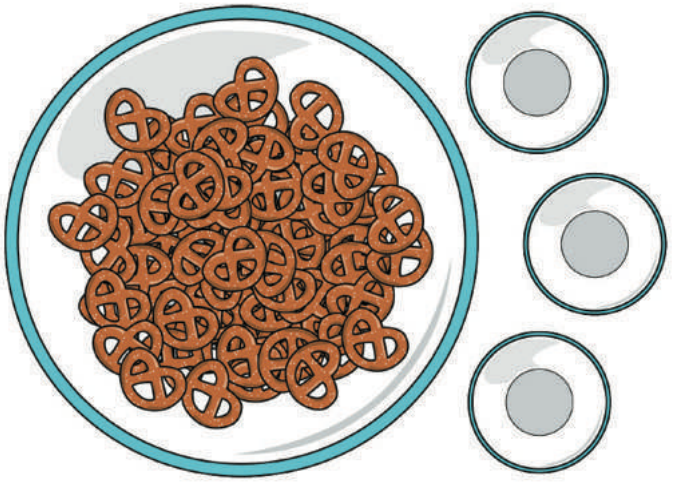
Core Knowledge® MATHEMATICS

Multiplying and Dividing Fractions



Student Workbook

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Multiplying and Dividing Fractions

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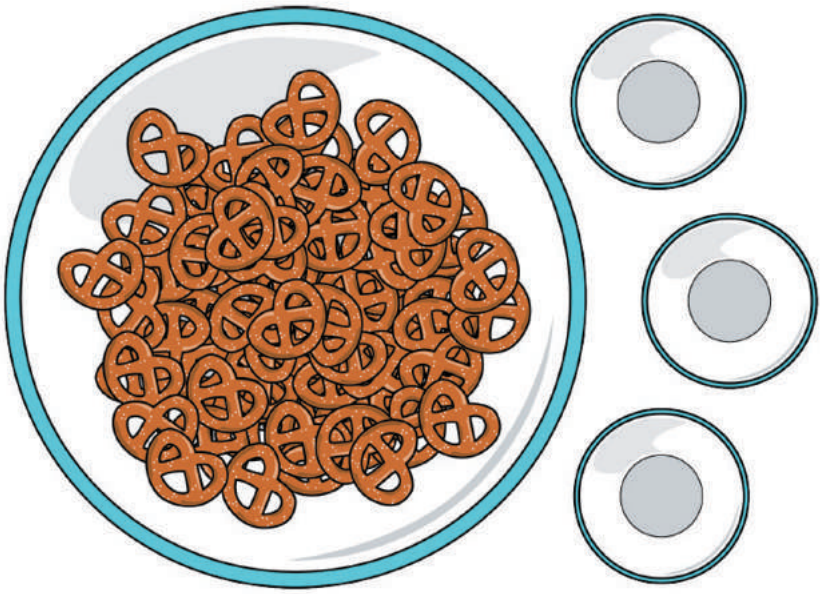


Multiplying and Dividing Fractions

Student Workbook

Core Knowledge Mathematics™

Lesson 1: One Piece of One Part

- Let's solve problems about unit fractions.

Warm-up: Notice and Wonder: Baked Macaroni and Cheese

What do you notice? What do you wonder?

1.1: Of What?

At a family dinner, a pan of macaroni and cheese is $\frac{1}{2}$ full. Lin eats $\frac{1}{3}$ of the remaining macaroni and cheese in the pan.

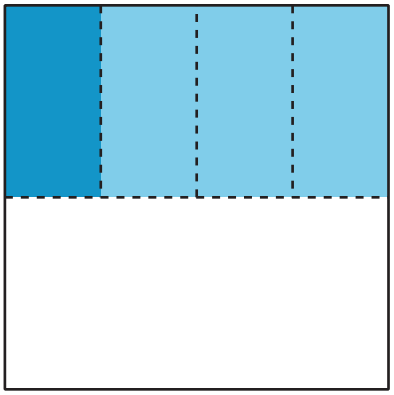
1. Draw a diagram to represent the situation.

2. Explain or show how you know your diagram represents the situation.

1.2: The Same, but Different

1. Explain or show how each diagram represents $\frac{1}{4}$ of $\frac{1}{2}$ of a pan of macaroni and cheese.

A



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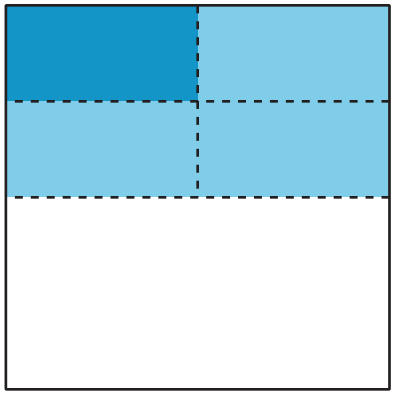


2. Use the diagrams to show that $\frac{1}{4}$ of $\frac{1}{2}$ is $\frac{1}{8}$ of the whole pan.

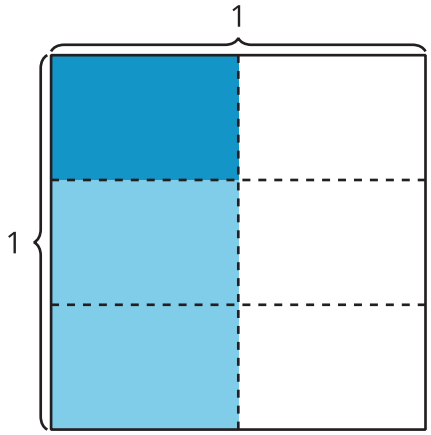
Lesson 2: Represent Unit Fraction Multiplication

- Let's write expressions to represent multiplication of unit fractions.

Warm-up: Which One Doesn't Belong: Diagrams

Which one doesn't belong?

A



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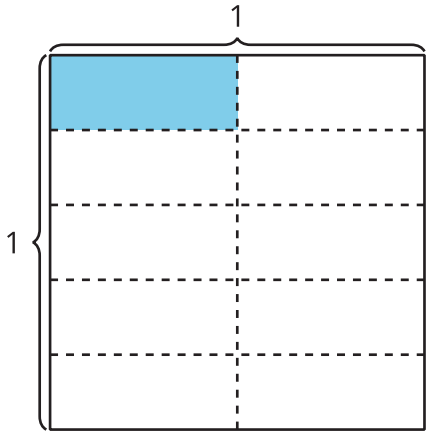

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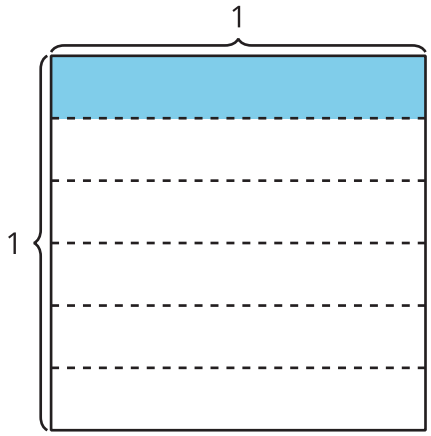

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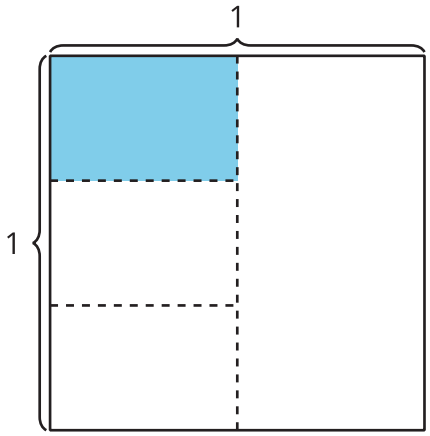
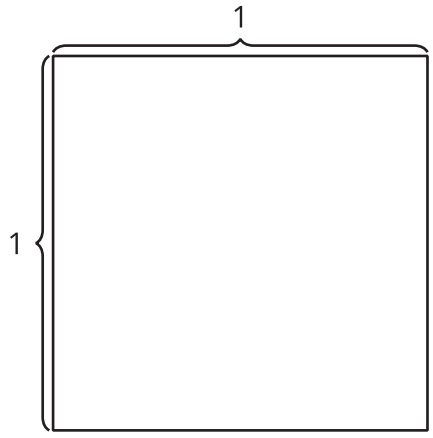
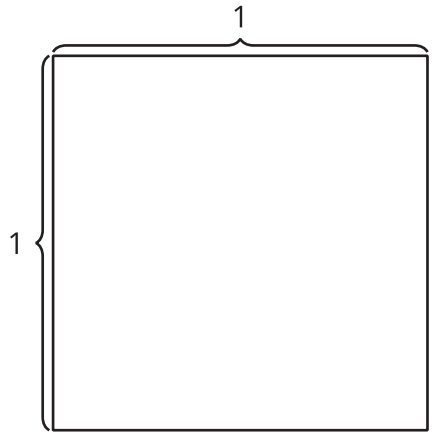


2.1: Interpret Diagrams

1. Show $\frac{1}{3}$ of the square.
   Shade $\frac{1}{4}$ of $\frac{1}{3}$ of the square.
   How much of the whole square is shaded?



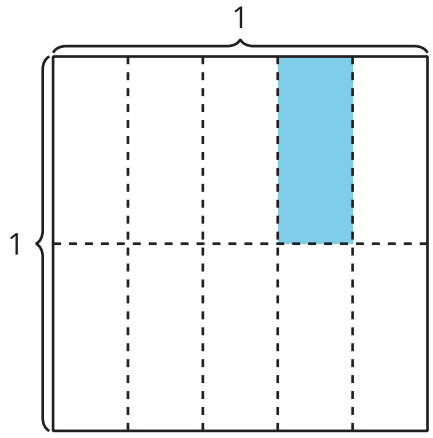
2. Show $\frac{1}{4}$ of the square.
   Shade $\frac{1}{3}$ of $\frac{1}{4}$ of the square.
   How much of the whole square is shaded?



3. How are the diagrams the same and how are they different?

2.2: Write an Expression

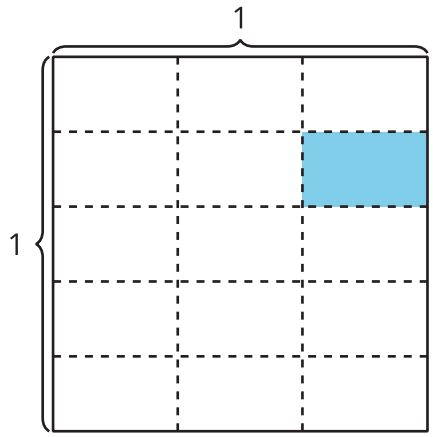
Priya shaded part of a square.



1. Explain or show how the expression $\frac{1}{5} \times \frac{1}{2}$ represents the area of the shaded piece.

2. Explain or show how the expression $\frac{1}{2} \times \frac{1}{5}$ represents the area of the shaded piece.

3. Write a multiplication expression to represent the area of the shaded piece. Be prepared to explain your reasoning.



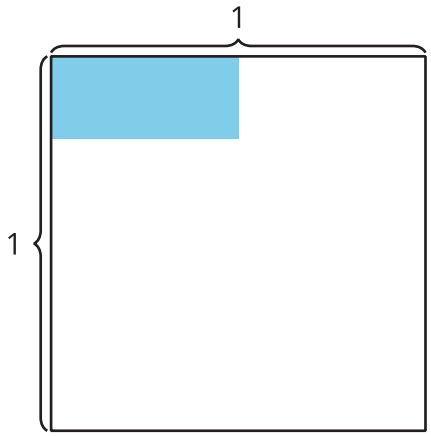
4. How much of the whole square is shaded?

Lesson 3: Multiply Unit Fractions

- Let's solve equations.

Warm-up: Estimation Exploration: How Much is Shaded?

What is the area of the shaded region?

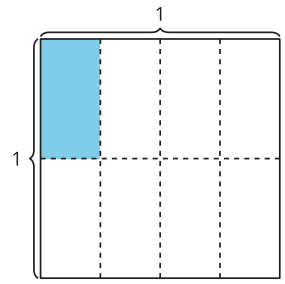


Record an estimate that is:

too low	about right	too high

3.1: Notice Patterns in Expressions

A



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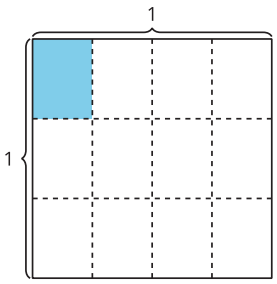

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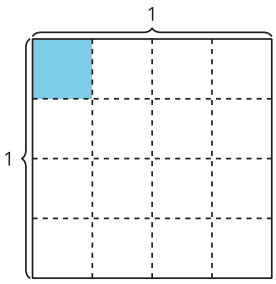

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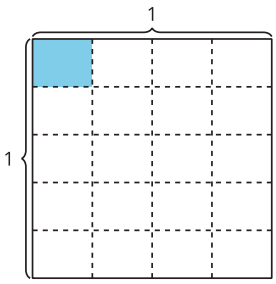
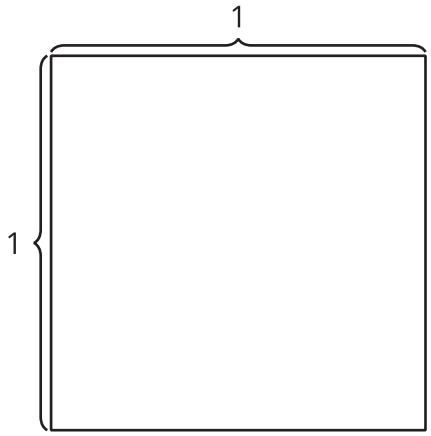


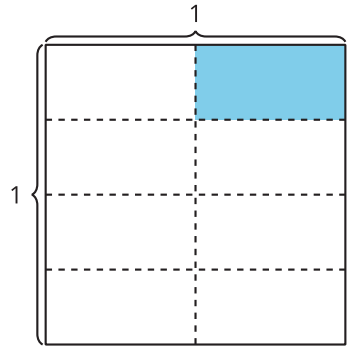
1. Choose one of the diagrams and write a multiplication expression to represent the shaded region. How much of the whole square is shaded? Explain or show your thinking.

2. If the pattern continues, draw what you think the next diagram will look like. Be prepared to explain your thinking.

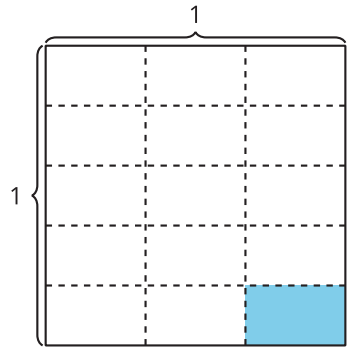


3.2: Write a Multiplication Equation

1. Write a multiplication equation to represent the area of the shaded piece.



2. Explain how the diagram represents the equation $\frac{1}{5} \times \frac{1}{3} = \frac{1}{15}$.



3. Find the value that makes each equation true. Use a diagram, if it is helpful.
   a. $\frac{1}{2} \times \frac{1}{6} = ?$

   b. $\frac{1}{4} \times \frac{1}{6} = ?$

Lesson 4: Situations about Multiplying Fractions

- Let's solve problems about multiplying unit fractions.

Warm-up: Number Talk: More Halving

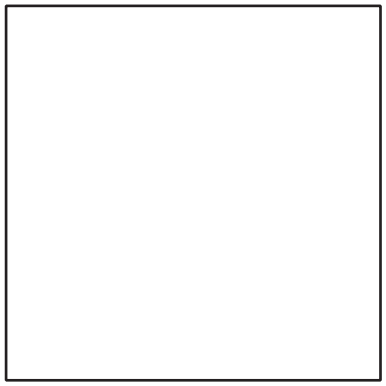
Find the value each expression mentally.

- $\frac{1}{2} \times \frac{1}{2}$
- $\frac{1}{3} \times \frac{1}{2}$
- $\frac{1}{4} \times \frac{1}{2}$
- $\frac{1}{5} \times \frac{1}{2}$

4.1: The Park

A city is designing a park on a rectangular piece of land. $\frac{2}{3}$ of the park will be used for different sports. $\frac{1}{2}$ of the land set aside for sports will be soccer fields.

1. Draw a diagram of the situation.

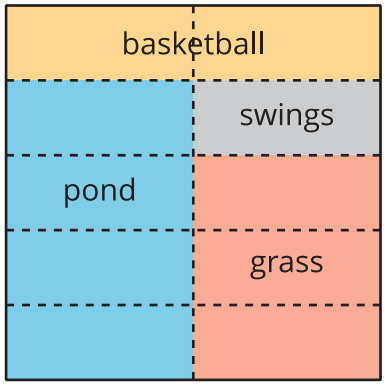


2. Write a multiplication expression to represent the fraction of the park that will be soccer fields.

3. What fraction of the whole park will be soccer fields? Explain or show your reasoning.

4.2: A Different Park

Here is a diagram for a different park that Elena drew.



1. Which part of the park can be represented with the expression $\frac{3}{5} \times \frac{1}{2}$? Explain or show your reasoning.

2. Pick one of the other parts of the park and write a multiplication expression for the fraction of the park it represents.

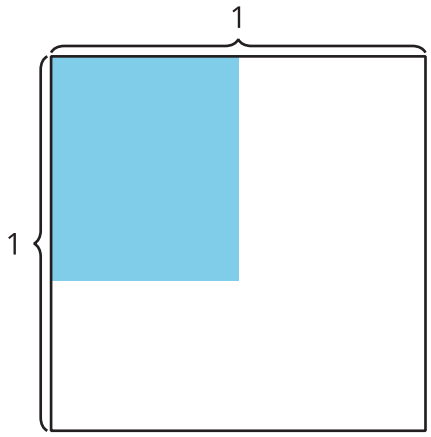
3. Trade expressions with your partner and figure out which part of the park their expression represents. Be prepared to explain your reasoning.

Lesson 5: Multiply a Unit Fraction by a Non-unit Fraction

- Let's multiply a unit fraction and a non-unit fraction.

Warm-up: Estimation Exploration: Shaded Rectangle

What is the area of the shaded region?



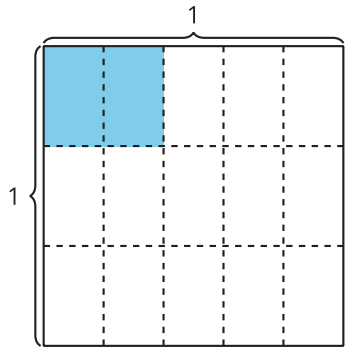
Record an estimate that is:

too low	about right	too high

5.1: Write Equations

1. Write a multiplication expression that represents the shaded region in each diagram.

A



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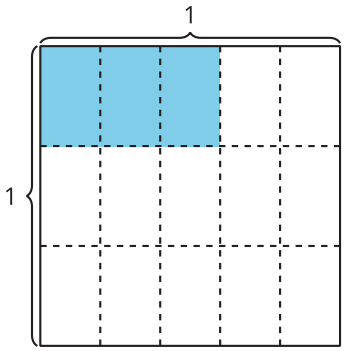

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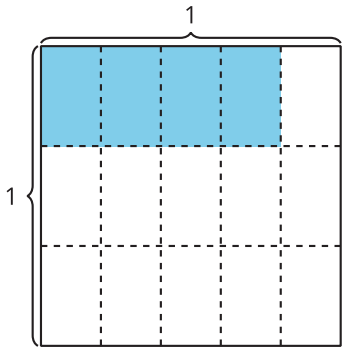
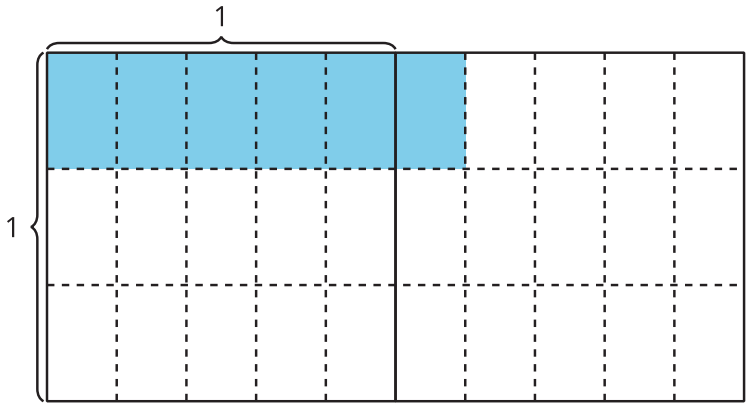


2. What patterns do you notice in the multiplication expressions?

3. Han wrote this equation to represent the area of the shaded region. Explain how the diagram represents the equation.

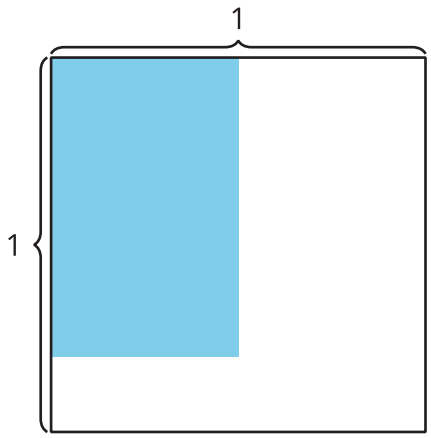
$\frac{6}{5} \times \frac{1}{3} = \frac{6}{15}$



5.2: Estimate With Expressions

Write a multiplication expression that might represent the area of the shaded region. Be prepared to explain your reasoning.

1.



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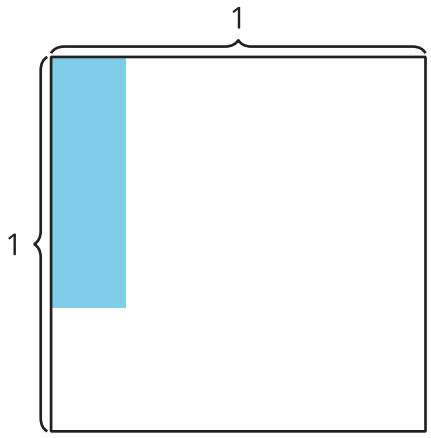

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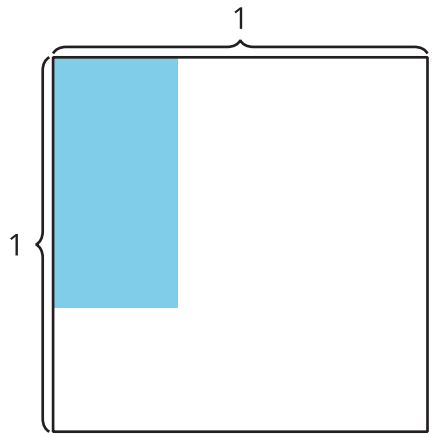

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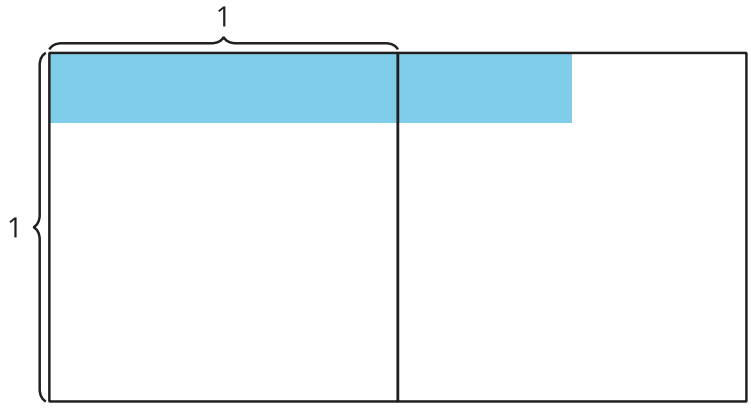


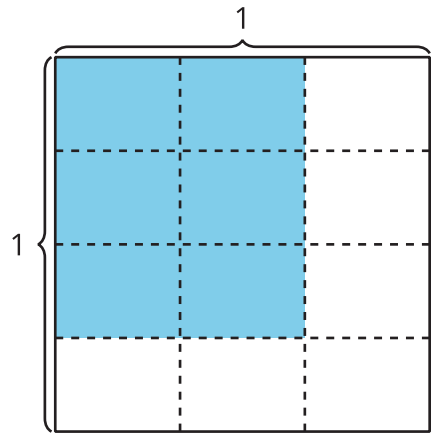
Lesson 6: Multiply Fractions

- Let's multiply two non-unit fractions using diagrams and expressions.

Warm-up: Which One Doesn't Belong: More Pieces

Which one doesn't belong?

A



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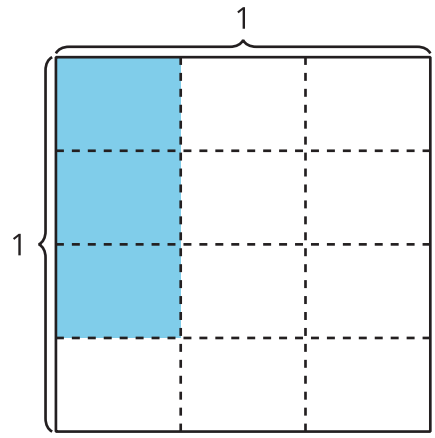

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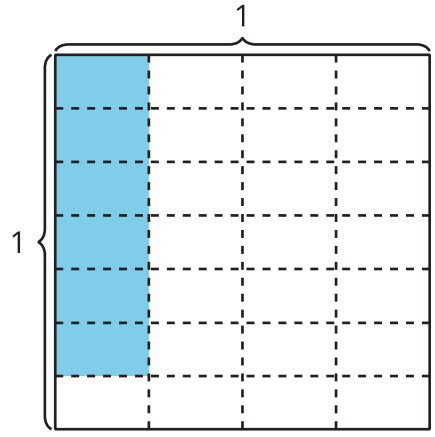

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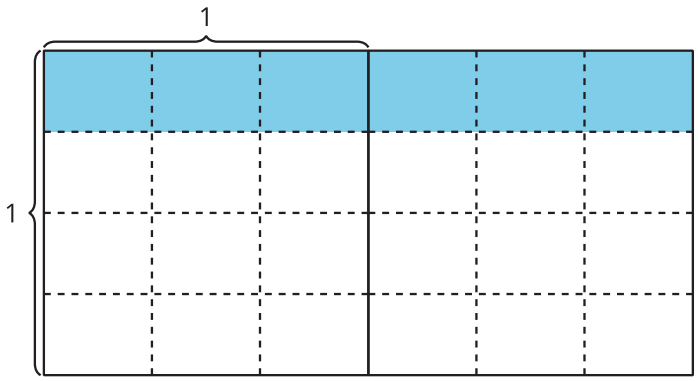
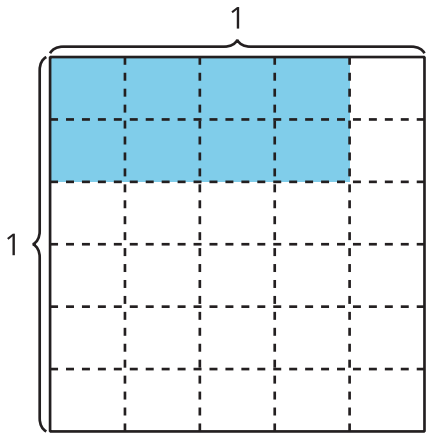


6.1: Many Expressions

Explain or show how each expression can represent the area of the shaded region in square units. Be prepared to share your thinking.



1. $\frac{8}{30}$

2. $2 \times 4 \times (\frac{1}{5} \times \frac{1}{6})$

3. $\frac{2}{6} \times \frac{4}{5}$

6.2: More Patterns

1. Complete the table.

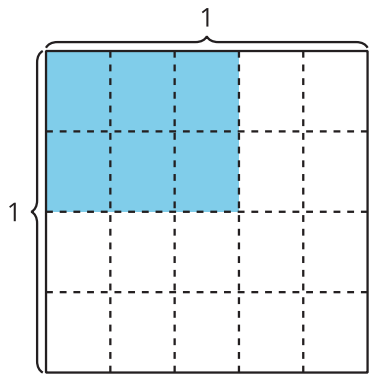
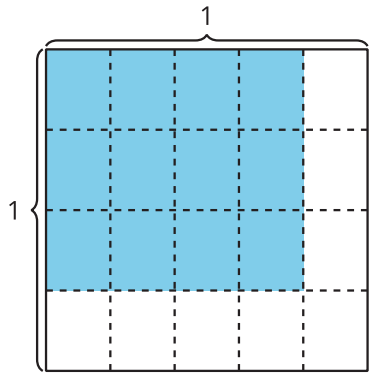
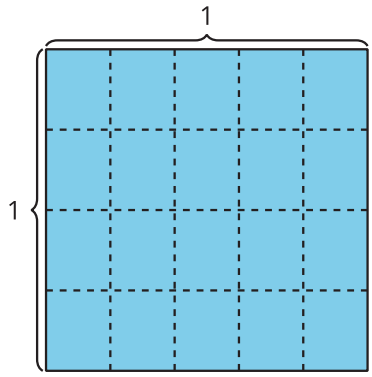
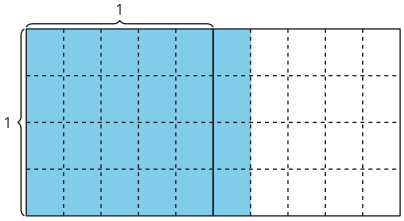
diagram	multiplication expression	shaded area (square units)
A 		
B 		

diagram	multiplication expression	shaded area (square units)
C 		
D 		

2. What patterns do you notice in the table?

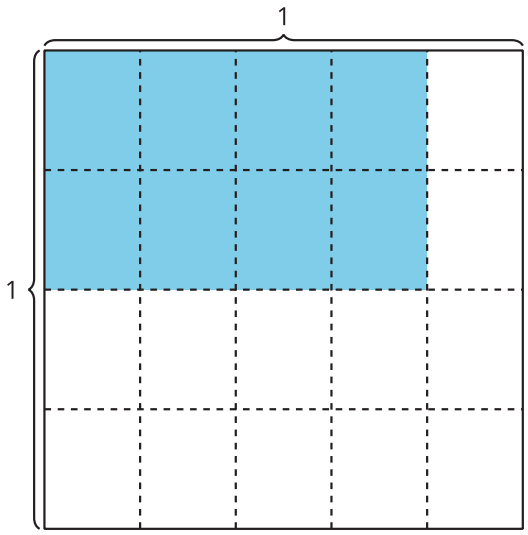
3. Explain or show how the expression $\frac{6\times4}{5\times4}$ represents the last diagram in the table.

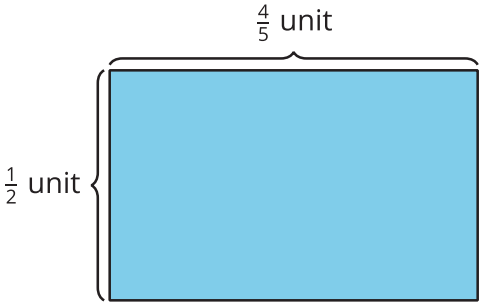
Lesson 7: Generalize Fraction Multiplication

- Let's use what we've learned to multiply any fractions.

Warm-up: Notice and Wonder: Two Diagrams

What do you notice? What do you wonder?

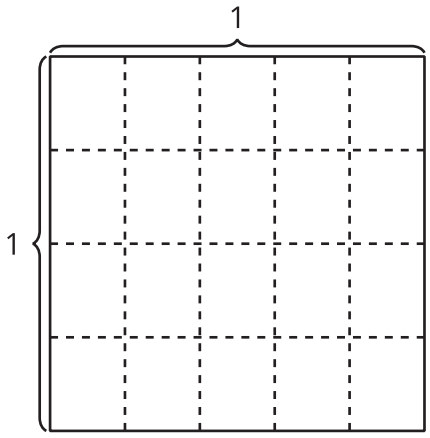




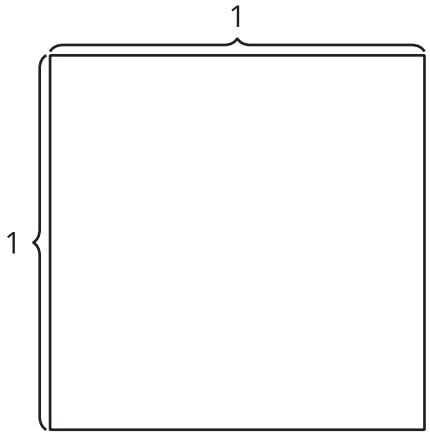
7.1: Equations and Area

1. Find the value of each product. Draw an area diagram if it is helpful.

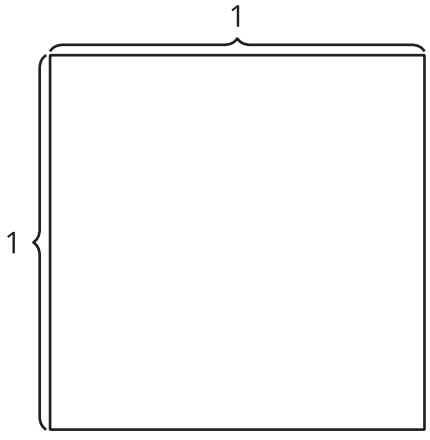
a. $\frac{2}{5} \times \frac{3}{4}$



b. $\frac{3}{7} \times \frac{4}{5}$

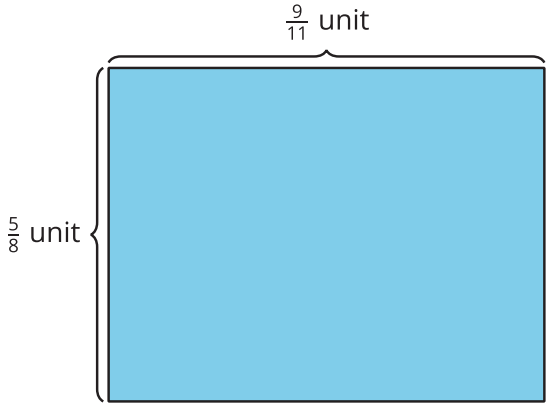


c. $\frac{9}{11} \times \frac{5}{8}$



2. How did you decide whether or not to draw a diagram? How did the diagrams influence how you found the products?

3. Diego drew this diagram for the product $\frac{9}{11} \times \frac{5}{8}$. How can the diagram help Diego find the value of $\frac{9}{11} \times \frac{5}{8}$?



7.2: Multiply Fractions

Find the value that makes each equation true. Draw a diagram, if it is helpful.

1. $\frac{3}{8} \times \frac{2}{5} = \_\_\_\_\_$

2. $\frac{3}{4} \times \frac{9}{5} = \_\_\_\_\_$

3. $\frac{10}{5} \times \frac{6}{5} = \_\_\_\_\_$

4. $\frac{8}{9} \times \_\_\_\_\_ = \frac{56}{36}$

5. $5 \times \_\_\_\_\_ = \frac{15}{8}$

Lesson 8: Apply Fraction Multiplication

- Let's solve problems about flags.

Warm-up: Number Talk: Fraction Multiplication

Find the value of each expression mentally.

- $\frac{1}{3} \times \frac{3}{5}$
- $\frac{2}{3} \times \frac{3}{5}$
- $\frac{5}{3} \times \frac{3}{5}$
- $\frac{2}{3} \times \frac{13}{5}$

8.1: Flags

Jada has a small replica of a flag of Thailand.

It is 5 inches wide and $7\frac{1}{2}$ inches long.

1. What is the area of the flag? Explain or show your reasoning.

2. Each red stripe is $\frac{5}{6}$ inches wide. What is the area of each red stripe? Explain or show your reasoning.

3. The blue stripe is $\frac{10}{6}$ inches wide. What is the area of the blue stripe? Explain or show your reasoning.

8.2: More Flags

Han has a replica of the flag of Colombia.

It is $3\frac{1}{2}$ inches wide and $5\frac{1}{4}$ inches long. The yellow stripe is $\frac{1}{2}$ of the width of the flag and the blue and red stripes are each $\frac{1}{4}$ of the width.

1. $\frac{1}{4} \times 3\frac{1}{2} = \frac{7}{8}$. The answer is $\frac{7}{8}$ inch. What is the question?

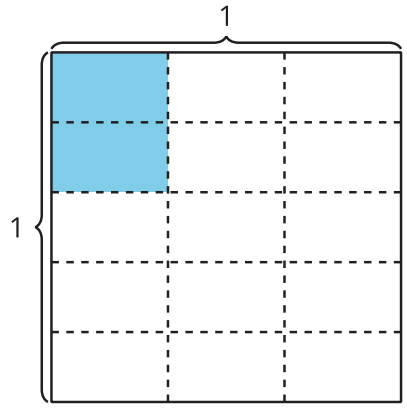
2. $\frac{1}{2} \times 3\frac{1}{2} = \frac{7}{4}$ and $\frac{7}{4} \times \frac{21}{4} = \frac{147}{16}$. The answer is $\frac{147}{16}$ square inches. What is the question?

Section Summary

Section Summary

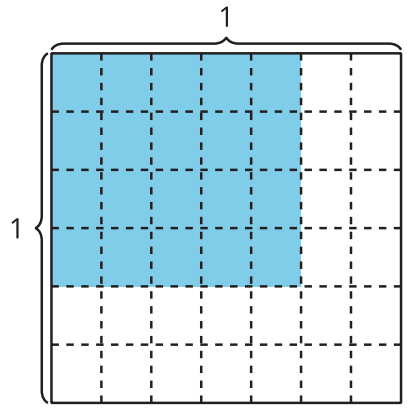
In this unit, we learned to multiply fractions. First we learned to multiply unit fractions. For example, we learned that $\frac{2}{5} \times \frac{1}{3} = \frac{2}{15}$.

A



In diagram A, we can see that $\frac{2}{5}$ of $\frac{1}{3}$ of a square is the same size as $\frac{2}{15}$ of the whole square. Next, we learned how to multiply any fraction by a fraction.

B



In diagram B, we can see that $\frac{4}{6} \times \frac{5}{7} = \frac{20}{42}$. We can multiply the numerators, 4×5 to find the numerator in the product. We can multiply the denominators, 6×7, to find the denominator in the product. We can represent this relationship with the equation: $\frac{(4\times5)}{(6\times7)} = \frac{20}{42}$. Diagram B shows 4×5 or 20 pieces with 6×7 or 42 pieces in the whole square.

Lesson 9: My Own Flag

- Let's design our own flag.

Warm-up: Notice and Wonder

What do you notice? What do you wonder?

9.1: Principles of Flag Design

1. Your teacher will assign you a principle of flag design. With your partner, discuss what the principle means. Why is the principle important for flag design?

   Principles of Good Flag Design

   a. Keep It Simple

   b. Use Meaningful Symbolism

   c. Use 2 to 3 Basic Colors

   d. No Lettering or Seals

   e. Be Distinctive or Be Related

2. For each flag from the warm up, explain or show how the flag represents the principles of flag design.

a.

b.

9.2: My Flag

1. Design your flag.
2. Imagine you are making your flag with fabric. About how much of each color fabric will you need in square inches?
3. Switch flags with a partner.
4. Describe the meaning of each symbol and color you used.
5. How do you see each of the design principles in your partner's flag?

Lesson 10: Concepts of Division

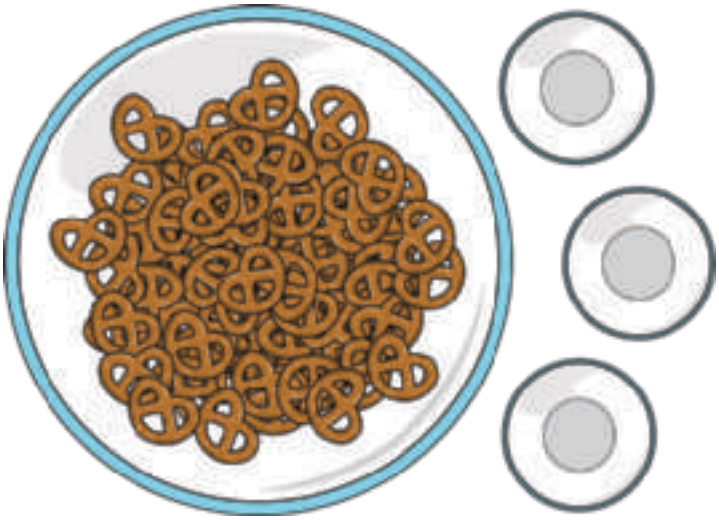
- Let's think about the size of quotients.

Warm-up: Number Talk: Same Dividend, Different Divisor

Find the value of each expression mentally.

- $120 \div 12$
- $120 \div 6$
- $120 \div 3$
- $120 \div 2$

10.1: Share Pretzels



Order the situations from greatest to least based on the number of pretzels each student will get. Be prepared to explain your reasoning.

3 students equally share 42 pretzels.
14 students equally share 42 pretzels.
3 students equally share 24 pretzels.
3 students equally share 45 pretzels.
7 students equally share 42 pretzels.
3 students equally share 6 pretzels.
6 students equally share 42 pretzels.

10.2: Division Patterns

1. Find the value of each expression.

   a. $36 \div 3$

   b. $12 \div 3$

   c. $9 \div 3$

   d. $6 \div 3$

   e. $3 \div 3$

   f. $1 \div 3$

2. What patterns do you notice?

3. Why is the quotient getting smaller?

4. What do you know about this expression: $\frac{1}{3} \div 3$?

5. Draw a diagram to represent $\frac{1}{3} \div 3$.

Lesson 11: Divide Unit Fractions by Whole Numbers

- Let's divide a unit fraction by a whole number.

Warm-up: Number Talk: Double the Divisor

Find the value of each expression mentally.

- $72 \div 4$
- $36 \div 4$
- $4 \div 4$
- $1 \div 4$

11.1: More Macaroni and Cheese

Jada and her 2 sisters equally share $\frac{1}{2}$ a pan of macaroni and cheese.

1. Draw a diagram to represent the situation.

2. Explain how this expression represents the situation: $\frac{1}{2} \div 3$

3. How much of the whole pan of macaroni and cheese will each person get?

11.2: More People Share

1. 4 people equally share $\frac{1}{2}$ a pan of macaroni and cheese.
   a. Draw a diagram to represent the situation.

   b. Explain how your diagram represents $\frac{1}{2} \div 4$.

   c. How much of the whole pan of macaroni and cheese did each person get? Be prepared to explain your reasoning.

2. 5 people equally share $\frac{1}{2}$ a pan of macaroni and cheese.

   a. Draw a diagram to represent the situation.

   b. Explain how your diagram represents $\frac{1}{2} \div 5$.

   c. How much of the whole pan of macaroni and cheese did each person get? Be prepared to explain your reasoning.

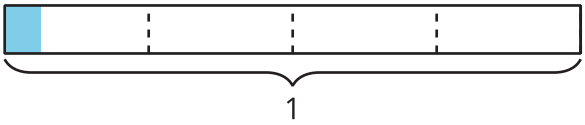
3. How are the problems the same? How are they different?

Lesson 12: Represent Division of Unit Fractions by Whole Numbers

- Let's make sense of diagrams that represent division of a unit fraction by a whole number.

Warm-up: Estimation Exploration: How Much is Shaded?

How much is shaded?



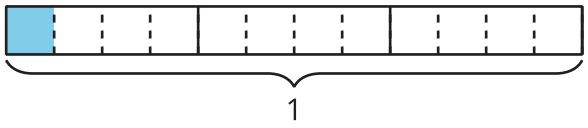
Record an estimate that is:

too low	about right	too high

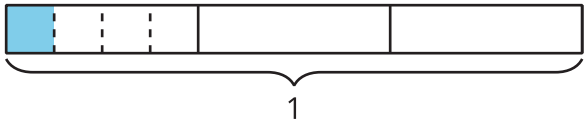
12.1: Diagrams, Equations, Situations

Priya and Mai used the diagrams below to find the value of $\frac{1}{3} \div 4$.

Priya's diagram:



Mai's diagram:



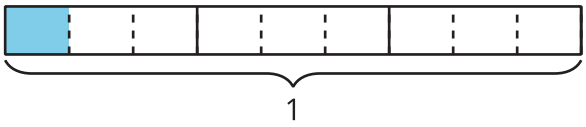
1. What is the same about the diagrams?

2. What is different?

3. Find the value that makes the equation true.

   $\frac{1}{3} \div 4 =$ _____

4. Han drew this diagram to represent $\frac{1}{3} \div 3$. Explain how the diagram shows $\frac{1}{3} \div 3$.



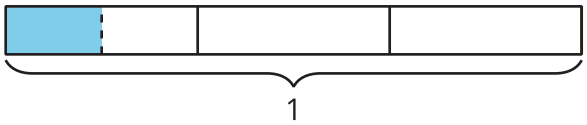
5. Find the value that makes the equation true. Explain or show your reasoning.

   $\frac{1}{3} \div 3 =$ _____

12.2: Priya's Work

1. Find the value of $\frac{1}{3} \div 2$. Explain or show your reasoning.

2. This is Priya's work for finding the value of $\frac{1}{3} \div 2$:



$\frac{1}{3} \div 2 = \frac{1}{2}$ because I divided $\frac{1}{3}$ into 2 equal parts and $\frac{1}{2}$ of $\frac{1}{3}$ is shaded in.

a. What questions do you have for Priya?

b. Priya's equation is incorrect. How can Priya revise her explanation?

12.3: Look for Patterns

1. Find the value that makes each equation true. Use a diagram if it is helpful.

   a. $\frac{1}{4} \div 2 =$ _____

   b. $\frac{1}{4} \div 3 =$ _____

   c. $\frac{1}{4} \div 4 =$ _____

2. What patterns do you notice?

3. How would you find the value of $\frac{1}{4}$ divided by any whole number? Explain or show your reasoning.

Lesson 13: Divide Whole Numbers by Unit Fractions

- Let's divide a whole number by a unit fraction.

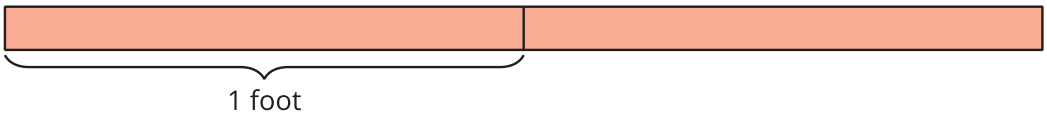
Warm-up: Notice and Wonder: Quilt

What do you notice? What do you wonder?

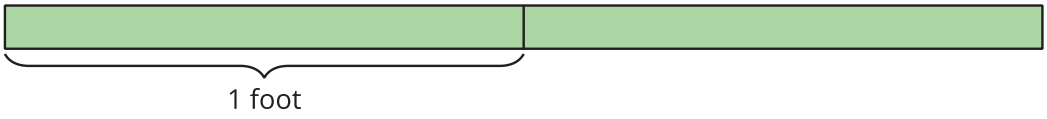
13.1: Paper Strips

Below are diagrams that show strips of different colored paper. Each strip is 2 feet long. The paper strips will be cut into different sized pieces.

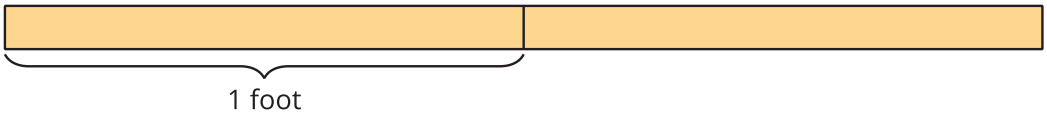
1. The red strip will be cut into pieces that are $\frac{1}{2}$ foot long. How many pieces will there be?



2. The green strip will be cut into pieces that are $\frac{1}{3}$ foot long. How many pieces will there be?



3. The yellow strip will be cut into pieces that are $\frac{1}{4}$ foot long. How many pieces will there be?



4. Describe what was the same about the problems you solved. Describe what was different.

13.2: More Paper Strips

Kiran has a yellow strip of paper that is 2 feet long. He wants to cut the strip into pieces that are $\frac{1}{6}$ foot long.

1. How many pieces will Kiran have? Explain or show your reasoning.

2. Write a division equation to represent the situation.

3. Describe how the equation $3 \div \frac{1}{6} = 18$ represents a strip of paper that is 3 feet long being cut into equal-sized pieces.

Lesson 14: Represent Division of Whole Numbers by Unit Fractions

- Let's solve problems involving division of a unit fraction by a whole number.

Warm-up: Number Talk: Increasing Quotients

Find the value of each expression mentally.

- $6 \div 1$
- $6 \div \frac{1}{2}$
- $6 \div \frac{1}{3}$
- $6 \div \frac{1}{6}$

14.1: Notice Patterns

Set A: Find the value that makes each equation true. Draw a diagram if it is helpful. What patterns do you notice?

- $3 \div \frac{1}{4} =$ _____
- $4 \div \frac{1}{4} =$ _____
- $5 \div \frac{1}{4} =$ _____
- $6 \div \frac{1}{4} =$ _____

Set B: Find the value that makes each equation true. Draw a diagram if it is helpful. What patterns do you notice?

- $3 \div \frac{1}{2} =$ _____
- $3 \div \frac{1}{3} =$ _____
- $3 \div \frac{1}{4} =$ _____
- $3 \div \frac{1}{5} =$ _____

What is the same about problem set A and B? What is different?

14.2: Match the Situation to the Expression

1. Match each problem to an expression that represents the problem. Some expressions will not have a match. Be prepared to explain your reasoning.
   a. One serving of popcorn is $\frac{1}{4}$ cup of kernels. There are 3 cups of kernels in the bowl. How many servings are in the bowl?

   b. One serving of orange juice is $\frac{1}{4}$ liter. The container of juice holds 2 liters. How many servings are in the container?

   c. One serving of granola is $\frac{1}{2}$ cup. The bag of granola holds 5 cups. How many servings are in the bag?

$\frac{1}{4} \div 3$

$\frac{1}{2} \div 5$

$3 \div \frac{1}{4}$

$\frac{1}{4} \div 2$

$5 \div \frac{1}{2}$

$2 \div \frac{1}{4}$

2. Find the value of each expression.

Lesson 15: Fraction Division Situations

- Let's write division situations and solve problems involving division of whole numbers and unit fractions.

Warm-up: Number Talk

Find the value of each expression mentally.

- $6 \div 3$
- $6 \div \frac{1}{3}$
- $\frac{1}{3} \div 6$
- $\frac{1}{3} \div 12$

15.1: Card Sort: Fraction Division Problem Sort

1. Your teacher will give you a set of cards. Match each expression with a situation. Some expressions do not have a matching situation.

2. Answer each question. Be prepared to share your reasoning.

15.2: Division Story Situations

1. Choose one of the expressions from the card sort that didn't have a match. Write a situation that matches the expression.

2. Trade situations with another group and answer their question.

Lesson 16: Reason About Quotients

- Let's apply what we know about division to make sure our answers make sense.

Warm-up: Estimation Exploration: How Many One Fifths?

$98 \div \frac{1}{5}$

Record an estimate that is:

too low	about right	too high

16.1: Greater Than or Less Than 1

$25 \div \frac{1}{5}$ $\frac{1}{7} \div 25$ $\frac{1}{8} \div 25$

$25 \div \frac{1}{7}$ $25 \div \frac{1}{8}$ $\frac{1}{5} \div 25$

1. Without finding the value of the expressions, write each expression under the correct category.

The value of the expression is less than 1	**The value of the expression is greater than 1**

2. Explain your strategy for determining whether a quotient is less than 1 or greater than 1.

16.2: Estimate and Divide

$25 \div \frac{1}{5}$ $\frac{1}{7} \div 25$ $\frac{1}{8} \div 25$

$25 \div \frac{1}{7}$ $25 \div \frac{1}{8}$ $\frac{1}{5} \div 25$

1. Without finding the value of the expressions, put the expressions in order from least to greatest.

2. Choose 2 expressions and find the value of the expressions.

Lesson 17: Fraction Multiplication and Division Situations

- Let's solve problems involving multiplying and dividing fractions.

Warm-up: Number Talk: Multiply and Divide

Find the value of each expression mentally.

- $5 \div \frac{1}{6}$
- $5 \times \frac{1}{6}$
- $\frac{1}{5} \div 6$
- $\frac{1}{5} \times \frac{1}{6}$

17.1: Info Gap: Tiles

Your teacher will give you either a problem card or a data card. Do not show or read your card to your partner.

If your teacher gives you the *problem card*:

1. Silently read your card and think about what information you need to answer the question.
2. Ask your partner for the specific information that you need.
3. Explain to your partner how you are using the information to solve the problem.
4. Solve the problem and explain your reasoning to your partner.

If your teacher gives you the *data card*:

1. Silently read the information on your card.
2. Ask your partner, "What specific information do you need?" and wait for your partner to ask for information. Only give information that is on your card. (Do not figure out anything for your partner!)
3. Before telling your partner the information, ask, "Why do you need that information?"
4. After your partner solves the problem, ask them to explain their reasoning and listen to their explanation.

Pause here so your teacher can review your work. Ask your teacher for a new set of cards and repeat the activity, trading roles with your partner.

17.2: Multiplication or Division

Solve each problem. Explain or show your reasoning.

1. If 11 grains of rice weigh $\frac{1}{3}$ gram, how much does each grain of rice weigh?

2. Mai's road is $\frac{9}{10}$ mile long. She ran $\frac{3}{4}$ of the length of her road. How far did she run?

3. If each tennis ball weighs $2\frac{1}{16}$ ounces, how much do 9 tennis balls weigh?

Lesson 18: Represent Situations with Multiplication and Division

- Let's represent problems with multiplication and division equations.

Warm-up: Number talk: Three and a Tenth

Find the value of each expression mentally.

- $3 \times \frac{1}{10}$
- $\frac{1}{10} \times 3$
- $\frac{1}{10} \div 3$
- $3 \div \frac{1}{10}$

18.1: Putting it All Together: Multiplication and Division

1. Diego's dad is making hamburgers for the picnic. There are 2 pounds of beef in the package. Each burger uses $\frac{1}{4}$ pound. How many burgers can be made with the beef in the package?

    a. Draw a diagram to represent the situation.

    b. Write a division equation to represent the situation.

    c. Write a multiplication equation to represent the situation.

2. Diego and Clare are going to equally share $\frac{1}{4}$ pound of potato salad. How many pounds of potato salad will each person get?

a. Draw a diagram to represent the situation.

b. Write a division equation to represent the situation.

c. Write a multiplication equation to represent the situation.

18.2: Multiplication or Division?

For your set of problems:

- Write a multiplication or division expression for each situation.
- Answer the question and write an equation. Make sure to include appropriate units. Draw a diagram, if needed.
- Trade papers with your partner, and check your partner's equations. If you disagree, work to reach an agreement.

Partner A:

1. The distance from Han's house to Priya's house is $\frac{4}{5}$ kilometer. Han has walked $\frac{3}{4}$ of the way already. How many kilometers has he walked?

2. Clare's science class will test water samples in class. If there is a total of $\frac{1}{2}$ gallon of water and 10 groups, how much water will each group get if they split the water equally?

3. A container with 3 kilograms of strawberries is $\frac{1}{5}$ full. How many kilograms can the container hold?

Partner B:

1. It takes Han 4 minutes to walk $\frac{1}{3}$ kilometer. How many minutes will it take him to walk 1 kilometer?

2. Clare's goal was to collect 4 kilograms of soil sample for her science project. She collected $2\frac{2}{3}$ times her goal. How many kilograms of soil did Clare collect?

3. A container that can hold a $\frac{1}{2}$ pound of strawberries is $\frac{3}{5}$ full. How many pounds of strawberries are in the container?

Lesson 19: Fraction Games

- Let's multiply and divide with fractions.

Warm-up: Estimation Exploration: Multiply Fractions

$28 \times 2\frac{8}{9}$

Record an estimate that is:

too low	about right	too high

19.1: Largest Product or Quotient

For each expression, work with your partner to decide what is the greatest product or quotient you can make with the numbers 1, 2, 3, 4, 5, and 6. For each expression, you can only use each number once. Explain or show your reasoning.

1. $\frac{\square}{\square} \times \frac{\square}{\square}$

2. $\square \div \frac{1}{\square}$

3. $\frac{1}{\square} \div \square$

19.2: Smallest Product or Quotient

For each expression, work with your partner to decide what is the smallest product or quotient you can make with the numbers 1, 2, 3, 4, 5, and 6. You can only use each number once for each expression. Explain or show your reasoning.

1. $\frac{\square}{\square} \times \frac{\square}{\square}$

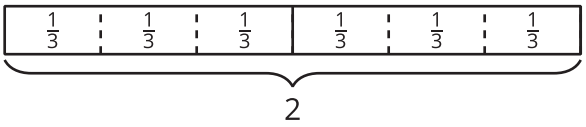
2. $\square \div \frac{1}{\square}$

3. $\frac{1}{\square} \div \square$

Section Summary

Section Summary
We used the relationship between multiplication and division to write both multiplication and division equations to represent the same situation. For example, there are 2 pounds of beef in the package. Each burger uses $\frac{1}{4}$ pound. How many burgers will the package make? We can write $2 \div \frac{1}{4} = 8$ and $8 \times \frac{1}{4} = 2$ to represent the situation.

We also wrote multiplication and division equations to represent the same diagram. For example:



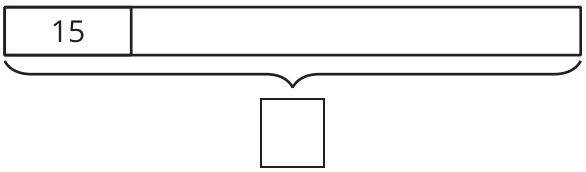
We can write $6 \times \frac{1}{3} = 2$ because the diagram shows 6 groups of $\frac{1}{3}$ and the total value is 2. We can also write $2 \div \frac{1}{3} = 6$ because the diagram shows that the number of groups of $\frac{1}{3}$ in 2 is 6.

Lesson 20: How Much in the Group?

- Let's solve more problems involving multiplication and division with fractions.

Warm-up: Estimation Exploration: What Number Goes in the Blank?

What number goes in the blank?



Record an estimate that is:

too low	about right	too high

20.1: Different Equations

1. If $\frac{1}{3}$ of the class is 9 students, how many students are in the class? Explain or show your reasoning.

2. Explain how each of these equations represents this situation.

   a. $\frac{1}{3} \times \_\_\_\_\_ = 9$

   b. $\_\_\_\_\_ \div 3 = 9$

   c. $3 \times 9 = \_\_\_\_\_$

20.2: How Big is the Class?

1. Jada's class has 24 students in it. That is $\frac{1}{4}$ of the total students in the 5th grade. How many students are in the 5th grade? Explain or show your reasoning.

2. Select **all** the equations that represent this situation.

   A. $\frac{1}{4} \times 24 = \_\_\_\_\_$

   B. $\_\_\_\_\_ \div 4 = 24$

   C. $\frac{1}{4} \div 24 = \_\_\_\_\_$

   D. $24 = \frac{1}{4} \times \_\_\_\_\_$

20.3: How Many in One Group?

Solve each problem. Show or explain your reasoning.

1. 250 mg of calcium is $\frac{1}{4}$ of the daily recommended allowance. What is the daily recommended allowance of calcium? Show or explain your reasoning.

2. A rocket took 60 days to get $\frac{1}{5}$ of the way to Mars. How many days did it take the rocket to get to Mars? Show or explain your reasoning.

Section A: Practice Problems

1. **Pre-unit**

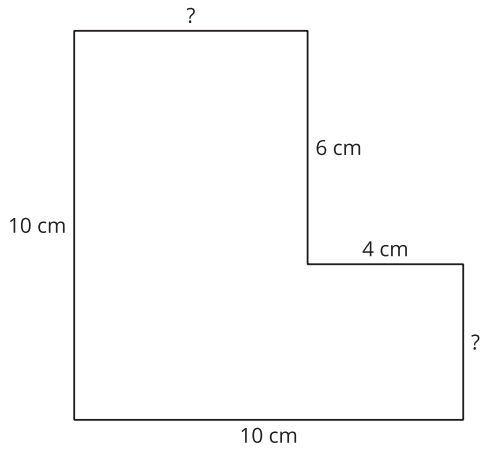
   There are 63 students in the cafeteria. There are 9 students at each table.

   a. At how many tables are the students seated?

   b. Write a division equation to represent your answer.

2. **Pre-unit**

   What is the area of this figure? Explain your reasoning.



3. **Pre-unit**

Select **all** expressions that are equivalent to $\frac{12}{5}$.

A. $6 \times \frac{2}{5}$

B. $5 \times \frac{1}{12}$

C. $12 \times \frac{1}{5}$

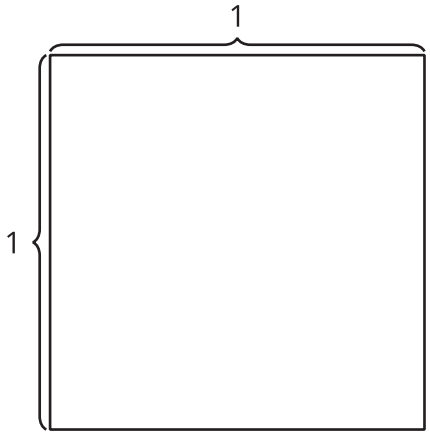
D. $8 \times \frac{4}{5}$

E. $4 \times \frac{3}{5}$

4. **Pre-unit**

Jada has 8 pennies. Each one weighs $\frac{5}{2}$ grams. How much do Jada's pennies weigh altogether? Explain your reasoning.

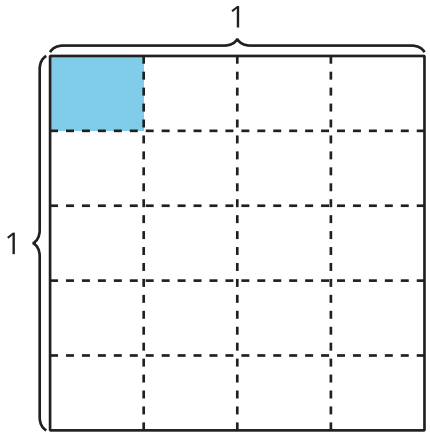
5. a. Shade $\frac{1}{2}$ of $\frac{1}{5}$ of the square.



b. Explain where you see $\frac{1}{2}$ of $\frac{1}{5}$ in your drawing.

(From Unit 3, Lesson 1.)

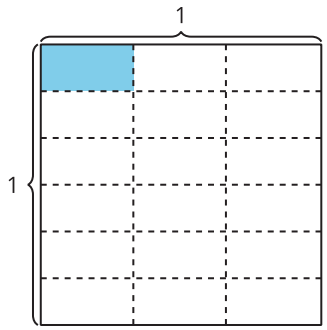
6. a. Write an expression for how much of the square is shaded.



b. Find the value of your expression.

(From Unit 3, Lesson 2.)

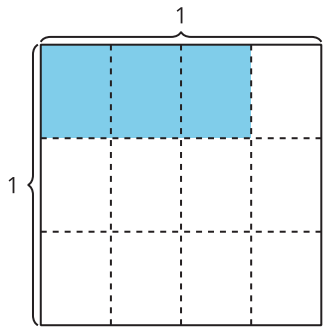
7. a. Write an equation representing the shaded part of the diagram.



b. Explain how the diagram shows each part of your equation.

(From Unit 3, Lesson 3.)

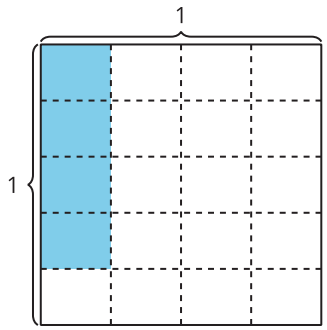
8. a. Write an expression for the shaded region of the square.



b. Explain how your expression matches the shaded region.

(From Unit 3, Lesson 4.)

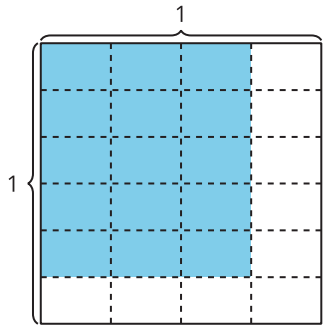
9. a. Write an expression for the area of the shaded region.



b. Explain how the diagram shows your expression.

(From Unit 3, Lesson 5.)

10. a. Write a multiplication expression for the area of the shaded region. Explain your reasoning.



b. What is the area of the shaded region in square units?

(From Unit 3, Lesson 6.)

11. Find the value that makes each equation true.

    a. $\frac{7}{10} \times \frac{3}{5} = \_\_\_\_$

    b. $\frac{2}{5} \times \_\_\_\_ = \frac{8}{45}$

    c. $\_\_\_\_ \times \frac{4}{9} = \frac{28}{45}$

    (From Unit 3, Lesson 7.)

12. This flag of Sweden is $3\frac{1}{5}$ inches wide and 2 inches tall. The rectangle in the upper right is $\frac{9}{5}$ inches wide and $\frac{4}{5}$ inch tall.

    a. What is the area of the whole flag?

    b. What is the area of the rectangle in the upper right?

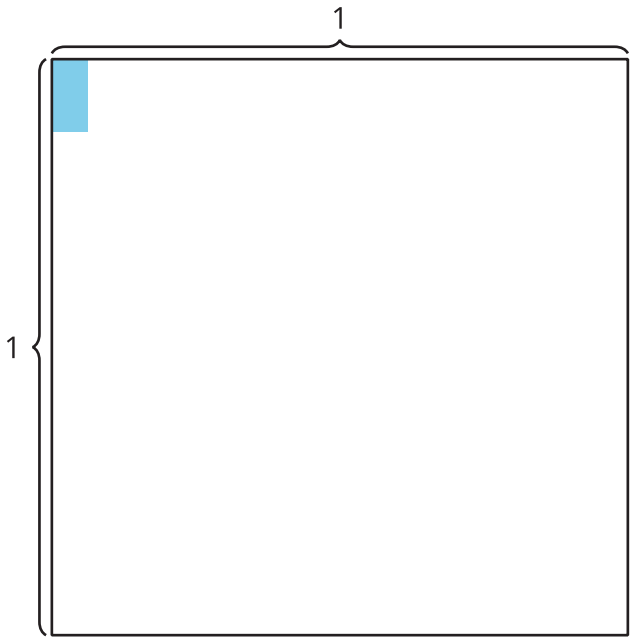
    (From Unit 3, Lesson 8.)

13. **Exploration**

On this American flag the width of the blue rectangle is $\frac{2}{5}$ the width of the flag. What fraction of the area of the flag is the blue rectangle? Explain or show your reasoning.

14. **Exploration**

Jada folded a square piece of paper in half many times, sometimes horizontally and sometimes vertically. She shaded the folded piece of paper and then unfolded it. Here is a picture.



What fraction of the paper did Jada shade? Explain how you know.

Section B: Practice Problems

1. For each pair of expressions, decide which is greater. Explain your choice without calculating the value of the expressions.

   a. $210 \div 3 \quad 210 \div 5$

   b. $210 \div 3 \quad 75 \div 3$

(From Unit 3, Lesson 10.)

2. A pan of macaroni and cheese is $\frac{1}{3}$ full. Four friends split the remaining macaroni and cheese equally.

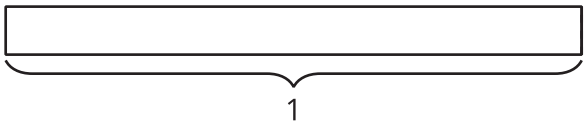
   a. Make a drawing that represents the situation.

   b. Write a division expression representing how much of a pan each friend gets.

   c. Explain how the drawing shows the division expression.

(From Unit 3, Lesson 11.)

3. a. Use the diagram to represent the expression $\frac{1}{5} \div 2$.



b. Explain how the diagram shows $\frac{1}{5} \div 2$.

c. What is the value of $\frac{1}{5} \div 2$?

(From Unit 3, Lesson 12.)

4. Mai has a strip of paper that is 3 feet long. She cuts it into $\frac{1}{4}$ foot strips.

a. How many $\frac{1}{4}$ foot strips does Mai make? Explain or show your reasoning.

b. Write a division equation to represent your answer.

(From Unit 3, Lesson 13.)

5. Find the value of each expression.

a. $5 \div \frac{1}{4}$

b. $6 \div \frac{1}{4}$

c. $3 \div \frac{1}{6}$

d. $3 \div \frac{1}{7}$

(From Unit 3, Lesson 14.)

6. Solve each problem. Write an equation showing your answer.

   a. There are 4 liters of water. How many $\frac{1}{2}$ liter bottles of water is that?

   b. 4 friends split $\frac{1}{2}$ pound of dried fruit equally. How many pounds of fruit does each friend get?

(From Unit 3, Lesson 15.)

7. Find the value of each expression. Explain or show your reasoning.

   a. $3 \div \frac{1}{4}$

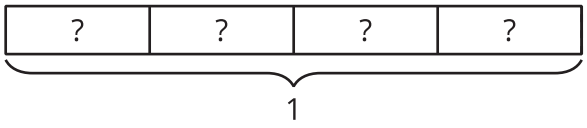
   b. $\frac{1}{5} \div 8$

(From Unit 3, Lesson 16.)

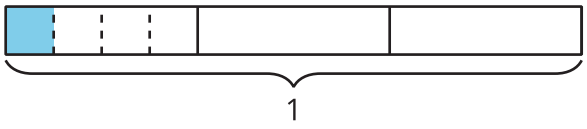
8. **Exploration**

For each diagram, write a story problem that the tape diagram represents. Then use the diagram to solve the problem.

A



B



9. **Exploration**

It takes Earth 1 year to go around the Sun.

a. During the time it takes Earth to go around around the Sun, Mercury goes around the Sun about 4 times. How many years does it take Mercury to make 1 full orbit of the Sun? Write an equation showing your answer.

b. During the time it takes Earth to go around the Sun, Saturn goes $\frac{1}{29}$ of the way around the Sun. How many years does it take Saturn to go around the Sun? Write an equation showing your answer.

Section C: Practice Problems

1. Solve each problem. Write an equation showing your answer.

   a. The container holds $\frac{1}{2}$ gallon of water. It is $\frac{3}{4}$ full. How many gallons of water are in the container?

   b. The container has $\frac{1}{2}$ gallon of water. 6 friends split the water equally. How many gallons of water does each friend get?

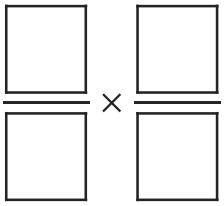
   c. The container has 1 gallon of water. Each bottle holds $\frac{1}{8}$ of a gallon. How many bottles of water does the container hold?

   (From Unit 3, Lesson 17.)

2. Clare has 5 yards of ribbon. It takes $\frac{1}{2}$ yard to make a bow. How many bows can Clare make with the ribbon? Write a multiplication and a division equation showing the solution.

   (From Unit 3, Lesson 18.)

3. Using the numbers 4, 5, 6, 7, 8, or 9, what is the largest product you can make?



You can use each number at most once. Explain or show your reasoning.

(From Unit 3, Lesson 19.)

4. 3 ounces is $\frac{1}{4}$ of the package of sunflower seeds. How many ounces of sunflower seeds are in the whole package? Explain or show your reasoning.

(From Unit 3, Lesson 20.)

5. A person drove 5 miles. That is $\frac{1}{3}$ of the distance from their home to work. How far is it from the person's home to work? Explain or show your reasoning.

(From Unit 3, Lesson 20.)

6. **Exploration**

   a. Each millimeter is $\frac{1}{1{,}000}$ of a meter. There are 1,000 micrometers in a millimeter. How many meters is a micrometer? Explain or show your reasoning.

   b. There are 1,000 nanometers in a micrometer. How many meters is a nanometer? (A single human hair can be about 50 micrometers thick. Nanometers can be used to describe the size of atoms.)

7. **Exploration**

   Jada wants to make a playpen for her dog with at least 70 square feet of space. She has 35 feet of fencing for the frame. Can Jada make a big enough playpen? Explain your reasoning.

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