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Fourth Grade – Standards

1. Developing understanding and fluency with multi-digit multiplication, and developing understanding of dividing to find quotients involving multi-digit dividends – Students generalize their understanding of place value to 1,000,000, understanding the relative sizes of numbers in each place. They apply their understanding of models for multiplication (equal-sized groups, arrays, area models), place value, and properties of operations, in particular the distributive property, as they develop, discuss, and use efficient, accurate, and generalizable methods to compute products of multi-digit whole numbers. Depending on the numbers and the context, they select and accurately apply appropriate methods to estimate or mentally calculate products. They develop fluency with efficient procedures for multiplying whole numbers; understand and explain why the procedures work based on place value and properties of operations; and use them to solve problems. Students apply their understanding of models for division, place value, properties of operations, and the relationship of division to multiplication as they develop, discuss, and use efficient, accurate, and generalizable procedures to find quotients involving multi-digit dividends. They select and accurately apply appropriate methods to estimate and mentally calculate quotients, and interpret remainders based upon the context.

2. Developing an understanding of fraction equivalence, addition and subtraction of fractions with like denominators, multiplication of fractions by whole numbers – Students develop understanding of fraction equivalence and operations with fractions. They recognize that two different fractions can be equal (e.g., 15/9 = 5/3), and they develop methods for generating and recognizing equivalent fractions. Students extend previous understandings about how fractions are built from unit fractions, composing fractions from unit fractions, decomposing fractions into unit fractions, and using the meaning of fractions and the meaning of multiplication to multiply a fraction by a whole number.

3. Understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, particular angle measures, and symmetry – Students describe, analyze, compare, and classify two-dimensional shapes. Through building, drawing, and analyzing two-dimensional shapes, students deepen their understanding of properties of two-dimensional objects and the use of them to solve problems involving symmetry.

MATHEMATICAL PRACTICES

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

OPERATIONS AND ALGEBRAIC THINKING

Use the four operations with whole numbers to solve problems.

4.OA.1 Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 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.2 Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison. (Note: See Glossary, Table 2.)

4.OA.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.

Gain familiarity with factors and multiples.

4.OA.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.

Generate and analyze patterns.

4.OA.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. For example, given the rule “Add 3” and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.

NUMERICAL PROPERTIES

4.NF.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

4.NBT.3 Use place value understanding to round multi-digit whole numbers to any place.

Use place value understanding and properties of operations to perform multi-digit arithmetic.

4.NBT.4 Fluently add and subtract multi-digit whole numbers using the standard algorithm.

4.NBT.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

4.NBT.6 Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

NUMBER AND OPERATIONS – FRACTIONS

Note: Grade 4 expectations in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, & 100.

Extend understanding of fraction equivalence and ordering.

4.NF.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.

4.NF.2 Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.
4.NF.3 Understand a fraction $\frac{a}{b}$ with $a > 1$ as a sum of fractions $\frac{1}{b}$.

a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.

b. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. Examples: $\frac{3}{8} = \frac{1}{8} + \frac{1}{8} + \frac{1}{8}; \frac{3}{8} = \frac{1}{8} + \frac{2}{8}; 2 \frac{1}{8} = 1 + \frac{1}{8} + \frac{2}{8} + \frac{1}{8}$.

c. Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction.

d. Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem.

4.NF.4 Apply and extend previous understandings of multiplication to multiply a fraction by a whole number.

a. Understand a fraction $\frac{a}{b}$ as a multiple of $\frac{1}{b}$. For example, use a visual fraction model to represent $\frac{5}{4}$ as the product $5 \times \frac{1}{4}$, recording the conclusion by the equation $\frac{5}{4} = 5 \times \frac{1}{4}$.

b. Understand a multiple of $\frac{a}{b}$ as a multiple of $\frac{1}{b}$, and use this understanding to multiply a fraction by a whole number. For example, use a visual fraction model to express $3 \times \frac{2}{5}$ as $6 \times \frac{1}{5}$, recognizing this product as $\frac{6}{5}$. (In general, $n \times \frac{a}{b} = (n \times a)/b$.)

c. 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?

Understand decimal notation for fractions, and compare decimal fractions.

4.NF.5 Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100. (Note: Students who can generate equivalent fractions can develop strategies for adding fractions with unlike denominators in general. But addition and subtraction with unlike denominators in general is not a requirement at this grade.) For example, express $3/10$ as $30/100$, and add $3/10 + 4/100 = 34/100$.

4.NF.6 Use decimal notation for fractions with denominators 10 or 100. For example, rewrite $0.62$ as $62/100$; describe a length as $0.62$ meters; locate $0.62$ on a number line diagram.

4.NF.7 Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols $>$, $=$, or $<$, and justify the conclusions, e.g., by using a visual model.

MEASUREMENT AND DATA

Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...

4.MD.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

4.MD.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.

Represent and interpret data.

4.MD.4 Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.

Geometric measurement: understand concepts of angle and measure angles.

4.MD.5 Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through $1/360$ of a circle is called a “one-degree angle,” and can be used to measure angles.

b. An angle that turns through $n$ one-degree angles is said to have an angle measure of $n$ degrees.

4.MD.6 Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

4.MD.7 Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

GEOMETRY

Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

4.G.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

4.G.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.
Multi-Step Multiplication

Standard: 4.OA.3  Additional/Supporting Standard(s): 4.NBT.4, 4.NBT.5, 4.NBT.6, 4.NBT.7
Mathematical Practice: 1, 2, 4, 5, 6
Student Outcomes: I can make reasonable estimates with two-step story problems. I can solve two-step problems using a variety of strategies. I can justify my reasoning for estimating and solving problems.

Building 10,000

Standard: 4.NBT.1  Additional/Supporting Standard(s): 4.NBT.4
Mathematical Practice: 2, 6, 7
Student Outcomes: I can use models to reason about place value. I can build numbers using place value.

Build A Number

Standard: 4.NBT.2  Additional/Supporting Standard(s): 4.NBT.1
Mathematical Practice: 1, 6, 7
Student Outcomes: I can determine the value of a number by its place in the number. I can accurately read and write multi-digit whole numbers.

Multiply Using the Distributive Property

Standard: 4.NBT.5  Additional/Supporting Standard(s): 4.NBT.2, 4.OA.1
Mathematical Practice: 1, 4, 6, 7
Student Outcomes: I can use multiple representations for multiplication. I can use the distributive property in multiplication. I can explain the distributive property and why it works.

Roll and Compare

Standard: 4.NBT.2
Mathematical Practice: 1, 2, 3, 6
Student Outcomes: I can read and write whole numbers up to 1,000,000. I can compare multi-digit numbers. I can explain number comparisons.

Rounding Numbers Roll

Standard: 4.NBT.3
Mathematical Practice: 1, 2, 3, 6
Student Outcomes: I can read and write whole numbers up to 1,000,000. I can round numbers to any given place less than or equal to 1,000,000. I can subtract whole numbers.
Strategies for Multiplying Multi-digit Numbers

Standard: 4.NBT.5  |  Additional/Supporting Standard(s): 4.OA.1, 4.OA.2
Mathematical Practice: 1, 2, 4, 6, 7
Student Outcomes: I can develop and implement a strategy for solving a multi-digit multiplication problem. I can use a variety of strategies to solve multi-digit multiplication problems. I can explain my reasoning when developing a multiplication strategy.

Fraction Card Games

Standard: 4.NF.2  |  Additional/Supporting Standard(s): 4.NF.1
Mathematical Practice: 2, 6, 7
Student Outcomes: I can compare two fractions with different numerators and/or denominators. I can recognize equivalent fractions.

Place the Fraction

Standard: 4.NF.2
Mathematical Practice: 1, 2, 3, 4, 6
Student Outcomes: I can use benchmark fractions to compare fractions.

Fractions in the Real World

Standard: 4.NF.2, 4.NF.3
Mathematical Practice: 1, 2, 3, 4, 6
Student Outcomes: I can identify fractional parts. I can find equivalent fractions. I can compose and decompose fractions in more than one way. I can record decompositions of fractions in an equation.

Fraction Cover Up

Standard: 4.NF.3d
Mathematical Practice: 1, 3, 4
Student Outcomes: I can identify fractional parts. I can find equivalent fractions. I can add and subtract fractions. I can relate numerical fractions to equivalent visual representations.

Give ‘Em Chocolate!

Standard: 4.NF.3  |  Additional/Supporting Standard(s): 4.NF.3.c
Mathematical Practice: 1, 4, 5, 8
Student Outcomes: I can decompose a fraction into a sum of fractions with the same denominator. I can record each decomposition using an equation. I can use models to demonstrate why my equation makes sense.

The Big H

Standard: 4.NF.3
Mathematical Practice: 1, 3, 4
Student Outcomes: I can identify fractional parts. I can find equivalent fractions. I can add and subtract fractions. I can relate numerical fractions to equivalent visual representations.
The Smallest Difference Wins

Standard: 4.NF.3
Mathematical Practice: 1, 3, 4
Student Outcomes: I can identify fractional parts. I can find equivalent fractions. I can add and subtract fractions. I can relate numerical fractions to equivalent visual representations.

Unit Fractions

Standard: 4.NF.3  1 Additional/Supporting Standard(s): 4.NF.3.c, 4.NF.3.d
Mathematical Practice: 4, 5, 6, 7
Student Outcomes: I can model a unit fraction from a whole. I can add and subtract unit fractions from a whole. I can decompose a whole into its units.

Multiplying Fractions by a Whole Number

Standard: 4.NF.4
Mathematical Practice: 1, 2, 3, 4, 6
Student Outcomes: I can identify unit fractions. I can relate addition to the multiplication of unit fractions. I can decompose fractions into unit fractions. I can multiply a whole number by a fraction.

Show What You Know: Multiple Representations of Decimals and Fractions

Standard: 4.NF.6  1 Additional/Supporting Standard(s): 4.NF.5, 4.NF.7
Mathematical Practice: 2, 4, 5, 6
Student Outcomes: I can create multiple representations of a decimal. I can compare and order decimals to the hundredths. I can use decimal notation for fractions.

Running the Race

Standard: 4.NF.7
Mathematical Practice: 1, 2, 3
Student Outcomes: I can compare decimals to the hundredths.

Measurement Toss

Standard: 4.MD.1
Mathematical Practice: 2, 4, 6
Student Outcomes: I can estimate the measurement distance. I can use a measurement tool for a precise measurement.

Building a Pen for Your Dog

Standard: 4.MD.3
Mathematical Practice: 1, 2
Student Outcomes: I can find the perimeter of a square or rectangle. I can find the missing sides of a square or rectangle, given the perimeter. I can find patterns between length and width of rectangles and squares.
Multi-Step Multiplication

Common Core Standard:
Use the four operations with whole numbers to solve problems.
4.OA.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.

Additional/Supporting Standard(s):
4.NBT.4, 4.NBT.5, 4.NBT.6, 4.NBT.7 Use place value understanding and properties of operations to perform multi-digit arithmetic.

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

Student Outcomes:
• I can make reasonable estimates with two-step story problems
• I can solve two-step problems using a variety of strategies
• I can justify my reasoning for estimating and solving problems

Materials:
• Two-Step task cards (1 set per group of 3-4 students)
• Student journals, blank or graph paper or individual white boards and markers

Advance Preparation:
• Teacher has story problems ready to display for the class or on individual sheets for students
• Teacher has sets of task cards cut apart and bagged for groups
• Students should be familiar with estimating sums using multiple strategies
• Students should be familiar with using multiple strategies for multiplication and explaining their strategies
• During small group work students should be grouped with others with like ability in math

Directions:
1. The teacher will present the problem on the board or has it printed so each student has their own copy: The class is filling bags of popcorn for the school’s Fall Carnival. Mary has filled 3 bags of popcorn. Thomas has filled 9 times as many as Mary. Amy has filled 5 times the amount of bags as Thomas. What is the overall total amount of popcorn bags that have been filled?
2. Teacher asks students to estimate mentally the total number of popcorn bags. Ask volunteers to share different methods of mental computation for this problem, and record their methods on the board. Students explain their reasoning.

   Ex.1. 3 x 10 = 30 (Thomas has about 30 bags)
   30 x 5 = 150 (Amy has about 150 bags)
   150 + 30 + 0 = 180 (I did not add Mary’s bags since it was just 3)

   Ex.2. 3 x 9 = 27 (I know 3x9 is 27 so Thomas has 27 bags. 27 is close to 30)
   30 x 5 = 150 (Amy has about 150)
   150 + (30 + 3) = 183 (I added Mary’s 3 bags to Thomas’ total so they have about 183 bags.)

3. Once a couple ways to estimate have been discussed, students solve problem finding the exact answer on their own using a strategy that makes sense to them.

4. Once finished, partners share their strategies.

5. Teacher facilitates a whole class discussion. Have several students with different strategies share their thinking using a document camera or white board for the whole class. Have students look at how the strategies are alike or different. Make connections with their estimates. How did estimating first help with solving the problem?

6. Present a second problem for students to estimate mentally.
   Ryan, Tom and Jordan collect baseball cards and are getting ready to make some trades. Ryan has 43 cards and Tom has twice as many as Ryan. Jordan has 50 more cards than Ryan and Tom have together. How many cards are available to trade?

7. Repeat steps 2-5.

8. Teacher divides the class into groups of 3-4 to use the format of “Show Down” to solve problems:
   • Teacher gives one student (student leader) in each group a set of two-step problems cards.
   • The student shows and reads the problem to the group
   • Individually students write an estimate to the problem either on a small white board or journal page (keeping their estimate to themselves)
   • When all students are ready, the student leader says “Show Down”, all other students show their estimates
   • The student leader has each group member explain how they arrived at their estimate
   • Students can use their white board to explain their thinking to the group

9. Once all in the group have shared, the student leader has the group solve the problem by finding the exact answer. When all are finished, the student leader says “Show Down”. All other students show their strategy for solving the problem. The group discusses the correct answer and strategies.

10. A new leader repeats the process. Students create their own multi-step problems to use for Show Down.
Questions to Pose:
As students work individually or with small groups:
- Can you describe your method to me? Can you explain why it works?
- How did you get your answer?

During whole group discussion:
- How does your strategy relate to…?
- Why did you decide to use this method?
- Do you think this strategy will work with other numbers?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students have difficulty estimating for a two-step problem.</td>
<td>Students practice estimating with one step problems.</td>
</tr>
<tr>
<td>Students have difficulty solving two-step problems.</td>
<td>If students can solve one-step problems, help them break the two-step problems into the two separate steps.</td>
</tr>
<tr>
<td></td>
<td>If students struggle with one-step problems, practice solving one-step problems guiding them to use problem solving strategies such as visualizing, making sense of the problem, drawing, etc.</td>
</tr>
</tbody>
</table>

Special Notes:
Students work in pairs to develop their own two-step problems to be used to play Show Down

Solutions:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Estimates</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole class problem 1</td>
<td>160-190</td>
<td>165 bags of popcorn</td>
</tr>
<tr>
<td>Whole class problem 2</td>
<td>290-320</td>
<td>308 baseball cards</td>
</tr>
<tr>
<td>Task 1</td>
<td>300-360</td>
<td>346 books</td>
</tr>
<tr>
<td>Task 2</td>
<td>4000-4300</td>
<td>4200 people</td>
</tr>
<tr>
<td>Task 3</td>
<td>50-60</td>
<td>56 blocks</td>
</tr>
<tr>
<td>Task 4</td>
<td>20-30</td>
<td>25 cans</td>
</tr>
</tbody>
</table>
## Task Cards

| 1.   | The school library has 286 books. If the school librarian buys 12 books each month for five months, how many books will the library have in all? |
| 2.   | On Friday, 1,050 people visited the zoo. Three times as many people visited on Saturday than on Friday. How many people visited the zoo on Friday and Saturday? |
| 3.   | Nyasia always takes the same route when she walks her dog. First, she walks 7 blocks to the park. Then she walks 9 blocks to the elementary school. Finally, she walks 12 blocks to get back home. Nyasia walks her dog 2 times each day. How many blocks does Nyasia's dog walk each day? |
| 4.   | Julian bought 9 packages of cat food and 5 packages of dog food. Each package of cat food contained 5 cans, and each package of dog food contained 4 cans. How many more cans of cat food than dog food did Julian buy? |
Building 10,000

Common Core Standard:
Generalize place value understanding for multi-digit whole numbers.
4.NBT.1 Recognize that in a multi-digit whole number, a digit in the one place represents ten times what it represents in the place to its right. For example, recognize that 70 ÷ 7 = 10 by applying concepts of place value and division.

Additional/Supporting Standard:
4.NBT.4 Generalize place value understanding for multi-digit whole numbers.

Standards for Mathematical Practice:
2. Reason abstractly and quantitatively
6. Attend to precision
7. Look for and make use of structure

Student Outcomes:
• I can use models to reason about place value.
• I can build numbers using place value.

Materials:
• Base ten blocks, enough to build ten 1000 cubes. If you don’t have enough use square boxes (such as tissue boxes) or make tagboard 1000 cubes if. You may also want paper copies of 100 flats to cover faces of the boxes

Advance Preparation:
• Gather base ten blocks, enough for groups of 4 to have:
  - ten 1s, ten longs (rods), ten flats and one 1000 cube
  - Have available materials to build 1000 cubes if needed
• Students need to be familiar with base ten materials

Directions:
1. Begin with a class discussion using the unit cubes of base ten blocks. Discuss the cube shape. Continue with a review that it takes 10 cubes to make a rod. 10 ones or 10 × 1 is 10. Discuss the shape. This is a long or a rod. Record on the board:

```
  10
  10 x 1
```
2. Ask the students “What do you think comes next?” When a student says 100, bring out a 100 flat. It takes ten rods to make a flat. Have students talk about the shape of the flat and 100 being $10 \times 10$. Record:

3. Review the shapes (cube, long, square), and numbers, $(1, 10, 100)$. At this point the teacher can have the table groups set up ten 1s and place it on top of a long to prove that ten 1s is also one 10. This can be repeated with ten longs placed on top of one flat. The teacher uses the language of ten 1s times 10 is one 10. Ten 10’s times 10 is one hundred.

4. Ask “What comes next?” Students will say 1000 or ten 100’s. At this point, students build ten 100s with ten flats. Students may stack them on top to make a cube or they may lay them out next to one another.

5. Once groups have made 1000, bring the group back to look at the structure and pattern of the numbers that have been written on the board. Use a student example of ten 100s stacked to make a cube. If a group does not have a 1000 cube built, introduce the 1000 cube base-ten block. Draw attention to the shape structure: cube, long, flat, cube. With every three places, the shapes repeat. Each cube represents a 1, and each long represents a 10, and each flat represents a 100.

6. Have students discuss what comes next. Emphasize the patterns they see. Once students agree that ten $\times$ 1000 comes next and it could be a long, have students discuss how the class could build 10,000.

- Students could use base-ten 1000 cubes along with thousand cubes made from 100 flats.
- Students could make a 1000 cube model from a square tissue box, gluing a paper copy of a flat on each face of the cube. Then put 10 together.
- Students could make a 1000 cube model from cutting poster board, gluing a paper copy of a flat on each face of the cube
- Students could use a combination of the techniques listed above
7. Once students have built 10,000, they arrange the cubes side by side to form a long strip of cubes. Depending on space, this could be done in a hall or on the playground.

8. Ask, “What comes next?” When students discover it is ten $\times$ 10,000 and the shape is a square, discuss how the class could build 100,000.
   - Students could measure the length of the 10,000 model. Using string or something similar, students mark off a square that would represent the 100,000 model. (building the 100,000 model is optional)

9. To conclude, the class will discuss connections to the size and magnitude of each model. See questions below.

Questions to Pose:
As students are working:
   - How does the long (10) relate to flat (100)?
   - What patterns or structure do you notice?
   - How would knowing the structure of number help you?
   - What is the relationship in size between the long (10,000) and the flat (100)?
   - What have you learned from building these numbers?

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<tr>
<td>Students have difficulty understanding a digit in the one place represents ten times what it represents in the place to its right.</td>
<td>Students work with models to build numbers. 20 is $2 \times 10$. Build a set of 2 and repeat it 10 times. Continue with 200. Build a set of 20 and repeat it 10 times.</td>
</tr>
</tbody>
</table>

Special Notes:
- This lesson could go over two days.
- The teacher should take pictures of the models at different stages.
- The teacher should make the connection between the model and where it would go on a number place value chart.
- Students can also build 1000s by making ten 100s charts and taping together. How many 1000 strips would be needed to make 10,000? How about 100,000? What would come next? How could we build the next number?
- Use Arrow cards to build numbers:

Solutions: N/A

Adapted from *Teaching Student-Centered Mathematics Grades 3-5* Van de Walle and Lovin (2006)
Build A Number

Common Core Standard:
**Generalize place value understanding for multi-digit whole numbers.**
4.NBT.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Additional/Supporting Standard(s):
4.NBT.1 Generalize place value understanding for multi-digit whole numbers.

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them
6. Attend to precision
7. Look for and make use of structure

Student Outcomes:
- I can determine the value of a number by its place in the number
- I can accurately read and write multi-digit whole numbers

Materials:
- One set of large digit cards, 0-9 for class demonstration
- One set of small digit cards, 0-9 for each student
- Build A Number Worksheet

Advance Preparation:
- Make one set large digit cards, 0-9 for class demonstration.
- Copy, cut and bag sets of small digit cards, 0-9 for each student
- Copies of Build A Number Worksheet, one per student
- Students have experience working with place value
- Consider grouping students for small group and partner work

Directions:
Whole Class:
1. Select 4-6 students to hold demonstration digit cards in front of the class for all to see
2. Students seated model the same digits at their seat with a small set of digit cards.
3. Teacher says a 4-6 digit number aloud. Students with the demo cards arrange themselves to create that number. Students at their seats use their small digit cards to create the number.
4. Teacher has students say the number in words.
5. Teacher has students point to the digit in the hundreds place, tens place etc. At this time, students with the demo cards hold the card up.
6. Repeat multiple times to assess place value concepts. Teacher should change digits and students to demonstrate in the front of the classroom.
7. Teacher will change from calling numbers to number clues.
   - Build the largest number you can
• Build a number less than 4803
• Build a number greater than 3750 and less than 3900
• Build a number 100 more than 1834

8. After students have had sufficient practice, they should be given the Build A Number Worksheet to choose their own digits. The number of digits will depend on student ability.

9. Students write 5-8 Build a Number clues
   • Students choose the digits they want to use and record them on their sheet
   • Student write a clue in box 1 to build a number that uses the chosen digits
   • In box 2, students write a clue that will build a new number but will still use the digits chosen on the sheet.

   Digits:  3  4  0  7  5

1. My number is a 4 digit number greater than 7000 and less than 7500.
2. My number is an even number between 3705 and 3800

   • Students create an answer key on the back of their paper. Some clues will have multiple answers or a range of answers.

Partner/small group:
1. Using their own Build A Number Worksheets and sets of small digit cards, students work in partners or a small groups to create numbers. One student reads their clue and other student in the group builds the number. After one student reads 1-3 clues, another student takes a turn at asking clues to match their chosen digits.

Questions to Pose:
During Whole Class:
• What strategies did you use to figure out the value of the digit?
• What would your number be if you added 10 more? 100 more? 1000 more?
• What would your number be if you subtracted 10? 100? 1000?
• What are some other numbers that would fit the clues

During small group/partner work:
• How do you know your number fits the clue?
• What are some other numbers that fit the clue?
• If I had (choose a number that does not fit clue) would it fit the clue? Why not?
Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students have difficulty reading the number correctly</td>
<td>Provide students with a place value chart with the number words written on it for support.</td>
</tr>
<tr>
<td>Students have difficulty placing the zero digit correctly</td>
<td>Provide students with a place value chart with the number words written on it for support.</td>
</tr>
<tr>
<td></td>
<td>Provide base-ten models to build the number.</td>
</tr>
</tbody>
</table>

Special Notes:
Students need to play Build A Number long enough to be successful in small groups.

Solutions: N/A

Adapted from mathwire.com
### Build A Number

Choose Your Digits

<p>| | | | | | |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>4.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5.</td>
<td>6.</td>
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<td></td>
</tr>
<tr>
<td>7.</td>
<td>8.</td>
<td></td>
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</tr>
</tbody>
</table>

Create an answer key on the back of this sheet.

*Adapted from mathwire.com*
Multiply Using the Distributive Property

Common Core Standard:
Use place value understanding and properties of operations to perform multi-digit arithmetic.

4.NBT.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

Additional/Supporting Standards: 4.NBT.2, 4.OA.1

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them
4. Model with mathematics
6. Attend to precision
7. Look for and make use of structure

Student Outcomes:
• I can use multiple representations for multiplication
• I can use the distributive property in multiplication
• I can explain the distributive property and why it works

Materials:
• Base ten blocks (at least 20 rods and 30 unit cubes per pair)
• Recording Sheet (one per student)

Advance Preparation:
• Gather base ten blocks. You may want to create a bag of blocks for each pair to make them easier to distribute.
• Make copies of the Recording Sheet
• Consider how students should be paired or grouped for this lesson
• Students should be familiar with mental computation and explaining their strategies
• Students should be able to flexibly record large numbers in multiple forms including expanded notation
• Students should understand that multiplication is a representation of equal groups
Directions:

1. Begin the lesson by writing 6 x 32 for all the students to see. Ask the students to compute 6 × 32 mentally without paper, pencil, or calculators. Ask volunteers to share different methods of mental computation for this problem, and record their methods on the board. Spotlight any method that uses the distributive property:

Example of a response that uses the distributive property:

\[
6 \times 32 = 6 \times 30 + 6 \times 2 = 180 + 12 = 192
\]

Point out how the number 32 was broken into 30 + 2. This makes it easier to multiply and add mentally. Thus, this problem could be written as follows:

\[
6 \times 32 = (6 \times 30) + (6 \times 2)
\]

2. Using base ten materials (such as blocks), students should model 6 x 32. This task should be completed independently or with a neighbor by showing 6 groups of 32 as shown below:

3. Using the base ten blocks, guide students to observe that they have 6 groups of 30 and 6 groups of 2. Ask the students, “How would these groups look in a number expression?” Help students make a connection between the blocks and the expression (6 x 30) + (6 x 2)

4. Have students record their drawings and solution in symbols on their Recording Sheets.

5. Present students with another problem 4 × 53 by recording it on the board. Ask the students to model this problem with base ten blocks. Have them draw their diagram on the Recording Sheet. Then work with a partner to show this problem using numbers and symbols. Students should take turns explaining the mathematics they are using and why it makes sense. Once all have explained the problem to their partners, write the steps on the board.

6. When most pairs have finished, ask students to share their thinking about the mathematics they are using. Based on student explanations, introduce the term “Distributive Property.” Ask student to explain how the distributive property is related to expanded notation. As students share their thinking record any method that makes this connection such as:

\[
53 = 50 + 3 \quad \text{So} \quad 4 \times 53 = (4 \times 50) + (4 \times 3)
\]

7. Once again, present a third problem such as 3 x 67 by writing it on the board. Ask students to solve the problem by grouping their blocks. They should use the same process of modeling the problem with blocks and recording their work on the Recording Sheet. This time, challenge students to use the term “distributive property” as they explain the mathematics they used with their partners.
8. When most pairs have finished, ask students to share the mathematics they used with the whole class. Challenge them to use the term “distributive property” as they explain their reasoning.

9. Finally students will apply their understanding in the context of a word problem such as: A candy company has orders for chocolate bars from 5 different stores. Each order contains 45 chocolate bars. Use the distributive property to figure out how many chocolate bars the candy company needs to make.

Students should solve this problem using the same process: modeling with blocks, recording on the Recording Sheet, and discussing their reasoning with a partner.

10. Once most pairs have completed the task, close the lesson by asking students to explain how using the distributive property can help you solve multiplication problems. This question might prompt a small group or whole-class discussion or it might be used as a journal prompt.

Questions to Pose:
As students work with their partner:
- How does your model/drawing connect to the numbers and symbols?
- Why does it make sense to use an addition symbol in the expression?
- How does breaking the number apart help you solve the problem?
- How did you decide where to start solving this problem?

During class discussion:
- Explain how the distributive property is helpful when you are multiplying large numbers. Create a multiplication problem that supports your explanation.
- What would happen if you tried to use the distributive property to solve a problem such as 458 x 7?
- How does the distributive property connect to the models we have been using?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students have difficulty decomposing numbers using place value. They have trouble recognizing that 32 is the same as 30 + 2.</td>
<td>Give students the opportunity to build two-digit numbers with a variety of manipulatives. Emphasize the values of tens and ones.</td>
</tr>
<tr>
<td>Students do not connect multiplication with equal groups.</td>
<td>Provide a variety of manipulatives for students to partition into equal groups. Encourage students to provide stories that match their manipulatives such as “Four squirrels each carried 8 acorns.” Help students write a multiplication expression that corresponds with their manipulatives and context.</td>
</tr>
</tbody>
</table>
Special Notes:
Follow up lessons could

- Extend to multiplying with larger numbers including three digits by one digit and four digits by one digit
- Vary the problem type based on Table 2 “Common Multiplication and Division Situations.” This table is found on page 89 of the Common Core State Standards for Mathematics Glossary. [http://www.corestandards.org/assets/CCSSI_Math%20Standards.pdf](http://www.corestandards.org/assets/CCSSI_Math%20Standards.pdf)
- This lesson applies the distributive property to decomposing large numbers (32 = 30+2). Provide problems that model and apply the distributive property in reverse such as 4 x (8 + 5)
- Explore whether or not the distributive property could be used in addition, subtraction, and division

Solutions: NA

*Adapted from “Exploring the Distributive Property” Mathematics Enhanced Scope and Sequence, Virginia Department of Education, 2011.*
# Multiply Using the Distributive Property

## Recording Sheet

Name ________________________________ Date _______________________

<table>
<thead>
<tr>
<th>Pictures</th>
<th>Numbers and Symbols</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Use ______ for tens and □ for ones.)</td>
<td>6\times32=(_\times_)+ (_\times_)</td>
</tr>
</tbody>
</table>

Roll and Compare

Common Core Standards

Generalize place value understanding for multi-digit whole numbers.

4.NBT.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
6. Attend to precision.

Student Outcomes:
- I can read and write whole numbers up to 1,000,000.
- I can compare multi-digit numbers.
- I can explain number comparisons.

Materials:
- handout
- number cube

Advance Preparation:
- Copy handout

Directions:
1. Students will roll a number cube 6 times and place the numbers in the place value chart on the activity sheet. The goal is to make the largest possible number.
2. After each player has made a 6-digit number, they will compare the numbers they created using the symbols <, >, =.
3. After choosing the correct symbol, students will explain how they know they are correct. They can also write their explanation down if you choose. Their explanation should include mathematical language about place value and the value of specific digits in each number.
4. Teacher circulates and checks for students’ understanding by asking them to read their mathematical expression and their explanation for their answer.
5. If students finish early, they can write their numbers in expanded form.
6. Play continues with the rolling of die to create another number.
Note – When working on this skill, I do not tell the students which number should go first in the comparison, because the mathematical symbols (<, >, =) should be the focus on what is correct, as well as the explanation.

Example:
**Number comparison:**

\[
345,654 \ < \ 632,321
\]

I know that my number is **less** (greater or less) than my partner’s number because the digit in the **hundred thousands** place has a value of **300,000** and my partner’s number has a digit in the **hundred thousands** with a value of **600,000**.

The following handout can be created so that students are using other place values – including decimals.

**Questions to Pose:**

**Before:**
Can you name a number that is larger than 525,786?
How do you know that your number is larger?

**During:**
If the goal is to make the largest number possible, what strategy are you using to make your number?
Can you explain how you know whose number is bigger?

**After:**
As you played the game what strategies did you use to make the largest number?
How did you determine which number was larger?
Consider these two numbers (write 675,982 and 675,992 on the board. Which number is larger?
How do you know?

**Possible Misconceptions/Suggestions:**

<table>
<thead>
<tr>
<th>Possible Misconceptions:</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students are not making the largest number possible.</td>
<td>Ask students to explain their strategy for placing numbers, and follow up by asking- “where should we put large digits when making a number?”</td>
</tr>
<tr>
<td>Students incorrectly compare numbers.</td>
<td>Ask students to explain which is bigger-hundreds thousands or ones? Follow up by talking with students about the idea that when we compare numbers we want to start with the greatest place value to determine which number is greater.</td>
</tr>
</tbody>
</table>
**Special Notes:** If students use number cards (0-9) to generate numbers, you will have a greater range of numbers compared to using a number cube marked 1-6.

**Solutions:**
Solutions will vary based on the numbers created.

<table>
<thead>
<tr>
<th>Millions</th>
<th>Hundred Thousands</th>
<th>Ten Thousands</th>
<th>Thousands</th>
<th>Hundreds</th>
<th>Tens</th>
<th>ones</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

**Number comparison:**

_____________________________           _______             __________________________________

I know that my number is ___________ (greater or less) than my partner’s number because the digit in the _____________ place has a value of _______________ and my partner’s number has a digit in the ______ with a value of __________.

<table>
<thead>
<tr>
<th>Millions</th>
<th>Hundred Thousands</th>
<th>Ten Thousands</th>
<th>Thousands</th>
<th>Hundreds</th>
<th>Tens</th>
<th>ones</th>
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</thead>
<tbody>
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</tbody>
</table>

**Number comparison:**

________________________________      _______        ___________________________________

I know that my number is ___________ (greater or less) than my partner’s number because the digit in the _____________ place has a value of _______________ and my partner’s number has a digit in the ______ with a value of __________.
Rounding Numbers Roll

Common Core Standards

Generalize place value understanding for multi-digit whole numbers.

4.NBT.3 Use place value understanding to round multi-digit whole numbers to any place.

Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
6. Attend to precision.

Student Outcomes:

• I can read and write whole numbers up to 1,000,000.
• I can round numbers to any given place less than or equal to 1,000,000.
• I can subtract whole numbers.

Materials:

• handout
• number cube (2 per pair of students)

Advance Preparation:

• Copy handout

Directions:

1. Each student needs one number cube and a worksheet. Before the game begins the teacher lets the class know they will be rolling a number cube to create numbers and then rounding the numbers. A complete game consists of the rolling and rounding of 4 different numbers. Once each player has completed their worksheet they will add their numbers and the winner is the player who comes closest to the specified sum goal. This goal is set by the teacher depending on the magnitude of the number. Sometimes the goal is 300,000 and sometimes 30,000. When playing this game the goal is to try and make the largest number for the given number of digits (e.g., the largest 5 digit number on a number cube marked 1-6 would be 66,666.

2. Students take turns rolling one number cube at a time. As students roll the number cube, they can place their number in any place that they want to until every place has been filled.
3. Once students completed the number, they round the number to each of the specified place values.
Questions to Pose:
Before:
If you had the digits, 3, 5, 6, 4, 2, and 1, what would be the largest number that you could make?
How did you figure that out?

During:
As you round, what strategy are you using to determine your answer?
How do you know that you are correct?

After:
Who wants to describe the strategy that they used to build their number?
Who wants to describe the strategy that they used to build their number?
If you had the digits: 3, 3, 6, 2, 1, and 4, what would be the largest number that you could make?
How do you know?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions:</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rounding errors</td>
<td>While tricks exist to teach rounding, we want students to reason and analyze why specific strategies exist. For example, if students are trying to round 621,344 to the nearest hundred, we want them to think about what the nearest hundreds are (621,300 or 621,400) and then reason about the idea that 621,300 is closer.</td>
</tr>
</tbody>
</table>

Special Notes:
Using number cards (0-9) will increase the range of numbers that students can create and work with. As an alternative, teachers may use a blank number cube and label them with higher one-digit numbers or use a 10 sided number cube.

The following handout can be created so that students are rounding to other place values – including tenths and hundredths.

Solutions:
The solutions will differ based on the numbers that are generated.
<table>
<thead>
<tr>
<th>Number</th>
<th>Rounded to nearest 10</th>
<th>Rounded to nearest 100</th>
<th>Rounded to nearest 1,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Strategies for Multiplying Multi-digit Numbers

Common Core Standard:
Use place value understanding and properties of operations to perform multi-digit arithmetic.
4.NBT.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

Additional/Supporting Standards:
4.OA.1, 4.OA.2 Use the four operations with whole numbers to solve problems.

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
4. Model with mathematics
6. Attend to precision
7. Look for and make use of structure

Student Outcomes:
• I can develop and implement a strategy for solving a multi-digit multiplication problem
• I can use a variety of strategies to solve multi-digit multiplication problems
• I can explain my reasoning when developing a multiplication strategy

Materials:
• Outdoor Adventure Store Recording Sheet (one per student)

Advance Preparation:
• Copy the Outdoor Adventure Store Recording Sheet
• Students should be comfortable with a variety of strategies for one-digit multiplication
• Students should have a strong understanding of the meaning of multiplication, especially the use of equal groups.

Directions:
1. Distribute the Outdoor Adventure Store Recording Sheet and ask students to read and solve the first problem.

2. Allow students to struggle. The students should be devising their own approaches to solve the problem. Some will draw pictures, others will add, some will use concepts of multiplication.

3. As you circulate note which strategies the students are using. Take note of common strategies, unique strategies, simple strategies, and strategies that are problematic.

4. Determine which students you will ask to share. Remember that your goal is to help students develop effective place-value based strategies that illustrate the meaning of multiplication. This is not a time to study the standard algorithm.
5. When most students have finished the first problem, invite several to share their strategies. Try to examine every type of strategy used in the room. At this point do not share the standard algorithm.

**Sharing Procedure**
1. Display the student’s strategy. You may use a document camera or have the student copy their work onto the board.
2. Ask the student to explain their reasoning for each step.
3. Ask questions to determine the student’s level of understanding, “Why did you…”
4. Allow the class to ask the student questions about the strategy.
5. To ensure others are listening, have each student explain the strategy to a neighbor.
6. Make any clarifying statements about the strategy.
7. Invite a new student to share a different strategy.

6. Once several strategies have been shared using the above process, direct the students to complete problem #2. This task requires the students to solve the same problem using a new approach. Encourage the students to use one of the approaches shared by a classmate.

7. Again, ask a few students to share. This sharing session can be much shorter because it is a second-look at the same multiplication problem.

8. Now move on the question #3 on the Recording Sheet and repeat the process described in steps 2-7.

9. To close the lesson, ask students to think about their favorite strategy from today. The students could discuss this strategy and why they like it with a partner or they could write their response in a journal.

**Questions to Pose:**
- Why did you…?
- How is Latisha’s strategy similar to Jonah’s? How are they different?
- Where did you run into difficulty in your work? Why was it problematic?
- Why is it important that your strategies are accurate and efficient?
- Which strategy is most efficient? Which strategy is least efficient?
Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students have difficulty developing their own strategy</td>
<td>Ask students to think about the strategies they could use for a simple problem such as $3 \times 4$. Connect these strategies to the problems in today’s lesson.</td>
</tr>
<tr>
<td>Students insist on using the standard algorithm which they learned outside of school</td>
<td>Explain that they may be able to use the standard algorithm in the future, but they must first be able to explain why the steps make sense. The purpose of today’s lesson is to explore the meaning of multiplication in multi-digit numbers. Later they may use these strategies to help them understand the standard algorithm, but not today. The standard algorithm for multiplication is found in 5th grade.</td>
</tr>
</tbody>
</table>

Special Notes:

- This is an introductory lesson to multiplying with multi-digit numbers. Students should develop their own strategies. If a student uses the standard algorithm because it was learned at home, suggest that she attempt a different strategy. Note the suggestion listed in the box above.

Solutions:

$$25 \times 14 = 350$$  $$21 \times 7 = 147$$
Outdoor Adventure Store Recording Sheet

Directions: Use what you know about multiplication to solve the following problems from the Outdoor Adventure Store.

1. Luis sells 25 hiking packs per day at the Outdoor Adventure Store. How many packs will he sell in 14 days?

2. Solve problem #1 using a different strategy.
3. Central Elementary School orders 21 packs of tablecloths for a school picnic. Each pack contains 7 tablecloths. How many tablecloths will they have for the picnic?

4. Solve problem #3 using a different strategy
Fraction Card Games

Common Core Standard:
Extend understanding of fraction equivalence and ordering.
4.NF.2 Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

Additional/Supporting Standards:
4.NF.1 Extend understanding of fraction equivalence and ordering

Standards for Mathematical Practice:
2. Reason abstractly and quantitatively
6. Attend to precision
7. Look for and make use of structure

Student Outcomes:
• I can compare two fractions with different numerators and/or denominators
• I can recognize equivalent fractions

Materials:
• Fraction Cards sets (1 set/pair) 38 cards in the set

Advance Preparation:
• Copy Fraction Cards on cardstock
• Consider how you will group students
• Students need to be familiar with fraction benchmarks such as ½
• Students need to understand fractions as parts of whole
• Students need to be familiar with finding equivalent fractions
• Students need to understand the larger the denominator, the smaller the parts

Directions:
Game 1: Concentration (2-3 students)
• Deal cards face down in five rows
• Players take turns turning over two cards at a time
• If the fractions are equivalent, the student keeps the pair
• The winner is the person with the most cards

Game 2: Go Fish (2-3 students)
• Deal five cards to each player, stack the rest of the cards in the middle of the table
• The object is to get pairs of equivalent fractions
• At each turn players may ask others in the group for a certain fraction
• As long as someone gives the person a card, the player may keep asking
• When no one has an equivalent fraction to give the player, the person ‘goes fishing’ by
drawing from the deck
• At end of game, the player with the most pairs wins

Game 3: War (2 students)
• Cards are divided between two players
• Each player lays down 1 card
• Players decide which fraction is greatest
  – Players may create common denominators
  – Compare to a benchmark fraction such as 0, ¼, ½, ¾, 1
• Player with the largest fraction picks up both cards
• If fractions are equivalent, players lay down a second card and compare
• At the end of the game the player with the most cards wins

Questions to Pose:
As students are playing games:
• What strategies are you going to use to figure out the value of the fraction?
• How might drawing a picture be helpful
• Give me an example of a fraction that is less than…greater than… equivalent to…?
• Describe the method you used to compare the fraction? Explain why it works?
• Is your fraction close to a benchmark? How can you tell?
• What are the benefits of using a common denominator to compare fractions?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students have difficulty seeing equivalent fractions</td>
<td>Students work with models such as pattern blocks, fraction strips, fraction circles and number lines to explore equivalents fractions, 1 blue parallelogram is 1/3 and 2 triangles are 1/3 of a hexagon</td>
</tr>
<tr>
<td>Students do not use benchmark fractions when comparing fractions</td>
<td>As teacher circulates to monitor student understanding, ask: Is your fraction close to a benchmark number? How can you tell? Give student different lengths of paper strips. Student folds in half then fourths. Student labels strips with 0, ¼, ½, ¾, 1</td>
</tr>
<tr>
<td>Students have difficulty comparing fractions with different denominators</td>
<td>Work with student to find common denominators when comparing fractions</td>
</tr>
</tbody>
</table>

Special Notes:
Games need to be played multiple times. Classroom discussions after students play games should focus on strategies for efficiently comparing fractions using common denominators and benchmarks.

Solutions: N/A
Place the Fraction

Common Core Standards
Extend understanding of fraction equivalence and ordering.

4.NF.2 Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
6. Attend to precision.

Student Outcomes:
- I can use benchmark fractions to compare fractions.
- I can find fractions equivalent to one half.

Materials:
- Fraction Cards, 1 set per pair
- A sheet of paper that has 3 columns marked 0, 1/2, and 1.

Advance Preparation:
- Fraction cards should be pre-made.
- Arrange the labels (0, 1/2, and 1) on a number line so that students can see and access them.

Directions:
1. Give each student (or pair of students) a paper plate with a fractional amount on it. They will work with partners about where their fraction should go on the number line.

Questions to Pose:
Before:
What do you know about the fraction 2/6? What is the relationship between the numerator and denominator? Do you think this fraction is closer to 0, ½, 1? Why?

What strategies can you use to determine whether fractions are closer to 0, 1/2, or 1?
During:
Is this fraction closer to 0, 1/2, or 1? How do you know where this fraction should be placed? Why?
What is your strategy for placing these fractions?

After:
Display a fraction for the class. Is this fraction closer to 0, 1/2, or 1? How do you know where this fraction should be placed? Why?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions:</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students place fraction cards in the wrong column.</td>
<td>Have students discuss and find equivalent fractions for 1/2 and 1, which will help students to determine which benchmark fractions are closer to (e.g., $\frac{5}{8}$ is closer to $\frac{1}{2}$, since $\frac{1}{2} = \frac{4}{8}$).</td>
</tr>
</tbody>
</table>

Special Notes: Fourths were intentionally omitted from this activity, since $\frac{1}{4}$ is exactly halfway between 0 and $\frac{1}{2}$. As a class you can pose $\frac{1}{4}$ and $\frac{3}{4}$ to students and discuss which benchmark it is closest to.

Students may need to draw a number line or a model of these fractions to help them determine the answers. Encourage students to use these representations to help them make sense of which benchmark these fractions are closer to.

Students can also create their own fraction cards to place as well.

Solutions:

**Closer to 0:**
2/12, 1/6, 2/10, 1/5

**Closer to 1/2:**
3/8, 5/8, 2/6, 2/3, 3/6, 5/10, 3/5,

**Closer to 1:**
5/6, 7/6, 3/3, 9/10, 4/5
### Fraction Cards

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<td>(\frac{3}{8})</td>
<td>(\frac{5}{8})</td>
<td>(\frac{2}{6})</td>
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<td>(\frac{3}{6})</td>
<td>(\frac{5}{6})</td>
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<tr>
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<tr>
<td>(\frac{7}{6})</td>
<td>(\frac{3}{3})</td>
<td>(\frac{5}{10})</td>
<td>(\frac{2}{10})</td>
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<tr>
<td>9</td>
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<td>1</td>
<td>4</td>
</tr>
<tr>
<td>(\frac{9}{10})</td>
<td>(\frac{3}{5})</td>
<td>(\frac{1}{5})</td>
<td>(\frac{4}{5})</td>
</tr>
</tbody>
</table>
Fractions in the Real World

Common Core Standards

Extend understanding of fraction equivalence and ordering.

4.NF.2 Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

4.NF.3 Understand a fraction $a/b$ with $a > 1$ as a sum of fractions $1/b$.

b. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model.

Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision

Student Outcomes:

• I can identify fractional parts.
• I can find equivalent fractions.
• I can compose and decompose fractions in more than one way.
• I can record decompositions of fractions in an equation.

Materials:

• Poster board or large construction paper

Advance Preparation:

• Put students into pairs.
• Make a visual model as a representation for students to understand the outcome of their work.

Directions:

1. Students will need their math journal or a piece of paper. Students can also use a digital camera if you wish.
2. Students will take a tour of the classroom or school building looking for examples of fractions in the real world.
3. For each example, students should draw or take a picture and write a description of fractions. Possible examples: Eight floor tiles are red and 4 are white, so students may say 8/12 of the tiles are red and 4/12 of the tiles are white.
4. Illustrate the fractions found and write equations to go with the fractional picture. For the example above, an equation may be 8/12 + 4/12 = 12/12 = 1. The equation should involve decomposing (breaking apart) the whole into fractional parts.

Questions to Pose:
Before:
We are going to look for fractions in the real world today. What are some examples of fractions that you see around this classroom?
What equations would represent the fractional representations?

During:
How would you describe the fractions in your own worlds?
What equations would represent the fractional representations?

After:
What examples of fractions did you find?
What were the equations that matched the representations?
If we had 8 donuts, and 3 were chocolate, 4 were powdered sugar, and 1 was jelly, what would be the fractional amount of each type of donut? What equation could we use to represent the whole group of donuts in terms of the different types of donuts?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions:</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students struggle to identify fractions in the real-world.</td>
<td>Discuss with students the idea that a fraction is part of a whole, and that they should look for a whole group of students, tiles, students in the hallway, or anything that comes in groups to help them get started.</td>
</tr>
<tr>
<td>Students struggle to write correct equations.</td>
<td>Discuss with students that the whole, which has a value of 1, can be broken apart into fractions that represent the different parts of a group. The denominator represents the number of equal parts in the group, while the numerator represents the number of items or the length or size of a particular part of the group.</td>
</tr>
</tbody>
</table>
Special Notes:
Reinforce the idea that fractions can be represented as lengths, areas, or sets (groups).

Solutions:
Solutions will vary based on the fractions that students identify.

5 \times \frac{1}{2} = 2 \frac{1}{2}

Each of the 5 butterflies has \frac{1}{2} of their body showing.
Fraction Cover Up

Common Core Standards
Build Fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.
4.NF.3d Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem.

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics

Student Outcomes:
• I can identify fractional parts.
• I can find equivalent fractions.
• I can add and subtract fractions.
• I can relate numerical fractions to equivalent visual representations.

Materials:
• Fraction cards or number cubes
• Pattern blocks
• Copies of Fraction Cover-Up sheet
• Colored pencils or crayons

Advance Preparation:
• Copy fraction cards or label die (labels need to be 1/6, 1/3, 2/6, 1/2, 2/3, 3/6)
• Gather pattern blocks
• Gather colored pencils

Directions:
1. Players take turns drawing a card and putting the equivalent pattern block on their hexagon. For example, if a student rolls 1/3, they can put down 1 blue parallelogram or 2 green triangles.
2. Before play continues, students need to make sure they have the least amount of pattern blocks possible on their sheet. For example, if I have 2 green triangles on my hexagon I need to trade for one blue rhombus. Students will check one another’s work and if their partner has not “simplified” their pattern blocks they will lose the next turn. If students trade in pattern blocks, they should record their equation on paper, e.g. 3 triangles for 1 trapezoid, 3/6 = ½.
3. The winner is the player who covers a specified number of hexagons – specified by the teacher.  
Note – If the pattern blocks are in short supply, students can color the hexagon when it is completely filled.

You can play where students have to color in all the hexagons on the page, or set a timer and the student who colors in the most hexagons before the timer goes off wins.

Questions to Pose:

Before:
If 6 triangles will cover this hexagon, what is the fractional amount of 1 triangle?
If 3 rhombuses will cover this hexagon, what is the fractional amount of 1 rhombus?
If 2 trapezoids will cover this hexagon, what is the fractional amount of 1 trapezoid?

During:
What types of trades have you made? How do you know that you were trading correctly?

After:
As you played the game, what types of trades did you make? How did you know that you were trading correctly?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions:</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students do not recognize that they can make trades.</td>
<td>Discuss with students possibilities for equivalent fractions by having them lay a trapezoid or rhombus on top of smaller pieces. If students find possible trades have them share their equations for equivalent fractions.</td>
</tr>
</tbody>
</table>

Special Notes: Note – If the pattern blocks are in short supply, students can color the hexagon when it is completely filled.

You can play where students have to color in all the hexagons on the page, or set a timer and the student who colors in the most hexagons before the timer goes off wins.

You can carry over from one hexagon to the next and you can also ask students to write equations as they roll. For example, if my first roll is 1/3 and I lay down a blue rhombus, my second roll is ½ and I lay down a red trapezoid and then I roll 1/3 again I would need to explain to students that I need to exchange the 1/3 (blue rhombus) for 2 green triangles because they are each worth 1/6.

I could also write the equation, 1/3 + 1/2+ 1/3 = 1 1/6

Solutions:
Solutions will vary based on the game.
Fraction Cover Up
Give ‘Em Chocolate!

Common Core Standard

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

4.NF.3 Understand a fraction a/b with a > 1 as a sum of fractions 1/b.
   a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.
   b. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. Examples: 3/8 = 1/8 + 1/8 + 1/8 ; 3/8 = 1/8 + 2/8 ; 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8.
   d. Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem.

Additional/Supporting Standard:

4.NF.3.c Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them
4. Model with mathematics
5. Use appropriate tools strategically
8. Look for and express regularity in repeated reasoning

Student Outcomes:
• I can decompose a fraction into a sum of fractions with the same denominator
• I can record each decomposition using an equation
• I can use models to demonstrate why my equation makes sense

Materials:
• Student manipulatives for twelfths such as fraction bars

Advance Preparation:
• Gather fraction manipulatives
• Copy the Record Sheet (optional)
• Consider how you will partner students
• Students should have an understanding of unit fractions as they relate to the whole.
Directions:
1. In this task students apply their understanding of unit fractions to a real-world context.

2. Describe the following situation for the students:
   *You bought 12 pounds of chocolate to give to 5 people as gifts. You want to give away all 12 pounds to the 5 people. What are the different ways I can partition my chocolate?*

3. Solicit student suggestions. For instance: 2/12 + 4/12 + 3/12 + 1/12 + 2/12
   Students may note that these are not equal portions.

4. Distribute the Recording Sheet or have the students create their own. Ensure that students understand the expectations of the task:
   - Work in pairs to come up with as many ways to partition the 12 pounds of chocolate as possible.
   - Record each method using an equation
   - Prove each method using a visual model such as a sketch or with manipulatives

5. Circulate as pairs of students work together on the task. As you circulate ask questions including those listed below.

6. To close the lesson, invite each group to present one way to partition the chocolate. Their presentation should include both an equation and visual model

Questions to Pose:

Before:
- What visual models could you use to represent your solutions?
- How might manipulatives help you solve this problem?

During:
- Describe the method you used to partition the chocolate?
- How does your visual model represent this solution?
- How does your equation represent this solution?
- How do the unit fractions relate to the whole?

After:
- What did you notice about partitioning the whole?
- What surprised you as you completed this task?
- How did working with unit fractions support your reasoning?
- How did the visual models and equations support your thinking?
- Are there any solutions that we’ve missed?
### Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students have difficulty breaking 12/12 into five parts.</td>
<td>Use a twelfths model such as bars, strips, or circles. Work with the student to physically separate the twelve parts into 5 groups. Guide the student as they record the fractional parts in an equation.</td>
</tr>
<tr>
<td>Students have trouble connecting the visual models, equations, and story problem.</td>
<td>Suggest that the student label the components with each of the 5 people. For instance:</td>
</tr>
</tbody>
</table>

![Diagram](image)

Mary

3/12

Mary

### Special Notes:

This task should be conducted after students have an understanding of unit fractions as they relate to the whole.

### Solutions:

There are many solutions. Some solutions include:

- \( \frac{3}{12} + \frac{3}{12} + \frac{3}{12} + \frac{2}{12} + \frac{1}{12} \)
- \( \frac{8}{12} + \frac{1}{12} + \frac{1}{12} + \frac{1}{12} + \frac{1}{12} \)
- \( \frac{7}{12} + \frac{2}{12} + \frac{1}{12} + \frac{1}{12} + \frac{1}{12} \)
Give ‘Em Chocolate

You bought 12 pounds of chocolate to give to 5 people as gifts. You want to give away all 12 pounds to the 5 people. What are the different ways I can partition my chocolate?

<table>
<thead>
<tr>
<th>Visual Model</th>
<th>Equation</th>
</tr>
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<tbody>
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The Big H

Common Core Standards

Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.
4.NF.3 Understand a fraction $\frac{a}{b}$ with $a > 1$ as a sum of fractions $\frac{1}{b}$.
   a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.

Standards for Mathematical Practice:
   1. Make sense of problems and persevere in solving them.
   3. Construct viable arguments and critique the reasoning of others.
   4. Model with mathematics.

Student Outcomes:
   • I can identify fractional parts.
   • I can find equivalent fractions.
   • I can add and subtract fractions.
   • I can relate numerical fractions to equivalent visual representations.

Materials:
   • Fraction cards labeled (1/12, 1/6, 1/4, 1/3, 1/2, 2/12, 2/6, 2/4, 3/12, 4/12, 5/12)
   • Big T sheet

Advance Preparation:
   • Make fraction cards.
   • Copy Big T sheet.

Directions:
   1. Put the fraction cards in a pile face down.
   2. Both players pick a card from the top of the pile.
   3. Turn your cards over and decide which has the larger fraction.
   4. The player with the larger fraction must cover with a shape or color that fractional amount of the H.
   5. Put both cards at the bottom of the pile.
   6. Choose two more cards and play as before.
   7. If the player with the larger fraction cannot color the fractional part shown on the card, put both cards back and pick two more.
   8. Each time a player picks a card, the fraction always refers to the whole H (18 parts).
   9. Continue playing until one person has colored the whole H.
Questions to Pose:
Before:
Show the Big T to students. How many pieces would be equivalent to 1/3 of the entire shape? How do you know?
How many pieces would be equivalent to 1/4 of the entire shape? How do you know?
How many pieces would be equivalent to 1/6 of the entire shape? How do you know?

During:
How do you know which fraction is larger?
How do you know how many squares to color in?

After:
How did you know which fraction is larger?
How did you know how many squares to color in?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions:</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students are not able to correctly compare fractions.</td>
<td>Support students in creating equivalent fractions or drawing a model using graph paper.</td>
</tr>
</tbody>
</table>

Special Notes:
The mathematical focus of this game is equivalent fractions and applying the understanding of them to compare fractions and to also determine how much of the Big T to cover. Questions and conversations should focus on representations of fractions and the comparison of fractions.
If you modify this game and make different fraction cards, be careful to stay within the appropriate denominators for Grade 4.

Solutions:
Solutions will vary based on the cards drawn during the game.
<p>| | | |</p>
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</tbody>
</table>
The Smallest Difference Wins

Common Core Standards
Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

4.NF.3 Understand a fraction $a/b$ with $a > 1$ as a sum of fractions $1/b$.
a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.

Student Outcomes:
• I can identify fractional parts.
• I can find equivalent fractions.
• I can add and subtract fractions.
• I can relate numerical fractions to equivalent visual representations.

Materials:
• Two Number Cubes
• Smaller Difference Wins Game Sheet and rules

Advance Preparation:
• Copy game sheets

Directions:
1. The teacher or students need to agree on a denominator (5, 6, 10, or 12) as well as a benchmark number. If you use a large denominator (10 or 12, we suggest a benchmark number of 1/2; 5, or 6 we suggest a benchmark of 2).
2. Players will take turns rolling both number cubes. They write the number they roll in one of the boxes on the game board. There are two possible places to place a number – numerator or discard box. After a number is written in the box, it cannot be changed.
3. After the first player has placed a number, the number cubes are passed to the next player.
4. Players roll twice so that they have a number in the numerator and a number in the discard box.
5. Players determine how close their fraction is to their benchmark number. The distance from the benchmark number is their score for the round. The goal is to earn the lowest score. Players should play multiple rounds with the same denominator.
Questions to Pose:
Before:
Let’s consider these fractions 1/6 and 4/6. Which is closer to 1/2? How do you know?

During:
How far is your fraction from the benchmark number? How do you know?
What strategy did you use to determine your score for the round?

After:
Let’s consider these fractions. Display 7/12 and 4/12. Which fraction is closest to 1/2? How do you know?
What would each students’ score be for this round? How do you know?
As you played this game, what strategy did you use to determine your score for the round?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions:</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students incorrectly subtraction fractions from the benchmark number.</td>
<td>Encourage students to use a representation (number line, area model) to work out the subtraction.</td>
</tr>
</tbody>
</table>

Special Notes:
The mathematical goal for this lesson is for students to create fractions and work on subtracting the fractions they create from the benchmark number (1/2 or 1). Focus your questions and observations on strategies that students use to subtract fractions. Encourage them to draw representations to support their work.

Solutions:
Solutions will vary based on the fractions that are made during the game.
The Smallest Difference Wins

Discard box

Discard box

Discard box

Discard box

Discard box

Discard box
Unit Fractions

Common Core Standard:
Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

4.NF.3 Understand a fraction $a/b$ with $a > 1$ as a sum of fractions $1/b$.
   a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.
   b. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. Examples: $3/8 = 1/8 + 1/8 + 1/8$; $3/8 = 1/8 + 2/8$; $2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8$.

Additional/Supporting Standard:
4.NF.3.c, 4.NF.3.d Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

Standards for Mathematical Practice:
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure

Student Outcomes:
• I can model a unit fraction from a whole
• I can add and subtract unit fractions from a whole
• I can decompose a whole into its units

Materials:
• Construction paper, 2 colors cut into 18” by 2” strips. (3 strips per student)

Advance Preparation:
• Cut strips of construction paper into equal size strips. Enough for each student to have 2 strips of one color and 1 strip of a second color
• Students need to be familiar with fractions being parts of a whole
• Students need to be familiar with working with a number line

Directions:
1. Teacher can have an activator or literature to tap prior knowledge of fractions
2. Students are given 2 strips of construction paper. At this point use only one color.
3. Students fold both strips into 8ths by folding it in half, in half again, in half a third time.
4. After each fold, ask student to tell their neighbor how many sections the strip will have.
5. After the 3 folds, students open the strip to find 8 sections. Have students talk about what they notice with the strip. (8 parts, there are 4 parts in each half, each section is 1/8, etc.)
6. Students repeat this process with the second strip of the same color.
7. Students cut apart all 16 sections and label each section with 1/8 and place in a pile on their table.
8. Teacher gives each student a third strip that is a different color, but the same size as the two previous strips. This strip does not need to be folded. This strip will be the ‘whole’.
9. Students place the whole on the table and get their eighths ready.
10. Teacher will have student work with the eighths placing them on top or directly under the whole. Pose questions such as:
   - Build 3 eighths, build 7 eighths, build 10 eighths, build 1 and 5 eighths
   - Add 2 eighths and 5 eighths, add 5 eighths and 5 eighths
   - Subtract 3 eighths from 9 eighths
   - Using partners, one partner builds 7 eighths and one partner builds 12 eighths, what do you notice.
   - Have students build an amount of eighths such as 6 eighths, ask what are the different ways 6/8 can be broken apart ( 2/8 + 4/8, or 3/8 + 3/8)
11. As students use the unit fractions to build, add, subtract, decompose and compare numbers, pose additional questions. See below.
12. Students summarize learning by a journal entry: How does the unit fraction relate to whole? Use both words and pictures in your entry.

Questions to Pose:
As students are working:
   - How does this unit fraction relate to the whole?
   - What fraction is 2 units less than what you have? Show me with your pieces.
   - Give me an example of a fraction that is less than…greater than…what you have.
   - Describe the method you used to compare the fraction.
   - Is your fraction close to a benchmark? How do you know?
   - Describe the method you used to add /the unit fractions.
   - What would your fraction look like using the symbols?
     (3 1/8 units could be 1/8 + 1/8 + 1/8 or 3/8)

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students have difficulty seeing the unit</td>
<td>Give student experiences</td>
</tr>
<tr>
<td>fraction in relation to the whole.</td>
<td>with halves and thirds</td>
</tr>
</tbody>
</table>

Special Notes:
Once students have practice working with unit fractions in eighths, have them practice with units in tenths and twelfths. Premade circles and rectangles divided into tenths and twelfths might be easier than student measuring or folding paper. Students need to see unit fractions using multiple models.

Solutions: N/A
Multiplying Fractions by a Whole Number

Common Core Standards:
Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.
4.NF.4 Apply and extend previous understandings of multiplication to multiply a fraction by a whole number.
   a. Understand a fraction $a/b$ as a multiple of $1/b$. For example, use a visual fraction model to represent $5/4$ as the product $5 \times (1/4)$, recording the conclusion by the equation $5/4 = 5 \times (1/4)$.
   b. Understand a multiple of $a/b$ as a multiple of $1/b$, and use this understanding to multiply a fraction by a whole number. For example, use a visual fraction model to express $3 \times (2/5)$ as $6 \times (1/5)$, recognizing this product as $6/5$. (In general, $n \times (a/b) = (n \times a)/b$.)

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
6. Attend to precision.

Student Outcomes:
• I can identify unit fractions.
• I can relate addition to the multiplication of unit fractions.
• I can decompose fractions into unit fractions.
• I can multiply a whole number by a fraction.

Materials:
• Pattern blocks

Advance Preparation:
• Gather pattern blocks

Directions:
1. Each student needs at least one yellow hexagon, 3 blue rhombi, 6 green triangles and 2 red trapezoids. For this activity, the yellow hexagon represents the whole. You can change this for rigor after this initial lesson.
2. Have students reason about the value of each pattern—hexagon = 1, trapezoid = $1/2$, rhombus = $1/3$, triangle = $1/6$.
3. After students have discussed and come up with the value of each pattern block, have students take each set of pattern blocks and write equivalent sentences with their models.
For example, 2/6 (two triangles) = 1/3 (one rhombus). There are several equivalencies that can be created.

4. Ask students to concentrate on the yellow hexagon and red trapezoids for now. Using their previous knowledge of the trapezoid value being one half, how many trapezoids would it take to equal the yellow hexagon? 2 – Therefore, ½ + ½ = 1 or, using the knowledge of the relationship between addition and multiplication, we could write the equation: ½ x 2 = 1

5. Continue asking these questions, and any more that you come up with:
   How many blue rhombi equal the yellow hexagon? Write an addition and multiplication equation with this information. 1/3 + 1/3 + 1/3 = 1 or 1/3 x 3 = 1 How many green triangles equal the yellow hexagon? 1/6+1/6+1/6+1/6+1/6+1/6 = 1 or 1/6 x 6 = 1.

6. Continue to write additional addition and multiplication sentences with all equivalencies that can be found. Some possibilities are: 1/6 x 2 = 2/6 or 1/3; ½ x 3 = 1 ½ or 1.5; 1/6 x 4 = 4/6 or 2/3, etc.

7. Have students complete the activity sheet attached. They may use pattern blocks to help them. Students should write a multiplication equation for each problem.

**Questions to Pose:**
What multiplication equation matches our representation with the pattern blocks?
How do you know the representation matches the equation?

<table>
<thead>
<tr>
<th>Possible Misconceptions:</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students struggle finding the product when multiplying fractions.</td>
<td>Encourage students to skip count or list the multiples when multiplying by fractions.</td>
</tr>
</tbody>
</table>

**Special Notes:**
The mathematical goals of these activities are for students to match multiplication equations up to mathematical representations. All of the activities here focus on only one type of pattern block (one denominator) at a time. The tasks at the end of the activity sheet add rigor while still allowing students to stay within the Grade 4 expectations of the Standards.

**Solutions:**
Multiplying Fractions with Pattern Blocks

Write an equation and determine the total value of each:

1) 4 rhombuses

2) 3 hexagons

3) 9 triangles

4) 4 triangles

5) 11 trapezoids

6) Which is larger: 7 triangles or 4 rhombuses?

7) Which is larger: 5 trapezoids or 14 triangles?

8) Which is larger: 9 rhombuses or 6 trapezoids?
Show What You Know: Multiple Representations of Decimals and Fractions

Common Core Standard:
Understand decimal notation for fractions, and compare decimal fractions.
4.NF.6 Use decimal notation for fractions with denominators 10 or 100. For example, rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram.

Additional/Supporting Standards:
4.NF.5, 4.NF.7

Standards for Mathematical Practice:
2. Reason abstractly and quantitatively
4. Model with mathematics
5. Use appropriate tools strategically
7. Look for and make use of structure

Student Outcomes:
• I can create multiple representations of a decimal
• I can compare and order decimals to the hundredths
• I can use decimal notation for fractions

Materials:
• Show What You Know Sheet or blank paper (at least 2 per student)
• Decimal Grids (several sheets per class)

Advance Preparation:
• Copy Show What You Know Sheets or gather blank paper
• Copy Decimal Grids
• Consider how you will create groups of 3-4 students
• Students should be familiar with representing decimals as fractions with denominators 10 or 100.
• Students should be comfortable with multiple representations of decimals including: number lines, grids, and using base ten blocks (where □ = 1)

Directions:
1. Begin by modeling today’s task with the whole group:
   • Choose a decimal in the hundredths place. Students will determine their own decimal.
   • Complete the graphic organizer on the Show What You Know Sheet. Alternatively, students may draw their own version on blank paper. (See example below)
2. Allow students ample time to complete their own graphic organizer. Be prepared to distribute decimal grids to students who need them.
3. Hopefully most students will have time to complete the process representing at least 2 different decimals.
4. Organize the students into groups of 3-4. In their groups the students should line up their decimals from least to greatest. As you circulate, emphasize that students should be using the representations to justify their reasoning.

5. When most groups have finished ordering the decimals, choose 6-8 graphic organizers to display.

6. Through whole-class discussion students should decide how to order the decimals from least to greatest. During this discussion ask questions (see below) to ensure that students justify their thinking.

7. To summarize the lesson, ask students to choose 3 of the decimals displayed to examine using symbols: >, <, or =. Students could also include visual models (such as a number line, grid, or fraction) to support their reasoning.

Questions to Pose:

Before:
- How could you use base ten blocks to model this decimal?
- How could you use a number line to show this decimal?

During:
- How do you know that this fraction is equivalent to your decimal?
- What would happen if you changed your number line so that it showed 2 wholes instead of 1 whole?
- How can you prove that this decimal is the largest? Or smallest? Or in between these?

After:
- What other ways could you represent this decimal?
- How can you prove this fraction is equivalent to this decimal?
- How do you know this decimal is the largest? Or smallest? Or in between these?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students have difficulty creating fractions that are equivalent to their decimal</td>
<td>Provide multiple opportunities for students to connect decimals on a grid with decimal names and fractional representations. Note that both decimals and fractions are parts of a whole.</td>
</tr>
<tr>
<td>Students struggle to order decimals</td>
<td>Refer back to the visual models created by students. Ensure that students are using the same size whole and type of representation when comparing. By comparing shaded grids, base ten blocks, or number lines students can reason why one decimal is larger or smaller than another.</td>
</tr>
</tbody>
</table>

Special Notes:
- This lesson should be used only after students have experience modeling decimals in multiple ways, including with fractions that have denominators 10 or 100.
Sample Solution:

\[
\begin{align*}
\text{0.2} & + 0.08 \\
\frac{28}{100} & = 0.28
\end{align*}
\]
Show What You Know

Directions: Choose a decimal to write in the center circle. Your decimal should be in the hundredths place. In each of the 4 boxes represent your decimal in another way:

• As a fraction
• In expanded notation
• Using a number line
• Shade a grid or draw base ten blocks (Your choice! Use a grid from your teacher or draw base ten blocks)
Decimal Grids

[Diagram of 12 decimal grids arranged in a 3x4 grid]
Running the Race

Common Core Standard:

Extend understanding of fraction equivalence and ordering.

4.NF.7 Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, <, and justify the conclusions, e.g., by using a visual model.

Additional/Supporting Standard: N/A

Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others

Student Outcomes:

• I can compare decimals to the hundredths

Materials:

• Running Times for a Mile Sheet

Advance Preparation:

• Make copies of the Running Times for a Mile Sheet. 1 for each group of students
• Students are familiar with decimal notation to the hundredths
• Consider grouping students for discussion

Directions:

1. Activate student knowledge of the sport of running. Make a reference to marathons, track and field and the Olympics. Time for running is recorded in decimals notation. Have a discussion about which is the best running time: 9.35 or 9.67 minutes.
2. The teacher could time students as a class doing jumping jacks or another activity. Teacher records the time on the board. The teacher has the students repeat the activity and records the time. Which time was best? Why?
3. Present the task to the students. “Who is the best runner?” and “How can you tell?” Groups of 3-4 students are given the Running Times for a Mile Sheet. As a group, students will justify their runner is the best. Assign a runner to each group. Some groups will have the same runner, but will work separately.
4. Each group will be responsible for writing their justification. The group will present to the class. Give students opportunities for a lively debate. The goal should be consensus, everyone agrees on one runner as the best.
5. Possible justifications might include:
   Hailey – Even though she came in last on the 3rd run, she had the fastest time for the first 2 runs.
   Jackson – His running times decrease each time. He keeps improving. If they continue, he will have a lower time. He must be practicing.
Paul - He is the best because he is consistent. He was close to first every time. He was always in the 7-minute range. He was only .02 away from 1st place on the final run.

**Questions to Pose:**
As groups are working:
- What strategy are you going to use to compare these two decimals?
- How do you know...?
- How can you convince the others that your answer makes sense?
- About how far apart are these two times?

**Possible Misconceptions/Suggestions:**

<table>
<thead>
<tr>
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<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students have difficulty comparing decimals.</td>
<td>Support the student as they build a model of the two decimals.</td>
</tr>
</tbody>
</table>

**Special Notes:**
The main point of this lesson is to construct a viable argument. They need to justify their conclusions and communicate them to others. They need to respond to the arguments of others.

**Solutions:** N/A
### Running Times for a Mile

<table>
<thead>
<tr>
<th>Student</th>
<th>Paul</th>
<th>Jackson</th>
<th>Hailey</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time in Min. 1st Run</strong></td>
<td>7.5</td>
<td>8.58</td>
<td>7.44</td>
</tr>
<tr>
<td><strong>Time in Min. 2nd Run</strong></td>
<td>7.84</td>
<td>8.11</td>
<td>7.83</td>
</tr>
<tr>
<td><strong>Time in Min. 3rd Run</strong></td>
<td>7.6</td>
<td>7.58</td>
<td>8.68</td>
</tr>
</tbody>
</table>
Measurement Toss

Common Core Standards
Solve problems involving measurement and conversion of measurement from a larger unit to a smaller unit.
4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb+ oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

Standards for Mathematical Practice:
2. Reason abstractly and quantitatively.
4. Model with mathematics
6. Attend to precision

Student Outcomes:
• I can estimate the measurement distance.
• I can use a measurement tool for a precise measurement.

Materials (choose from the following)
• Beanbags
• Paper plates
• Nerf balls
• Chalkboard eraser
• Frisbee
• Beach balls
• Possible materials for target: hula hoop, trash can, rope in a circle, pylon
• Possible starting line markers: ruler/meter stick, piece of rope, measuring tape line

Advance Preparation:
• Put students into groups.
• Set up place to toss objects and targets.

Directions:
1. Students will toss an object onto a target, or get as close to the target as possible.
2. Students start behind a starting line and take turns attempting to toss an object into a ring. Students choose the distance between the starting line and the target, at least 5 meters apart. (Each group of students needs to choose a different distance.)
3. At each attempt, the student estimates the distance between where the object landed and the target (in meters). You could also measure and estimate the distances in yards.
4. Student will share their estimate with the group and then record the estimate on the score sheet.
5. The student now uses a meter stick to measure the distance between where the object landed and the target.
6. Record this distance on the score sheet.
7. The difference between the estimate and the actual measurement is the students’ score for the round. The goal is to get the lowest score possible.
8. The differences can be scored for a game total.
9. When finished with score, fill in the T-chart comparing centimeters and meters.

Questions to Pose:
During:
Why did you choose that estimate?
How far do you think your estimate is from your actual distance?
After:
How close was your estimate to your actual distance?
Did your estimates become closer to your actual distance as you played the game?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions:</th>
<th>Suggestions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students make unreasonable estimates.</td>
<td>Ask students or have students ask each other to explain the reasoning of their estimate, with a focus on benchmarks. An example may include, “I know that a meter is this long (uses hands), so I think that the distance from my target is twice that amount.”</td>
</tr>
<tr>
<td>Students make measurement errors</td>
<td>Remind students and help them to place the beginning of the measuring tool at the beginning of the distance being measured. Also make sure that if students have to use the measuring tool repeatedly that they precisely mark where the measuring tool ended so there are no gaps or overlaps.</td>
</tr>
<tr>
<td>Students make subtraction errors</td>
<td>Help students to use tools, such as open number lines, or strategies such as breaking numbers apart or adding up to support students’ work.</td>
</tr>
</tbody>
</table>

Special Notes:
This activity provides a rich opportunity for students to practice their estimation skills. You may want to introduce this activity by discussing the length of the measuring tool (meter stick or yard stick), and encourage students to reference this when they make their estimates.

Solutions:
Solutions vary based on students’ estimates and the distance of each toss.
Score Sheet

<table>
<thead>
<tr>
<th>Estimate</th>
<th>Actual</th>
<th>Difference</th>
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<tbody>
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</tbody>
</table>

Score Total _____

centimeters | meters
---|---
100 | 1

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NC DEPARTMENT OF PUBLIC INSTRUCTION

FOURTH GRADE
Building a Pen for Your Dog

Common Core Standards
Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.
4.MD.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems.

Standards for Mathematical Practice:
1. Make sense of problems and persevere in solving them.
2. Construct viable arguments and critique the reasoning of others.

Student Outcomes:
• I can find the perimeter of a square or rectangle.
• I can find the missing sides of a square or rectangle, given the perimeter.
• I can find patterns between length and width of rectangles and squares.

Materials:
• Grid paper
• Problem (found below)
• Square tiles

Advance Preparation:
• Gather grid paper.
• Gather square tiles.
• Copy the problem sheet.
• Consider how you will partner students.
• Students should have an understanding or perimeter and area.

Directions:
1. Review the meaning of perimeter with the class.
2. Let class know that today you are going to solve a problem involving building a pen for your dog.
3. Discuss the problem and determine what it is asking.
4. Let students know that they can use grid paper and/or square tiles to represent the pen.
5. Give students time to work through the problem.
6. After working through the problem, use grid paper and discussion to present solutions, asking students to justify their answers.
7. Create a T-chart to represent length and width.
8. Discuss the relationship between length and width on T-chart. (They always add up to 15, because that is half of the perimeter).

Questions to Pose:
Before:
When would you need to find perimeter in real life situations?
What does the word perimeter mean?

During:
Do you notice a pattern between the length and width of the rectangle? If so, what is it?
How do you know if the length and width are correct for your pen?

After:
What happens to the length when the width changes?
What happens to the width as the length changes? Which pen do you think will be the largest for the dog? How do you know?

Possible Misconceptions/Suggestions:

<table>
<thead>
<tr>
<th>Possible Misconceptions</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students confuse perimeter and area.</td>
<td>Continue to give students real-life examples of perimeter (e.g., fencing, baseboard of a room) and area (paint on a wall, space inside a room).</td>
</tr>
<tr>
<td>Students incorrectly calculate perimeter and area by leaving out or using the wrong dimensions.</td>
<td>Reinforce the idea that students’ equations and calculations need to match their mathematic</td>
</tr>
</tbody>
</table>

Special Notes:
This task can be done multiple times with different numbers. Students who struggle may benefit from using a perimeter of 8 or 12 or 16 initially. Advanced students can work with larger numbers if you wish. If the total perimeter is divisible by 4, then the shapes that can be made also include a square, which is the shape that will have the largest area.

Solutions:
For a perimeter of 24 feet possible dimensions and areas:
1 x 11= 11, 2 x 10= 20, 3 x 9= 27, 4 x 8= 32, 5 x 7= 35, 6 x 6= 36
Building a Pen for your Dog

My friend has a dog and she wants to build a pen for the dog to stay in while she is at work for the day. A friend of hers works at Lowes. He gave her 24 feet of free fencing.

What could her pen look like? Is there only one way to build the pen or does she have options?

Note: The dog pen has to be shaped like a rectangle (square).