Grade/Subject	**Grade 5 Math**
Unit Title	**Unit 1- Order of Operations and Whole Numbers**
Overview of Unit	• WRITE AND INTERPRET NUMERICAL EXPRESSIONS • UNDERSTAND THE PLACE VALUE SYSTEM • PERFORM OPERATIONS WITH MULTI-DIGIT WHOLE NUMBERS AND WITH DECIMALS TO HUNDREDTHS.
Pacing	**5-6 Weeks**

Essential Questions (and Corresponding Big Ideas)

- **Essential Question** (Corresponding Big Idea)
  - Why is it important to follow an order of operations?
  - How can I write an expression that demonstrates a situation or context?
  - How can an expression be written given a set value?
  - What is the difference between an equation and an expression?
  - In what kinds of real world situations might we use equations and expressions?
  - How can we evaluate expressions?
  - How does multiplying a whole number by a power of ten affect the product?
  - How can estimating help us when solving multiplication problems?
  - What strategies can we use to efficiently solve multiplication problems?
  - How can I use what I know about multiplying multiples of ten to multiply two whole numbers?
  - How can estimating help us when solving division problems?
  - What strategies can we use to efficiently solve division problems?
  - How can I effectively explain my mathematical thinking and reasoning to others?
  - How can I effectively critique the reasoning of others?

Core Content Standards	Explanations and Examples (Developed by Arizona DOE)
5.OA.1	Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
5.OA.2	Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.

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 1/10 of what it represents in the place to its left.
5.NBT.2	Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and 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.
5.NBT.5	Fluently multiply multi-digit whole numbers using the standard algorithm.
5.NBT.6	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, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

Standards for Mathematical Practice	Explanations and Examples
1. Make sense of problems and persevere in **solving them**	• **Students solve problems by applying their understanding of operations with whole numbers, including the order of operations. Students seek the meaning of a problem and look for efficient ways to solve it.**
2. Reason abstractly and quantitatively	• **Students demonstrate abstract reasoning to connect quantities to written symbols and create a logical representation of the problem at hand. Students write simple expressions that record calculations with numbers and represent numbers using place value concepts.**
3. Construct viable arguments and critique the reasoning of others	• **Students 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 explain their thinking to others and respond to others' thinking.**

4. Model with mathematics	• **Students use base ten blocks, drawings, and equations to represent place value and powers of ten. They interpret expressions and connect them to representations.**
5. Use appropriate tools strategically	• **Students select and use tools such as estimation, graph paper, and place value charts to solve problems with whole number operations.**
6. Attend to precision	• **Students use clear and precise language (math talk) in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to expressions, place value, and powers of ten**
7. Look for and make use of structure	• **Students use properties of operations as strategies to add, subtract, multiply, and divide with whole numbers. They explore and use patterns to evaluate expressions. Students utilize patterns in place value and powers of ten and relate them to graphical representations of them.**
8. **Look for and express regularity in repeated reasoning**	• **Students use repeated reasoning to understand algorithms and make generalizations about patterns. Students connect place value and properties of operations to fluently perform operations.**

ISTE Standards

(http://www.iste.org/standards/nets-for-students.aspx)
After reading their descriptions, DELETE those that do not apply to this unit of study and indicate the substandard(s) that do apply to the unit.

1. **Creativity**
2. **Communication and Collaboration**
3. **Research and Information Fluency**

4. **Critical Thinking, Problem Solving, and Decision Making**
5. **Digital Citizenship**
6. **Technology Operations and Concepts**

K-U-D	
KNOW *Facts, formulas, information, vocabulary*	**DO** *Skills of the discipline, social skills, production skills, processes (usually verbs/verb phrases)* *Hint: Use the standards!*
• Algorithm • Distributive Property • Dividend • Divisor • Equation • Exponents • Expression • Measurement Division (or repeated subtraction) • Multiplicand • Multiplier • Order of Operations • Partition Division (or fair-sharing) • Partial Product • Partial Quotient • Product • Properties of Operations • Quotient • Remainder	• Solve problems by representing mathematical relationships between quantities using mathematical expressions and equations. • Use the four whole number operations efficiently, including the application of order of operations. • Write, evaluate, and interpret mathematical expressions with and without using symbols. • Apply strategies for multiplying a 2- or 3-digit number by a 2-digit number. • Develop paper-and-pencil multiplication algorithms (not limited to the traditional algorithm) for 3- or 4-digit number multiplied by a 2- or 3-digit number. • Apply paper-and-pencil algorithms for division. • Solve problems involving multiplication and division. • Investigate the effects of multiplying whole numbers by powers of 10.

UNDERSTAND

Big ideas, generalizations, principles, concepts, ideas that transfer across situations

- Students will understand that multiplication may be used to find the total number of objects when objects are arranged in equal groups**.**
- Students will understand that one of the factors in multiplication indicates the number of objects in a group and the other factor indicates the number of groups.
- Students will understand that the dividend, divisor, quotient, and remainder are related in the following manner: dividend = divisor x quotient + remainder.
- Students will understand that the properties of multiplication and division help us solve computation problems easily and provide reasoning for choices we make in problem solving.

Math Grade 5

Vocabulary
• Algorithm • Distributive Property • Dividend • Divisor • Equation • Exponents • Expression • Measurement Division (or repeated subtraction) • Multiplicand • Multiplier • Order of Operations • Partition Division (or fair-sharing) • Partial Product • Partial Quotient • Product • Properties of Operations • Quotient • Remainder
Tools/Manipulatives
• **Math Journals** • **Color tiles** • **Number tiles** • **Dice** • **iPads** • **Graph paper** • **Base Ten Blocks** • **Place Value Mats**

Grade/Subject	**Grade 5 Math**
Unit Title	**Unit 2/Decimals**
Overview of Unit	This unit calls for students to reason about the magnitude of numbers. Students should work with the idea that the tens place is ten times as much as the ones place, and the ones place is 1/10th the size of the tens place. In 4th grade, students examined the relationships of the digits in numbers for whole numbers only. This standard extends this understanding to the relationship of decimal fractions. Students use base ten blocks, pictures of base ten blocks, and interactive images of base ten blocks to manipulate and investigate the place value relationships. They use their understanding of unit fractions to compare decimal places and fractional language to describe those comparisons. Before considering the relationship of decimal fractions, students express their understanding that in multi-digit whole numbers, a digit in one place represents 10 times what it represents in the place to its right and 1/10 of what it represents in the place to its left. Students should build on their work from 4th grade, where they worked with both decimals and fractions interchangeably. Expanded form is included to build upon work in 5.NBT.2 and deepen students' understanding of place value. Students build on the understanding they developed in fourth grade to read, write, and compare decimals to thousandths. They connect their prior experiences with using decimal notation for fractions and addition of fractions with denominators of 10 and 100. They use concrete models and number lines to extend this understanding to decimals to the thousandths. Models may include base ten blocks, place value charts, grids, pictures, drawings, manipulatives, technology-based, etc. They read decimals using fractional language and write decimals in fractional form, as well as in expanded notation. This investigation leads them to understanding equivalence of decimals. Students should go beyond simply applying an algorithm or procedure for rounding. The expectation is that students have a deep understanding of place value and number sense and can explain and reason about the answers they get when they round. Students should have numerous experiences using a number line to support their work with rounding. In 5th grade, students begin adding, subtracting, multiplying and dividing decimals. This work should focus on concrete models and pictorial representations, rather than relying solely on the algorithm. The use of symbolic notations involves having students record the answers to computations ($2.25 \times 3 = 6.75$), but this work should not be done without models or pictures. This standard includes students' reasoning and explanations of how they use models, pictures, and strategies. This standard requires students to extend the models and strategies they developed for whole numbers in grades 1-4 to decimal values. Before students are asked to give exact answers, they should estimate answers based on their understanding of operations and the value of the numbers.
Pacing	**5-6 Weeks**

Essential Questions (and Corresponding Big Ideas)
• **Essential Question** (Corresponding Big Idea) What is the relationship between decimals and fractions? • How can we read, write, and represent decimal values? • How are decimal numbers placed on a number line? • How can rounding decimal numbers be helpful? • How can you decide if your answer is reasonable? • How do we compare decimals? • Why is place value important when adding whole numbers and decimal numbers? • How does the placement of a digit affect the value of a decimal number? • Why is place value important when subtracting whole numbers and decimal numbers? • What strategies can I use to add and subtract decimals? • How do you round decimals? • How does context help me round decimals?

Core Content Standards	Explanations and Examples (Developed by Arizona DOE)
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 1/10 of what it represents in the place to its left. **Example:** A student thinks, "I know that in the number 5555, the 5 in the tens place (5555) represents 50 and the 5 in the hundreds place (5555) represents 500. So a 5 in the hundreds place is ten times as much as a 5 in the tens place or a 5 in the tens place is 1/10th of the value of a 5 in the hundreds place. Based on the base-10 number system, digits to the left are times as great as digits to the right; likewise, digits to the right are 1/10th of digits to the left. For example, the 8 in 845 has a value of 800 which is ten times as much as the 8 in the number 782. In the same spirit, the 8 in 782 is 1/10th the value of the 8 in 845.
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, e.g., 347.392 = 3 × 100 + 4 × 10 + 7 × 1 + 3 ×

	(1/10) + 9 x (1/100) + 2 × (1/1000). b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. **Example:** Some equivalent forms of 0.72 are: 72/100 7/10 + 2/100 7 × (1/10) + 2 × (1/100) 0.70 + 0.02 **Examples:** Comparing 0.25 and 0.17, a student might think, "25 hundredths is more than 17 hundredths". They may also think that it is 8 hundredths more. They may write this comparison as 0.25 > 0.17 and recognize that 0.17 < 0.25 is another way to express this comparison. Comparing 0.207 to 0.26, a student might think, "Both numbers have 2 tenths, so I need to compare the hundredths. The second number has 6 hundredths and the first number has no hundredths so the second number must be larger. Another student might think while writing fractions, "I know that 0.207 is 207 thousandths (and may write 207/1000). 0.26 is 26 hundredths (and may write 26/100) but I can also think of it as 260 thousandths (260/1000). So, 260 thousandths is more than 207 thousandths.
5.NBT.4	Use place value understanding to round decimals to any place. This standard refers to rounding. Students should go beyond simply applying an algorithm or procedure for rounding. The expectation is that students have a deep understanding of place value and number sense and can explain and reason about the answers they get when they round. Students should have numerous experiences using a number line to support their work with rounding. **Example:** Round 14.235 to the nearest tenth. Students recognize that the possible answer must be in tenths thus, it is either 14.2 or 14.3. They then identify that 14.235 is closer to 14.2 (14.20) than to

	14.3 (14.30).
5.NBT.7	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. This work should focus on concrete models and pictorial representations, rather than relying solely on the algorithm. The use of symbolic notations involves having students record the answers to computations (2.25 × 3= 6.75), but this work should not be done without models or pictures. This standard includes students' reasoning and explanations of how they use models, pictures, and strategies. **Example:** 4 - 0.3 3 tenths subtracted from 4 wholes. One of the wholes must be divided into tenths. The solution is 3 and 7/10 or 3.7. **Example:** 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? Student 1: 1.25 + 0.40 + 0.75 First, I broke the numbers apart. 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 0.05's to get 0.10. I combined 0.40 and 0.20 to get 0.60. I added the 1 whole from 1.25. I ended up with 1 whole, 6 tenths, 7 more tenths, and another 1 tenths, so the total is 2.4.
Standards for Mathematical Practice	**Explanations and Examples**
9. Make sense of problems and persevere in solving them	• **Students solve problems by applying their understanding of operations with whole numbers, including the order of operations. Students seek the meaning of a problem and look for efficient ways to solve it.**

10. Reason abstractly and quantitatively	• **Students demonstrate abstract reasoning to connect quantities to written symbols and create a logical representation of the problem at hand. Students write simple expressions that record calculations with numbers and represent numbers using place value concepts.**
11. Construct viable arguments and critique the reasoning of others	• **Students 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 explain their thinking to others and respond to others' thinking.**
12. Model with mathematics	• **Students use base ten blocks, drawings, and equations to represent place value and powers of ten. They interpret expressions and connect them to representations.**
13. Use appropriate tools strategically	• **Students select and use tools such as estimation, graph paper, and place value charts to solve problems with whole number operations.**
14. Attend to precision	• **Students use clear and precise language (math talk) in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to expressions, place value, and powers of ten**
15. Look for and make use of structure	• **Students use properties of operations as strategies to add, subtract, multiply, and divide with whole numbers. They explore and use patterns to evaluate expressions. Students utilize patterns in place value and powers of ten and relate them to graphical representations of them.**

16. **Look for and express regularity in repeated reasoning**	• **Students use repeated reasoning to understand algorithms and make generalizations about patterns. Students connect place value and properties of operations to fluently perform operations.**

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8. **Communication and Collaboration**
9. **Research and Information Fluency**
10. **Critical Thinking, Problem Solving, and Decision Making**
11. **Digital Citizenship**
12. **Technology Operations and Concepts**

K-U-D

KNOW *Facts, formulas, information, vocabulary*	**DO** *Skills of the discipline, social skills, production skills, processes (usually verbs/verb phrases)* *Hint: Use the standards!*
• decimal • fraction • decimal point • hundredths • ones • place value • rounding • tenths • thousandths	• understand place value relationships to the thousandths • compare decimals • order, add, and subtract one, two, and three digit decimals. • compare decimals and express their relationship using the symbols, >,<, or = • place decimals on a number line • represent decimal addition and subtraction on a number line • use decimals to solve problems

UNDERSTAND
Big ideas, generalizations, principles, concepts, ideas that transfer across situations

• Students will understand that like whole numbers, the location of a digit in decimal numbers determines the value of the digit.
• Students will understand that rounding decimals should be “sensible” for the context of the problem.
• Students will understand that decimal numbers can be represented with models.
• Students will understand that addition and subtraction with decimals are based on the fundamental concept of adding and subtracting the numbers in like position values.

MATH Grade 5

Unit Assessment/Performance Task	DOK
See separate performance task and rubric templates	

Vocabulary
• decimal • fraction • decimal point • hundredths • ones • place value • rounding • tenths • thousandths
Interdisciplinary Connections
Tools/Manipulatives
• **Place value mats** • **Dice** • **Number tiles** • **Math Journals** • **Graph paper** • **iPads**

Grade/Subject	Grade 5 Math
Unit Title	Unit 3/Multiplying & Dividing with Decimals
Overview of Unit	**Perform operations with multi-digit whole numbers and with decimals to the hundredths:** General methods used for computing products of whole numbers extend to products of decimals. Because the expectations for decimals are limited to thousandths and expectations for factors are limited to hundredths at this grade level, students will multiply tenths with tenths and tenths with hundredths, but they need not multiply hundredths with hundredths. Before students consider decimal multiplication more generally, they can study the effect of multiplying by 0.1 and by 0.01 to explain why the product is ten or a hundred times as small as the multiplicand (moves one or two places to the right). They can then extend their reasoning to multipliers that are single-digit multiples of 0.1 and 0.01 (e.g., 0.2 and 0.02, etc.). There are several lines of reasoning students can use to explain the placement of the decimal point in other products of decimals. Students can think about the product of the smallest base-ten units of each factor. For example, a tenth times a tenth is a hundredth, so 3.2 x 7.1 will have an entry in the hundredths place. Note, however, that students might place the decimal point incorrectly for 3.2 x 8.5 unless they take into account the 0 in the ones place in the product of 32 x 85. (Or they can think of 0.2 x 0.5 as 10 hundredths.) They can also think of decimals as fractions or as whole numbers divided by 10 or 100. When they place the decimal point in the product, they have to divide by a 10 from each factor or 100 from one factor. For example, to see that 0.6 x 0.8 = 0.48, students can use fractions: 6/10 x 8/10 = 48/100. Students can also reason that when they carry out the multiplication without the decimal point, they have multiplied each decimal factor by 10 or 100, so they will need to divide by those numbers in the end to get the correct answer. Also, students can use reasoning about the sizes of numbers to determine the placement of the decimal point. For example, 3.2 x 8.5 should be close to 3 x 9, so 27.2 is a more reasonable product for 3.2 x 8.5 than 2.72 or 272. This estimation based method is not reliable in all cases, however, especially in cases students will encounter in later grades. Students can summarize the results of their reasoning such as those above as specific numerical patterns and then as one general overall pattern such as “the number of decimal places in the product is the sum of the number of decimal places in each factor.” General methods used for computing quotients of whole numbers extend to decimals with the additional issue of placing the decimal point in the quotient. As with decimal multiplication, students can first examine the cases of dividing by 0.1 and 0.01 to see that the quotient becomes 10 times or 100 times as large as the dividend. For example, students can view 7 ÷ 0.1 = as asking how many tenths are in 7. Because it takes 10

	tenths to make 1, it takes 7 times as many tenths to make 7, so 7 ÷ 0.1 = 7 x 10 = 70. Or students could note that 7 is 70 tenths, so asking how many tenths are in 7 is the same as asking how many tenths are in 70 tenths, which is 70. In other words, 7 ÷ 0.1 is the same as 70 ÷ 1. So dividing by 0.1 moves the number 7 one place to the left, the quotient is ten times as big as the dividend. As with decimal multiplication, students can then proceed to more general cases. Dividing by a decimal less than 1 results in a quotient larger than the dividend and moves the digits of the dividend one place to the left.
Pacing	**5-6 Weeks**

Essential Questions (and Corresponding Big Ideas)
• **Essential Question** (Corresponding Big Idea) • How can we use exponents to represent powers of 10? • How does multiplying or dividing by a power of ten affect the product? • How can we use models to help us multiply and divide decimals? • How do the rules of multiplying whole numbers relate to multiplying decimals? • How are multiplication and division related? • How are factors and multiples related to multiplication and division? • What are some patterns that occur when multiplying and dividing by decimals? • How can we efficiently solve multiplication and division problems with decimals? • What strategies are effective for finding a missing factor or divisor? • How can we check for errors in multiplication or division of decimals?

Core Content Standards	**Explanations and Examples** (Developed by Arizona DOE)
5.NBT.2	Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and 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.
5.NBT.7	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
Standards for Mathematical Practice	**Explanations and Examples**
17. Make sense of problems and persevere in	• **Students solve problems by applying and**

solving them	**extending their understanding of multiplication and division to decimals. Students seek the meaning of a problem and look for efficient ways to solve it. They determine where to place the decimal point in calculations.**
18. Reason abstractly and quantitatively	• **Students demonstrate abstract reasoning to connect decimal quantities to fractions, and to compare relative values of decimal numbers. Students round decimal numbers using place value concepts.**
19. Construct viable arguments and critique the reasoning of others	• **Students construct arguments using concrete referents, such as objects, pictures, and drawings. They explain calculations and placement of the decimal point, based upon models and rules that generate patterns. They explain their thinking to others and respond to others' thinking.**
20. Model with mathematics	• **Students use base ten blocks, drawings, number lines, and equations to represent decimal place value, multiplication and division. They determine which models are most efficient for solving problems.**
21. Use appropriate tools strategically	• **Students select and use tools such as graph or grid paper, base ten blocks, and number lines to accurately solve multiplication and division problems with decimals.**
22. Attend to precision	• **Students use clear and precise language, (math talk) in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to decimal place**

	value and use decimal points correctly.
23. Look for and make use of structure	• **Students use properties of operations as strategies to multiply and divide with decimals. Students utilize patterns in place value and powers of ten to correctly place the decimal point.**
24. **Look for and express regularity in repeated reasoning**	• **Students use repeated reasoning to understand algorithms and make generalizations about patterns. Students connect place value and properties of operations to fluently multiply and divide decimals.**

ISTE Standards
(*http://www.iste.org/standards/nets-for-students.aspx*) *After reading their descriptions, DELETE those that do not apply to this unit of study and indicate the substandard(s) that do apply to the unit.* **13. Creativity** **14. Communication and Collaboration** **15. Research and Information Fluency** **16. Critical Thinking, Problem Solving, and Decision Making** **17. Digital Citizenship** **18. Technology Operations and Concepts**

K-U-D	
KNOW *Facts, formulas, information, vocabulary*	**DO** *Skills of the discipline, social skills, production skills, processes (usually verbs/verb phrases)* *Hint: Use the standards!*
• array • associative property of multiplication • commutative property of multiplication • distributive property	• understand place value • use whole number exponents to denote powers of 10 • compare decimals

• dividend • division • divisor • factor • hundred thousands • hundreds • hundredths • identity property of multiplication • measurement division (or repeated subtraction) • millions • multiple • multiplier • ones • partial products • partition/partitive division (or fair-sharing) • place value • product • quotient • remainder • ten thousands • tens • tenths • thousands	• model multiplication and division of decimals • multiply and divide decimals by powers of 10 • use estimation when multiplying and dividing decimals • multiply and divide decimals with fluency • determine relationship between quantities algebraically • recognize student errors in multiplication and division of decimals • use decimals to solve problems

UNDERSTAND

Big ideas, generalizations, principles, concepts, ideas that transfer across situations

- Students will understand **that** the placement of the decimal is determined by multiplying or dividing a number by 10 or a multiple of 10.
- Students will understand **that** multiplication and division are inverse operations of each other.
- Students will understand **that** rules for multiplication and division of whole numbers also apply to decimals.

Unit Assessment/Performance Task	DOK
See separate performance task and rubric templates	

Vocabulary

- array
- associative property of multiplication
- commutative property of multiplication
- distributive property
- dividend
- division
- divisor
- factor
- hundred thousands
- hundreds
- hundredths
- identity property of multiplication
- measurement division (or repeated subtraction)
- millions
- multiple
- multiplier
- ones
- partial products
- partition/partitive division (or fair-sharing)
- place value
- product
- quotient
- remainder
- ten thousands
- tens
- tenths
- thousands

Interdisciplinary Connections
Tools/Manipulatives
• **Place value mats** • **Dice** • **Number tiles** • **Math Journals** • **Graph paper** • **iPads**

Grade/Subject	**Grade 5 Math**
Unit Title	**Unit 4/Addition, Subtraction, Multiplication & Division of Fractions**
Overview of Unit	**USE EQUIVALENT FRACTIONS AS A STRATEGY TO ADD AND SUBTRACT FRACTIONS**: Students apply their understanding of fractions and fraction models to represent the addition and subtraction of fractions with unlike denominators as equivalent calculations with like denominators. They develop fluency in calculating sums and differences of fractions, and make reasonable estimates of them. Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: fraction, equivalent, addition/ add, sum, subtraction/subtract, difference, unlike denominator, numerator, benchmark fraction, estimate, reasonableness, and mixed numbers. **APPLY AND EXTEND PREVIOUS UNDERSTANDINGS OF MULTIPLICATION AND DIVISION TO MULTIPLY AND DIVIDE FRACTIONS**: Students also use the meaning of fractions, of multiplication and division, and the relationship between multiplication and division 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.) Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: fraction, numerator, denominator, operations, multiplication/multiply, division/divide, mixed numbers, product, quotient, partition, equal parts, equivalent, factor, unit fraction, area, side lengths, fractional side lengths, scaling, comparing. It is important that students are eventually able use an algorithm to compute with fractions. However, building understanding through the use of manipulatives, mathematical representations, and student discourse while students develop these algorithms through problem solving tasks is research-based best practice.
Pacing	**5-6 Weeks**

Essential Questions (and Corresponding Big Ideas)
• **Essential Question** (Corresponding Big Idea) • How are equivalent fractions helpful when solving problems? • How can a fraction be greater than 1? • How can a model help us make sense of a problem? • How can comparing factor size to 1 help us predict what will happen to the product? • How can we tell if a fraction is greater than, less than, or equal to one whole? • What models can we use to help us add and subtract fractions with different denominators? • What strategies can we use for adding and subtracting fractions with different denominators? • When should we use models to solve problems with fractions? • How can I use a number line to compare relative sizes of fractions? • What connections can we make between the models and equations with fractions? • What does dividing a unit fraction by a whole number look like? • What does dividing a whole number by a unit fraction look like?

Core Content Standards	Explanations and Examples (Developed by Arizona DOE)
5.NF.1	• **Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.** **For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)**
5.NF.2	• **Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers.** **For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.**
5.NF.3	• **Interpret a fraction as division of the numerator by the denominator (a/b = a ÷ b). Solve word problems involving division of whole numbers**

	leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. **For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?**
5.NF.4	• **Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.** ➢ **a. Interpret the product (a/b) × q as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations a × q ÷ b.** **For example, use a visual fraction model to show (2/3) × 4 = 8/3, and create a story context for this equation. Do the same with (2/3) × (4/5) = 8/15. (In general, (a/b) × (c/d) = ac/bd.)** ➢ **b. Find the area of a rectangle with fractional side lengths by tiling it with unit 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.**

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 fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $a/b = (n \times a)/(n \times b)$ to the effect of multiplying a/b by 1.**
5.NF.6	• **Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.**

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.** **For example, create a story context for (1/3) ÷ 4, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (1/3) ÷ 4 = 1/12 because (1/12) × 4 = 1/3.** ➢ **b. Interpret division of a whole number by a unit fraction, and compute such quotients.** **For example, create a story context for 4 ÷ (1/5), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that 4 ÷ (1/5) = 20 because 20 × (1/5) = 4.** ➢ **c. Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem.** ➢ **For example, how much chocolate will each person get if 3 people share ½ lb of chocolate equally? How many 1/3-cup servings are 2 cups of raisins**
5.MD.2	• **Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots.** **For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were _____.**

Standards for Mathematical Practice	Explanations and Examples
25. Make sense of problems and persevere in solving them	• **Students make sense of the meaning of addition, subtraction, multiplication and division of fractions with whole- number multiplication and division.**
26. Reason abstractly and quantitatively	• **Students demonstrate abstract reasoning to create and display area models of multiplication and both sharing and measuring models for division. They extend this understanding from whole numbers to their work with fractions.**
27. Construct viable arguments and critique the reasoning of others	• **Students construct and critique arguments regarding their understanding of fractions greater than, equal to, and less than one whole.**
28. Model with mathematics	• **Students draw representations of their mathematical thinking as well as use words and numbers to explain their thinking.**
29. Use appropriate tools strategically	• **Students select and use tools such as candy bars, measuring sticks, and manipulatives of different fraction sizes to represent situations involving the relationship between fractions.**
30. Attend to precision	• **Students attend to the precision when comparing and contrasting fractions and whether or not they are equivalent. Students use appropriate terminology when referring to fractions.**
31. Look for and make use of structure	• **Students develop the concept of addition with fractions using common and unlike denominators through the use of various manipulatives.**

32. **Look for and express regularity in repeated reasoning**	• **Students relate new experiences to experiences with similar contexts when allowing students to develop relationships for fluency and understanding of fractional computation. Students explore operations with fractions with visual models and begin to formulate generalizations.**

ISTE Standards

(http://www.iste.org/standards/nets-for-students.aspx)
After reading their descriptions, DELETE those that do not apply to this unit of study and indicate the substandard(s) that do apply to the unit.

19. Creativity
20. Communication and Collaboration
21. Research and Information Fluency
22. Critical Thinking, Problem Solving, and Decision Making
23. Digital Citizenship
24. Technology Operations and Concepts

K-U-D

KNOW *Facts, formulas, information, vocabulary*	**DO** *Skills of the discipline, social skills, production skills, processes (usually verbs/verb phrases)* *Hint: Use the standards!*
• simplify • common denominator • unlike denominator • numerator • improper fraction • mixed number • unit fraction • equivalent • reasonableness • estimate • benchmark fraction • addition/add • subtraction/subtract • difference	• Add/Subtract fractions with like denominators • Add/Subtract mixed numbers • Convert mixed numbers to improper fractions • Convert improper fractions to mixed numbers • Compare fractions using >, <, = • Plot fractions on a number line • Use visual models to compare and find equivalent fractions • Multiply a fraction by a whole number • Convert fractions to decimals with powers of ten

UNDERSTAND *Big ideas, generalizations, principles, concepts, ideas that transfer across situations*
• Students will understand **that** a fraction is another representation for division. • Students will understand **that** fractions are relations – the size or amount of the whole matters. • Students will understand **that** fractions may represent division with a quotient less than one. • Students will understand **that** equivalent fractions represent the same value. • Students will understand **that** with unit fractions, the greater the denominator, the smaller the piece is. • Students will understand **that** pieces don't have to be congruent to be equivalent. • Students will understand **that** fractions and decimals are different representations for the same amounts and can be used interchangeably.

Unit Assessment/Performance Task	DOK
*****See separate performance task and rubric templates*****	

Vocabulary
• simplify • common denominator • unlike denominator • numerator • improper fraction • mixed number • unit fraction • equivalent • reasonableness • estimate • benchmark fraction • addition/add • subtraction/subtract • difference

Interdisciplinary Connections

Tools/Manipulatives
• **Fraction Strips/bars** • **Dice** • **Number tiles** • **Math Journals** • **Graph paper** • **iPads**

Math Grade 5

Grade/Subject	Grade 5/Math
Unit Title	Unit 5/2D Figures
Overview of Unit	In this unit, students will closely explore the attributes of shapes and classify shapes according to these attributes. Students will also understand that shapes can belong to sub categories and that many shapes can belong to more than one category. Students will be able to place shapes in a hierarchy according to the shapes attributes and definitions. This unit will culminate with the students analyzing a famous piece of artwork, naming and classifying shapes by attributes and creating their own piece of artwork using different types of triangles in the Geometry and Art performance task.
Pacing	2-3 weeks

Essential Questions (and Corresponding Big Ideas)

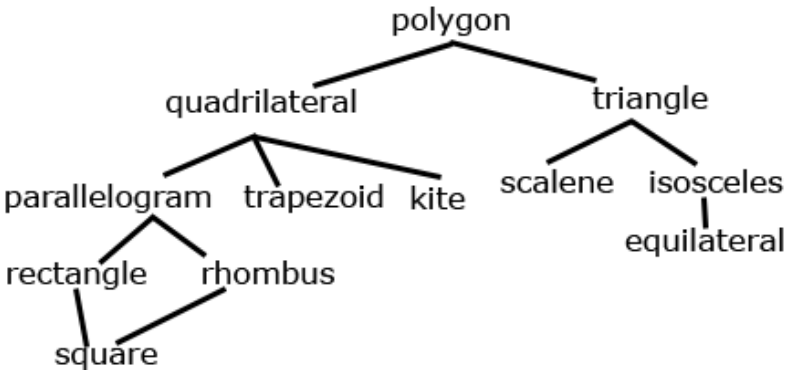
- How can plane figures be categorized and classified?
- What are properties of a quadrilateral?
- How can you classify different types of quadrilaterals?
- How can angle and side measurements help us create and classify triangles?
- Why are some quadrilaterals classified as parallelograms?
- Why is a square always a rectangle?
- What are ways to classify triangles?
- Where is geometry found in our everyday world?

From Teaching Student Centered Mathematics, Page 186, (Van De Walle and Lovin 2006)

- "Shapes exist in great variety. There are many different ways to describe attributes of shapes. The more ways that one can classify and discriminate shapes, the better one understands them."
- "Shapes have properties that can be used when describing and analyzing them. Awareness of these properties helps us appreciate shapes in our world. Properties can be explored and analyzed in a variety of ways."

"An analysis of geometric properties leads to deductive reasoning in a geometric environment."

Core Content Standards	Explanations and Examples (Developed by Arizona DOE)
5.G.B.3. Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.*	Geometric properties include properties of sides (parallel, perpendicular, congruent), properties of angles (type, measurement, congruent), and properties of symmetry (point and line). **Example**: • If the opposite sides on a parallelogram are parallel and congruent, then rectangles are parallelograms • A sample of 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? ○ Regular polygons have all of their sides and angles congruent. Name or draw some regular polygons. ○ All rectangles have 4 right angles. Squares have 4 right angles so they are also rectangles. True or False? ○ A trapezoid has 2 sides parallel so it must be a parallelogram. True or False? Technology Connections: http://illuminations.nctm.org/ActivityDetail.aspx?ID=70
5.G.B.4. Classify two-dimensional figures in a hierarchy based on properties.	Properties of figure may include: • Properties of sides—parallel, perpendicular, congruent, number of sides • Properties of angles—types of angles, congruent **Examples**: • A right triangle can be both scalene and isosceles, but not equilateral. • A scalene triangle can be right, acute and obtuse. • Triangles can be classified by: Angles ○ Right: The triangle has one angle that measures 90º. ○ Acute: The triangle has exactly three angles that measure between 0º and 90º. ○ Obtuse: The triangle has exactly one angle that measures greater than 90º and less than 180º. Sides ○ Equilateral: All sides of the triangle are the same length. ○ Isosceles: At least two sides of the triangle are the same length. ○ Scalene: No sides of the triangle are the same length. 
Standards for Mathematical Practice	**Explanations and Examples**
33. Make sense of problems and persevere in	**1.** Students solve problems by applying their understanding of

solving them	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?"
34. Reason abstractly and quantitatively	**2.** Fifth graders 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.
35. Construct viable arguments and critique the reasoning of others	**3.** In fifth grade, 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.
36. Model with mathematics	**4.** Students 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.
37. Use appropriate tools strategically	**5.** 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.
38. Attend to precision	**6.** Students 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

39. Look for and make use of structure 40. Look for and express regularity in repeated reasoning	their answers in cubic units. **7.** In fifth grade, 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.** 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.

ISTE Standards

(http://www.iste.org/standards/nets-for-students.aspx)
After reading their descriptions, DELETE those that do not apply to this unit of study and indicate the substandard(s) that do apply to the unit.

25. Creativity
26. Communication and Collaboration
27. Research and Information Fluency
28. Critical Thinking, Problem Solving, and Decision Making
29. Digital Citizenship
30. Technology Operations and Concepts

K-U-D

KNOW *Facts, formulas, information, vocabulary*	**DO** *Skills of the discipline, social skills, production skills, processes (usually verbs/verb phrases)* *Hint: Use the standards!*
• Attribute • Category • Sub-category • Two-dimensional • acute angle, obtuse angle, right angle • Parallel, congruent, adjacent, intersecting, perpendicular • Acute triangle, right triangle, obtuse triangle • Equilateral triangle, isosceles triangle, scalene triangle • Irregular polygon, regular polygon • Polygon • Triangle	• Classify (polygons by attribute) • Classify (quadrilaterals) • Classify (different types of quadrilaterals by their attributes) • Classify, sort and label (triangles according to angles and sides) • Identify and sort (2 dimensional geometric figures by their properties) • Classify (2 dimensional figures in a hierarchy based on properties)

• Quadrilateral • Parallelogram • Rectangle • Rhombus/rhombi • Square • Trapezoid • Pentagon • Hexagon • Octagon	

UNDERSTAND

Big ideas, generalizations, principles, concepts, ideas that transfer across situations

- The students will understand that shapes are defined by their attributes.
- The students will understand that there can be multiple ways to classify a polygon.
- The students will understand that 2D figures can fit into more than one category.

Vocabulary

- Bisect (divide into two equal parts)
- Hierarchy (series of ordered groupings of shapes)
- Hexagon (6 sided polygon)
- Acute Angle (angle measuring less than 90 degrees)
- Acute triangle (triangle/ all angles are acute)
- Angle (the union of two different rays sharing a common vertex)
- Attribute (given quality or characteristic)
- Congruent (same size/same shape)
- Degree measure of an angle (subdivide the length around a circle into 360 arcs of equal length; a central angle for any of these arcs is called a *one-degree angle* and is said to have angle measure of 1 degree)
- Equilateral Triangle (a triangle with all sides equal/all angles equal)
- Irregular polygon (and polygon that is not a regular polygon-see defn. of regular polygon below)
- Isosceles Triangle (a triangle with at least 2 equal sides/2 equal angles)
- Kite (quadrilateral with two pairs of two equal sides that are also adjacent; a kite can be a rhombus if all sides are equal)
- Obtuse angle (angle measure from 91 degrees to 179 degrees)
- Obtuse triangle (triangle with one obtuse angle)
- Parallel lines (two lines in a plane that do not intersect)
- Parallelogram (four-sided closed figure with opposite sides that are parallel and equal)
- Pentagon (five-sided polygon)
- Perpendicular (two lines are *perpendicular* if they intersect, and any of the angles formed between the lines are 90° angles)
- Perpendicular bisector (line that cuts a line segment into two equal parts at 90°)
- Plane (flat surface that extends infinitely in all directions)

- Polygon (closed figure made up of line segments)
- Quadrilateral (closed figure with four sides)
- Rectangle (parallelogram with four 90° angles)
- Rectangular prism (three-dimensional figure with six rectangular sides)
- Regular polygon (polygon that is equilateral and equiangular)
- Rhombus (parallelogram with four equal sides)
- Right angle (angle formed by perpendicular lines; angle measuring 90°)
- Right triangle (a triangle with 1 right angle)
- Scalene triangle (a triangle with 3 unequal sides/3 unequal angles)
- Square (rectangle with all equal sides)
- Straight angle (angle measuring exactly 180 degrees)
- Trapezoid (quadrilateral with at least one pair of parallel sides)
- Two-dimensional figures (figures on a plane)

Interdisciplinary Connections

Art: To familiarize students with shapes and attributes, students create a scene in which they incorporate and label specific shapes

Science: Students look to nature to explore where they can see two dimensional shapes in their surroundings

Language Arts: Engage students through the use of read-alouds (list of possible geometry read-aloud books is in literacy connections section above)

Tools/Manipulatives

Pattern blocks
Protractors
Centimeter grid paper
Set square or right angle template
Rulers (for measuring sides and for straight edge to draw shapes)

Works Cited

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Common Core Standards Writing Team. (2013, March 1). Progressions for the Common Core State Standards in Mathematics (draft). Tucson, AZ: Institute for Mathematics and Education, University of Arizona.

Van de Walle, J. A., Lovin, L.H (2006). Teaching Student-Centered Mathematics, grades 3-5. (Vol. 2). New Jersey: Pearson.

Clements, Douglas, Sarama, Julie, Learning and Teaching Early Math: The Learning Trajectories Approach (Studies in Mathematical Thinking and Learning Series) (2009)

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Mentoring Minds (2013). Motivation Math: Student Addition

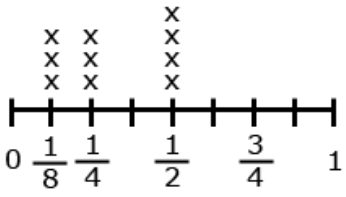
Growing With Mathematics, McGraw Hill Wright Group

MATH Grade 5

Grade/Subject	Grade 5/Math
Unit Title	Unit 6/Volume and Measurement
Overview of Unit	In this unit, students will explore volume, first by using manipulatives, then by solving using a formula. Students will also convert measurement through different units in both standard and metric systems. Students will also analyze and create line plots creating an understanding that line plots show the "shape" of data. This unit will culminate with the "Cake Baking Record" performance task. In this task, students will use their knowledge of volume, metric conversions and multiplying and dividing fractions to plan for baking a cake that can be submitted to the Guinness Book of World Records as the largest cake.
Pacing	4-5 weeks

Essential Questions (and Corresponding Big Ideas)

- How and why do we convert between units of measure?
- How do we measure volume?
- How are volume and area alike and different?
- What is the relationship between volumes of geometric solids?
- Why are some tools better to use than others when measuring volume?
- Why is volume represented with cubic units and area represented with square units?
- How can data sets be represented and analyzed using a line plot?

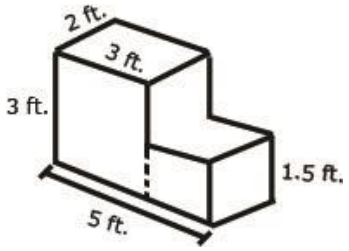
Core Content Standards	Explanations and Examples (Developed by Arizona DOE)
5.MD.A.1. Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.	In fifth grade, students build on their prior knowledge of related measurement units to determine equivalent measurements. Prior to making actual conversions, they examine the units to be converted, determine if the converted amount will be more or less units than the original unit, and explain their reasoning. They use several strategies to convert measurements. When converting metric measurement, students apply their understanding of place value and decimals.
5.MD.B.2. Make a line plot to display a data set of measurements in fractions of a unit ($1/2$, $1/4$, $1/8$). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.*	Ten beakers, measured in liters, are filled with a liquid. Liquid in Beakers  Amount of Liquid (in Liters) The line plot above shows the amount of liquid in liters in 10 beakers. If the liquid is redistributed equally, how

	much liquid would each beaker have? (This amount is the mean.) Students apply their understanding of operations with fractions. They use either addition and/or multiplication to determine the total number of liters in the beakers. Then the sum of the liters is shared evenly among the ten beakers.
5.MD.C.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.	Students' prior experiences with volume were restricted to liquid volume. As students develop their understanding 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. This cubic unit is written with an exponent of 3 (e.g., in^3, m^3). Students connect this notation to their understanding of powers of 10 in our place value system. Models of cubic inches, centimeters, cubic feet, etc., are helpful in developing an image of a cubic unit. Student's estimate how many cubic yards would be needed to fill the classroom or how many cubic centimeters would be needed to fill a pencil box.
5.MD.C.4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.	Students understand that same sized cubic units are used to measure volume. They select appropriate units to measure volume. For example, they make a distinction between which units are more appropriate for measuring the volume of a gym and the volume of a box of books. They can also improvise a cubic unit using any unit as a length (e.g., the length of their pencil). Students can apply these ideas by filling containers with cubic units (wooden cubes) to find the volume. They may also use drawings or interactive computer software to simulate the same filling process. Technology Connections: http://illuminations.nctm.org/ActivityDetail.aspx?ID=6
5.MD.C.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, e.g., to represent the associative property of multiplication. b. Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right 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 adding the volumes of the non-overlapping parts,	Students need multiple opportunities to measure volume by filling rectangular prisms with cubes and looking at the relationship between the total volume and the area of the base. They derive the volume formula (volume equals the area of the base times the height) and explore how this idea would apply to other prisms. Students use the associative property of multiplication and decomposition of numbers using factors to investigate rectangular prisms with a given number of cubic units. **Examples**: • When given 24 cubes, students make as many rectangular prisms as possible with a volume of 24 cubic units. Students build the prisms and record possible dimensions.

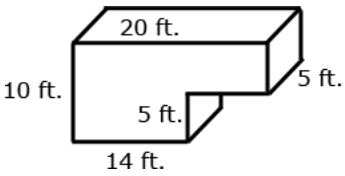
applying this technique to solve real world problems.

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

- Students determine the volume of concrete needed to build the steps in the diagram below.



- A homeowner is building a swimming pool and needs to calculate the volume of water needed to fill the pool. The design of the pool is shown in the illustration below.



Standards for Mathematical Practice	Explanations and Examples
41. Make sense of problems and persevere in solving them	**9.** Students 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?"
42. Reason abstractly and quantitatively	**10.** Fifth graders 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.
43. Construct viable arguments and critique the reasoning of others	**11.** In fifth grade, 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.
44. Model with mathematics	**12.** Students 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.
45. Use appropriate tools strategically	**13.** 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.
46. Attend to precision	**14.** Students 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.
47. Look for and make use of structure	**15.** In fifth grade, 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.
48. Look for and express regularity in repeated reasoning	**16.** 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.

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31. **Creativity**
32. **Communication and Collaboration**
33. **Research and Information Fluency**
34. **Critical Thinking, Problem Solving, and Decision Making**
35. **Digital Citizenship**
36. **Technology Operations and Concepts**

K-U-D

KNOW *Facts, formulas, information, vocabulary*	**DO** *Skills of the discipline, social skills, production skills, processes (usually verbs/verb phrases)* *Hint: Use the standards!*
• Cubic units • Square units • Area=length X width • Right rectangular prism • Volume = length X width X height • Volume = area X height • Metric units • Metric measurement conversions are based on 10 and the powers of 10 • Customary units • Familiarity with customary conversions: • *Customary conversions of length: 1 foot = 12 inches, 1 yard = 3 feet, 1 mile = 5,280 feet* • *Customary conversions of capacity: 1 gallon=4 quarts, 1 quart = 2 pints, 1 pint = 2 cups* • *Customary conversions of weight: 1 pound = 16 ounces* • Line plot	• Understand (cubic units) • Fill (boxes with cubic units to find volume) • Count (cubic units to find volume) • Relate (finding volume to repeatedly adding area) • Relate (finding volume by counting cubic units to multiplying the length, width and height) • Apply (the formula v = l x w x h or v = b x h to solve real world problems) • Determine (volumes of non-overlapping right rectangular prisms by adding the volumes of the each non-overlapping part) • Apply (finding the volume of non-overlapping right rectangular prisms to solve real world problems) • Convert (measurements within certain measurement system, metric and customary) • Apply (measurement conversions to solve real world problems) • Create (line plots to show distribution of data using fractions) • Use (operations with fractions to solve real world

	problems using line plots)

UNDERSTAND

Big ideas, generalizations, principles, concepts, ideas that transfer across situations

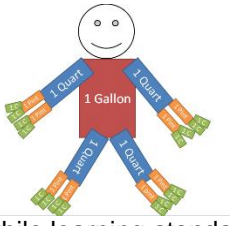
- Students will understand that volume refers to the space taken up by the object itself (the size of the three dimensional region)
- Students will understand that volume is measured and represented in cubic units.
- Students will understand the reasoning behind the formula used to find volume (v=l x w x h)
- Students will understand that volume can be expressed in both customary and metric units.
- Students will understand that when converting larger units to smaller units within the same system of measurement, there will be a greater number of smaller units. (same is true for converting smaller to larger-there will be fewer larger units)
- Students will understand that volume is related to area in that the area of the base is multiplied by the height.
- Students will understand that a line plot can show the "shape" of the collected data.

Vocabulary

Area (the number of square units that covers a two-dimensional shape)
Base (one face of a three dimensional solid)
Cubic units (cubes of the same size used for measuring volume)
Height (adjacent layers of the base that form a rectangular prism)
Rectangular prism (three-dimensional figure with six rectangular sides)
Right rectangular prism (rectangular prism with only 90 degree angles)
Unit cube (cube whose sides all measure 1 unit)
Volume of a solid (measurement of space or capacity)
Customary units of measurement (inches, feet, yards, miles, pounds, ounces, cups, pints, quarts, gallons)
Metric units of measurement (kilo-, meter, liter, gram, centi-, milli-)
Line plot (a display of distributed data)

Interdisciplinary Connections

Art: students learn to draw 3D cubes and 3D figures using unit cubes
Art: Students create "gallon man" to use as a visual while learning capacity conversions.



Art: Students create "yard bug" to use as a visual while learning standard length conversions

Language Arts: Engage students through the use of read-alouds (list of possible read-aloud books is in literacy connections section above)

Cooking/Baking: Students can read recipe cards and double or triple certain ingredients and convert cups to pints, pints to gallons.
Tools/Manipulatives
Centimeter cubes Centimeter grid paper Ruler

Works Cited

Common Core State Standards Initiative. (2010). Common core state standards for English language arts & literacy in history/social studies, science, and technical subjects. Washington, DC: National Governors Association Center for Best Practices and the Council of Chief State School Officers.

Common Core Standards Writing Team. (2013, March 1). Progressions for the Common Core State Standards in Mathematics (draft). Tucson, AZ: Institute for Mathematics and Education, University of Arizona.

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Clements, Douglas, Sarama, Julie, Learning and Teaching Early Math: The Learning Trajectories Approach (Studies in Mathematical Thinking and Learning Series) (2009)

Georgia Department of Education Georgiastandards.org

Mentoring Minds (2013). Motivation Math: Teacher Addition

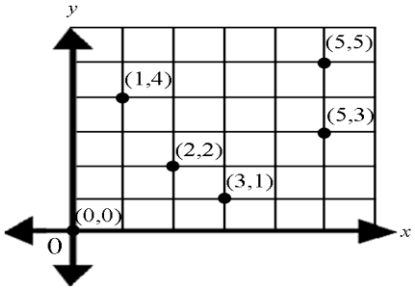
Mentoring Minds (2013). Motivation Math: Student Addition

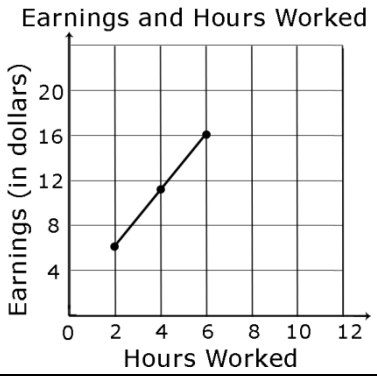
Growing With Mathematics, McGraw Hill Wright Group

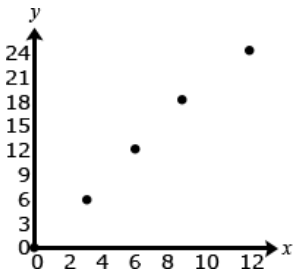
Grade/Subject	Grade 5/Math
Unit Title	Unit 7/Geometry and the Coordinate Plane
Overview of Unit	In this unit, the focus of instruction is on formulating data through finding patterns, generating ordered pairs and accurately displaying this data on a coordinate grid. Students will represent real world mathematical problems on coordinate grids to find patterns, interpret data and make predications. In the culminating task, What's the Better Buy, students will be comparing two price plans being offered at the Wolcott Fair and graphing data to select which plan would be the better buy.
Pacing	3-4 weeks

Essential Questions (and Corresponding Big Ideas)

- How does the coordinate system work?
- What relationship can be determined by analyzing two sets of given rules?
- How can we represent numerical patterns on a coordinate grid?
- How can a coordinate system help you better understand other map systems?

Core Content Standards	Explanations and Examples (Developed by Arizona DOE)
5.G.1. Use a pair of 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 axis, with the convention that the names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate).	**Examples**: • Students can use a classroom size coordinate system to physically locate the coordinate point (5, 3) by starting at the origin point (0,0), walking 5 units along the x axis to find the first number in the pair (5), and then walking up 3 units for the second number in the pair (3). The ordered pair names a point in the plane.  • Graph and label the points below in a coordinate system. ○ A (0, 0) ○ B (5, 1) ○ C (0, 6) ○ D (2.5, 6)

	○ E (6, 2) ○ F (4, 1) G (3, 0)
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.	**Examples**: • Sara has saved $20. She earns $8 for each hour she works. ○ If Sara saves all of her money, how much will she have after working 3 hours? 5 hours? 10 hours? ○ Create a graph that shows the relationship between the hours Sara worked and the amount of money she has saved. ○ What other information do you know from analyzing the graph? • Use the graph below to determine how much money Jack makes after working exactly 9 hours. 
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, and graph the ordered pairs on a coordinate plane. *For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.*	**Examples**: • Use the rule "add 3" to write a sequence of numbers. Starting with a 0, students write 0, 3, 6, 9, 12, . . . • Use the rule "add 6" to write a sequence of numbers. Starting with 0, students write 0, 6, 12, 18, 24, . . . After comparing these two sequences, the students notice that each term in the second sequence is twice the corresponding terms of the first sequence. One way they justify this is by describing the patterns of the terms. Their justification may include some mathematical notation (See example below). A student may explain that both sequences start with zero and to generate each term of the second sequence he/she added 6, which is twice as much as was added to produce the terms in the first sequence. Students may also use the distributive property to describe the relationship between the two numerical patterns by reasoning that 6 + 6 + 6 = 2 (3 + 3 + 3). ○ 0, $\overset{+3}{}$ 3, $\overset{+3}{}$ 6, $\overset{+3}{}$ 9, $\overset{+3}{}$12, . . .

	○ 0, $^{+6}$ 6, $^{+6}$ 12, $^{+6}$18, $^{+6}$ 24, . . . Once students can describe that the second sequence of numbers is twice the corresponding terms of the first sequence, the terms can be written in ordered pairs and then graphed on a coordinate grid. They should recognize that each point on the graph represents two quantities in which the second quantity is twice the first quantity. <u>Ordered pairs</u> (0, 0) (3, 6) (6, 12) (9, 18) 
Standards for Mathematical Practice	**Explanations and Examples**
49. Make sense of problems and persevere in solving them	**17.** Students 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?"
50. Reason abstractly and quantitatively	**18.** Fifth graders 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.
51. Construct viable arguments and critique the reasoning of others	**19.** In fifth grade, 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.

52. Model with mathematics	**20.** Students 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.
53. Use appropriate tools strategically	**21.** 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.
54. Attend to precision	**22.** Students 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.
55. Look for and make use of structure	**23.** In fifth grade, 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.
56. Look for and express regularity in repeated reasoning	**24.** 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.

ISTE Standards

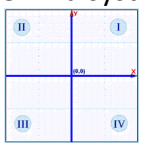
(http://www.iste.org/standards/nets-for-students.aspx)
After reading their descriptions, DELETE those that do not apply to this unit of study and indicate the substandard(s) that do apply to the unit.

37. Creativity

38. Communication and Collaboration
39. Research and Information Fluency
40. Critical Thinking, Problem Solving, and Decision Making
41. Digital Citizenship
42. Technology Operations and Concepts

K-U-D	
KNOW *Facts, formulas, information, vocabulary*	**DO** *Skills of the discipline, social skills, production skills, processes (usually verbs/verb phrases)* *Hint: Use the standards!*
Numerical patterns Rules Ordered pairs Coordinate plane Coordinate system First quadrant Points Lines Axis/axes x-axis y-axis horizontal vertical intersection of lines origin ordered pairs x-coordinate y-coordinate	• Generate (two number patterns using given rules) • Identify (relationship between corresponding terms and between two numbers) • Form (ordered pairs from a pattern) • Create (a coordinate grid using perpendicular lines with an origin at (0,0)) • Plot and graph (ordered pairs in the first quadrant of a coordinate plane) • Represent (real world and mathematical problems using a coordinate graph model)
UNDERSTAND *Big ideas, generalizations, principles, concepts, ideas that transfer across situations*	
• A plot point on a coordinate plane represents two values (ordered pair) • Predictions and interpretations about real world situations can be made by looking at graphical representations	

Vocabulary

- Axis/axes: a fixed reference line for the measurement of coordinates
- Coordinates: each of a group of numbers used to indicate the position of a point, line, or plane.
- Coordinate plane: plane formed by the intersection of a horizontal number line with a vertical number line.
- Coordinate system: a system of coordinates that use numbers to represent a point or lines
- First quadrant:  First of 4 areas made when we divide up a plane by an **x** and **y** axis (see picture)
- Horizontal: the direction from left to right: parallel to the horizon; at right angles to the vertical
- Intersection of lines: point where two lines cross
- Line
- Ordered pairs: a pair of mathematical objects. The order in which the objects appear in the pair is significant: the ordered pair (*a*, *b*) is different from the ordered pair (*b*, *a*) unless *a* = *b*.
- Origin: the point on the coordinate plane where the x-axis and y-axis intersect (0,0)
- Point: an exact location or position
- Rule: a procedure that a pattern must follow
- Vertical: straight up and down; perpendicular to the horizon
- X-axis: the principal or horizontal axis on the coordinate plane
- X-coordinate: the first number in an ordered pair, locating a point on the x-axis of a coordinate plane
- Y-axis: the secondary or vertical axis on the coordinate plane
- Y-coordinate: the second number in an ordered pair, locating a point on the y-axis of a coordinate plane

Interdisciplinary Connections

Language Arts: Engage students through the use of read-alouds (list of possible read-aloud books is in literacy connections section above)

Social Studies: Students look at map of country and place over a coordinate grid. Students can name the states that they have visited by listing the coordinate points of each state.

Social Studies: Any map work can involve the coordinate system for location

Science: Plot growth or measurement over time. Ex. Weather (plot temperature throughout morning and graph. Ordered pair could be the time and temperature.) Plot rainfall over time (plot amount of rainfall throughout morning. Ordered pair could be the time and amount of rainfall)

Tools/Manipulatives

Rulers
Graph paper

Works Cited

Common Core State Standards Initiative. (2010). Common core state standards for English language arts & literacy in history/social studies, science, and technical subjects. Washington, DC: National Governors Association Center for Best Practices and the Council of Chief State School Officers.

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