Kentucky Academic Standards for Mathematics: Grade 5 Overview

Operations and Algebraic Thinking (OA)	Number and Operations in Base Ten (NBT)	Number and Operations Fractions (NF)	Measurement and Data (MD)	Geometry (G)
• Write and interpret numerical expressions. • Analyze patterns and relationships.	• Understand the place value system. • Perform operations with multi-digit whole numbers and with decimals to hundredths.	• Use equivalent fractions as a strategy to add and subtract fractions. • Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	• Convert like measurement units within a given measurement system. • Understand and apply the statistics process. • Geometric measurement: understand concepts of volume and relate volume to multiplications and to addition.	• Graph points on the coordinate plane to solve real-world and mathematical problems. • Classify two-dimensional figures into categories based on their properties.

In grade 5, instructional time should focus on three critical areas:

1. **In the Numbers and Operations - Fractions and Operations and Algebraic Thinking domains, students will:**
    - apply their knowledge of fractions and fraction models to illustrate the addition and subtraction of fractions with unlike denominators as equivalent calculations with like denominators;
    - establish fluency in calculating sums and differences with fractions and make a reasonable estimate of those sums and differences;
    - use the meaning of fractions, of multiplication and division, and the relationship between those operations to understand and explain why the procedures for multiplying and dividing fractions make sense.

    (Note: This is limited to the case of dividing unit fractions by whole numbers and whole numbers by unit fractions.)
2. **In the Operations and Algebraic Thinking and Number and Operations in Base Ten, students will:**
    - develop understanding of why division procedures work based on the meaning of base-ten numerals and properties of operations;
    - apply understandings of models for decimals, decimal notation and properties of operations to add and subtract decimals to hundredths;
    - develop fluency with decimal computations to hundredths and make reasonable estimates of their computation;
    - use the relationship between decimals and fractions, as well as the relationship between finite decimals and whole numbers to understand and explain why the procedures for multiplying and dividing finite decimals make sense.
3. **In the Measurement and Data and Geometry domains, students will:**
    - recognize volume as an attribute of three-dimensional space;
    - understand that a 1-unit by 1-unit cube is the standard unit for measuring volume;
    - understand that volume can be measured by finding the total number of same-size units of volume required to fill the space without gaps or overlaps;
    - choose appropriate units, strategies and tools for solving problems which involve estimating and measuring volume;
    - decompose three-dimensional shapes and find volumes of right rectangular prisms by viewing them as decomposed into layers of arrays of cubes;
    - measure attributes of shapes in order to determine volumes to solve real world and mathematical problems.

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

Cluster: Write and interpret numerical expressions.

Standards	Clarifications
KY.5.OA.1 Use parentheses, brackets or braces in numerical expressions and evaluate expressions that include symbols. **MP.1**, **MP.3**	Students work with the order of first evaluating terms in parentheses, then brackets, [] and then braces, {}. Coherence KY.5.OA.1→ KY.6.EE.2
KY.5.OA.2 Write simple expressions with numbers and interpret numerical expressions without evaluating them. **MP.2**, **MP.7**	Students translate from words "add 8 and 7, then multiply by 2" to 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product. KY.6.EE.2 Coherence KY.4.OA.1→ KY.5.OA.2→KY.6.EE.3 KY.6.EE.4

Attending to the Standards for Mathematical Practice

Students move between words and symbols, understanding equivalent ways to express a statement. Students interpret the statement "The sum of 347, 124 and 99, divided by 30 as, (347 + 124 + 99) ÷ 30 and as $\frac{347+124+99}{30}$ (**MP.7**). As they evaluate such expressions, they realize there are options within the order of operations. In this expression, they add the three values and then divide by 30, or divide each addend by 30 and get the same answer. They think of a context to convince themselves two options will lead to the same answer (**MP.2**). In this case, students consider the two options and see the first idea is less 'messy' and therefore, a good choice (**MP.1**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

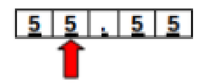
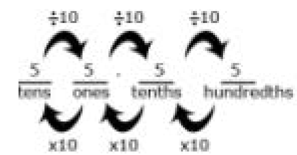
Operations and Algebraic Thinking	
Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Cluster: Analyze patterns and relationships.	
Standards	**Clarifications**
KY.5.OA.3 Generate numerical patterns for situations. a. Generate a rule for growing patterns, identifying the relationship between corresponding terms (x, y). b. Generate patterns using one or two given rules (x, y). c. Use tables, ordered pairs and graphs to represent the relationship between the quantities. **MP.2**, **MP.4**	Given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, students generate terms in the resulting sequences (creating ordered pairs). Students observe the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so. Graph the ordered pairs on a coordinate plane. Coherence KY.4.OA.5→ KY.5.OA.3→KY.6.EE.9
Attending to the Standards for Mathematical Practice	
Students notice when they apply a rule, like add 3, several patterns emerge. The explicit pattern is the new value is 3 more than the original value. But, as they explore they notice if they pick an input that is 5 more than the last input, then the output is also 5 more. They reason about this contextually, for example thinking of people ages in three years. So, if they have a sibling that is 5 years older now, in three years, they will still be 5 years older (**MP.2**). They represent these patterns on graphs and use the graphs to make sense of the situation (**MP.4**)	

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Number and Operations in Base Ten Note: grade 5 expectations in this domain are limited to decimals through the thousandths place.

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

Cluster: Understand the place value system.

Standards	Clarifications
KY.5.NBT.1 Recognize 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. **MP.2**, **MP.7**	In the number 55.55, each digit is 5, but the value of each digit is different because of the placement.  The arrow points to is 1/10 of the 5 to the left and 10 times greater than the 5 to the right. The 5 in the ones place is 1/10 of 50 and 10 times greater than five tenths.  Note: grade 5 expectations in this domain are limited to decimals through the thousandths place. Coherence KY.4.NBT.1→KY.5.NBT.1
KY.5.NBT.2 Multiply and divide by powers of 10. ● Explain patterns in the number of zeros of the product when multiplying a number by powers of 10. ● Explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. ● Use whole-number exponents to denote powers of 10. **MP.3**, **MP.8**	Students recognize when a number is multiplied by 10, a zero is added to the end because each digit's value became 10 times larger. Students use the same reasoning to explain in the problem. ● $523 \times 10^3 = 523{,}000$ The place value of 523 is increased by 3 places. ● $5.223 \times 10^2 = 522.3$ The place value of 5.223 is increased by 2 places. ● $52.3 \div 10^1 = 5.23$ The place value of 52.3 is decreased by one place. Note: grade 5 expectations in this domain are limited to decimals through the thousandths place. Coherence KY.5.NBT.2→ KY.6.EE.1

Standards	Clarifications
KY.5.NBT.3 Read, write and compare decimals to thousandths. a. Read and write decimals to thousandths using base-ten numerals, number names and expanded form. b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. **MP.2**, **MP.5**, **MP.7**	a. For the number 347.392… ● number name: three hundred forty-seven and three hundred ninety-two thousandths ● expanded form: $347.392 = 3 \times 100 + 4 \times 10 + 7 \times 1 + 3 \times (\frac{1}{10}) + 9 \times (\frac{1}{100}) + 2 \times (\frac{1}{1000})$ Students relate numbers they are comparing back to common benchmarks of 0, $\frac{1}{2}$ (0.5, 0.50 and 0.500) and 1. When comparing numbers, 0.35 and 0.12, students make the connection 0.35 > 0.12, but also see the relationship of 0.12 < 0.35. Note: grade 5 expectations in this domain are limited to decimals through the thousandths place. KY.4.NBT.2 Coherence KY.4.NF.7→ KY.5.NBT.3
KY.5.NBT.4 Use place value understanding to round decimals to any place. **MP.5**, **MP.7**	Students go beyond application of an algorithm or procedure when rounding. Students demonstrate a deeper understanding of number sense and place value and explain and reason about the answers they get when they round. Note: grade 5 expectations in this domain are limited to decimals through the thousandths place. Coherence KY.4.NBT.3→ KY.5.NBT.4

Attending to the Standards for Mathematical Practice
Students compare the value of the digits based on where they are in a number (**MP.7**). They reason 10 tens equal 100, 70 tens equal 700 and this can be illustrated with base 10 blocks or other visuals (**MP.2**). Students look across series of problems to notice a pattern when multiplying by 10, 100 or 1000 (**MP.8**) and justify why patterns exist (why 36 x 100 = 3600), rather than superficially noting 'you add zeros,' they explain or show there are actually 36 *hundreds*, so 3600 (**MP.3**). Students use similar reasoning to compare decimal values, explaining tenths are larger than hundredths and therefore, they look to first see which values have more tenths before looking at how many hundredths it has (**MP.2**, **MP.7**). Students use tools such as number lines and base 10 blocks to see place value relationships with decimals in order to compare and to round (**MP.5**).

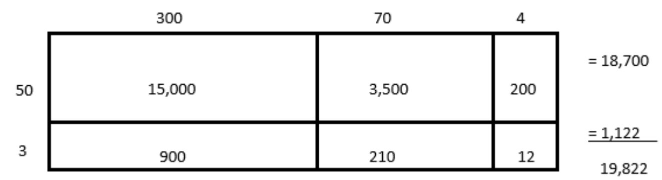
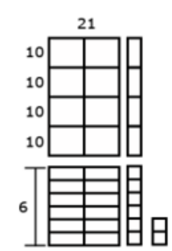
The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

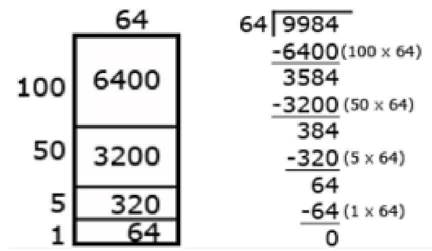
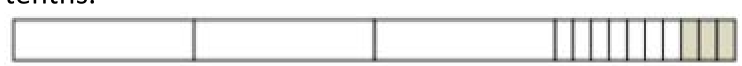
Number and Operations in Base Ten

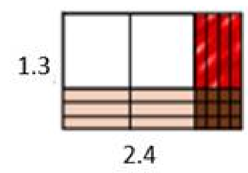
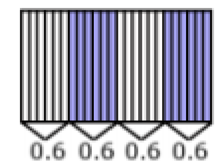
Standards for Mathematical Practice

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

Cluster: Perform operations with multi-digit whole numbers and with decimals to hundredths.

Standards	Clarifications
KY.5.NBT.5 Fluently multiply multi-digit whole numbers (not to exceed four-digit by two-digit multiplication) using an algorithm. **MP.7**, **MP.8**	Students make connections from previous work with multiplication, using models/representations to develop an efficient algorithm to multiply multi-digit whole numbers.  374 × 53 12 (3 × 4) 210 (3 × 70) 900 (3 × 300) 200 (50 × 4) 3,500 (50 × 70) 15,000 (50 × 300) 19, 822 Coherence KY.4.NBT.5→ KY.5.NBT.5→KY.6.NS.3
KY.5.NBT.6 Divide up to four-digit dividends by two-digit divisors. a. Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors using… ● strategies based on place value ● the properties of operations ● the relationship between multiplication and division b. Illustrate and explain the calculation by using equations, rectangular arrays and/or area models. **MP.2**, **MP.3**, **MP.4**	Students build upon the knowledge of division they gained in grades 3 and 4. Students connect previous understanding of partitive and measurement models for division to an algorithm, including partial quotients. Some examples include: 968 ÷ 21 = Students use base ten models by representing 962 and use the model to make an array with one dimension of 21. Student continues to make the array until no more groups of 21 can be made. Remainders are not part of the array. 

Standards	Clarifications
	Students use an area model for division shown below. As the student uses the area model, s/he keeps track of how much of the 9,984 is left to divide.  Students use expanded notation 2682 ÷ 25 = (2000 + 600 +80 + 2) ÷ 25. Students use his or her understanding of the relationship between 100 and 25, to think "I know 100 divided by 25 is 4 so 200 divided by 25 is 8 and 2000 divided by 25 is 80. Then 600 divided by 25 has to be 24. Since 3 × 25 is 75, I know that 80 divided by 25 is 3 with a remainder of 5. I can't divide 2 by 25 so 2 plus the 5 leaves a remainder of 7. 80 + 24 + 3 =107. So the answer is 107 with a remainder of 7." Students use an equation that relates division to multiplication, 25 × n = 2682, a student might estimate the answer to be slightly larger than 100 because s/he recognizes that 25 × 100 =2500. Coherence KY.4.NBT.6→ KY.5.NBT.6→KY.6.NS.2
KY.5.NBT.7 Operations with decimals to hundredths. a. Add, subtract, multiply and divide decimals to hundredths using… ● concrete models or drawings ● strategies based on place value ● properties of operations ● the relationship between addition and subtraction b. Relate the strategy to a written method and explain the reasoning used. **MP.2**, **MP.3**, **MP.5**	Students connect previous experiences with the meaning of multiplication and division of whole numbers to multiplication and division of decimals using estimation, models and place value structure. For example: 3 tenths subtracted from 4 wholes. The wholes must be divided into tenths.  The answer is 3 and $\frac{7}{10}$ or 3.7 An area model can be used for illustrating products.

Standards	Clarifications
	 2.4 × 1.3 .12 .60 .40 +2.00 3.12 Students describe the partial products displayed by the area model. For example, "$\frac{3}{10}$ times $\frac{4}{10}$ is $\frac{12}{100}$. $\frac{3}{10}$ times 2 is $\frac{6}{10}$ or $\frac{60}{100}$. 1 group of $\frac{4}{10}$ is $\frac{4}{10}$ or $\frac{40}{100}$. 1 group of 2 is 2." Students dividing decimals for example could find the number in each group or share by applying the fair sharing model or separating decimals in to equal parts such as 2.4 ÷ 4 = 0.6  Coherence KY.4.NBT.6→ KY.5.NBT.7→KY.6.NS.3

Attending to the Standards for Mathematical Practice

Students understand when given a multiplication problem, they have a choice in how they solve it and select a way that makes sense for the values in the problem. For example, for 1234 x 12, they see the small numbers lend to a break apart strategy and solve the problem this way:

1234 x 10 = 12340

1234 x 2 = 2468

Then add the partial products to equal 14,808 (**MP.7**). Other students may stack the two values and use an algorithm. Students recognize a rectangle is an effective model for ensuring all partial products are calculated, for both whole numbers and decimals (**MP.4**). As students explore problems with decimal values, they reason about the problem, rather than following rules devoid of meaning (count the number of decimal places). For example, when multiplying 4 x 1.5, they use a break apart strategy, as they have for whole numbers, noticing 4 x 1 = 4 and 4 x 0.5 = 2, so therefore, 4 x 1.5 = 6 (**MP.2**). They explain why this works and when they use this strategy (**MP.3**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Number and Operations - Fractions

Standards for Mathematical Practice

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

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

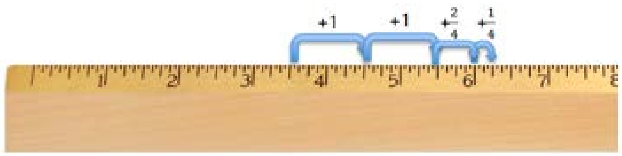
Standards	Clarifications
KY.5.NF.1 Efficiently add and subtract fractions with unlike denominators (including mixed numbers) by… ● using reasoning strategies, such as counting up on a number line or creating visual fraction models ● finding common denominators **MP.2**, **MP.3**	Using common denominator $\frac{2}{3}+\frac{5}{4}=\frac{8}{12}+\frac{15}{12}=\frac{23}{12}$ In general, $\frac{a}{b}+\frac{c}{d}=\frac{(ad+bc)}{bd}$ KY.4.NF.1 Coherence KY.4.NF.3→ KY.5.NF.1→KY.6.EE.7
KY.5.NF.2 Solve word problems involving addition and subtraction of fractions. a. Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators. b. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. **MP.1**, **MP.4**	a. For example: Mary ate $\frac{1}{3}$ of the pizza. Tommy ate $\frac{2}{5}$ of the pizza. How much of the total pizza did they eat together? ● making equivalent fractions to add/subtract fractions ● using visual representations to add/subtract fractions ○ Area Model ○ Linear Model b. Recognize an incorrect result $\frac{2}{5}+\frac{1}{2}=\frac{3}{7}$, by observing that $\frac{3}{7}<\frac{1}{2}$. Note: Estimation skills include identifying when estimation is appropriate, determining method of estimation and verifying solutions or determining the reasonableness of situations using various estimation strategies. The skill of estimating within context allows students to further develop their number sense. Coherence KY.4.NF.3→KY.5.NF.2

Attending to the Standards for Mathematical Practice

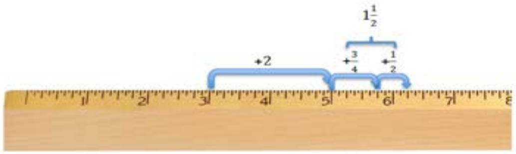
As students add and subtract fractions, they make sense of situations in story problems, selecting and creating representations of the situation such as partitioned rectangles or number lines (**MP.1**, **4**). Students notice if the fractions in the problem can be solved using a reasoning strategy, or if it is more efficient to find common denominators (**MP.2**). For example, for the problem $2\frac{3}{4}+3\frac{1}{2}$, students may mentally or physically refer to a ruler and use a counting up strategy:

Attending to the Standards for Mathematical Practice

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



$2\frac{3}{4} + 3\frac{1}{2} = 3 + 2 + \frac{3}{4} + \frac{1}{2} = 5 + 1\frac{1}{4} = 6\frac{1}{4}$



Or, students use a break apart strategy noticing $\frac{3}{4}$ is $\frac{1}{2} + \frac{1}{4}$ and therefore, reason there are 6 wholes and $\frac{1}{4}$ more, so $6\frac{1}{4}$ is the sum. Other students rewrite the fractions as $2\frac{3}{4} + 3\frac{2}{4}$ and add the whole numbers and fractions separately and then combine them. Students explain their reasoning strategies and students listen to others who solved the problem differently than they solved it and determine if the reasoning makes sense, if it is efficient and if the answer is correct (**MP.3**).

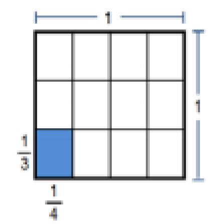
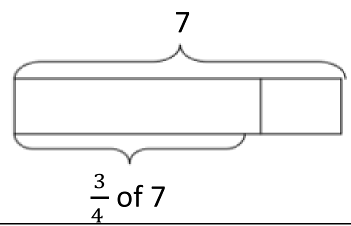
The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

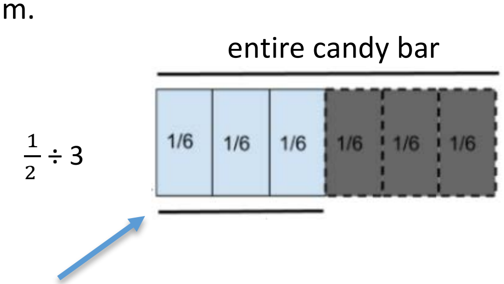
Number Operations - Fractions

Standards for Mathematical Practice

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

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

Standards	Clarifications
KY.5.NF.3 Interpret a fraction as division of the numerator by the denominator ($\frac{a}{b} = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers by using visual fraction models or equations to represent the problem. **MP.4**, **MP.8**	For example students interpret $\frac{3}{4}$ as the result of dividing 3 by 4, noting that $\frac{3}{4}$ multiplied by 4 equals 3 and when 3 wholes are shared equally among 4 people each person has a share of size $\frac{3}{4}$. Coherence KY.5.NF.3→KY.6.RP.2
KY.5.NF.4 Apply and extend previous understanding of multiplication to multiply a fraction or whole number by a fraction. a. Interpret the product $(\frac{a}{b})$ x q as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations a x $q \div b$. b. Find the area of a rectangle with fractional side lengths by tiling it with squares of the appropriate unit fraction side lengths and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles and represent fraction products as rectangular areas. **MP.1**	a. Students use a visual fraction model to show $(\frac{2}{3})$ x 4 = $\frac{8}{3}$ and create a story context for this equation. Do the same with $(\frac{2}{3})$ x $(\frac{4}{5})$ = $\frac{8}{15}$. (In general, $(\frac{a}{b})$ x $(\frac{c}{d})$ = $\frac{ac}{bd}$.)  b. For example the shaded portion shows the rectangle with the appropriate unit fraction side lengths. Coherence KY.4.NF.4→ KY.5.NF.4→KY.6.G.1
KY.5.NF.5 Interpret multiplication as scaling (resizing), by: a. Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication. b. Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a	$\frac{1}{4}$ x 7 is less than 7 because 7 is multiplied by a factor less than 1 so the product must be less than 7. 

Standards	Clarifications
fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $\frac{a}{b} = \frac{(n \times a)}{(n \times b)}$ to the effect of multiplying $\frac{a}{b}$ by 1. **MP.2**, **MP.6**	Coherence KY.4.OA.1→ KY.5.NF.5→KY.6.RP.1
KY.5.NF.6 Solve real world problems involving multiplication of fractions and mixed numbers. **MP.4**, **MP.5**	KY.5.MD.2 Coherence KY.4.NF.4→KY.5.NF.6
KY.5.NF.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. a. Interpret division of a unit fraction by a non-zero whole number and compute such quotients. b. Interpret division of a whole number by a unit fraction and compute such quotients. c. Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions. **MP.1**, **MP.4**, **MP.8**	Students build upon the knowledge of division they gained in grades 3 and 4. Students connect previous understanding of division of whole numbers to divide whole numbers by unit fractions and unit fractions by whole numbers. Division of a fraction by a fraction is not a requirement at grade 5. a. Create a story context for $(\frac{1}{3}) \div 4$ and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that $(\frac{1}{3}) \div 4 = \frac{1}{12}$ because $(\frac{1}{12}) \times 4 = \frac{1}{3}$. b. Create a story context for $4 \div (\frac{1}{5})$ and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that $4 \div (\frac{1}{5}) = 20$, because $20 \times (\frac{1}{5}) = 4$. c. By using visual fraction models and equations to represent the problem.  Each child will get one piece. Half to be shared with 3 students. Coherence KY.4.NF.4→ KY.5.NF.7→KY.6.NS.1

Attending to the Standards for Mathematical Practice
Students look for repeated reasoning in order to understand the meaning of the operations (**MP.8**). Rather than memorize rules that do not make sense, students use mathematical representations to consider the relative size of their answers (**MP.4**). For example, students solve the classic "brownie sharing" problems, wherein brownies are shared equally with children. In considering how 4 children share 5 brownies. They use drawings of rectangles and partition to show each child will get $1\frac{1}{4}$ brownies. As students continue to explore brownie sharing, they notice patterns. In this case, they see $5 \div 4$ means the same as $\frac{5}{4}$ (**MP.4**). Students reason quantitatively as they work on scaling problems in context (**MP.2**). For example, in $\frac{3}{4}$ of 16, students might reason the answer is less than 16. To solve it, they begin by thinking $\frac{1}{4}$ of 16 is 4, then think 3 groups of 4 is 12. As students divide a problem such as $4 \div \frac{1}{8}$, $7 \div \frac{1}{8}$, $10 \div \frac{1}{8}$, they notice how many eighths in one whole and then multiply by how many wholes they have. This pattern leads to an understanding of why it looks like they are multiplying by the denominator (**MP.8**).

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

Cluster: Convert like measurement units within a given measurement system.

Standards	Clarifications
KY.5.MD.1 Convert among different size measurement units (mass, weight, liquid volume, length, time) within one system of units (metric system, U.S. standard system and time). **MP.3**, **MP.8**	Within the same system convert measurements in a larger unit in terms of a smaller unit and a smaller unit in terms of a larger unit. Use these conversions in solving multi-step, real world problems. Coherence KY.4.MD.1→ KY.5.MD.1→KY.6.RP.3

Attending to the Standards for Mathematical Practice

Students notice patterns about how units and measurements relate to each other (**MP.8**). For example, students measure various objects in meters and in centimeters (using a meter stick). As they measure their items, they record the measurements in a table. They notice the object that measures about 300 centimeters also measures about 3 meters (**MP.8**). They explain why this pattern is true, arguing each of the meters has 100 centimeters, so 3 meters will have 300 centimeters and more generally explaining the smaller the unit the more of unit there will be when measuring the same object (**MP.3**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Measurement and Data	
Standards for Mathematical Practice	
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Cluster: Understand and apply the statistics process.	
Standards	**Clarifications**
KY.5.MD.2 Identify and gather data for statistical questions focused on both categorical and numerical data. Select an appropriate data display (bar graph, pictograph, dot plot). Make observations from the graph about the questions posed. **MP.4**, **MP.5**, **MP.6**	Generate questions for which data can be gathered and sort questions that are categorical (Possible question: What is your favorite after-school activity?) and questions that are numerical (Possible question: How many times can you say/write your name in one minute?). After gathering data on a question, students discuss which graphs are possible and which ones are not possible, and why. Students select one type of graph that fits the data gathered and create the graph, by hand or by using technology. KY.6.SP.2 Coherence KY.4.MD.4→ KY.5.MD.2→KY.6.SP.4
Attending to the Standards for Mathematical Practice	
After gathering data on a question of interest, students recognize they have many data points and therefore, decide they will do a scaled graph (**MP.4**). In creating the graph, they decide to do a picture graph and pick a scale of 1 picture = 4 data points (**MP.6**). In another situation, students recognize they have numerical data and create a dot plot and decide to use a spreadsheet on the computer to create the graph (**MP.5**). Students compare how dot plots and bar graphs are similar and different, recognizing when to use each (**MP.6**).	

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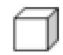
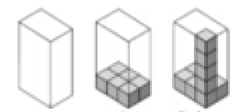
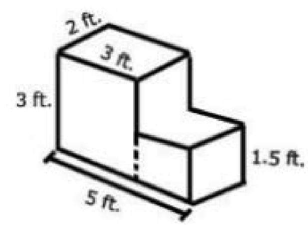
Measurement and Data

Standards for Mathematical Practice

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

Cluster: Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.

Standards	Clarifications
KY.5.MD.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units. **MP.6**	a.   b. Coherence KY.3.MD.5→ KY.5.MD.3
KY.5.MD.4 Measure volumes by counting unit cubic cm, cubic in, cubic ft. and improvised units. **MP.5**, **MP.6**	Coherence KY.3.MD.6→ KY.5.MD.4
KY.5.MD.5 Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. a. Find the volume of a right 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, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes. b. Apply the formulas *V= l x w x h* and *V = B x h* for rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems. c. Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by	For example, students determine the volume of concrete needed to build the steps in the diagram below.  Coherence KY.4.MD.3→ KY.5.MD.5→KY.6.G.2

Standards	Clarifications
adding the volumes of the non-overlapping parts, applying this technique to solve real world problems. **MP.1**, **MP.4**, **MP.8**	

Attending to the Standards for Mathematical Practice
Students use cubes to cover a bottom layer of a rectangular prism, understanding cube as a unit cube (**MP.5**). As students place the cubes in layers to fill the rectangular solid, they notice the number of cubes in each layer can be found by multiplying [number of cubes in one row] x [number of rows] and this product (the base) can be multiplied by how many layers to determine how many unit cubes will fill the container (**MP.8**). Students connect this idea to the formulas for volume and use these formulas to solve problems (**MP.4**). When a three-dimensional shape is not a single rectangular solid, students analyze the shape and its measurements to determine how to decompose the shape and find the volume of each prism (**MP.1**).

Standards for Mathematical Practice	
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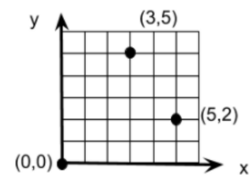
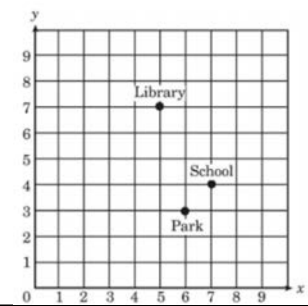
Cluster: Graph points on the coordinate plane to solve real-world and mathematical problems.

Standards	Clarifications
KY.5.G.1 Use a pair perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis and the second number indicates how far to travel in the direction of the second. **MP.4**, **MP.7**	This standard pertains to the first quadrant only which limits to positive ordered pairs only.  Coherence KY.5.G.1→KY.6.NS.6
KY.5.G.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane and interpret coordinate values of points in the context of the situation. **MP.1**, **MP.6**	For example, students use the coordinate grid, which ordered pair represents locations of places or objects.  KY.6.NS.8 Coherence KY.5.G.2→KY.6.G.3

Attending to the Standards for Mathematical Practice

Students notice a coordinate axis, is in fact, coordinating a horizontal number line with a vertical number line (**MP.7**). These two lines need a title, scale and a label in order to be understood by a reader (**MP.6**). Students record data in their graph from exploring a pattern and gain insights about the pattern. For example, students graph data from a two-column table that shows the cost of buying pineapples (one pineapple costs $2, three pineapples costs $6) and use the coordinate axis to explain what they notice about the relationship between the number of pineapples and the cost of pineapples (**MP.1**).

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

Cluster: Classify two-dimensional figures into categories based on their properties.

Standards	Clarifications
KY.5.G.3 Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. **MP.3**, **MP.6**	For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles. Coherence KY.4.G.2→ KY.5.G.3
KY.5.G.4 Classify two-dimensional figures in a hierarchy based on properties. **MP.1**, **MP.7**	Figures from previous grades: polygons, rhombus/rhombi, rectangle, square, triangle quadrilateral, pentagon, hexagon, cube, trapezoid, half/quarter, circle. For example: • Polygon - a closed plan figure formed from line segments that meet only at their endpoints. • Quadrilateral - a four-sided polygon • Rectangle - a quadrilateral with two pairs of congruent parallel sides and four right angles. • Rhombus - a parallelogram with all four sides equal in length • Square - a parallelogram with four congruent sides and four right angles. Coherence KY.4.G.2→ KY.5.G.4

Attending to the Standards for Mathematical Practice

As they have done in grade 3, students describe attributes they notice for a particular type of quadrilateral, focusing on side lengths and angles (**MP.6**). They compare the lists of defining attributes across shapes to notice what they have in common and what is different**.** (**MP.7**). They explain some types of quadrilaterals (parallelograms) are also rectangles because all the attributes of a parallelogram are also attributes of a rectangle (**MP.3**). They use this analysis to build an understanding of a rectangle as a special case of a parallelogram (a parallelogram with 90 degree angles) and use these understandings to create a hierarchy of quadrilaterals (**MP.1**).

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