North Carolina Department of Public Instruction
INSTRUCTIONAL SUPPORT TOOLS
FOR ACHIEVING NEW STANDARDS

5th Grade Mathematics ● Unpacked Contents
For the new Standard Course of Study that will be effective in all North Carolina schools in the 2017-18 School Year.

This document is designed to help North Carolina educators teach the 5th Grade Mathematics Standard Course of Study. NCDPI staff are continually updating and improving these tools to better serve teachers and districts.

What is the purpose of this document?
The purpose of this document is to increase student achievement by ensuring educators understand the expectations of the new standards. This document may also be used to facilitate discussion among teachers and curriculum staff and to encourage coherence in the sequence, pacing, and units of study for grade-level curricula. This document, along with on-going professional development, is one of many resources used to understand and teach the NC SCOS.

What is in the document?
This document includes a detailed clarification of each standard in the grade level along with a *sample* of questions or directions that may be used during the instructional sequence to determine whether students are meeting the learning objective outlined by the standard. These items are included to support classroom instruction and are not intended to reflect summative assessment items. The examples included may not fully address the scope of the standard. The document also includes a table of contents of the standards organized by domain with hyperlinks to assist in navigating the electronic version of this instructional support tool.

How do I send Feedback?
Link for: Feedback for NC's Math Unpacking Documents We will use your input to refine our unpacking of the standards. Thank You!

Just want the standards alone?
Link for: NC Mathematics Standards

North Carolina Course of Study – 5th Grade Standards

Standards for Mathematical Practice

Operations & Algebraic Thinking	Number & Operations in Base Ten	Number & Operations-Fractions	Measurement & Data	Geometry
Write and interpret numerical expressions. **NC.5.OA.2** *Analyze patterns and relationships.* **NC.5.OA.3**	*Understand the place value system.* **NC.5.NBT.1** **NC.5.NBT.3** *Perform operations with multi-digit whole numbers.* **NC.5.NBT.5** **NC.5.NBT.6** *Perform operations with decimals.* **NC.5.NBT.7**	*Use equivalent fractions as a strategy to add and subtract fractions.* **NC.5.NF.1** *Apply and extend previous understandings of multiplication and division to multiply and divide fractions.* **NC.5.NF.3** **NC.5.NF.4** **NC.5.NF.7**	*Convert like measurement units within a given measurement system.* **NC.5.MD.1** *Represent and interpret data.* **NC.5.MD.2** *Understand concepts of volume.* **NC.5.MD.4** **NC.5.MD.5**	*Understand the coordinate plane.* **NC.5.G.1** *Classify quadrilaterals.* **NC.5.G.3**

Standards for Mathematical Practice

Practice	Explanation and Example
1. Make sense of problems and persevere in solving them.	Mathematically proficient students in grade 5 should solve problems by applying their understanding of operations with whole numbers, decimals, and fractions including mixed numbers. They solve problems related to volume and measurement conversions. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, "What is the most efficient way to solve the problem?", "Does this make sense?", and "Can I solve the problem in a different way?".
2. Reason abstractly and quantitatively.	Mathematically proficient students in grade 5 should recognize that a number represents a specific quantity. They connect quantities to written symbols and create a logical representation of the problem at hand, considering both the appropriate units involved and the meaning of quantities. They extend this understanding from whole numbers to their work with fractions and decimals. Students write simple expressions that record calculations with numbers and represent or round numbers using place value concepts.
3. Construct viable arguments and critique the reasoning of others.	In fifth grade mathematical proficient students may construct arguments using concrete referents, such as objects, pictures, and drawings. They explain calculations based upon models and properties of operations and rules that generate patterns. They demonstrate and explain the relationship between volume and multiplication. They refine their mathematical communication skills as they participate in mathematical discussions involving questions like "How did you get that?" and "Why is that true?" They explain their thinking to others and respond to others' thinking.
4. Model with mathematics.	Mathematically proficient students in grade 5 experiment with representing problem situations in multiple ways including numbers, words (mathematical language), drawing pictures, using objects, making a chart, list, or graph, creating equations, etc. Students need opportunities to connect the different representations and explain the connections. They should be able to use all of these representations as needed. Fifth graders should evaluate their results in the context of the situation and whether the results make sense. They also evaluate the utility of models to determine which models are most useful and efficient to solve problems.
5. Use appropriate tools strategically.	Mathematically proficient fifth graders consider the available tools (including estimation) when solving a mathematical problem and decide when certain tools might be helpful. For instance, they may use unit cubes to fill a rectangular prism and then use a ruler to measure the dimensions. They use graph paper to accurately create graphs and solve problems or make predictions from real world data.
6. Attend to precision.	Mathematically proficient students in grade 5 continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to expressions, fractions, geometric figures, and coordinate grids. They are careful about specifying units of measure and state the meaning of the symbols they choose. For instance, when figuring out the volume of a rectangular prism they record their answers in cubic units.
7. Look for and make use of structure.	In fifth grade mathematically proficient students look closely to discover a pattern or structure. For instance, students use properties of operations as strategies to add, subtract, multiply and divide with whole numbers, fractions, and decimals. They examine numerical patterns and relate them to a rule or a graphical representation.
8. Look for and express regularity in repeated reasoning.	Mathematically proficient fifth graders use repeated reasoning to understand algorithms and make generalizations about patterns. Students connect place value and their prior work with operations to understand algorithms to fluently multiply multi-digit numbers and perform all operations with decimals to hundredths. Students explore operations with fractions with visual models and begin to formulate generalizations.

Return to Standards

Write and interpret numerical expressions.

NC.5.OA.2 Write, explain, and evaluate numerical expressions involving the four operations to solve up to two-step problems. Include expressions involving:

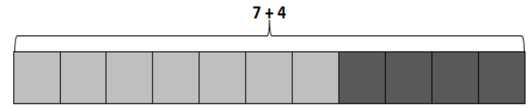
- Parentheses, using the order of operations.
- Commutative, associative and distributive properties.

Clarification

Students will need to be able to describe relationships in expressions, and they will also need to evaluate the expression. This standard calls for two things: describing the relationships between expressions or within expressions and evaluating expressions using order of operations and properties. Calculations are expected, however, there will only be two steps when solving a problem [ex. 5 + (3 x 2) and not (5 x 6) + (3 x 4)]. Expressions in this standard can include whole numbers, decimals, and fractions. Work with decimals and fractions is limited to the number sizes and specific denominators specified in other standards (NC.5.NBT.7, NC.5.NF.1, NC.5.NF.3, NC.5.NF.4, NC.5.NF.7)

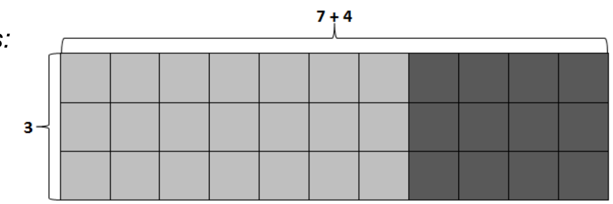
Checking for Understanding

Below is a picture that represents 7 + 4



- Draw a picture that represents 3 x (7 + 4)
- How many times bigger is the value of 3 x (7 + 4) than 7 + 4? Explain your reasoning.

Possible responses:



The value of 3 x (7 + 4) is three times the value of 7 + 4. We can see this in the picture since 3 x (7 + 4) is visually represented as 3 equal rows with 7 + 4 squares in each row.

In this type of picture, the student shows that the numbers 7 + 4 are represented by the number of objects, and the number of groups represents the multiplier.

Adapted from Illustrative Mathematics (www.illustrativemathematics.org)

Describe how the expression 5 x (10 x 10) relates to 10 x 10.

Possible response:

The expression 5(10 x 10) is 5 times larger than the expression 10 x 10 since I know that I that 5(10 x 10) means that I have 5 groups of (10 x 10).

Write and interpret numerical expressions.

NC.5.OA.2 Write, explain, and evaluate numerical expressions involving the four operations to solve up to two-step problems. Include expressions involving:

- Parentheses, using the order of operations.
- Commutative, associative and distributive properties.

Clarification	Checking for Understanding
	Sandy walked $\frac{3}{4}$ mile on Monday and $\frac{3}{4}$ mile on Tuesday. On Wednesday, she walked 3 times as much as Monday and Tuesday combined. Write an expression to show how many miles Sandy walked on Wednesday. *Possible response:* $3 \cdot \left(\frac{3}{4} + \frac{3}{4}\right)$ Serenity has $\frac{1}{4}$ of a pound of turkey and $\frac{1}{8}$ of a pound of ham on each sandwich. She has 4 sandwiches. Serenity can't decide which expression matches her situation: Explain which expression matches her situation and why. $4 \times \frac{1}{4} + \frac{1}{8}$ OR $4 \times (\frac{1}{4} + \frac{1}{8})$ *Possible response:* *The expression that matches is the second one with the parentheses. Each sandwich has turkey and ham, so I have 4 groups with* $\frac{1}{4} + \frac{1}{8}$ *in each group.* --- Nico solves both expressions. A: 1.5 x 0.16 - 0.09 B: 1.5 x (0.16 - 0.09) Which expression is greater? What is the difference in the value between the two expressions? *Possible response:* *Expression A has a value of 0.15. Expression B has a value of 0.105.* *Expression A is greater. The difference between the expressions is 0.045.*

Return to Standards

Analyze patterns and relationships.

NC.5.OA.3 Generate two numerical patterns using two given rules.

- Identify apparent relationships between corresponding terms.
- Form ordered pairs consisting of corresponding terms from the two patterns.
- Graph the ordered pairs on a coordinate plane.

Clarification

This standard extends the work from Fourth Grade, where students generate numerical patterns when they are given one rule. In Fifth Grade, students are given two rules and generate the terms in the resulting sequences. Students are also expected to interpret a real-world context with two patterns, create a table and analyze the relationships between those terms.

In terms of graphing, after determining the resulting sequences of patterns, students are expected to identify, record, and graph ordered pairs on a coordinate plane (first quadrant only). After graphing the ordered pairs for each rule, students can analyze the relationship between the results. This work intersects the expectations in NC.5.G.1.

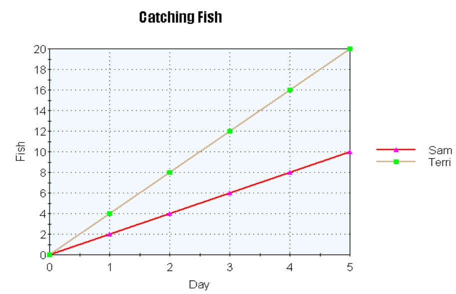
Checking for Understanding

Describe the pattern:
Since Terri catches 4 fish each day, and Sam catches 2 fish, the amount of Terri's fish is always greater. Terri's fish is also always twice as much as Sam's fish. Today, both Sam and Terri have no fish. They both go fishing each day. Sam catches 2 fish each day. Terri catches 4 fish each day. How many fish do they have after each of the five days? Make a graph of the number of fish. Plot the points on a coordinate plane and make a line graph, and then interpret the graph.

Make a chart (table) to represent the number of fish that Sam and Terri catch.

Possible response:

Days	**Sam's Total Number of Fish**	**Terri's Total Number of Fish**
0	0	0
1	2	4
2	4	8
3	6	12
4	8	16
5	10	20



My graph shows that Terri always has more fish than Sam. Terri's fish increases at a higher rate since she catches 4 fish every day. Sam only catches 2 fish every day, so his number of fish increases at a smaller rate than Terri.

Mary spends $20 a month buying magazines. Tammy spends $15 a month buying magazines. Mary spends $60 in 3 months. How long does it take Tammy to spend $60? Make a table to show the amount each woman spends on magazines. Plot the points on a coordinate plane and interpret the graph.

Possible response:

Mary	
Month	Amount
1	20
2	40
3	60

Tammy	
Month	Amount
1	15
2	30
3	45
4	60

Analyze patterns and relationships.
NC.5.OA.3 Generate two numerical patterns using two given rules.

- Identify apparent relationships between corresponding terms.
- Form ordered pairs consisting of corresponding terms from the two patterns.
- Graph the ordered pairs on a coordinate plane.

Clarification	Checking for Understanding

Checking for Understanding

Cora and Cecilia each use chalk to make their own number patterns on the sidewalk. They make each of their patterns 10 boxes long and line their patterns up so they are next to each other. Cora puts 0 in her first box and decides that she will add 3 every time to get the next number. Cecilia puts 0 in her first box and decides that she will add 9 every time to get the next number.

a. Complete each girl's sidewalk pattern.
b. How many times greater is Cecilia's number in the 5th box than Cora's number in the 5th box? What about the numbers in the 8th box? The 10th box?
c. What pattern do you notice in your answers for part b? Why do you think that pattern exists?
d. Write your data as ordered pairs and graph the points on a coordinate plane.
e. What pattern do you notice about your graph? Why do you think that pattern exists?

Cora:

0	3								

Cecilia:

0	9								

Possible Responses:

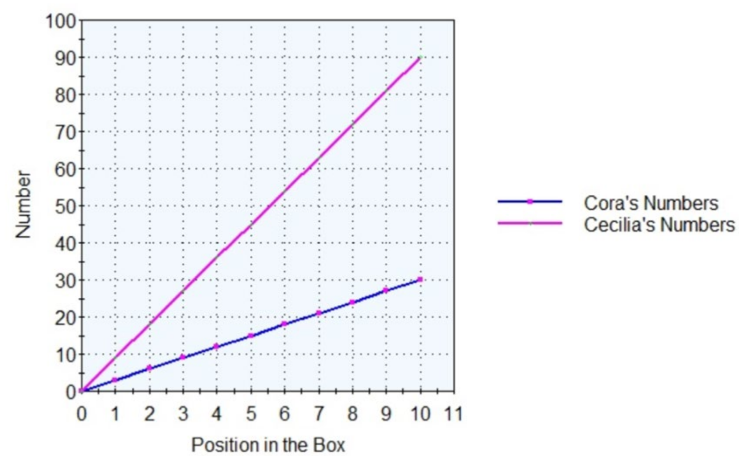
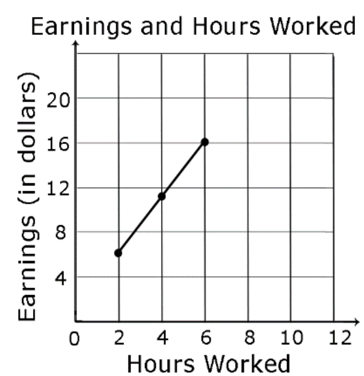
a. 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30
0, 9, 18, 27, 36, 45, 54, 63, 72, 81, 90

b. Cecilia's number in the 5th box is 36. Cora's number is 12. Since 12 x 3 = 36, Cecilia's number is 3 times greater than Cora's number. For the 8th box Cora's number is 24 and Cecilia's number is 72. Cecilia's number is still 3 times greater. For the 10th number Cora's number is 30 and Cecilia's number is 90. Cecilia's number is still three times greater than Cora's number.

c. Cecilia's number is always three times greater than Cora's number. They both started at 0 and Cecilia adds 9 each time while Cora adds 3 each time. Since 9 is 3 times greater than 3 and they start at the same point Cecilia's number will always be 3 times greater than Cora's number.

d. Cora- (1,3); (2,6); (3, 9); (4, 12); (5, 15); (6, 18); (7, 21); (8, 24); (9, 27), (10, 30)
Cecilia- (1, 9); (2, 18); (3, 27); (4, 36); (5, 45); (6, 54); (7, 63); (8, 72); (9, 81); (10, 90)

Analyze patterns and relationships.
NC.5.OA.3 Generate two numerical patterns using two given rules.
- Identify apparent relationships between corresponding terms.
- Form ordered pairs consisting of corresponding terms from the two patterns.
- Graph the ordered pairs on a coordinate plane.

Clarification	Checking for Understanding
	Cecilia's and Cora's Numbers  e. *In the graph the pattern that I notice is that the difference between Cecilia's and Cora's numbers continue to increase. Cecilia's numbers are always three times the value of Cora's numbers.* Use the graph below to determine how much money Jack makes after working exactly 9 hours. 

Analyze patterns and relationships. **NC.5.OA.3** Generate two numerical patterns using two given rules. • Identify apparent relationships between corresponding terms. • Form ordered pairs consisting of corresponding terms from the two patterns. • Graph the ordered pairs on a coordinate plane.	
Clarification	**Checking for Understanding**
	Marcello and Johan are both walking on the track. Marcello is 15 feet ahead of Johan. Marcello walks 5 feet per second and Johan walks 7 feet per second. Complete a table that shows their distance for the first 10 seconds that they walk. Will Johan ever be in front of Marcello? If so, how long will it take for Johan to get ahead of Marcello? *Possible response:*

Time	*Marcello*	*Johan*	*Distance*
0	*15*	*0*	*15*
1	*20*	*7*	*13*
2	*25*	*14*	*11*
3	*30*	*21*	*9*
4	*35*	*28*	*7*
5	*40*	*35*	*5*
6	*45*	*42*	*3*
7	*50*	*49*	*1*
8	*55*	*56*	*1*
9	*60*	*63*	*3*

Johan gets ahead of Marcello. Johan is ahead of Marcello after 8 seconds.

Return to Standards

Number and Operations in Base Ten

Understand the place value system.

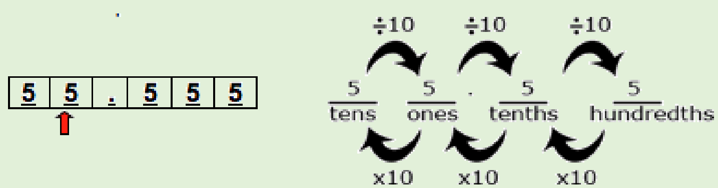
NC.5.NBT.1 Explain the patterns in the place value system from one million to the thousandths place.

- Explain that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and $\frac{1}{10}$ of what it represents in the place to its left.
- Explain patterns in products and quotients when numbers are multiplied by 1,000, 100, 10, 0.1, and 0.01 and/or divided by 10 and 100.

Clarification

In this standard, students extend their understanding of the base-ten system and the magnitude of digits in a number to the relationship between adjacent places. This standard also extends student understanding of the relationships of digits in whole numbers to the relationship of decimal fractions. Students should work with the idea that the tens place is ten times as much as the ones place, and the ones place is $\frac{1}{10}$ the size of the tens place.

For example: In the number 55.55, each digit is 5, but the value of the digits is different because of the placement. The 5 that the arrow points to is 1/10 of the 5 to the left and 10 times the 5 to the right. The 5 in the ones place is 1/10 of 50 and 10 times five tenths.



Students are also expected to apply the relationship between adjacent digits when looking at the relationship between digits that are non-adjacent.

For example: In the number 4.054, what is the difference in the magnitudes of the 4s?

The 4 in the ones place is three places to the left of the 4 in the thousandths place. Therefore, the difference in the value of the digits is 10 times greater for each of the three places, which the magnitude of the 4 in the ones place 10 x 10 x 10 or 1,000 times greater.

In this standard, digits may be compared to digits up to 3 places to the left (x1,000) or 2 places to the right (÷100 or x 0.01)

Checking for Understanding

Juanita and Aniyah were playing a game where they drew digits and placed them on a game board. Juanita built the number 426.7. Aniyah built the number 746.2.

- How much smaller is the 4 in Aniyah's number than the 4 in Juanita's number?
- How much bigger is the 7 in Aniyah's number than the 7 in Juanita's number?
- Write a sentence explaining how the size of the 2 in Aniyah's number compares to the size of the 2 in Juanita's number.

Possible Response:

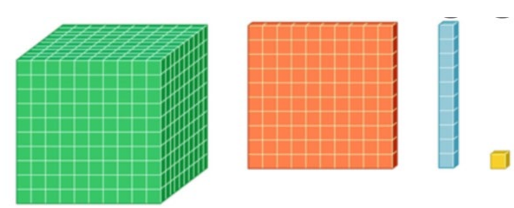
The 4 in Aniyah's number is in the tens place so it has a value of 40. The 4 in Juanita's number is in the hundreds place so it has a value of 100. Since the tens place is 1 place to the right of the hundreds places the value of the 4 in Aniyah's number is one-tenth the value of the 4 in Juanita's number.

In class Veronica told her teacher that when you multiply 138 and 2.67 by 10, you just always add 0 to the end of the number. Think about her statement (conjecture), then answer the following questions.

- For both numbers, does Veronica's statement (conjecture) work?
- When doesn't Veronica's statement (conjecture) work? Is it also true for division? When you divide a number by 10, can you just remove a 0 from the end of the number? Try it with 5.289 and 52,890.
- When does that work? When doesn't that work?

Maria's teacher gives Maria a set of place value blocks and tells her that the rod now has a value of 0.01. Her teacher asks her to find the value of:
a small cube?
a flat square?
a large cube?

Explain your reasoning.



Understand the place value system. **NC.5.NBT.1** Explain the patterns in the place value system from one million to the thousandths place. • Explain that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and $\frac{1}{10}$ of what it represents in the place to its left. • Explain patterns in products and quotients when numbers are multiplied by 1,000, 100, 10, 0.1, and 0.01 and/or divided by 10 and 100.	
Clarification	**Checking for Understanding**
	Possible response: *The small cube is $\frac{1}{10}$ the size of rod so it has a value of 0.01 x 0.1 so 1 cube has a value of 0.001.* *The flat square is 10 times larger than the rod so it has a value of 0.01 x 10 so 1 flat square has a value of 0.1* *The cube is 10 times larger than the flat square which is 10 x 10 larger than the rod. So, the cube has a value of 10 x 10 x 0.01 which is 1.*

Return to Standards

Understand the place value system.
NC.5.NBT.3 Read, write, and compare decimals to thousandths.

- Write decimals using base-ten numerals, number names, and expanded form.
- Compare two decimals to thousandths based on the value of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Clarification

In this standard, students build on their previous understandings of reading and writing whole numbers in various forms to reading, writing, and comparing decimals to the thousandths place.

Written form or number name refers to writing out a number in words like "two thousand, eight hundred fifty-six." Traditional expanded form is 2,856 = 2,000 + 800 + 50 + 6. However, students should explore the idea that 2856 could also be 28 hundreds + 5 tens + 6 ones or 1 thousand + 18 hundreds + 56 ones. They should also show understanding by expanding a number by place value such as (2 x 1,000) + (8 x 100) + (5 x 10) + (6 x 1).

Students read decimals using fractional language and write decimals in fractional form, as well as in expanded notation. The number 361.248 would be read three hundred sixty-one and two hundred forty-eight thousandths. In expanded form this number would be written 300 + 60 + 1 + 0.2 + 0.04 + 0.008.

Just as with whole numbers, students should be comfortable with various forms of numbers and with expanding numbers by place value such as (3 x 100) + (6 x 10) + (1 x 1) + (2 x 0.1) + (4 x 0.01) + (8 x 0.001). Students are expected to use decimal as well as fraction notation for tenths, hundredths, and thousandths.

Also, in this standard, students use their understanding of the value of digits to compare two numbers by examining the value of each digit. Building on their understanding of comparing whole numbers, students would compare tenths to tenths, hundredths to hundredths, and thousandths to thousandths.

Students are expected to be able to compare numbers presented in various forms. This standard focuses on comparing numbers and using reasoning about place value to support the use of the symbols <, >, =.

Checking for Understanding

Mike's teacher asked him to write 987.654 using expanded notation. Mike wrote 900 + 80 + 7 + 0.6 + 0.50 + 0.400

What is Mike's misconception? How would you explain expanded notation to help Mike understand expanded notation?

The table below shows the results of the Men's 100 Meter Freestyle Final at the London 2012 Olympics.

Country	Time (in seconds)
Australia	47.5
Brazil	47.92
Canada	47.8
Cuba	48.04
France	47.48
Netherlands	47.88
Russia	48.44
United States	47.52

Put the countries in order from first to last place.

Using the times above, write 3 expressions comparing the various times. Use symbols for greater than or less than in your expressions. Write a sentence to go with each expression.

Mackenzie said that Russia won the gold medal. Is she correct? Why or why not? Vikas said that Australia won the gold medal. Is she correct? Why or why not?

Possible responses:

McKenzie's misconception is that the greatest number means the fastest time. However, in the case of a race the smallest number means the fastest time.

Vikas' misconception is that 47.5 is smaller than 47.48. Since the tens and ones place are the same looking at the tenths place indicates that 47.48 is smaller than 47.5. France won the gold medal.

Understand the place value system. **NC.5.NBT.3** Read, write, and compare decimals to thousandths. • Write decimals using base-ten numerals, number names, and expanded form. • Compare two decimals to thousandths based on the value of the digits in each place, using >, =, and < symbols to record the results of comparisons.	
Clarification	**Checking for Understanding**
	Cassandra measured the weight of her full backpack in kilograms. Her backpack weighed 5.622 kilograms. Her friends Henry, Stella, Giovanni, and Charlotte weighed their backpacks. Henry's backpack was 5.631 kilograms. Stella's backpack was 5.289 kilograms. Giovanni's backpack was 5.607 kilograms. Charlotte's backpack was 5.7 kilograms. Tell which backpacks were heavier and which backpacks were lighter than Cassandra's. Use numbers and symbols to show each comparison. *Responses:* *Heavier: Charlotte (5.7), Henry (5.631)* *Lighter: Stella (5.621), Giovanni (5.607)*

Return to Standards

Perform operations with multi-digit whole numbers.
NC.5.NBT.5 Demonstrate fluency with the multiplication of two whole numbers up to a three-digit number by a two-digit number using the standard algorithm.

Clarification

In this standard, students connect the foundational, conceptual work for multiplication from third and fourth grade to an efficient algorithm, including but not limited to the US standard algorithm. In third grade, students explored the meaning of whole number multiplication. In fourth grade, students built on that understanding by multiplying three-digit factors times a one-digit factor and multiplying two two-digit factors. To develop understanding of multiplication, students used a variety of strategies, including area models, partial products, and the properties of operations. The area model helps students visualize the components of the product and connect partial products to an efficient algorithm.

The U.S. standard algorithm is the end of a progression of other strategies and students should not be forced into the algorithm (or any specific algorithm) without extensive opportunities to work with the other strategies. "In mathematics, an algorithm is defined by its steps and not by the way those steps are recorded in writing. With this in mind, minor variations in methods of recording standard algorithms are acceptable." (Fuson & Beckmann, 2013).

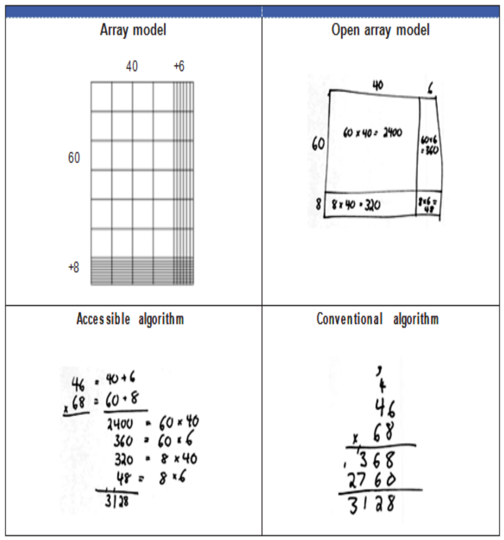


Fig. 18. Methods for multi-digit multiplication, using 68 × 46. Adapted from Fuson (2003, p. 303).

Students are fluent when they display accuracy, efficiency, and flexibility. Students develop fluency by understanding and internalizing the relationships that exist between and among numbers. By studying patterns and number relationships, students can internalize strategies for efficiently solving problems.

Checking for Understanding

There are 225 dozen cookies in the bakery. How many cookies are there?

Possible responses:

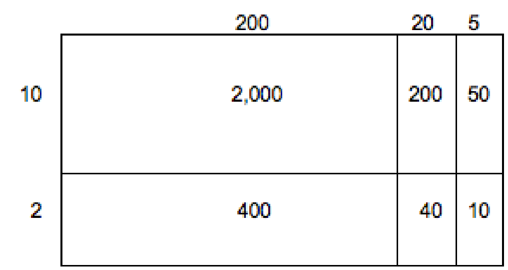
Student A
225 x 12
I broke 12 up into 10 and 2.
225 x 10 = 2,250
225 x 2 = 450
2,250 + 450 = 2,700

Student B
225x12
I broke up 225 into 200 and 25.
200 x 12 = 2,400
I broke 25 up into 5 x 5, so I had 5 x 5 x12 or 5 x 12 x 5.
5 x12= 60. 60 x 5 = 300
I then added 2,400 and 300
2,400 + 300 = 2,700.

Student C
I doubled 225 and cut 12 in half to get 450 x 6.
I then doubled 450 again and cut 6 in half to get 900 x 3.
900 x 3 = 2,700.

Draw an array model for 225 x 12. Explain how this model connects to the standard algorithm.

Possible responses:



2,000
400
200
40
50
+ 10
2,700

```
      1
    2 2 5
  x   1 2
    4 5 0
+ 2 2 5 0
  2 7 0 0
```

In the U.S. standard algorithm I see 450 which is the sum of the 3 numbers in the bottom row of the array model (400 + 40 + 10 = 450). I see 2,250 which is the sum of the 3 numbers in the top row of the array model (2,000 + 200 + 50 = 2,250).

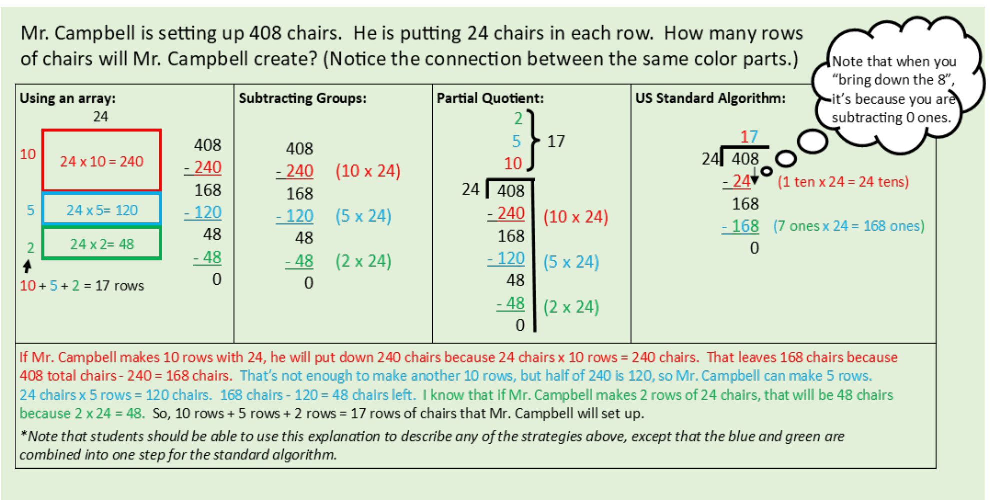
Return to Standards

Perform operations with multi-digit whole numbers.
NC.5.NBT.6 Find quotients with remainders when dividing whole numbers with up to four-digit dividends and two-digit divisors using rectangular arrays, area models, repeated subtraction, partial quotients, and/or the relationship between multiplication and division. Use models to make connections and develop the algorithm.

Clarification

In this standard, students extend their work with dividing a four-digit number by a one-digit number from fourth grade to dividing a four-digit number by a two-digit number. In grades 3 and 4, students built an understanding of the meaning of division through partitive (partition) and measurement (repeated subtraction) contexts. Students build deeper understanding of division through the use of various strategies as well as making connections between the relationship of multiplication and division. Experience with using arrays, area models, repeated subtraction, and partial quotients will help students connect to an efficient algorithm in subsequent grades. This standard also references remainders.

The focus of this standard is to build conceptual understanding of division with larger numbers. Students are expected to use various strategies and explain their thinking. Although the US standard algorithm for division may be introduced, students are not expected to master this algorithm until middle school. The U.S. standard algorithm is the end of a progression of other strategies and students should not be forced into the algorithm (or any specific algorithm) without extensive opportunities to work with the other strategies. “In mathematics, an algorithm is defined by its steps and not by the way those steps are recorded in writing. With this in mind, minor variations in methods of recording standard algorithms are acceptable.” (Fuson & Beckmann, 2013).



(Continued on the next page)

Checking for Understanding

There are 1,716 students participating in Field Day. They are put into teams of 16 for the competition. How many teams get created? If you have left over students, what do you do with them?

Possible responses:

Student A
1,716 divided by 16
There are 100 16s in 1,716.
1,716 – 1,600 = 116
I know there are at least 6 16s.
116 - 96 = 20
I can take out at least 1 more 16.
20 - 16 = 4
There were 107 teams with 4 students left over. If we put the extra students on different team, 4 teams will have 17 students.

Student B
1,716 divided by 16.
There are 100 16’s in 1,716.
Ten groups of 16 is 160. That’s too big.
Half of that is 80, which is 5 groups.
I know that 2 groups of 16’s is 32.
I have 4 students left over.

1716 -1600	100
116 -80	5
36 -32	2
4	

Student C
1,716 ÷ 16 =
I want to get to 1,716
I know that 100 16’s equals 1,600
I know that 5 16’s equals 80
1,600 + 80 = 1,680
Two more groups of 16’s equals 32, which gets us to 1,712
I am 4 away from 1,716
So we had 100 + 5 + 2 = 107 teams.
Those other 4 students can just hang out.

Student D
How many 16’s are in 1,716?
We have an area of 1,716. I know that one side of my array is 16 units long. I used 16 as the height. I am trying to answer the question what is the width of my rectangle if the area is 1,716 and the height is 16. 100 + 7 = 107 R 4

	100	7
16	100 x 16 = 1,600	7 x 16 =112
	1,716 - 1,600 = 116	116 - 112 = 4

Perform operations with multi-digit whole numbers.
NC.5.NBT.6 Find quotients with remainders when dividing whole numbers with up to four-digit dividends and two-digit divisors using rectangular arrays, area models, repeated subtraction, partial quotients, and/or the relationship between multiplication and division. Use models to make connections and develop the algorithm.

Clarification

This standard builds from work in Fourth Grade (NC.4.OA.3), where students are required to solve division tasks and interpret remainders. All problems involving remainders should be in a real-world context that influences how the remainder should be interpreted.

In both Grades 4 and 5 here are ways that students are expected to interpret remainders:

There are 19 pens that need to be shared between 3 friends and myself (19 ÷ 4)		
Give quotient and remainder If we leave the leftover pens on the table how many pens does each person get? *(4)* How many pens are left on the table? *(3)*	***Put remainder in 1 group*** If we give all of the leftovers to only 1 person how many pens will people receive? *3 people receive 4 pens* *1 person receives 7 pens.*	***Share remainder among groups*** If we give the leftovers to different people until we run out how many pens will people receive? *3 people receive 5 pens* *1 person receives 4 pens*
There are 130 children going on the field trip. Twenty-four children can fit on a bus.		
Adding 1 to the quotient How many busses are needed in order to take all of the children? *(6)*	***Give quotient and remainder*** How many of the busses have 24 children? (5) How many children are on the bus that does not have 24 children? (10)	

Checking for Understanding

The pencil packaging factor has 2,106 that are put into 78 boxes. If the same number of pencils is in each box how many boxes does she see?

a. Solve the task using an array.
b. Solve the task using Partial Quotients.
c. Solve the task using the US Standard Algorithm.
d. What similarities do you see between the strategies?

Array

	78
20	78 x 20 = 1,560
5	78 x 5 = 390
2	78 x 2 = 156

```
  2,106
- 1,560
    546
   -390
    156
   -156
      0
```

Getting Started
1 x 78 = 78
2 x 78 = 156
5 x 78 = 390
10 x 78 = 780

Partial Quotients

```
         2
         5
        20
78 | 2,106
    -1,560   | 78 x 20
       546
      -390   | 78 x 5
        56
       -56   | 78 x 2
         0
```

Standard Algorithm

```
        27
78 | 2,106
    -1,560   subtract 20 groups of 78
       546
      -390
        56   subtract 7 groups of 78
       -56
         0
```

I notice that I can subtract 20 groups of 78 first. Then I can subtract 5 groups of 78 followed by 2 more groups of 78. I could also just subtract 7 groups of 78.

Return to Standards

Perform Operations with decimals.
NC.5.NBT.7 Compute and solve real-world problems with multi-digit whole numbers and decimal numbers.

- Add and subtract decimals to thousandths using models, drawings or strategies based on place value.
- Multiply decimals with a product to thousandths using models, drawings, or strategies based on place value.
- Divide a whole number by a decimal and divide a decimal by a whole number, using repeated subtraction or area models. Decimals should be limited to hundredths.
- Use estimation strategies to assess reasonableness of answers.

Clarification

This standard extends students' previous experiences with adding and subtracting whole numbers and their understanding of place value with decimals. In this standard, students use various strategies to compute problems in context with the four operations.

Operation	Number limits
Addition	6 digits Numbers to the thousandths place
Subtraction	6 digits Numbers to the thousandths place
Multiplication	3-digit number multiplied by a 2-digit number All numbers can be through the thousandths place
Division	4-digit number divided by a 2-digit number Quotients limited to the hundredths place.

This standard includes expectations that students utilize models, drawings, and strategies based on place value as approaches to solving problems. This standard focuses on student understanding of the use of place value when computing rather than learning rules about moving the decimal point with little connection to place value and the meaning of the operations. Students are expected to independently create and use models, drawings, place value strategies, and other strategies used previously with whole number operations (see NC.5.NBT.5 and NC.5.NBT.6) other than the US standard algorithm to solve problems with decimals

This standard also requires students to use estimation strategies to determine if an answer is reasonable. See examples on the next page.

Checking for Understanding

Addition

A recipe for a cake requires 1.25 cups of milk, 0.40 cups of oil, and 0.75 cups of water. How much liquid is in the mixing bowl?

Possible responses: 1.25 + 0.40 + 0.75

Student A

- *I broke 1.25 into 1.00 + 0.20 + 0.05*
- *I left 0.40 like it was.*
- *I broke 0.75 into 0.70 + 0.05*
- *I combined my two 0.05s to get 0.10.*
- *I combined 0.20, 0.10, and 0.70 to get 1.0.*
- *I added the 1 whole from 1.25.*
- *I ended up with 2 whole and 4 tenths, which equals 2.40 cups.*

Student B

- *I saw that the 0.25 in 1.25 and the 0.75 for water would combine to equal 1 whole.*
- *I then added the 2 wholes and the 0.40 to get 2.40.*

Addition and Subtraction

An orange, an apple, and a banana are all in the grocery basket. The apple weighs 129.875 grams. The banana weighs 98.067 grams. The entire basket weighs 334.012 grams.
Estimate to the nearest gram the weight of the orange.
Find the weight of the orange.

Possible Response:

Estimate: 130 + 98 + Orange = 334
228 + Orange = 334
334 - 228 = Orange = 106

Actual weight: 129.875 + 98.067 + Orange = 334.012

First, I will solve: 129.875 + 98.067 using expanded form.

100 + 20 + 9 + 0.8 + 0.07 + 0.005
+90 + 8 + 0.0 + 0.06 + 0.007
100+110 + 17+0.8 + 0.13 + 0.012 = 227.942

Perform Operations with decimals.
NC.5.NBT.7 Compute and solve real-world problems with multi-digit whole numbers and decimal numbers.

- Add and subtract decimals to thousandths using models, drawings or strategies based on place value.
- Multiply decimals with a product to thousandths using models, drawings, or strategies based on place value.
- Divide a whole number by a decimal and divide a decimal by a whole number, using repeated subtraction or area models. Decimals should be limited to hundredths.
- Use estimation strategies to assess reasonableness of answers.

Clarification

Estimation examples:

- When adding 3.6 + 1.7, a student might estimate the sum to be larger than 5 because 3.6 is more than 3 ½ and 1.7 is more than 1 ½.
- When subtracting 5.4 – 0.8, student might estimate the answer to be a little more than 4.4 because a number less than 1 is being subtracted.
- When multiplying 6 x 2.4, a student might estimate an answer between 12 and 18 since 6 x 2 is 12 and 6 x 3 is 18. Another student might give an estimate of a little less than 15 because s/he figures the answer to be very close, but smaller than 6 x 2 ½ and thinks of 2 ½ groups of 6 as 12 (2 groups of 6) + 3 (½ of a group of 6).

Checking for Understanding

Possible response (continued):

Orange = 334.012 - 227.942. I will use expanded form.

13 0.9
20 ~~14~~ ~~1.0~~ 0.11
300 + ~~30~~ + 4 + ~~0.0~~ + ~~0.01~~ + 0.002
-(200 + 20 + 7 + 0.9 + 0.04 + 0.002)
100 + 0 + 6 + 0 + 0.07 + 0 = 106.070

Addition and Subtraction

At the North Carolina Zoo there is a bucket that contains food for the gorillas and the grizzly bears. The gorilla food weighs 5.384 kg. The gorilla food weighs 0.796 kg more than the grizzly bear food. How much food for both gorillas and grizzly bears are in the bucket?

Possible Responses:

Gorilla food = 5.384 kg
Grizzly food = 5.384 - 0.796, which is also 0.796 + ___ = 5.384
I am going to add up from 0.796 until I reach 5.384.

*0.796 + **0.004** = 0.80*
*0.80 + **0.20** = 1*
*1+ **4** = 5*
*5 + **0.384** = 5.384*
Answer = 0.004 + 0.2 + 4 + 0.384 = 4.588 kg
Total = 5.384 + 4.588

I am going to start with 5.384 and add the 4.588 one place at a time.
5.384 + 4 + 0.5 + 0.08 + 0.008
5.384 + 4 = 9.384
9.384 + 0.5 = 9.884
9.884 + 0.08 = 9.964
9.964 + 0.008 = 9.972 kg

Perform Operations with decimals.

NC.5.NBT.7 Compute and solve real-world problems with multi-digit whole numbers and decimal numbers.

- Add and subtract decimals to thousandths using models, drawings or strategies based on place value.
- Multiply decimals with a product to thousandths using models, drawings, or strategies based on place value.
- Divide a whole number by a decimal and divide a decimal by a whole number, using repeated subtraction or area models. Decimals should be limited to hundredths.
- Use estimation strategies to assess reasonableness of answers.

Clarification

Checking for Understanding

<u>Multiplication</u>

You live 14 hundredths of a mile from your friends' house. After walking 3 tenths of the distance, you stop to talk to another friend. How much of a mile have you walked? (0.3 x .14)

Possible responses:

<u>Using the Area Model</u>

	0.1	*0.04*
0.3	*0.3 x 0.1 = 0.03*	*0.3 x 0.04 = 0.012*

0.03
+ <u>0.012</u>
0.042

<u>Using Reasoning about the Decimal Point</u>

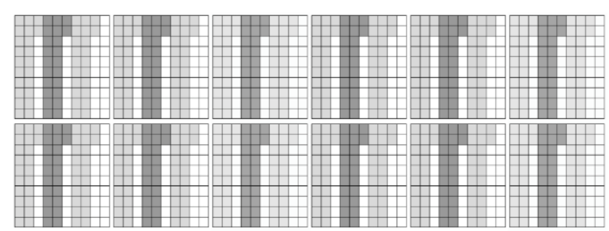
0.3 x 0.14 = ___
3 x 14 = 42
Since we multiplied 0.3 by a number that is close to 0.1 the answer will be close to 0.03.
Therefore, it makes sense that the answer is 0.042.

<u>Multiplication</u>

A gumball costs $0.22. How much do 12 gumballs cost? Estimate the total, and then calculate. Was your estimate close?

Possible response:

I estimate that the answer will be close to the product of 0.20 x 10 which is 2.
I used decimal grids and shaded in 12 groups that are 0.22 each.



I counted 24 tenths which has a value of 2.4 and 24 hundredths which has a value of 0.24. That makes a combined value of 2.64 so 0.22 x 12 = 2.64.

Perform Operations with decimals.
NC.5.NBT.7 Compute and solve real-world problems with multi-digit whole numbers and decimal numbers.

- Add and subtract decimals to thousandths using models, drawings or strategies based on place value.
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- Divide a whole number by a decimal and divide a decimal by a whole number, using repeated subtraction or area models. Decimals should be limited to hundredths.
- Use estimation strategies to assess reasonableness of answers.

Clarification

Checking for Understanding

Multiplication and Subtraction

Trinity buys containers of water for a science project. Each container holds 2.75 Liters. After using some containers for a science project, she has 3.5 containers left. If Trinity started with 12 containers how much water has she used?

Possible responses:

If Trinity started with 12 containers and has 3.5 left, we can find how many containers she used by subtracting 3.5 from 12. 12 - 3.5 = 8.5

Each container holds 2.75 Liters so the amount of water she used is 2.75 x 8.5

Area Model

	8	0.5
2	8 x 2 = 16	2 x 0.5 = 1
0.7	8 x 0.7 = 5.6	0.7 x 0.5 = 0.35
0.05	8 x 0.05 = 0.40	0.5 x 0.05 = 0.025

```
   16
  5.6
  1
  0.4
  0.35
+0.025
23.375
```

Partial Quotients

```
       2 . 7  5
       x  8 . 5
          2  5
       3  5  0
    1  0  0  0
       4  0  0
    5  6  0  0
 +1 6  0  0  0
 2  3  3  7  5
```

My estimate is that my product is close to the product of 3 times 9 so my answer is close to 27. So the decimal goes after the first 3 so my answer is 23.375.

Perform Operations with decimals.
NC.5.NBT.7 Compute and solve real-world problems with multi-digit whole numbers and decimal numbers.

- Add and subtract decimals to thousandths using models, drawings or strategies based on place value.
- Multiply decimals with a product to thousandths using models, drawings, or strategies based on place value.
- Divide a whole number by a decimal and divide a decimal by a whole number, using repeated subtraction or area models. Decimals should be limited to hundredths.
- Use estimation strategies to assess reasonableness of answers.

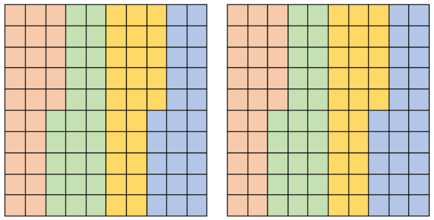
Clarification	Checking for Understanding

Clarification

Checking for Understanding

<u>Division: "how many groups" interpretation</u>
Sarah makes 2 pounds of trail mix. How many bags will she need if she puts 0.25 pounds of mix in each bag?

Possible response:



The equation for this context is 2 ÷ 0.25 = __.

I showed the two pounds of mix using decimal squares. Then, I colored in 25 squares to represent 25 hundredths. I continued to do that until all of the squares had been colored. Since 2 pounds ÷ 0.25 pound = 8 bags, Sarah will need 8 bags for her trail mix.

Division and Subtraction
A pack of water contains 16 bottles of water. The pack regularly costs $15.06 but is on sale. The sales price is $2.58 lower than the regular price. What is the price per bottle of the sales price?

Possible Response:
First, I need to find the sales price for the pack of water.
$15.06 - $2.58.

0.9
4 ~~1~~ 0.16
10 + ~~5~~ + ~~0.0~~ + ~~0.06~~
<u>- (2 + 0.5 + 0.08)</u>
10 + 2 + 0.4 + 0.08 = 12.48

Perform Operations with decimals.

NC.5.NBT.7 Compute and solve real-world problems with multi-digit whole numbers and decimal numbers.

- Add and subtract decimals to thousandths using models, drawings or strategies based on place value.
- Multiply decimals with a product to thousandths using models, drawings, or strategies based on place value.
- Divide a whole number by a decimal and divide a decimal by a whole number, using repeated subtraction or area models. Decimals should be limited to hundredths.
- Use estimation strategies to assess reasonableness of answers.

Clarification	Checking for Understanding
	The sales price of the pack is \$12.48 so the cost per bottle is \$12.48÷16 = __ *Answer:* *0.5 + 0.2 + 0.08 = 0.78* *0. 08* *0. 2* *0. 5* *16 ⟌ \$1 2. 4 8* *- 8. 0 0* *16 x 0.5 = 8* *4. 4 8* *- 3. 2 0* *16 x 0.2 = 3.2* *1. 2 8* *-1. 2 8* *16 x 0.08 = 1.28* *0*

Return to Standards

Use equivalent fractions as a strategy to add and subtract fractions.

NC.5.NF.1 Add and subtract fractions, including mixed numbers, with unlike denominators using related fractions: halves, fourths and eighths; thirds, sixths, and twelfths; fifths, tenths, and hundredths.

- Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers.
- Solve one-and two-step word problems in context using area and length models to develop the algorithm. Represent the word problem in an equation.

Clarification

While working on NC.5.NF.1 students should be able to estimate and find the answer to one- and two- step word problems involving fractions with unlike denominators using related fractions. Adding and subtracting only related fractions is new to 5th grade. Related fractions are fractions in which one denominator is a multiple of the other, e.g., halves, fourths, and eighths.

Students should be able to assess the reasonableness of answers by estimating sums and differences to the nearest half or whole number.

Students should have ample experiences creating area and length models to build understanding. The use of these models allows students to use reasonableness to find a common denominator prior to using the algorithm. For example, when adding $\frac{1}{3}+\frac{1}{6}$, Grade 5 students should apply their understanding of equivalent fractions and their ability to rewrite fractions in an equivalent form to find common denominators.

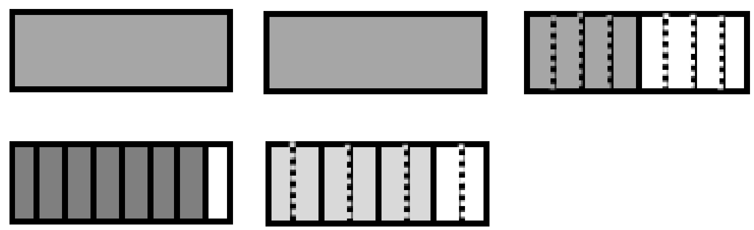
Checking for Understanding

There is some ham in the refrigerator. Tyrisha uses $\frac{3}{4}$ of a pound to make sandwiches and Jacquel uses $\frac{7}{8}$ of a pound to make sandwiches. If there is now $2\frac{1}{2}$ pounds of ham left over, how much ham was there before Tyrisha and Jacquel used some.

Possible responses:

Student 1:

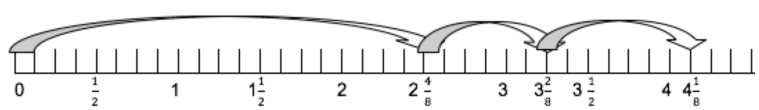
We do not know what we started with, but we know we ended with $2\frac{1}{2}$ pounds of ham. Before Jacquel took ham, there was $\frac{7}{8}$ of a pound more ham. Before Tyrisha took ham, there was $\frac{3}{4}$ more. I need to solve $2\frac{1}{2}+\frac{7}{8}+\frac{3}{4}$. I knew that since $\frac{7}{8}$ and $\frac{3}{4}$ were greater than a half but less than 1, that my total would be close to but less than 4 and $\frac{1}{2}$.



I represented the halves as eighths by partitioning each half into 4 parts making eighths. So $\frac{1}{2}$ is the same as 4/8. The $\frac{7}{8}$ was already eighths. I partitioned each fourth into 2 parts to make eighths, so the $\frac{3}{4}$ was $\frac{6}{8}$. Then I combined the $\frac{4}{8}$, $\frac{7}{8}$, and $\frac{6}{8}$.

Student 2:

I know that $2\frac{1}{2}$ is the same as 2 and $\frac{4}{8}$. I also know that $\frac{3}{4}$ is $\frac{6}{8}$. So, I used the expression: $2\frac{4}{8}+\frac{6}{8}+\frac{7}{8}$. I used the number line to jump from zero.



Return to Standards

Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

NC.5.NF.3 Use fractions to model and solve division problems.

- Interpret a fraction as an equal sharing context, where a quantity is divided into equal parts.
- Model and interpret a fraction as the division of the numerator by the denominator.
- Solve one-step word problems involving division of whole numbers leading to answers in the form of fractions and mixed numbers, with denominators of 2, 3, 4, 5, 6, 8, 10, and 12, using area, length, and set models or equations.

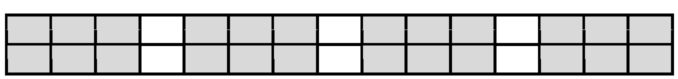
Clarification

While working on NC.5.NF.3, students are expected to associate fractions with division, understanding that $5 \div 3$ can be written and expressed as $\frac{5}{3}$.

In this standard, students make explicit connections between a fraction and an equal sharing (division) context. Students are expected to be able to represent these real-world contexts using area, length, and set models with the denominators specified in the standard.

Answers/ Quotients to these division contexts can be in the form of fractions less than 1, whole numbers, or mixed numbers. Students are expected to apply their understanding of equivalent fractions (NC.3.NF.3, NC.4.NF.1) while working with this standard.

Strategies for solving equal sharing tasks (Empson & Levi, 2011):

Four bags of crackers are being shared between myself and 5 friends.	
Non-anticipatory sharing	Child does not anticipate or estimate how much each person will get. Here they decided to give everyone a half. They may or may not share the final bag. 
Additive Coordination *Sharing one item at a time*	Child shows each bag and shares each bag by the number of people. In this case each bag will be split into sixths. 

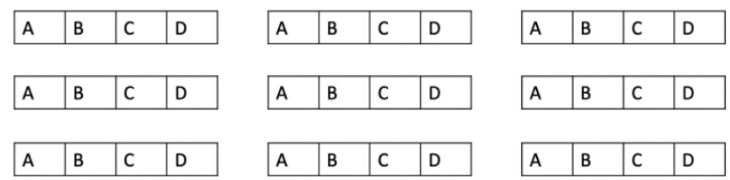
Checking for Understanding

If 4 people want to share a 9-foot piece of ribbon equally, how many feet of ribbon should each person get?

Possible responses (also see strategies in the Clarification):

Student A:

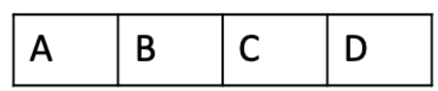
Each person is a group, so I partitioned each foot into fourths. I then counted.



Based on my picture each person will get 9 sections and each section is $\frac{1}{4}$, *so each person will get* $\frac{9}{4}$ which can be renamed as $2\frac{1}{4}$.

Student B:
I am trying to figure out how many 4s are in 9.
I skip counted by 4s up to 9.
4, 8. That is 2 groups of 4 and I have 1 leftover since 8 is 1 away from 9.
This means each person will get 2 feet of ribbon.
8 is 1 away from 9 so there is 1 left that needs to be partitioned between the 4 people.

Student C:
I am splitting 8 feet of ribbon into 4 groups. Each person will get 2 whole feet of ribbon. I have 1 foot of ribbon left that I will share between 4 people.



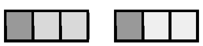
Each person will get $\frac{1}{4}$ *of a whole as well as their original 2 feet. Each person will 2* $\frac{1}{4}$ *feet of a ribbon.*

Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

NC.5.NF.3 Use fractions to model and solve division problems.

- Interpret a fraction as an equal sharing context, where a quantity is divided into equal parts.
- Model and interpret a fraction as the division of the numerator by the denominator.
- Solve one-step word problems involving division of whole numbers leading to answers in the form of fractions and mixed numbers, with denominators of 2, 3, 4, 5, 6, 8, 10, and 12, using area, length, and set models or equations.

Clarification

Additive Coordination Sharing groups of items	Student represents each bag. They see that 2 bags split into thirds gets 6 pieces. Therefore each person will get 2 pieces and each piece is $\frac{1}{3}$ so each student receives $\frac{2}{3}$ of a bag. [A | B | C] [D | E | F] [A | B | C] [D | E | F]
Ratio	Student may or may not draw the whole model. They use knowledge from repeated halving to look at smaller numbers. In our example they may know that 4 things shared between 6 people is equivalent to 2 things being shared between 3 people. They then realize that each person will get $\frac{2}{3}$ of a bag of chips. 
Multiplicative Coordination	Student does not need to draw a model. They can independently explain that the numerator is the number of things being shared and the denominator is the number of people or groups that the things are being divided into (e.g., 4 bags shared between 6 people means each person will receive 46 of a bag.

Checking for Understanding

There are 7 packages of crackers on the counter. If Nina divides them equally between herself and 3 friends, how many packages does each person get?

Possible responses:

Student A:

There are 7 packages that are being equally shared among 4 people. I can write that as 7 divided by 4.

[a | b | c | d] [a | b | c | d] [a | b | c | d] [a | b | c | d]

[a | b | c | d] [a | b | c | d] [a | b | c | d]

Each person gets 7 fourths, which can be represented as 7 x $\frac{1}{4} = \frac{7}{4}$.

Student B:

First, I gave each person 1 whole package.

[A] [B] [C] [D]

With the 3 remaining packages, I gave each person $\frac{1}{2}$ *of a package. With the last package, each person received* $\frac{1}{4}$. *Each person got* $1 + \frac{1}{2} + \frac{1}{4}$ *or* $1\frac{3}{4}$ *packages.*

[A | A | B | B] [C | C | D | D] [A | B | C | D]

Student C:

I am sharing 7 packs between 4 people. Each person will get $\frac{7}{4}$, *which can get renamed as* $1\frac{3}{4}$.

Return to Standards

Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

NC.5.NF.4 Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction, including mixed numbers.

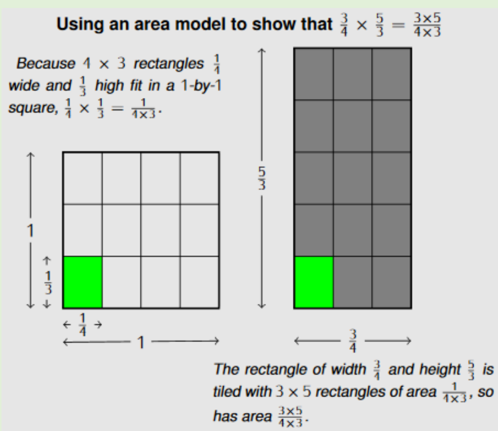
- Use area and length models to multiply two fractions, with the denominators 2, 3, 4.
- Explain why multiplying a given number by a fraction greater than 1 results in a product greater than the given number and when multiplying a given number by a fraction less than 1 results in a product smaller than the given number.
- Solve one-step word problems involving multiplication of fractions using models to develop the algorithm.

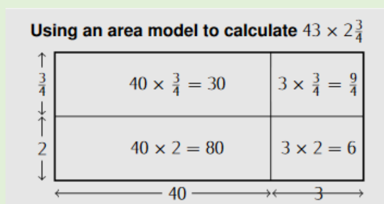
Clarification

This standard extends students' work with multiplication from earlier grades. In fourth grade, students worked with multiplying fractions less than one by whole numbers. The beginning of their exploration with fraction multiplication included recognizing that a fraction such as $\frac{3}{4}$ can be represented as 3 pieces that are each one-fourth (3 x $\frac{1}{4}$).

This standard references both the multiplication of a fraction by a whole number and the multiplication of two fractions, including mixed numbers. Multiplication of a fraction by a whole number is open to denominators 2, 3, 4, 5, 6, 8, 10, and 12 because this skill was introduced in fourth grade. Multiplication of a fraction by a fraction is limited to ONLY the denominators 2, 3, and 4. This standard includes situations where students must multiply two mixed numbers together.

Students are expected to create and use visual fraction models (area models, tape diagrams, number lines) during their work with this standard. The language in the standard "develop the algorithm" means that models should always be used and the algorithm is limited to only exposure at the same time as models in Grade 5.





Checking for Understanding

<u>Use area and length models to multiply two fractions, with the denominators 2, 3, and 4.</u>

Multiplying Two Mixed Numbers

There are 3 $\frac{1}{4}$ packages of pencils on the desk. One full package weighs 1 $\frac{1}{2}$ pounds. How much do all of the containers weigh?

Possible response:

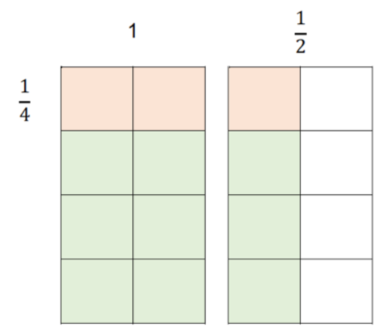
<u>Decomposing a Factor and Using Models</u>

The equation that matches the situation is 3 $\frac{1}{4}$ x 1 $\frac{1}{2}$. I am going to decompose the 3 $\frac{1}{4}$ into 3 and $\frac{1}{4}$.

3 $\frac{1}{4}$ x 1 $\frac{1}{2}$ = (3 x 1 $\frac{1}{2}$) + ($\frac{1}{4}$ + 1 $\frac{1}{2}$).

I know 3 packages = 1 $\frac{1}{2}$ + 1 $\frac{1}{2}$ + 1 $\frac{1}{2}$ = 4 $\frac{1}{2}$ pounds.

For the last package in the picture, I need to find $\frac{1}{4}$ of 1 $\frac{1}{2}$.



Based on the picture $\frac{1}{4}$ of 1 $\frac{1}{2}$ shows 3 parts shaded and there are 8 parts in the whole. So, $\frac{1}{4}$ of 1 $\frac{1}{2}$ is $\frac{3}{8}$. The answer is 4 $\frac{1}{2}$ + $\frac{3}{8}$ = 4 $\frac{7}{8}$.

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NC.5.NF.4 Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction, including mixed numbers.

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Clarification	Checking for Understanding

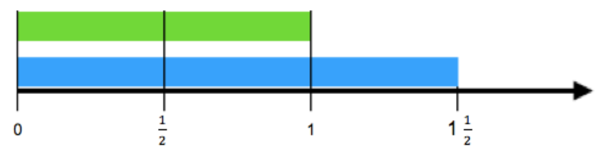
Checking for Understanding

Fraction (part) of a Fraction, Whole Number or a Mixed Number

Paige has $1\frac{1}{2}$ feet of rope for a project. She only needs $\frac{2}{3}$ of it. How much rope does she need?

Possible responses:

Length Model



$1\frac{1}{2}$ is equal to $\frac{3}{2}$. Since we needed $\frac{2}{3}$ of the rope my picture shows that $\frac{1}{3}$ of $\frac{3}{2}$ is $\frac{1}{2}$. So, $\frac{2}{3}$ of $\frac{3}{2}$ is $\frac{1}{2}$ plus $\frac{1}{2}$ which is 1.

Open Array

	1	$\frac{1}{2}$
$\frac{2}{3}$	$\frac{2}{3}$ x 1 = $\frac{2}{3}$	$\frac{2}{3}$ x $\frac{1}{2}$ = $\frac{2}{6}$

Answer:

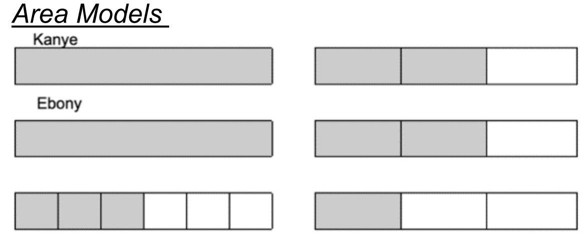
$\frac{2}{3} + \frac{2}{6} = \frac{4}{6} + \frac{2}{6} = 1$

Multiplicative Comparison

Kanye ran $1\frac{2}{3}$ miles on Monday. His sister Ebony ran $1\frac{1}{2}$ times more miles than Kanye. How far did Ebony run?

Possible Responses:

Area Models



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Clarification

Checking for Understanding

Kanye ran 1 and $\frac{2}{3}$ miles which is the top area model. Ebony ran 1 and $\frac{1}{2}$ times as much which is the same amount as Kanye plus another $\frac{1}{2}$ of Kanye's amount. In the bottom model I shaded $\frac{1}{2}$ of the whole which is $\frac{1}{2}$ and $\frac{1}{2}$ of the $\frac{2}{3}$ which is $\frac{1}{3}$. That means Ebony ran 1 + $\frac{2}{3}$ + $\frac{1}{2}$ + $\frac{1}{3}$ which is 2 and $\frac{1}{2}$ miles.

Open Array

	1	$\frac{2}{3}$
1	1 x 1 = 1	1 x $\frac{2}{3}$ = $\frac{2}{3}$
$\frac{1}{2}$	1 x $\frac{1}{2}$ = $\frac{1}{2}$	$\frac{1}{2}$ x $\frac{2}{3}$ = $\frac{2}{6}$

Ebony's distance

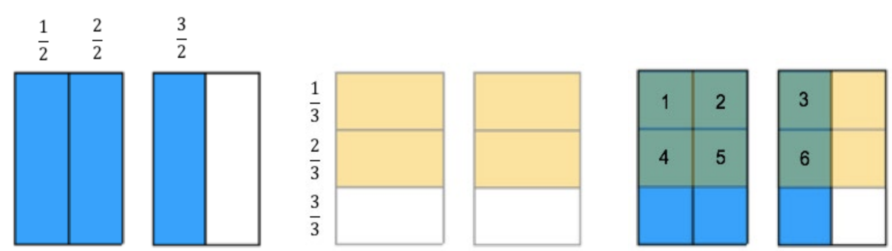
1 + $\frac{2}{3}$ + $\frac{2}{6}$ + $\frac{1}{2}$

1 + $\frac{4}{6}$ + $\frac{2}{3}$ + $\frac{1}{2}$

2 + $\frac{1}{2}$ = 2 and $\frac{1}{2}$ miles

Explain why multiplying a given number by a fraction greater than 1 results in a product greater than the given number and when multiplying a given number by a fraction less than 1 results in a product smaller than given number.

Sonya is multiplying $\frac{2}{3}$ x $\frac{3}{2}$. She tells Susan that her product will be greater than $\frac{2}{3}$. Is Sonya correct? Model the problem and explain why Sonya is correct or not.



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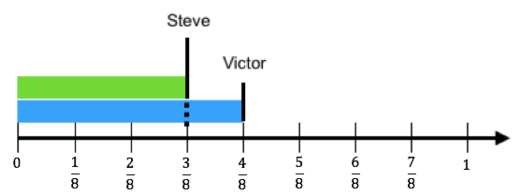
Clarification	Checking for Understanding
	Sonya is correct. Since $\frac{3}{2}$ is greater than 1 the product of $\frac{2}{3}$ x $\frac{3}{2}$ will be greater than $\frac{2}{3}$. In the picture we see that the answer is $\frac{3}{3}$ or 1, which is greater than $\frac{2}{3}$. <u>Solve one-step word problems involving multiplication of fractions using models to develop the algorithm.</u> Victor runs $\frac{1}{2}$ of a mile each day. Steve runs $\frac{3}{4}$ of the distance that Victor runs. How long does Steve run? Use a model and write a sentence to support your answer. Explain how the algorithm matches your answer. *Possible response:* *Steve runs less than Victor. Victor ran $\frac{1}{2}$ a mile each day which is equal to $\frac{4}{8}$ of a mile each day. Steve ran $\frac{3}{4}$ of Victor's distance. In the picture I partitioned $\frac{1}{2}$ into 4 equal parts and each of those parts was $\frac{1}{8}$. Steve ran 3 of those 4 parts, which can be represented by $\frac{1}{8} + \frac{1}{8} + \frac{1}{8}$ or 3 x $\frac{1}{8}$, which equals $\frac{3}{8}$.* 

Return to Standards

Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

NC.5.NF.7 Solve one-step word problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions using area and length models, and equations to represent the problem.

Clarification

While students are working on NC.5.NF.7, this is the first time that students are dividing with fractions. In fourth grade students divided whole numbers and multiplied a whole number by a fraction. The concept *unit fraction* is a fraction that has a one as the numerator. Students should be able to model all of the word problems using area and length models. There is no limit with the denominators since they are dividing a whole number by a unit fraction OR a unit fraction by a whole number. The algorithm to divide fractions should not be introduced in Grade 5.

Checking for Understanding

Repeated Addition

Tyler decided to collect canned food to donate to a local organization. He had small boxes that he used to store the canned food in. Each week he filled up $2\frac{3}{4}$ boxes with cans. How many boxes does he have full of cans after 2 weeks? 3 weeks? Tyler's goal was to collect more than 12 boxes during the $4\frac{1}{2}$ weeks in January. Did Tyler meet his goal?

Possible responses:

<u>Repeated Addition and Multiplication</u>

Two weeks: $2\frac{3}{4} + 2\frac{3}{4} = 4\frac{6}{4} = 5\frac{2}{4}$. *That is the same as* $2\frac{3}{4} \times 2 = 5\frac{2}{4}$

Three weeks: $2\frac{3}{4} \times 3 = (2 \times 3) + (\frac{3}{4} \times 3) = 6 + \frac{9}{4} = 6 + 2\frac{1}{4} = 8\frac{1}{4}$

4.5 weeks: $2\frac{3}{4} \times 4\frac{1}{2} = (2\frac{3}{4} \times 4) + 2\frac{3}{4} \times \frac{1}{2})$

$2\frac{3}{4} \times 4 = 2 \times 4 + \frac{3}{4} \times 4 = 8 + 3 = 11$

$2\frac{3}{4} \times \frac{1}{2} = 2 \times \frac{1}{2} + \frac{3}{4} \times \frac{1}{2} = 1 + \frac{3}{8} = 1\frac{3}{8}$

Total for $4\frac{1}{2}$ *weeks* $= 11 + 1\frac{3}{8} = 12\frac{3}{8}$

Tyler met his goal of collecting more than 12 boxes.

<u>Open Array</u>

	2	$\frac{3}{4}$
4	$4 \times 2 = 8$	$4 \times \frac{3}{4} = 3$
$\frac{1}{2}$	$\frac{1}{2} \times 2 = 1$	$\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$

Total: $8 + 3 + 1 + \frac{3}{8} = 12\frac{3}{8}$

Part of a Set

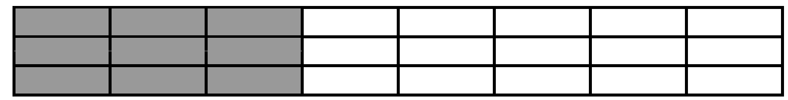
There are 24 apples in the basket. $\frac{3}{8}$ of the apples are red. The rest are green How many of each color are there in the basket?

Apply and extend previous understandings of multiplication and division to multiply and divide fractions.
NC.5.NF.7 Solve one-step word problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions using area and length models, and equations to represent the problem.

Clarification	Checking for Understanding

Checking for Understanding

Possible response:

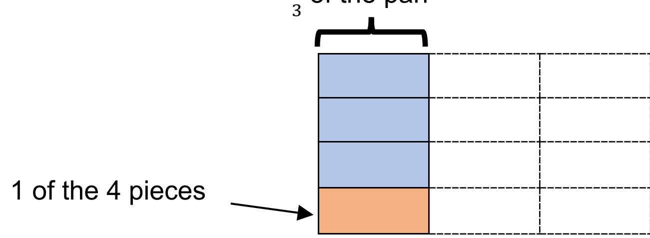


The array is partitioned into 8 columns and 3 rows. We know that we need to find $\frac{3}{8}$ of 24. Based on my array we have 8 columns and 1 column is $\frac{1}{8}$ of 24 which is 3. In order to find $\frac{3}{8}$ I can multiply 3 times 3 to get 9 red apples. That means that the number of green apples is 24 minus 9 which is 15 apples.

Unit Fraction Divided by a Whole Number
Four students sitting at a table were given $\frac{1}{3}$ of a pan of brownies to share. How much of the whole pan will each student get if they share the section of brownies equally?

Possible responses:

Student A:
The diagram shows the $\frac{1}{3}$ pan divided into 4 equal shares with each share equaling $\frac{1}{12}$ of the pan.



Student B:

I split the whole into three equal parts. Then I split the first third into 4 equal pieces since the third was being shared between 4 people. Each person gets 1 out of 12 or $\frac{1}{12}$ of the pan.

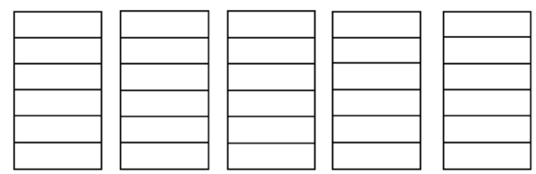
Apply and extend previous understandings of multiplication and division to multiply and divide fractions.
NC.5.NF.7 Solve one-step word problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions using area and length models, and equations to represent the problem.

Clarification	Checking for Understanding
	Student C: *We have $\frac{1}{3}$ of a pan of brownies to share between 4 people. If we share the brownies between 2 people then the third will be split in half so everyone will get $\frac{1}{6}$ of the pan. Since 4 is double 2 we will cut each of the 2 sixths into 2 equal pieces so we would have 4 pieces and each piece would be half of $\frac{1}{6}$, which is $\frac{1}{12}$ of the pan.*

Whole Number Divided by a Unit Fraction
Create a word problem for 5 ÷ $\frac{1}{6}$. Find your answer and then draw a picture to prove your answer and use multiplication to reason about whether your answer makes sense. How many $\frac{1}{6}$ are there in 5?

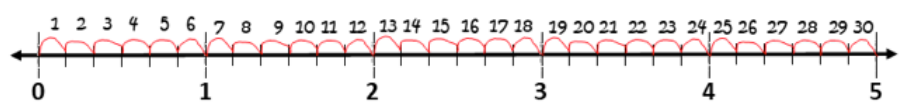
Possible responses:

Student A:
There are 5 cups of goldfish crackers on the counter. Each student receives $\frac{1}{6}$ of a cup of goldfish crackers. How many students can be fed with the 5 cups of goldfish crackers?



There are 30 pieces that are $\frac{1}{6}$ of a cup. 30 x $\frac{1}{6}$ = $\frac{30}{6}$ = 5 cups.

Student B:
I have 5 feet of yarn. For my project I have to cut the yarn into pieces that are one-sixth of a foot long. How many pieces will I have?



Return to Standards

Convert like measurement units within a given measurement system.

NC.5.MD.1 Given a conversion chart, use multiplicative reasoning to solve one-step conversion problems within a given measurement system.

Clarification

In this standard, students will be provided with the information needed to make a conversion and students will convert measurements within the same system of measurement. Conversions should be limited to one step but may be included within a multi-step problem. Numbers within the conversions can include whole numbers, decimals, and fractions.

Students will work with customary and metric measurement systems, as well as, time, exploring the relationship between the units.

Checking for Understanding

Tom purchased a 40 lb. bag of dog food. Knowing that there are 16 oz in a pound, if Tom used a 5-ounce scoop, how many scoops are in the bag?

Possible responses:

Student A:

40 lbs. x 16 oz = 16 x 4 x 10 = 64 tens which is 640 oz

	5	640
100	100 x 5 = 500	-500 140
20	20 x 5 = 100	-100 40
8	8 x 5 = 40	-40 0

640 ounces ÷ 5 ounces per scoop = ___

Using the area model, 640 divided by 5 is 100 + 20 + 8 or 128.
There are 128 5-ounce scoops in the bag.

Student B:

40 lbs x 16 oz = 640 oz
640 oz ÷ 5 oz = ___ scoops

5 x 12 = 60
5 x 120 = 600
5 x 8 = 40
5 x 128 = 640
There are 128 scoops in the bag.

Mrs. Pitchford buys 24 ounces of sweet potatoes, 13 ounces of baked potatoes, and 19 ounces of squash. If there are 16 ounces in a pound how many pounds of vegetables did she buy?

Possible Response:

Total in ounces= 24 + 13 + 19 = 61
Total in pounds= 61 ÷ 16 = ___
16 + 16 + 16 = 48. There are 3 16s in 48 so 61 ounces is 3 pounds with some leftover. The leftover is 61- 48 = 13 ounces.
$3\frac{13}{16}$ *pounds of vegetables.*

Convert like measurement units within a given measurement system.
NC.5.MD.1 Given a conversion chart, use multiplicative reasoning to solve one-step conversion problems within a given measurement system.

Clarification

Checking for Understanding

Khalil placed 3 books he is reading in a stack. The books are 1.23 centimeters, 0.724 centimeters, and 2.1 centimeters thick. How many millimeters thick was the stack? Note: 1 centimeter = 10 millimeters

Possible response:

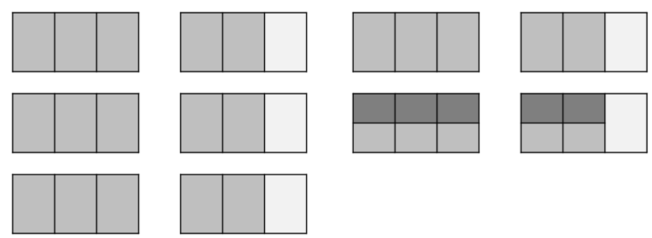
Total in centimeters: 1.23 + 0.724 + 2.1

1 .2 3
0 .7 2 4
+2 .1
4 .0 5 4 cm which is 40.54 millimeters

A restaurant has 4 full bottles of orange juice and 1 half bottle of juice. Each bottle holds $1\frac{2}{3}$ quarts of juice. The restaurant serves juice in glasses that hold 1 cup. How many 1-cup size glasses of juice can the restaurant serve using the juice they have? Note: 1 quart = 4 cups

Possible Response:

There are $4\frac{1}{2}$ bottles of juice and each holds $1\frac{2}{3}$ quarts of juice. We need to multiply them together to find the total number of quarts.



In the model there are 4 wholes shaded and there are 8 thirds shaded in the first 4 bottles of the juice. The bottom right grid shows half of one whole and two-thirds which is $\frac{5}{6}$. The total is $4 + \frac{8}{3} + \frac{5}{6}$.

$4 + 2\frac{2}{3} + \frac{5}{6} = 6 + \frac{4}{6} + \frac{5}{6} = 6\frac{9}{6} = 7\frac{3}{6}$ which could be rewritten as $7\frac{1}{2}$ quarts. I need to multiply by 4 since there are 4 cups in quart.

$7\frac{1}{2} \times 4 = 7 \times 4 + \frac{1}{2} \times 4 = 28 + 2 = 30$ cups.

Return to Standards

Represent and interpret data.
NC.5.MD.2 Represent and interpret data.

- Collect data by asking a question that yields data that changes over time.
- Make and interpret a representation of data using a line graph.
- Determine whether a survey question will yield categorical or numerical data, or data that changes over time.

Clarification

In this standard, students will interact with data concepts by designing a question that yields data that changes over time, collecting data, representing that data in tables and line graphs, and interpreting the data. Students are expected solve one-step and two-step questions regarding the data and their representation.

Students have previously formulated survey questions that yield categorical (3rd and 4th grade) and numerical data (4th grade). To extend this work, students are expected to determine whether a specific question yields categorical data, numerical data, or data that changes over time.

Checking for Understanding

Mrs. Smith's class wanted to track the temperature of water after 5 ice cubes are added to a cp of water. The data that one group collected is in the table below.

a. Graph the data on the chart.

January	Temp
1	70°
2	62°
3	56°
4	53°
5	51°
6	51°
7	52°
8	55°
9	59°
10	61°

b. When were the low temperature on or above 60°?
c. What were the coldest 3 days?
d. On which days did the temperature increase? Decrease? Stay the same? Explain how you can use the line graph to answer these questions?
e. During the 10 minutes, between which time interval did the temperature decrease the most? Between which time interval did the temperature increase the most?

Write 3 survey questions. Write one question that yields categorical data, one question that yields numerical data, and one question that yields data that changes over time. Label each question with both the type of data it will yield and the type of graph that should be used to share the data.

Possible responses:

Categorical data: On *what day of the week (Monday-Friday) do you play with your friends after school the most? I would use a bar graph for this data because categories are being compared.*

Numerical Data: How many pets do you have in your house? I would use a line plot for this data because the answers will all be numbers.

Changes over time: *What is your heart rate every 10 seconds after jogging in place for a minute? I would use a line graph for this data because heart rate changes over time.*

Return to Standards

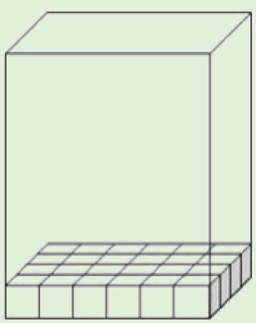
Understand concepts of volume.
NC.5.MD.4 Recognize volume as an attribute of solid figures and measure volume by counting unit cubes, using cubic centimeter, cubic inches, cubic feet, and improvised units.

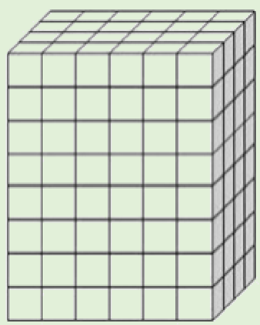
Clarification

In this standard, students begin their exploration of volume by building and exploring right rectangular prisms with cubes. Right rectangular prisms are 3-dimensional shapes that all have rectangular faces and all angles are right angles. As students develop their understanding of volume they understand that a 1-unit by 1-unit by 1-unit cube is the standard unit for measuring volume. This cube has a length of 1 unit, a width of 1 unit and a height of 1 unit and is called a cubic unit.

The concept of volume should be extended from area with the idea that students are covering an area (the bottom of cube) with a layer of unit cubes and then adding layers of unit cubes on top of the bottom layer. Students should pack cubes (without gaps) to build right rectangular prisms and count the cubes to determine the volume or build right rectangular prisms from cubes and see the layers as they build

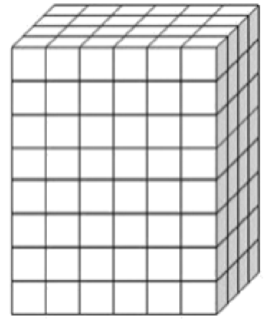
For example:
Students will pack cubes into a rectangular prism and continue layering the unit cubes until the prism is full. Then, students count the number of unit cubes to determine volume.





Checking for Understanding

Find the volume of this figure.



Possible response:
I can see that the top layer of the prism has 24 cubes. Since this is a rectangular prism, I know that each layer will have the same number of cubes. So, if I think about packing the prism with cubes, I would count 24 for each layer. I could build a model of this prism with cubes so I can count the number of cubes, or I can add 24 + 24 + 24 + 24 + 24 + 24 + 24 + 24

While finding the volume of a rectangular prism, Cedrick filled the bottom of the box with unit cubes. How can that help him find the volume of the entire rectangular prism?

Possible Responses:

Student A:
I can count all of the cubes in the bottom layer. Then I can repeatedly add up that number in each layer to find the volume.

Student B:
I know that volume can be found by looking at the area of the base or bottom layer of the rectangular prism. I can use the length and width and multiply them together to find the number of cubes in each layer. I then can add up that number for each layer to find the volume.

Return to Standards

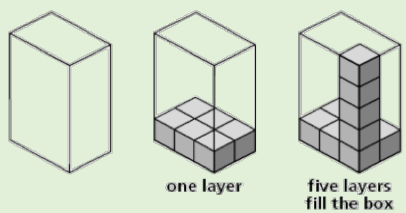
Understand concepts of volume.
NC.5.MD.5 Relate volume to the operations of multiplication and addition.

- Find the volume of a rectangular prism with whole-number side lengths by packing it with unit cubes and show that the volume is the same as would be found by multiplying the edge lengths.
- Build understanding of the volume formula for rectangular prisms with whole-number edge lengths in the context of solving problems.
- Find volume of solid figures with one-digit dimensions composed of two non-overlapping rectangular prisms.

Clarification

This standard involves finding the volume of right rectangular prisms in various contexts. Students will describe and reason about why the formula for volume is true by relating packing and counting cubes to the formula. Students cover the bottom of a right rectangular prism (length x width) with multiple layers (height) to show the volume formula (length x width x height) is an extension of the formula for the area of a rectangle.

For example:

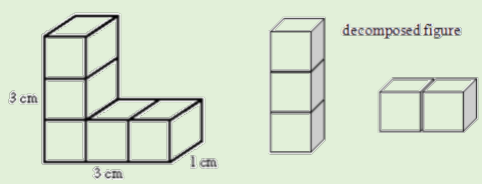


(3 x 2) represented by first layer
(3 x 2) x 5 represented by number of 3 x 2 layers
(l x w) x h = V
B x h = V

Students are expected to find the volumes of right rectangular prisms with edges whose lengths are whole numbers and solve real-world and mathematical problems involving prisms.

Students will extend their work with the area of composite figures into the context of volume. Students should decompose 3-dimensional figures into right rectangular prisms in order to find the volume of the entire 3-dimensional figure, recognizing that volume is additive.

For example:
Students decompose 3-dimensional figures composed of unit cubes into rectangular prisms:



Checking for Understanding

<u>Build understanding of the volume formula for rectangular prisms with whole-number edge lengths in the context of solving problems.</u>

Use these 24 cubes to build as many different rectangular prisms as possible and record the dimensions. Record your answers in the table below.

What do you notice about the product of the length, width, and height for each prism?

Possible response:

Length	Width	Height
1	2	12
2	2	6
4	2	3
8	3	1

Luiz says in class, "I think that I can multiply the area of the base by the number of layers to find the volume." Luiz's teacher gives the following tasks to the class to explore.

Prism A: Length: 11, Width: 12, Height: 56
Prism B: Length: 24, Width: 22, Height: 14

For each rectangular prism what equation using the length, width, and height should be used to find the volume?

For each rectangular prism what equation using the area of the base and the height should be used to find the volume?

<u>Find volume of solid figures with one-digit dimensions composed of two non-overlapping rectangular prisms.</u>

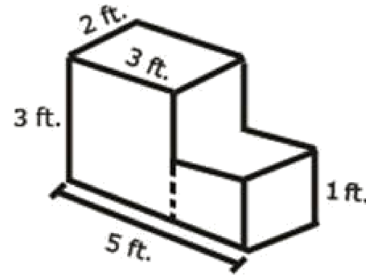
Determine the volume of concrete needed to build the steps in the diagrams below.

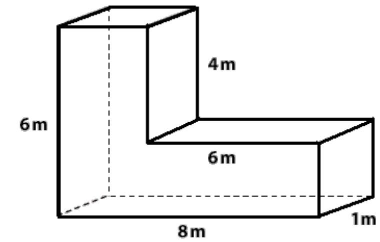
Understand concepts of volume.
NC.5.MD.5 Relate volume to the operations of multiplication and addition.

- Find the volume of a rectangular prism with whole-number side lengths by packing it with unit cubes and show that the volume is the same as would be found by multiplying the edge lengths.
- Build understanding of the volume formula for rectangular prisms with whole-number edge lengths in the context of solving problems.
- Find volume of solid figures with one-digit dimensions composed of two non-overlapping rectangular prisms.

Clarification

Checking for Understanding





<u>Find the volume of a rectangular prism with whole-number side lengths by packing it with unit cubes and show that the volume is the same as would be found by multiplying the edge lengths.</u>

Julius and Mackenzie are making rectangular prism towers using cubes. They decided to compare their towers to see which one is larger. Julius' tower has a length of 8 cubes, a width of 5 cubes, and a height of 12 cubes. Mackenzie's tower has a base of 35 cubes and a height of 12 cubes. Which tower has a greater volume? Explain how you know.

Possible Responses:

Student A:
The volume of Julius' tower is 8 x 5 x 12. 8 x 5 = 40. 40 x 12 = 480. So the volume of Julius' tower is 480 cubic units. Mackenzie's has a base that is 35 cubes. I found the volume by multiplying 35 x 12. That is 420 cubic units. So, the volume of Julius' tower is 60 cubic units more than Mackenzie's tower.

Student B:
I know Julius' tower has a larger volume because the heights are the same, and Julius' base is 8 x 5, which is 40 square units. And Mackenzie's base is 35 square units. The difference between the two towers is 5 x 12, which is 60 square units.

Understand concepts of volume. **NC.5.MD.5** Relate volume to the operations of multiplication and addition. • Find the volume of a rectangular prism with whole-number side lengths by packing it with unit cubes and show that the volume is the same as would be found by multiplying the edge lengths. • Build understanding of the volume formula for rectangular prisms with whole-number edge lengths in the context of solving problems. • Find volume of solid figures with one-digit dimensions composed of two non-overlapping rectangular prisms.	
Clarification	**Checking for Understanding**
	Temple and Katie were both building right rectangular prisms. Temple's prism had a length of 6, a width of 4, and a height of 3. Katie's prism had a base with an area that was half of Temple's, but the volume of her prism was larger than Temple's prism. If the height of Katie's prism is less than 10 units what could the possible dimensions be for Katie's prism? *Possible Responses:* *Student A:* *Temple's prism has a volume of 6 x 4 x 3 which is 72 cubic units. The base of Temple's prism was 24 since 6 x 4= 24.* *Katie's prism has a base area that is half of Temple's which is 24 ÷ 2 = 12 square units.* *Katie's height must give her prism a volume greater than 72 but is less than 10. Since the volume is the area of the base times the height that means that 12 x height = 72. The height has to be greater than 6 but less than 10.* *Student B:* *Katie's prism has a base area that is half of 24 which is 12 square units. Katie's length and width could be any numbers that multiply to equal 12 which could be 6 x 2, 4 x 3, or 12 x 1.* *Since Katie's prism is larger than Temple's, Katie's prism must have a height that gives her a volume of more than 72 cubic units. Katie's base is 12 square units so the height of Katie's prism must be greater than 6 but less than 10.*

Return to Standards

Understand the coordinate plane.

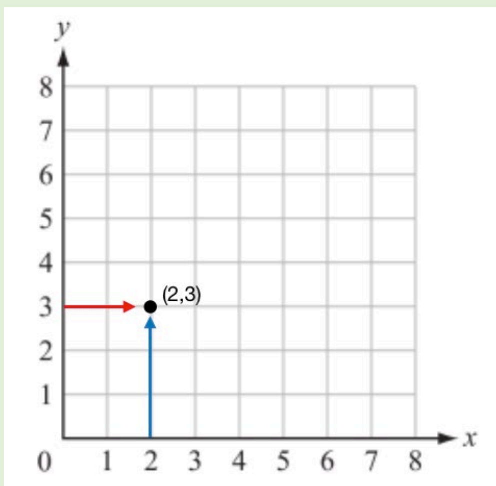
NC.5.G.1 Graph points in the first quadrant of a coordinate plane, and identify and interpret the *x* and *y* coordinates to solve problems.

Clarification

In this standard, students are introduced to the coordinate plane and learn to plot points in the first quadrant in order to solve real-world and mathematical problems. Problems include traveling from one point to another and identifying the coordinates of missing points in geometric figures, such as squares, rectangles, and parallelograms.

Students should understand that the coordinate plane is formed by a horizontal number line, called the x-axis, and a vertical number line, called the y-axis. The two axes intersect at a point called the origin (0,0). Students need to understand coordinates define a distance from the y-axis and a distance from the x-axis.

Students should distinguish between two different ways of viewing the point (2, 3). First, they should view the coordinates as instructions: “right 2, up 3”. They should also understand the coordinates as the point defined by being a distance 2 from the *y*-axis and a distance 3 from the *x*-axis.



Checking for Understanding

Plot these points on a coordinate grid.
Point A: (2,6); Point B: (4,6); Point C: (6,3); Point D: (2,3)
Connect the points in order. Make sure to connect Point D back to Point A.

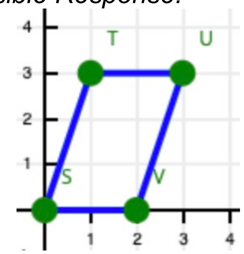
1. What geometric figure is formed? What attributes did you use to identify it?
2. What line segments in this figure are parallel?
3. What line segments in this figure are perpendicular?

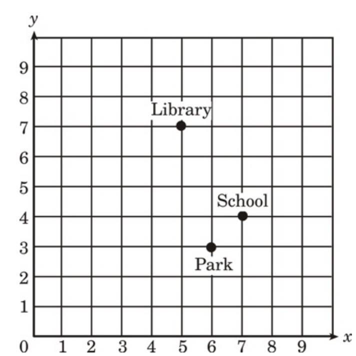
Possible response:

I made a trapezoid. The line segments that are parallel AB and DC. The perpendicular line segments are AD and DC.

Yasmin wants to make a parallelogram that does not have any right angles. She plots the following points: Point S: (0,0), Point U: (3, 3). If line segment TU is 2 units long, where can Points T and V be to make her shape?

Possible Response:





Using the coordinate grid, which ordered pair represents the location of the school?
Explain a possible path from the school to the library.

Return to Standards

Classify quadrilaterals.

NC.5.G.3 Classify quadrilaterals into categories based on their properties.

- Explain that attributes belonging to a category of quadrilaterals also belong to all subcategories of that category.
- Classify quadrilaterals in a hierarchy based on properties.

Clarification

This standard calls for students to reason about the attributes (properties) of quadrilaterals in order to classify quadrilaterals into categories. Geometric attributes include properties of sides (parallel, perpendicular, equal length), properties of angles (type, measurement), and properties of symmetry. Students should understand that if a category contains certain attributes, then all quadrilaterals in that category have that attribute.

> **For example:**
> If a parallelogram has four sides and opposite sides are parallel and equal, then all shapes that meet these criteria are parallelograms including squares, rectangles, and rhombuses.

The notion of congruence ("same size and same shape") may be part of classroom conversation but the concepts of congruence and similarity do **not** appear until middle school.

Note: North Carolina has adopted the exclusive definition for a trapezoid. A trapezoid is a quadrilateral with *exactly* one pair of parallel sides.

This standard also calls for students to classify quadrilaterals into a hierarchy based on the relationship between shapes based on attributes.

Checking for Understanding

<u>Explain that attributes belonging to a category of quadrilaterals also belong to all subcategories of that category.</u>

Questions that might be posed to students include:

A parallelogram has 4 sides with both sets of opposite sides parallel. What types of quadrilaterals are parallelograms?

Possible responses:
Rectangle, square, parallelogram

All rectangles have 4 right angles. Squares have 4 right angles so squares are always also rectangles. True or False? Explain why. Are rectangles always squares? Explain why.

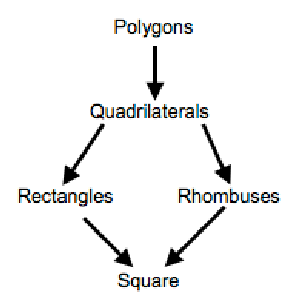
Possible Response:
A square always is a parallelogram with 4 right angles so a square can always also be called a rectangle.

A rectangle is a parallelogram with 4 right angles and a square is a rectangle that has 4 sides that are the same length. Not all rectangles are squares. Therefore, a rectangle is sometimes, but not always, a square.

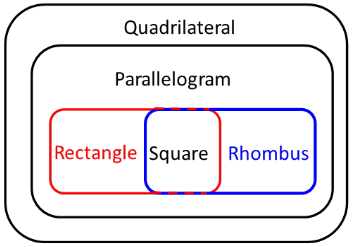
A trapezoid has 2 sides parallel, so it is always a parallelogram. True or False? Explain why.

Possible Response:
A trapezoid has exactly 1 pair of parallel sides and a parallelogram must have 2 pairs of parallel sides. A trapezoid can never be a parallelogram.

<u>Classify quadrilaterals in a hierarchy based on properties.</u>
Create a Hierarchy Diagram using the following terms:
polygons – a closed plane figure formed from line segments that meet only at their endpoints.
quadrilaterals - a four-sided polygon.
rectangles - a quadrilateral with two pairs of equal, parallel sides and four right angles.
rhombus – a parallelogram with all four sides equal in length.
square – a parallelogram with four equal sides and four right angles.



Classify quadrilaterals.
NC.5.G.3 Classify quadrilaterals into categories based on their properties.
- Explain that attributes belonging to a category of quadrilaterals also belong to all subcategories of that category.
- Classify quadrilaterals in a hierarchy based on properties.

Clarification	**Checking for Understanding**
	Create a Hierarchy Diagram using the following terms: **quadrilateral** – a four-sided polygon. **parallelogram** – a quadrilateral with two pairs of parallel and congruent sides. **rectangle** – a quadrilateral with two pairs of equal, parallel sides and four right angles. **rhombus** – a parallelogram with all four sides equal in length. **square** – a parallelogram with four equal sides and four right angles.  *(Possible response)*

Return to Standards