Essential Questions:

- How does the Instructional Materials Evaluation Tool (IMET) reflect the major features of the Standards and the Shifts?

- What understandings support high-quality, accurate application of the IMET metrics?

Goals:

✓ Understand how aligned materials embody the shifts inherent in the Common Core State Standards

✓ Understand the precise meaning of each metric of the IMET

✓ Recognize examples and non-examples related to each metric of Alignment Criterion 1 of the IMET
**AC Metric 1A:** The materials support the development of students’ conceptual understanding of key mathematical concepts, especially where called for in specific content standards or cluster headings.

- Where the Standards explicitly require students to understand concepts, do the assignments that students work on build that understanding and do assessment tasks reveal whether students understand the mathematics in question?

4.OA.A Use the four operations with whole numbers to solve problems.

4.OA.A.1 Interpret a multiplication equation as a comparison, e.g., interpret $35 = 5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.

4.OA.B.4 Find all factor pairs for a whole number in the range 1–100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1–100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1–100 is prime or composite.

4.MD.A.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.
AC Metric 1A: The materials support the development of students’ conceptual understanding of key mathematical concepts, especially where called for in specific content standards or cluster headings.

- Do the materials feature high-quality conceptual problems and conceptual discussion questions?

**Standard/Cluster:** 4.NF.A Extend understanding of fraction equivalence and ordering

Which number is larger?

1.7 or 17 twelfths

Explain how you can tell without drawing a picture.
**AC Metric 1A:** The materials support the development of students’ conceptual understanding of key mathematical concepts, especially where called for in specific content standards or cluster headings.

**Standard/Cluster:** 4.NF.A.1 Explain why a fraction a/b is equivalent to a fraction (n × a)/(n × b) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.

**1) Breaking all parts into two equal parts to create equivalent fractions.**

Draw the first picture below on the board. Tell students that a parent and a child were sharing a cake, so the parent divided the cake into two pieces. The child wanted two pieces, so the parent cut the cake again and gave the child two pieces. Now draw the second picture.

ASK: How did the shape change? How did the size of the pieces change? Did the child get more cake be getting two pieces? Why or why not?

Ask students to write a fraction to represent each picture. Have students discuss which fraction is greater (or if they are equal.)

After the discussion, write the following equation on the board.

\[
\frac{1}{2} = \frac{2}{4} \quad \Rightarrow \quad \frac{1 \times 2}{2 \times 2} = \frac{2}{4}
\]

SAY: The fractions are equal because the pictures have the same amount shaded. Then show how the numerators and denominators are related by multiplication, as in the second picture above. SAY: Both people get twice as many pieces, but the same amount of cake as before.

**Exercises:** Copy the shapes in your notebook. Break each part in half to create equivalent fractions. Write the fractions in your notebook.

a) \(\frac{1}{3}\)  

b) \(\frac{2}{3}\)  

c) \(\frac{3}{4}\)  

d) \(\frac{3}{4}\)

Answers: a) \(\frac{1}{3} = \frac{2}{6}\)  

b) \(\frac{2}{3} = \frac{4}{6}\)  

c) \(\frac{1}{4} = \frac{2}{8}\)  

d) \(\frac{3}{4} = \frac{6}{8}\)

Sample pictures for a):

2) **Visual Learning: Equivalent Fractions**

How can you find two ways to name the same part of a whole? A fraction describes one or more parts of a whole that is divided into equal parts. Equivalent fractions name the same part of a whole. Write a fraction that is equivalent to \(\frac{1}{4}\).
AC Metric 1A: The materials support the development of students' conceptual understanding of key mathematical concepts, especially where called for in specific content standards or cluster headings.

Cluster: 4.NF.C Understand decimal notation for fractions, and compare decimal fractions.

**Activity**

**Comparing 0.25 and 0.3**

Distribute copies of 10 × 10 Squares (M15) to students.

Write 0.25 and 0.3 on the board.

**Which of these two decimal fractions of the square is a larger portion of the square? How do you know?**

Ask students to use their 10 × 10 squares to illustrate their explanations. They should work with a partner and then be ready to share their thinking with the group. As students work, if you see some representations that you think will be useful for students to look at together, ask the students to copy those onto the transparency 10 × 10 Squares (T67).

Bring the class together to share a few responses. Some responses might be based on a drawing like the one below.

**Students might say:**

"I know that 0.25 is halfway between 0.2 and 0.3 (two tenths and three tenths) and 3 tenths is more than 2 and a half tenths."

"0.25 is the same as \(\frac{25}{100}\), and 0.3 is the same as \(\frac{30}{100}\). \(\frac{30}{100}\) is more than \(\frac{25}{100}\) because it is 30 pieces out of 100 instead of 25 pieces."

"0.25 is two and one half tenths. And 0.3 is 3 whole tenths, so it is \(\frac{1}{2}\) of a tenth more."

"I thought 0.25 was bigger because it has more numbers in it. But when I drew the picture it was obvious that the 5 in the 0.25 is half of a tenth, so it is pretty small."
Write 0.5 and 0.45 on the board and ask students to determine which decimal is greater. Allow students to work for a few minutes and then bring them together to share their ideas.

**Students might say:**

“I always look at the tenths first. I saw that 0.45 has \( \frac{9}{20} \) and 0.5 has 5 tenths, so I knew that 0.5 is a larger number.”

“I got confused because 45 is a bigger number than 5. But then Amelia reminded me that the 4 in 0.45 and 5 in 0.5 are tenths and the 5 in 0.45 is 5 hundredths, which is really small compared to a tenth.”

**ONGOING ASSESSMENT: Observing Students at Work**

Students compare decimal fractions of a 10 \( \times \) 10 square.

- **Can students represent tenths and hundredths as part of the square?**
- **Can students use the representations and/or reason about the meaning of the decimal numbers to compare them?**

**DIFFERENTIATION: Supporting the Range of Learners**

**Intervention** If some students have difficulty comparing tenths and hundredths, they may need more time comparing decimals that are multiples of 0.1.

**Extension** Challenge students who can easily explain the given comparisons to compare 0.75 and 0.8 or 0.05 and 0.3. Ask them to determine not only which of the two is greater but how much greater it is.

**ELL** English Language Learners may have difficulty understanding the first question because of the complexity of its structure. A shorter series of questions with fewer prepositional phrases will enhance understanding. For example, say, 0.25 is a decimal fraction of this square. 0.3 is the decimal fraction of this square. Which is a larger part of the square? How do you know? Use models and write the questions on the board as needed.

**Math Note**

1. **Place Value of Decimal Fractions** Many apply their knowledge of whole numbers to decimals. They may think that 0.25 is greater than 0.3 because they are thinking of the whole numbers 25 and 3. If no one brings up this issue, bring it yourself. Why is 0.3 larger than 0.25 when you consider the place values of the digits in these numbers in comparison to the value of the digits in 25 and 3.
## Decimal Compare

Students use their Decimal Cards (M26) to play *Decimal Compare*. They compare two decimal fractions that are multiples of 0.1 or of 0.05 and determine which is greater. Comparing these decimals provides an opportunity for students to become familiar with reading and writing decimals and determining the relative sizes of these numbers.

Introduce the game by writing two decimals from the deck of cards on the board or by showing two transparent Decimal Cards (T71) on the overhead. In this first example, choose two multiples of 0.1, such as 0.4 and 0.9, and ask students which is greater.

Although it should be fairly obvious to students that 0.9 is greater than 0.4, it is important to make sure that all students can read 0.9 as $\frac{9}{10}$ and be able to picture how much closer it is to 1 than $\frac{4}{10}$. Use a few more examples, including one or two in which students compare hundredths with hundredths and tenths with tenths.

- **How do you say this number?**
- **How do you know which number is larger?**
- **What does the digit in the tenths place mean? What does the digit in the hundredths place mean?**
- **Is this number more or less than 0.5? Is it more or less than 1?**
- **How many tenths more is the larger number?**
- **Can you show each of these numbers on a 10 × 10 square?**

### Decimal Cards

<table>
<thead>
<tr>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
<th>0.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>one tenth</td>
<td>two tenths</td>
<td>three tenths</td>
<td>four tenths</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.05</th>
<th>0.06</th>
<th>0.07</th>
<th>0.08</th>
</tr>
</thead>
<tbody>
<tr>
<td>five tenths</td>
<td>six tenths</td>
<td>seven tenths</td>
<td>eight tenths</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.09</th>
<th>0.10</th>
<th>0.11</th>
<th>0.12</th>
</tr>
</thead>
<tbody>
<tr>
<td>nine tenths</td>
<td>ten tenths</td>
<td>eleven tenths</td>
<td>twelve tenths</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.13</th>
<th>0.14</th>
<th>0.15</th>
<th>0.16</th>
</tr>
</thead>
<tbody>
<tr>
<td>fifteen hundredths</td>
<td>sixteen hundredths</td>
<td>seventeen hundredths</td>
<td>eighteen hundredths</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.17</th>
<th>0.18</th>
<th>0.19</th>
<th>0.20</th>
</tr>
</thead>
<tbody>
<tr>
<td>twentyseven hundredths</td>
<td>twentyeight hundredths</td>
<td>twentynine hundredths</td>
<td>thirty hundredths</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.35</th>
<th>0.36</th>
<th>0.37</th>
<th>0.38</th>
</tr>
</thead>
<tbody>
<tr>
<td>thirtyfive hundredths</td>
<td>thirty-six hundredths</td>
<td>thirty-seven hundredths</td>
<td>thirty-eight hundredths</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.75</th>
<th>0.85</th>
<th>0.95</th>
<th>1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>seventy five hundredths</td>
<td>eighty five hundredths</td>
<td>ninety five hundredths</td>
<td>one hundred hundredths</td>
</tr>
</tbody>
</table>

---

**Students compare using Decimal Cards.**
After examining a few examples for about ten minutes, explain to students that they will use their own set of Decimal Cards (M26) to play Decimal Compare with a partner. Although students have played several other types of “compare” games and will be familiar with the structure of the game, make available copies of the game rules Decimal Compare (M27).

**ONGOING ASSESSMENT: Observing Students at Work**

Students compare decimal numbers with digits in the tenths and/or hundredths places.

- Can students read these numbers?
- Can students determine the value of each number?
- Can students determine which number is greater? Do they have more difficulty with certain comparisons?
- Do students visualize representing these numbers on the $10 \times 10$ square? Do they reason about the relationship of the numbers to 1 or to 0.5?

**DIFFERENTIATION: Supporting the Range of Learners**

**Intervention** Some students may be able to visualize the numbers on a $10 \times 10$ square, but other students may need to actually represent each number in order to compare them. If students who need to shade in a grid for each number find that it takes too long to play each round, suggest a variation of the game: students pick a card, represent the number on a $10 \times 10$ Square (M15), and decide whether it is closer to 0, $\frac{1}{2}$, or 1.

**SESSION FOLLOW-UP**

**Daily Practice and Homework**

- **Daily Practice:** For ongoing review, have students complete *Student Activity Book* page 49.

- **Homework:** On *Student Activity Book* page 50, students shade in the value of various decimals in tenths and hundredths on a $10 \times 10$ grid.

- **Student Math Handbook:** Students and families may use *Student Math Handbook* pages 69 and G4 for reference and review. See pages 170–176 in the back of this unit.
AC Metric 1B: The materials are designed so that students attain the fluencies and procedural skills required by the Standards.
- Is progress toward fluency and procedural skill interwoven with students’ developing conceptual understanding of the operations in question?

Standard/Cluster: 4.NBT.C Use place value understanding and properties of operations to perform multi-digit arithmetic.
**AC Metric 1B:** The materials are designed so that students attain the fluencies and procedural skills required by the Standards.

- Is progress toward fluency and procedural skill interwoven with students' developing conceptual understanding of the operations in question?
- Do the materials in grades K–6 provide repeated practice toward attainment of fluency standards? Evaluate

**Standard/Cluster:** 4.NBT.B.4 Fluently add and subtract multi-digit whole numbers using the standard algorithm.

**Teach**

**Learn**

Sometimes You Regroup More Than Once
(pages 84 to 86)

Students learn to find the sum of two 4-digit numbers with regrouping in ones, tens, and hundreds.

- Using base-ten blocks, review regrouping concepts: 10 ones = 1 ten, 10 tens = 1 hundred, and 10 hundreds = 1 thousand.
- Write the numbers 1,153 and 4,959 on the board and show students how to add, using base-ten blocks on a Place-Value Mat (TR01).
- Revise the strategy of adding numbers from right to left.
- Show the addition steps with regrouping in the ones, tens and hundreds.
- Add the ones:
  
  3 ones + 9 ones = 12 ones = 1 ten and 2 ones
- Then add the tens:
  
  5 tens + 5 tens + 1 ten = 11 tens = 1 hundred 1 ten
Step 2
Add the tens.

\[
\begin{array}{c}
1, 1 \ 5 \ 3 \\
+ 4, 9 \ 5 \ 9 \\
\hline
1 \ 2
\end{array}
\]

1 ten + 5 tens
+ 5 tens
= 11 tens
Regroup the tens.
11 tens
= 1 hundred 1 ten

Step 3
Add the hundreds.

\[
\begin{array}{c}
1 \ 5 \ 3 \\
+ 4, 9 \ 5 \ 9 \\
\hline
1 \ 1 \ 2
\end{array}
\]

1 hundred
+ 1 hundred
+ 9 hundreds
= 11 hundreds
Regroup the hundreds.
11 hundreds
= 1 thousand 1 hundred

The sum of 1,153 and 4,959 is 6,112.

Guided Practice
Add. Use base-ten blocks to help you.

1. \[3, 628 + 1,795 = 5,423\]
2. \[5,348 + 3,792 = 9,140\]

Solve.

3. One year, the population of Crystal Town is 7,325.
   Within the same year, 2,501 people move into the town.
   How many people are now in Crystal Town? 9,826 people

4. Mr. Streep makes 4,728 dinner rolls in a day.
   Mr. Wu makes 1,584 more dinner rolls than Mr. Streep.
   How many dinner rolls does Mr. Wu make? 6,312 rolls

Best Practices
This activity can be applied to the problem in the remainder of the lesson. It can provide practice and the benefit of hearing someone else’s thinking. Put students in pairs and ask them to exchange their papers. If they find an error, have students write a brief explanation of the mistake. Partners can discuss their findings.

Check for Understanding

Guided Practice (page 86)

1 and 2. These exercises provide practice in adding 4-digit numbers with regrouping in ones, tens, and hundreds. Allow students to use base-ten blocks, as needed. Working in pairs will also help them verbalize and reflect on their processes.

3 and 4. Have students apply the addition strategies with regrouping in ones, tens, and hundreds to solve real-world problems involving addition.
Let’s Practice

Add. Use base-ten blocks to help you.

1. The sum of 3,562 and 4,729 is ___ 8,291 ___.
2. The sum of 6,185 and 2,847 is ___ 9,032 ___.
3. $8,943 + 268 = \boxed{9,211}$
4. $1,628 + 4,586 = \boxed{6,214}$

Solve.

3. Cathy and Jordan take a walk through the forest. Cathy takes Route A and Jordan takes Route B. There are 3 places where Route A and Route B cross. They agree to meet at each place to add the two numbers that they see along the way. Find the three answers.

[Map diagram showing Routes A and B with distances 4410, 2352, 3240 marked]

Differentiated Instruction

English Language Learners

Some students may struggle with the language in the word problems on page 86. You may want to provide paraphrased versions. For example, you can rephrase Exercise 3 as follows: Crystal Town has 7,325 people. Then 2,501 more people move in. Crystal Town now has ____ people.

Exercise 4 would be: Mr. Streep makes 4,728 rolls.
Mr. Wu makes 1,584 more rolls than Mr. Streep.
Mr. Wu makes ____ rolls.

Students practice adding with regrouping in ones, tens, and hundreds in Practice 3, pages 51 to 54 of Workbook 3A. These pages (with the answers) are shown on page 87A.

**Differentiation Options**

Depending on students’ success with the Workbook pages, use these materials as needed.

**Struggling:** Reteach 3A, pp. 47–50

**On Level:** Extra Practice 3A, pp. 35–40
Practice and Apply
Workbook pages for Chapter 3, Lesson 3.3

Addition with Regrouping in Ones, Tens, and Hundreds

Follow the steps to add. Fill in the blanks.

1. Step 1
   \[ \begin{array}{c}
   5,532 \\
   + 2,089 \\
   \hline
   \end{array} \]
   Add the ones and regroup the ones.
   \[2 \text{ ones} + 9 \text{ ones} = 11 \text{ ones} = 1 \text{ ten} 1\text{ one}\]

   Step 2
   \[ \begin{array}{c}
   5,532 \\
   + 2,089 \\
   \hline
   \end{array} \]
   Add the tens and regroup the tens.
   \[1 \text{ ten} + 3 \text{ tens} + 8 \text{ tens} = 12 \text{ tens} = 1 \text{ hundred} 2 \text{ tens}\]

   Step 3
   \[ \begin{array}{c}
   5,532 \\
   + 2,089 \\
   \hline
   \end{array} \]
   Add the hundreds and regroup the hundreds.
   \[1 \text{ hundred} + 5 \text{ hundreds} + 9 \text{ hundreds} = 15 \text{ hundreds} = 1 \text{ thousand} 5 \text{ hundreds}\]

   Step 4
   \[ \begin{array}{c}
   5,532 \\
   + 2,089 \\
   \hline
   \end{array} \]
   Add the thousands.
   \[1 \text{ thousand} + 5 \text{ thousands} + 2 \text{ thousands} = 8 \text{ thousands}\]

Put On Your Thinking Cap!
Workbook pages for Put on Your Thinking Cap!

Challenging Practice

Use the digits below. Make as many 4-digit numbers as you can. Do not begin with '4.' For each number, use each digit only once. Then add two 4-digit numbers where you do not need to regroup.

3 5 9 2 0 7 
\[ \begin{array}{c}
5,207 \\
+ 3,072 \\
\hline
8,279
\end{array} \]

1. Now you try it!

Answers vary.
Sample answers:
2,035 + 2,073 = 4,108
3,905 + 7,950 = 11,855
5,037 + 9,752 = 14,789
5,239 + 9,752 = 14,991

2. \[ \begin{array}{c}
3,625 \\
+ 2,2 \boxed{6} \\
\hline
5,820
\end{array} \]

3. \[ \begin{array}{c}
5,8 \boxed{8} 9 \\
+ 3,6 \boxed{1} 5 \\
\hline
9,4 \boxed{3} 4
\end{array} \]

Problem Solving

Find the missing numbers.

1. \[ \begin{array}{c}
3,625 \\
+ 2,2 \boxed{6} \\
\hline
5,8 \boxed{8} 9
\end{array} \]

Find the page numbers of the book.

Each of the pages has a 3-digit page number. The number on Page A is an even number. The sum of its digits is 7. The number on Page B is an odd number. The sum of its digits is 8. What are the two possible page numbers for Page A and Page B?

Answers vary.
Sample answer:
Page A – 502, 322, 304, 214
Page B – 521, 323, 305, 125
AC Metric 1C: The materials are designed so that teachers and students spend sufficient time working with applications, without losing focus on the Major Work of each grade.

- Are there single- and multi-step contextual problems that develop the mathematics of the grade, afford opportunities for practice, and engage students in problem solving?

Standard/Cluster: 4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

1) A grower packs 4,568 peaches. He packs the most peaches possible, dividing them equally into 9 boxes, and then gives away the remaining peaches.
   - How many peaches does he give away?
   - If he sells 7 boxes, how many peaches does he have left?

2)

<table>
<thead>
<tr>
<th>Divide.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. 270 ÷ 9</td>
</tr>
<tr>
<td>10. 240 ÷ 6</td>
</tr>
<tr>
<td>14. 1,800 ÷ 2</td>
</tr>
<tr>
<td>18. There are 150 cheerleaders marching in the parade in 5 equal groups. If each group has the same number of cheerleaders, how many are in each group?</td>
</tr>
<tr>
<td>19. The Fourth of July celebrations will feature a “Battle of the Bands.” The 8 winning bands will share equally the total prize money of $2,400. How much will each band receive?</td>
</tr>
</tbody>
</table>
AC Metric 1C: The materials are designed so that teachers and students spend sufficient time working with applications, without losing focus on the Major Work of each grade.
- Do application problems particularly stress applying the Major Work of the grade?

1) **Use a pattern to solve each problem.**

4. **Analyze** Diego is building a figure with 9 cans at the base. Each row has one less can than the row below. How many cans are in the fifth row he builds?

5. Mike reads the first 10 pages of his book on Monday. He reads 3 pages more each day than the day before. How many pages will he read on Friday?

2) 1) A clown needs 275 balloons for a party he is going to, but the balloons only came in packs of 8. How many packs of balloons does he need to buy?

2) A florist splits 878 flowers into vases by putting 9 flowers in each vase. She needs more flowers to fill the last vase. How many more flowers does she need so that the last vase also has 9?
**AC Metric 1C:** The materials are designed so that teachers and students spend sufficient time working with applications, without losing focus on the Major Work of each grade.

- Does modeling build slowly across K–8, with applications that are relatively simple in earlier grades and when students are encountering new content? In grades 6–8, do the problems begin to provide opportunities for students to make their own assumptions or simplifications in order to model a situation mathematically?

**Standard/Cluster:** 2.OA.A.1 Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.

A pencil costs 59 cents, and a sticker costs 20 cents less. How much do a pencil and a sticker cost together?

**Standard/Cluster:** 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Shelbi is running in a half marathon today. About ½ hour before the race, she parks her car in a garage about ¼ mile from the starting line. The prices for parking are shown in the following table:

<table>
<thead>
<tr>
<th>Less than 1 hour</th>
<th>$8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour to less than 2 hours</td>
<td>$12</td>
</tr>
<tr>
<td>2 hours to less than 3 hours</td>
<td>$15</td>
</tr>
<tr>
<td>3 hours or more</td>
<td>$18</td>
</tr>
</tbody>
</table>

As she is running, she remembers that she only has $13. What is the slowest pace Shelbi can run, in minutes per mile, and still pay less than $13 for parking? Explain your answer. State any assumptions you made.
AC Metric 1C: The materials are designed so that teachers and students spend sufficient time working with applications, without losing focus on the Major Work of each grade.

- Are there single- and multi-step contextual problems that develop the mathematics of the grade, afford opportunities for practice, and engage students in problem solving?
- Do application problems particularly stress applying the Major Work of the grade?
- Does modeling build slowly across K–8, with applications that are relatively simple in earlier grades and when students are encountering new content? In grades 6–8, do the problems begin to provide opportunities for students to make their own assumptions or simplifications in order to model a situation mathematically?

**Standard/Cluster:** 4.NF.B.4c Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem. For example, if each person at a party will eat $\frac{3}{8}$ of a pound of roast beef, and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?

---

**Lesson 13-3**

**Domain:** Number and Operations—Fractions

**Cluster:** Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

**Standards**

4.NF.B.4b Apply and extend previous understandings of multiplication to multiply a fraction by a whole number. Understand a multiple of $\frac{1}{2}$ as a multiple of $\frac{1}{6}$ and use this understanding to multiply a fraction by a whole number. 4.NF.B.4c Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem.

**Objective**

Students will multiply a whole number and a fraction to solve problems.

**Quick and Easy Lesson Overview**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Essential Understanding</th>
<th>Vocabulary</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will multiply a whole number and a fraction to solve problems.</td>
<td>To multiply a fraction by a whole number, one must multiply the whole number by the numerator of the fraction and then divide the product by the denominator of the fraction.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Math Background**

Students have used models to develop an understanding of multiplying a fraction by a whole number. With concrete materials and pictures, they have shown that for any fraction with $b \neq 0$, $\frac{a}{b}$ multiplied by a whole number, $n$, $n \times \frac{a}{b} = \left[ n \times a \right] \times \frac{1}{b} = \frac{n \times a}{b}$. By developing this representation from appropriate contexts, students will be able to recognize when this type of mathematical representation is useful for solving a problem. In a situation where a number of the same-sized fractional parts are being joined together, students will know that the total amount is the product of the fraction and the number of parts.
Problem-Based Interactive Learning

Overview: Students work together to solve a problem that involves joining equal-sized parts and results in multiplication of a fraction by a whole number.

Focus: When do you need to multiply a fraction by a whole number?

Set the Purpose: You have learned how to multiply a fraction by a whole number. Today, we'll think about the kind of problem situation that would require us to multiply a fraction by a whole number and find the product to solve the problem.

Connect: Suppose you have three bags, each with 4 pounds of sugar in it. How can you show how much sugar there is in all? [By adding $4 + 4 + 4$ or by multiplying $3 \times 4$] Why can you use multiplication to represent this situation? [Because it joins equal-sized groups]

Pose the Problem: A recipe for 1 gallon of fruit punch calls for $\frac{3}{4}$ cup of orange juice. How much orange juice is needed to make 8 gallons of fruit juice?

Link to Prior Knowledge: Have a whole group discussion of possible ways to represent the problem such as drawing pictures, using a number line, and using repeated addition.

Instruct in Small Steps: How many gallons of fruit punch are being made? [8] How much orange juice does each gallon need? [6 cups] We can think of each gallon as a separate group. We can think of the amount of orange juice in each gallon as the size of each group. What addition sentence can you write to show how much orange juice there is in all? $\frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4}$ Can you use multiplication to represent this addition sentence? [Yes] Why? [All of the groups are an equal size]

Write a multiplication sentence for the addition sentence. \[8 \times \frac{3}{4} = \frac{8 \times 3}{4} = \frac{24}{4} = 6\] How much orange juice does it take to make 8 gallons of fruit punch? [6 cups]

Extend: Milo runs $\frac{3}{4}$ mile each day. How many miles does he run in one week? [4 1/2 miles]
Exercise 7

**Error Intervention**

If students have difficulty writing the number sentence, then ask: _Are there equal groups?_ [Yes] _What operation can be used to find how many granola bars Sarah’s friend has?_ [Multiplication]

**Reteaching** For another example and more practice, assign Reteaching Set B on p. 354.

## Independent Practice

Ask students to look for patterns when multiplying a whole number and a fraction. They should notice that they can multiply the whole number by the numerator to find the numerator of the fraction that is the answer. Then they can check to see if the product can be written in simplest form.

**Do you know HOW?**
For 1–4, multiply.
1. $8 \times \frac{1}{4} = 2$
2. $13 \times \frac{3}{4} = \frac{39}{4}$
3. $7 \times \frac{2}{3} = \frac{14}{3}$
4. $9 \times \frac{1}{5} = \frac{9}{5}$

For 5 and 6, write a multiplication equation for each situation.
5. Medicine taken in 10 days if the dose is $\frac{3}{4}$ ounce per day.
   
   
   $10 \times \frac{3}{4} = \frac{30}{4} = 7\frac{1}{2}$

6. The total length needed to decorate 9 boxes if each box uses $\frac{1}{2}$ yard of ribbon.
   
   
   

**Do you UNDERSTAND?**
Write a number sentence that describes each situation.

7. **Model** Sarah has $\frac{1}{4}$ of a granola bar. Her friend has 5 times as many granola bars. How many granola bars does Sarah’s friend have?

   $\frac{1}{2} \times 5 = 2\frac{1}{2}$ granola bars

8. **Model** Sue needs $\frac{5}{8}$ cup of cocoa to make one batch of chocolate pudding. She wants to make 4 batches of pudding to take to a party. Write and solve an equation to show how much cocoa Sue will need.

   $\frac{5}{8} \times 4 = \frac{20}{8} = 2\frac{1}{2}$

**Independent Practice**

For 9–17, multiply. Write the product in simplest form.
9. $4 \times \frac{1}{3} = \frac{4}{3}$
10. $6 \times \frac{3}{8} = \frac{18}{8} = \frac{3}{4}$
11. $8 \times \frac{2}{3} = \frac{16}{3} = 5\frac{1}{3}$
12. $12 \times \frac{5}{6} = 10$
13. $11 \times \frac{2}{3} = \frac{22}{3} = 7\frac{1}{3}$
14. $5 \times \frac{7}{8} = \frac{35}{8} = 4\frac{3}{8}$
15. $7 \times \frac{3}{4} = \frac{21}{4}$
16. $9 \times \frac{3}{5} = \frac{27}{5} = 5\frac{2}{5}$
17. $4 \times \frac{5}{8} = \frac{20}{8} = 2\frac{1}{2}$
For 18 and 19, write a number sentence for each situation and find the answer.

18. The total distance Mary runs in one week if she runs 3 miles each day.
   \[ 7 \times 7 = 49 \text{ miles} \]

19. The length of 5 pieces of ribbon laid end to end if each piece is 3 yards long.
   \[ 5 \times \frac{2}{3} = \frac{10}{3} = 3 \frac{1}{3} \text{ yards} \]

Problem Solving

20. Model
   Malik swims \(\frac{3}{4}\) of a mile each day. How many miles will he swim in 8 days? Write a number sentence and solve.
   \[ 8 \times \frac{3}{4} = \frac{24}{4} = 6 \text{ miles} \]

21. Sean is making picture frames. Each frame uses \(\frac{3}{4}\) yard of wood. What is the total length of wood Sean will need to make 12 frames?
   \[ 9 \frac{3}{4} \text{ yards} \]

22. Persevere
   Sun is making 7 fruit tarts. Each tart needs \(\frac{1}{4}\) cup of strawberries and \(\frac{1}{2}\) cup of blueberries. What is the total amount of fruit that Sun needs for her tarts?
   \[ 7 \text{ cups of fruit} \]

23. Writing to Explain
   Lydia is making 4 loaves of rye bread and 3 loaves of wheat bread. Each loaf takes \(\frac{1}{4}\) cup of sugar. What is the total amount of sugar Lydia will need? Explain.
   See margin.

24. Reason
   Olivia is doing her math homework. For each problem, she uses \(\frac{3}{4}\) of a sheet of paper. How many sheets of paper will she need to complete 20 problems?
   \[ A \quad 4 \text{ sheets} \]
   \[ B \quad 5 \frac{1}{2} \text{ sheets} \]
   \[ C \quad 15 \text{ sheets} \]
   \[ D \quad 20 \frac{2}{3} \text{ sheets} \]

Early Finishers
Write a problem to go along with \(18 \times \frac{2}{3}\). Then, solve the problem. [Each player on a soccer team ate \(\frac{2}{3}\) of an orange as a snack. If there are 18 players, how many oranges did they eat in all? 12 oranges; \(18 \times \frac{2}{3} = \frac{36}{3} = 12\)]

Exercises 20-26. Remind students to check for reasonableness when solving each problem.