As a challenge, ask students to tell the perimeter of the fifth or tenth rectangle in the series.

a Total area:

$6\frac{2}{5} + 9\frac{22}{25} + 14\frac{2}{25}$

$= 6\frac{10}{25} + 9\frac{22}{25} + 14\frac{2}{25}$

$= 29\frac{34}{25}$

$= 30\frac{9}{25}\text{ cm}^2$

$= 30.36\text{ cm}^2$

The total area is $30\frac{9}{25}\text{ cm}^2$.

a $2 \times 3.2 = 6.4$

$2.6 \times 3.8 = 9.88$

$3.2 \times 4.4 = 14.08$

30.36

The total area is 30.36 cm^2.

b. Perimeter:

#1 $(2\times2)+(2\times3.2)$
$= 4 + 6.4$
$= 10.4$

#2 $(2\times2.6)+(2\times3.8)$
$= 5.2 + 7.6$
$= 12.8$

#3 $(2\times3.2)+(2\times4.4)$
$= 6.4 + 8.8$
$= 15.2$

Perimeter:

#1 $2 \times 5\frac{1}{5} = 10\frac{2}{5}$

#2 $2 \times 6\frac{2}{5} = 12\frac{4}{5}$

#3 $2 \times 7\frac{3}{5} = 15\frac{1}{5}$

Total Perimeter $38\frac{2}{5}$

$40 - 38\frac{2}{5}$
$= 1\frac{3}{5}$

There was $1\frac{3}{5}$ cm of wire left.

Total perimeter:

$10.4\text{ cm} + 12.8\text{ cm} + 15.2\text{ cm} = 38.4\text{ cm}$

$40\text{ cm} - 38.4\text{ cm} = 1.6\text{ cm}$

There was 1.6 cm of wire left.

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Student Debrief (10 minutes)

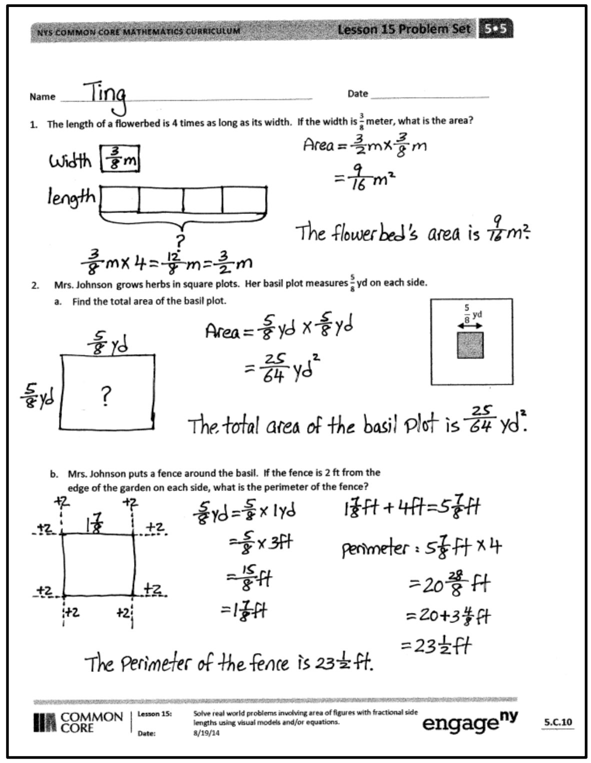
Lesson Objective: Solve real world problems involving area of figures with fractional side lengths using visual models and/or equations.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.

Any combination of the questions below may be used to lead the discussion.

- Compare the problems for which the distributive property seems most efficient and the problems for which multiplying improper fractions (or using decimals to multiply) seems so. What influences your choice of strategy?
- Sort problems from yesterday and today's lessons (Lessons 14 and 15) from simple to complex. What do the problems have in common? Have students compare their sort to a partner's.


NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 15 Problem Set 5•5

Name Ting Date

1. The length of a flowerbed is 4 times as long as its width. If the width is $\frac{3}{8}$ meter, what is the area?

Width $\boxed{\frac{3}{8}m}$

length

$\frac{3}{8}m \times 4 = \frac{12}{8}m = \frac{3}{2}m$

Area $= \frac{3}{2}m \times \frac{3}{8}m = \frac{9}{16}m^2$

The flowerbed's area is $\frac{9}{16}m^2$.

2. Mrs. Johnson grows herbs in square plots. Her basil plot measures $\frac{5}{8}$ yd on each side.

a. Find the total area of the basil plot.

$\frac{5}{8}$ yd, $\frac{5}{8}$ yd, ?

Area $= \frac{5}{8}$ yd $\times \frac{5}{8}$ yd $= \frac{25}{64}$ yd^2

The total area of the basil plot is $\frac{25}{64}$ yd^2.

b. Mrs. Johnson puts a fence around the basil. If the fence is 2 ft from the edge of the garden on each side, what is the perimeter of the fence?

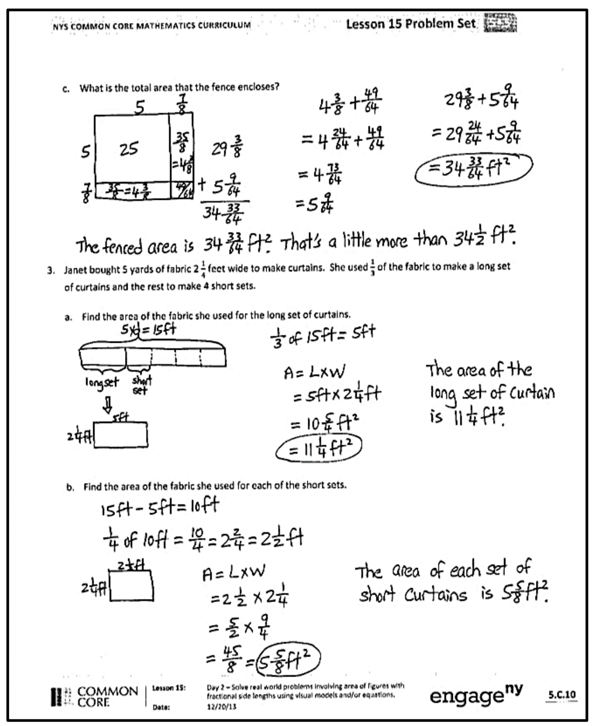
$\frac{5}{8}$ yd $= \frac{5}{8} \times 1$ yd $= \frac{5}{8} \times 3$ ft $= \frac{15}{8}$ ft $= 1\frac{7}{8}$ ft

$1\frac{7}{8}$ ft + 4 ft = $5\frac{7}{8}$ ft

perimeter: $5\frac{7}{8}$ ft $\times 4 = 20\frac{28}{8}$ ft $= 20 + 3\frac{4}{8}$ ft $= 23\frac{1}{2}$ ft

The perimeter of the fence is $23\frac{1}{2}$ ft.

COMMON CORE Lesson 15: Solve real world problems involving area of figures with fractional side lengths using visual models and/or equations. Date: 8/19/14 engage^{ny} 5.C.10


NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 15 Problem Set

c. What is the total area that the fence encloses?

$4\frac{3}{8} + \frac{49}{64} = 4\frac{24}{64} + \frac{49}{64} = 4\frac{73}{64} = 5\frac{9}{64}$

$29\frac{3}{8} + 5\frac{9}{64} = 29\frac{24}{64} + 5\frac{9}{64} = 34\frac{33}{64}$ ft^2

The fenced area is $34\frac{33}{64}$ ft^2. That's a little more than $34\frac{1}{2}$ ft^2.

3. Janet bought 5 yards of fabric $2\frac{1}{4}$ feet wide to make curtains. She used $\frac{1}{3}$ of the fabric to make a long set of curtains and the rest to make 4 short sets.

a. Find the area of the fabric she used for the long set of curtains.

5 yd = 15 ft; $\frac{1}{3}$ of 15 ft = 5 ft

$A = L \times W = 5$ ft $\times 2\frac{1}{4}$ ft $= 10\frac{5}{4}$ ft$^2 = 11\frac{1}{4}$ ft^2

The area of the long set of curtain is $11\frac{1}{4}$ ft^2.

b. Find the area of the fabric she used for each of the short sets.

15 ft − 5 ft = 10 ft

$\frac{1}{4}$ of 10 ft $= \frac{10}{4} = 2\frac{2}{4} = 2\frac{1}{2}$ ft

$A = L \times W = 2\frac{1}{2} \times 2\frac{1}{4} = \frac{5}{2} \times \frac{9}{4} = \frac{45}{8} = 5\frac{5}{8}$ ft^2

The area of each set of short curtains is $5\frac{5}{8}$ ft^2.

COMMON CORE Lesson 15: Day 2 – Solve real world problems involving area of figures with fractional side lengths using visual models and/or equations. Date: 12/20/13 engage^{ny} 5.C.10

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students' understanding of the concepts that were presented in today's lesson and planning more effectively for future lessons. The questions may be read aloud to the students.

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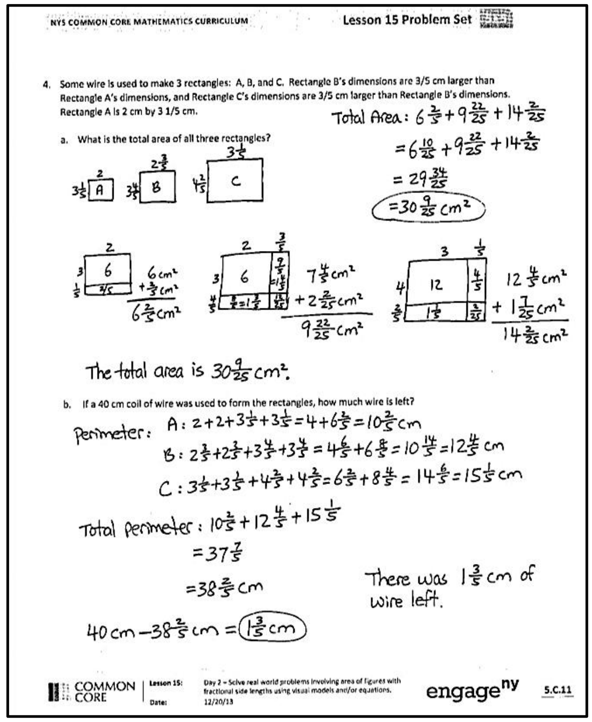

NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 15 Problem Set

4. Some wire is used to make 3 rectangles: A, B, and C. Rectangle B's dimensions are 3/5 cm larger than Rectangle A's dimensions, and Rectangle C's dimensions are 3/5 cm larger than Rectangle B's dimensions. Rectangle A is 2 cm by 3 1/5 cm.

a. What is the total area of all three rectangles?

Total Area: $6\frac{2}{5} + 9\frac{22}{25} + 14\frac{2}{25}$

$= 6\frac{10}{25} + 9\frac{22}{25} + 14\frac{2}{25}$

$= 29\frac{34}{25}$

$= 30\frac{9}{25}\text{ cm}^2$

$6\text{ cm}^2 + \frac{3}{5}\text{ cm}^2 = 6\frac{2}{5}\text{ cm}^2$

$7\frac{4}{5}\text{ cm}^2 + 2\frac{2}{25}\text{ cm}^2 = 9\frac{22}{25}\text{ cm}^2$

$12\frac{4}{5}\text{ cm}^2 + 1\frac{7}{25}\text{ cm}^2 = 14\frac{2}{25}\text{ cm}^2$

The total area is $30\frac{9}{25}\text{ cm}^2$.

b. If a 40 cm coil of wire was used to form the rectangles, how much wire is left?

Perimeter: A: $2+2+3\frac{1}{5}+3\frac{1}{5} = 4+6\frac{2}{5} = 10\frac{2}{5}$ cm

B: $2\frac{3}{5}+2\frac{3}{5}+3\frac{4}{5}+3\frac{4}{5} = 4\frac{6}{5}+6\frac{8}{5} = 10\frac{14}{5} = 12\frac{4}{5}$ cm

C: $3\frac{1}{5}+3\frac{1}{5}+4\frac{2}{5}+4\frac{2}{5} = 6\frac{2}{5}+8\frac{4}{5} = 14\frac{6}{5} = 15\frac{1}{5}$ cm

Total perimeter: $10\frac{2}{5}+12\frac{4}{5}+15\frac{1}{5}$

$= 37\frac{7}{5}$

$= 38\frac{2}{5}$ cm

$40\text{ cm} - 38\frac{2}{5}\text{ cm} = 1\frac{3}{5}\text{ cm}$

There was $1\frac{3}{5}$ cm of wire left.

COMMON CORE | Lesson 15: Day 2 – Solve real world problems involving area of figures with fractional side lengths using visual models and/or equations. Date: 12/20/13 engage^ny 5.C.11

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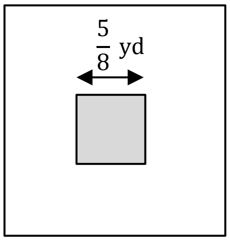
Name ____ Date ______________________

1. The length of a flowerbed is 4 times as long as its width. If the width is $\frac{3}{8}$ meter, what is the area?

2. Mrs. Johnson grows herbs in square plots. Her basil plot measures $\frac{5}{8}$ yd on each side.

   a. Find the total area of the basil plot.



   b. Mrs. Johnson puts a fence around the basil. If the fence is 2 ft from the edge of the garden on each side, what is the perimeter of the fence?

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c. What is the total area that the fence encloses?

3. Janet bought 5 yards of fabric $2\frac{1}{4}$ feet wide to make curtains. She used $\frac{1}{3}$ of the fabric to make a long set of curtains and the rest to make 4 short sets.

a. Find the area of the fabric she used for the long set of curtains.

b. Find the area of the fabric she used for each of the short sets.

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4. Some wire is used to make 3 rectangles: A, B, and C. Rectangle B's dimensions are $\frac{3}{5}$ cm larger than Rectangle A's dimensions, and Rectangle C's dimensions are $\frac{3}{5}$ cm larger than Rectangle B's dimensions. Rectangle A is 2 cm by $3\frac{1}{5}$ cm.

   a. What is the total area of all three rectangles?

   b. If a 40 cm coil of wire was used to form the rectangles, how much wire is left?

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Name ______________________________ Date ________________

Wheat grass is grown in planters that are $3\frac{1}{2}$ inch by $1\frac{3}{4}$ inch. If there is a 6×6 array of these planters with no space between them, what is the area covered by the planters?

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Name ____ Date ______________________

1. The width of a picnic table is 3 times its length. If the length is $\frac{5}{6}$ yd long, what is the area in square feet?

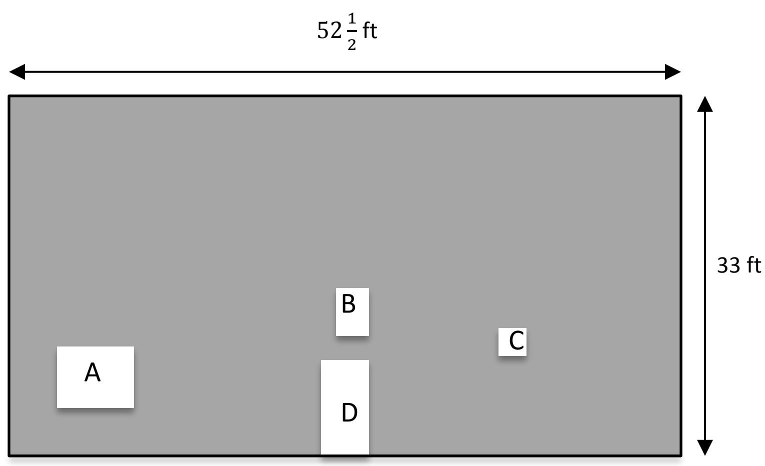
2. A painting company will paint this wall. The homeowner gives them the following dimensions:

   Window A is $6\frac{1}{4}$ ft × $5\frac{3}{4}$ ft.

   Window B is $3\frac{1}{8}$ ft × 4 ft.

   Window C is $9\frac{1}{2}$ ft^2.

   Door D is 8 ft × 4 ft.



   What is the area of the painted part of the wall?

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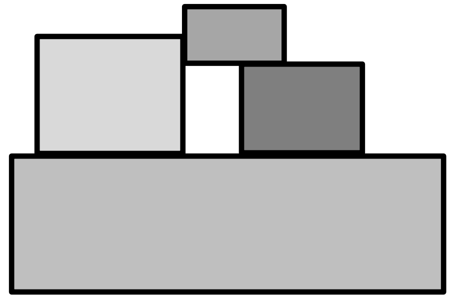
3. A decorative wooden piece is made up of four rectangles as shown to the right. The smallest rectangle measures $4\frac{1}{2}$ inches by $7\frac{3}{4}$ inches. If $2\frac{1}{4}$ inches are added to each dimension as the rectangles get larger, what is the total area of the entire piece?



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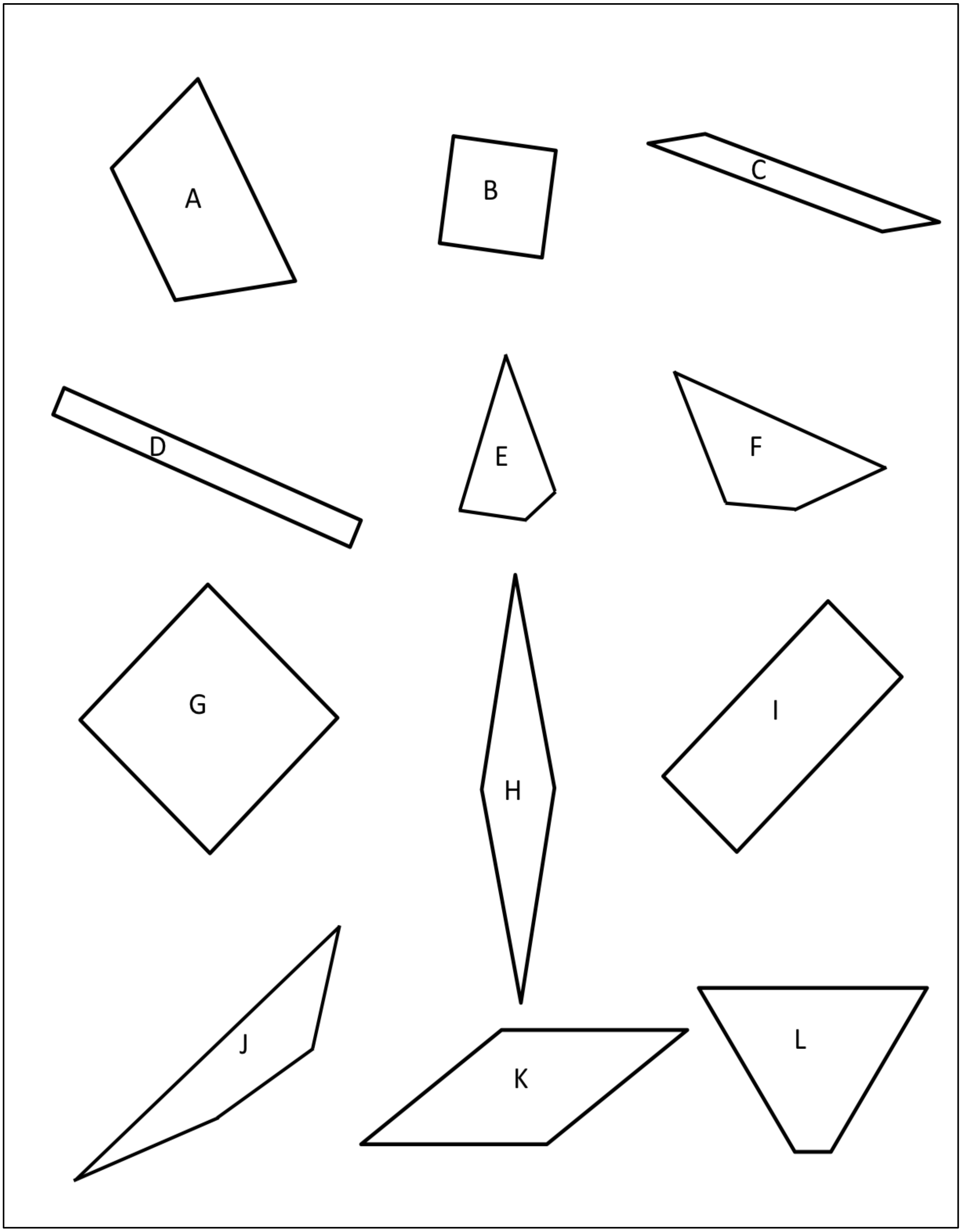

shape sheet

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