Mathematics

Curriculum
Grade 6

COMMON CORE STATE STANDARDS IN CONNECTICUT

Approved by Instructional Council on April 12, 2013

Overview:
This curriculum is aligned to the Common Core State Standards for Mathematics.
Standards are coded (see below). For each standard, or cluster of standards, activities are listed that are specific to those standards. Extensions, technology and other support materials (including those found in the teachers' manuals) are listed to help with differentiation of math instruction.

Standards for Mathematical Practice: The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. The Mathematical Practices should be used when planning lessons.
(See Appendix A for a full description of each standard with explanations and examples for your grade level.)

Standards for Mathematical Content: Examples and Explanations of each content standard can be found within this document. These examples were adapted from a document titled *MATHEMATICS: Arizona Academic Content Standards.*

Glossary of Terms: Key terms needed to understand the units of study can be found in Appendix A.

Vocabulary:
A list of important mathematical vocabulary can be found at the end of each unit. Students need to become fluent with vocabulary so that they can communicate effectively in mathematics. It is suggested that math vocabulary be posted for each unit, and that students have opportunities to "define" terms using words, numbers, pictures, examples and by making connections to their lives or other areas of mathematics.

Pacing Guide: Refer to the pacing guide for a sequence of units of study.

21st Century Skills: skills needed to be prepared for 21st century life, work and citizenship. An overview of these skills and Outcomes for 21st Century Skills in Math can be found in Appendix A.

Key to Coding:

Standards define what students should understand and be able to do.
Clusters are groups of related standards. Note that standards from different clusters may sometimes be closely related, because mathematics is a connected subject.
Domains are larger groups of related standards. Standards from different domains may sometimes be closely related.

Example:
CC.6.RP.1 refers to Common Core, Grade 6, Ratios and Proportional Relationships, standard 1.

Domain and clusters for Grade 6 can be found on the next page. Standards are listed in the text of the curriculum.

Grade 6

Domains	Ratios & Proportional Relationships	The Number System	Expressions and Equations	Geometry	Statistics and Probability
Clusters	• Understand ratio concepts and use ratio reasoning to solve problems	• Apply and extend previous understandings of multiplication and division to divide fractions by fractions • Compute fluently with multi-digit numbers and find common factors and multiples • Apply and extend previous understandings of numbers to the system of rational numbers	• Apply and extend previous understandings of arithmetic to algebraic expressions • Reason about and solve one-variable equations and inequalities • Represent and analyze quantitative relationships between dependent and independent variables	• Solve real-world and mathematical problems involving area, surface area, and volume	• Develop understanding of statistical variability • Summarize and describe distributions
Mathematical Practices	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.				

In Grade 6, instructional time should focus on four critical areas:

1. Connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems

• Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative size of quantities, students connect their understanding of multiplication and division with ratios and rates. Thus students expand the scope of problems for which they can use multiplication and division to solve problems, and they connect ratios and fractions. Students solve a wide variety of problems involving ratios and rates.

2. Completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers

• Students use the meaning of fractions, the meanings of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understandings of number and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers, and in particular negative integers. They reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.

3. Writing, interpreting, and using expressions and equations

• Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as $3x = y$) to describe relationships between quantities.

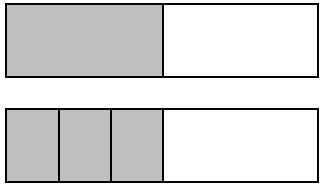
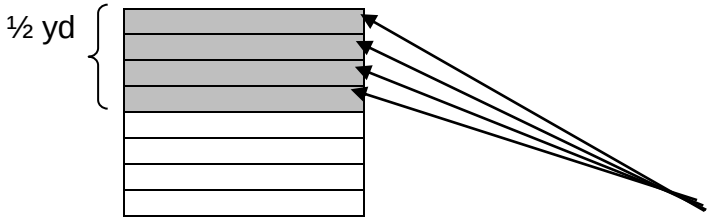
4. Developing understanding of statistical thinking

• Building on and reinforcing their understanding of number, students begin to develop their ability to think statistically. Students recognize that a data distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is roughly the middle value. The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students recognize that a measure of variability (interquartile range or mean absolute deviation) can also be useful for summarizing data because two very different sets of data can have the same mean and median yet be distinguished by their variability. Students learn to describe and summarize numerical data sets, identifying clusters, peaks, gaps, and symmetry, considering the context in which the data were collected.

Students in Grade 6 also build on their work with area in elementary school by reasoning about relationships among shapes to determine area, surface area, and volume. They find areas of right triangles, other triangles, and special quadrilaterals by decomposing these shapes, rearranging or removing pieces, and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposing them into pieces whose area they can determine. They reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths. They prepare for work on scale drawings and constructions in Grade 7 by drawing polygons in the coordinate plane.

Unit 1: Operating with Positive Rational Numbers **Pacing: 30 days + 5 days for reteaching/enrichment**
In this unit, students compute fluently with multi-digit whole numbers and decimals. They also divide fractions by fractions.

DOMAINS and standards: **THE NUMBER SYSTEM and GEOMETRY**

Priority and Supporting Common Core State Standards	Explanation and Examples
Students will apply and extend previous understandings of multiplication and division to divide fractions by fractions. **6.NS.1. INTERPRET and COMPUTE quotients of fractions, and SOLVE word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem.** *For example, create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is 2/3 (In general, (a/b) ÷ (c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?*	**6.NS.1.** Contexts and visual models can help students to understand quotients of fractions and begin to develop the relationship between multiplication and division. Model development can be facilitated by building from familiar scenarios with whole or friendly number dividends or divisors. Computing quotients of fractions build upon and extends student understandings developed in Grade 5. Students make drawings, model situations with manipulatives, or manipulate computer generated models. Examples: • 3 people share $\frac{1}{2}$ pound of chocolate. How much of a pound of chocolate does each person get? Solution: (Bar model) Each person gets $\frac{1}{6}$ lb of chocolate.  • Manny has $\frac{1}{2}$ yard of fabric to make book covers. Each book is made from $\frac{1}{8}$ yard of fabric. How many book covers can Manny make? Solution: Manny can make 4 book covers.  $\frac{1}{2} \div \frac{1}{8} = 4$ $\frac{1}{8}$ yard Continued on next page

• Represent $\frac{3}{4} \div \frac{3}{8}$ in a problem context and draw a model to show your solution.

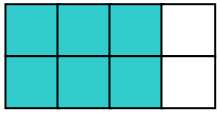
Context: You have $\frac{3}{4}$ yard of rope. Into how many $\frac{3}{8}$ yard pieces can you cut the rope?

Explanation of Model:

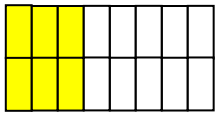
The first model shows $\frac{3}{4}$ yard. The second model shows $\frac{3}{8}$ yard.

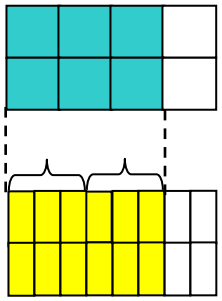
The third model shows how many $\frac{3}{8}$s will fit in $\frac{3}{4}$.

$\frac{3}{4}$



$\frac{3}{8}$





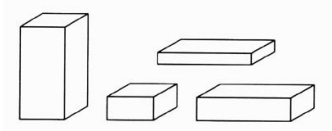
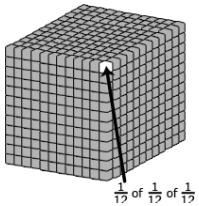
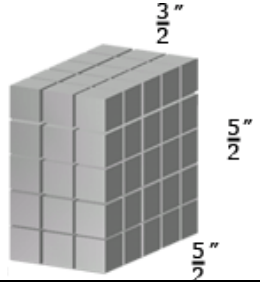
Two $\frac{3}{8}$s will fit in $\frac{3}{4}$

So, $\frac{3}{4} \div \frac{3}{8} = 2$

Priority and Supporting Common Core State Standards	Explanation and Examples
Students will compute fluently with multi-digit numbers and find common factors and multiples. 6.NS.2. FLUENTLY DIVIDE multi-digit numbers using the standard algorithm.	6.NS.2.Students are expected to fluently and accurately divide multi-digit whole numbers. Divisors can be any number of digits at this grade level. As students divide they should continue to use their understanding of place value to describe what they are doing. When using the standard algorithm, students' language should reference place value. For example, when dividing 32 into 8456, as they write a 2 in the quotient they should say, "there are 200 thirty-twos in 8456" and could write 6400 beneath the 8456 rather than only writing 64.

2 32)8456	There are 200 thirty twos in 8456.
2 32)8456 6400 2056	200 times 32 is 6400. 8456 minus 6400 is 2056.
26 32)8456 6400 2056	There are 60 thirty-twos in 2056
26 32)8456 6400 2056 1920 136	60 times 32 is 1920. 2056 minus 1920 is 135
264 32)8456 6400 2056 1920 136 128 8	There are 4 thirty-twos in 136. 4 times 32 is 128. The remainder is 8. There is not a full thirty-two in 8; there is only part of a thirty-two in 8. This can also be written as $\frac{8}{32}$ or $\frac{1}{4}$. There is ¼ of a thirty-two in 8. 8456 = 264 × 32 + 8

Priority and Supporting Common Core State Standards	Explanation and Examples
6.NS.3. FLUENTLY ADD, SUBTRACT, MULTIPLY and DIVIDE multi-digit decimals using the standard algorithm for each operation.	6.NS.3. The use of estimation strategies supports student understanding of operating on decimals. Example: First estimate the sum and then find the exact sum of 14.4 and 8.75. An estimate of the sum would be 14 + 9 or 23. Students could also state if their estimate is low or high, they would expect their answer to be greater than 23. Students can use their estimates to self-correct. Answers of 10.19 or 101.9 indicate that students are not considering the concept of place value when adding (adding tenths to tenths or hundredths to hundredths) whereas answers like 22.125 or 22.79 indicate that students are having difficulty understanding how the four-tenths and seventy-five hundredths fit together to make one whole and 25 hundredths. Students use the understanding they developed in 5^{th} grade related to the patterns involved when multiplying and dividing by powers of ten to develop fluency with operations with multi-digit decimals.

Priority and Supporting Common Core State Standards	Explanation and Examples
Students will solve real-world and mathematical problems involving area, surface area, and volume. 6.G.2. FIND the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. APPLY the formulas *V = l w h* and *V = b h* to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.	.6.G.2. Students need multiple opportunities to measure volume by filling rectangular prisms with blocks and looking at the relationship between the total volume and the area of the base. Through these experiences, students derive the volume formula (volume equals the area of the base times the height). NOTE: right rectangular prism - A prism with six rectangular faces where the lateral edge is perpendicular to the plane of the base. Examples:  In addition to filling boxes, students can draw diagrams to represent fractional side lengths, connecting with multiplication of fractions. This process is similar to composing and decomposing two dimensional shapes. Examples: • The model shows a cubic foot filled with cubic inches. The cubic inches can also be labeled as a fractional cubic unit with dimensions of $\frac{1}{12}$ ft ^{3}.  • The models show a rectangular prism with dimensions (3/2), 5/2, and 5/2 inches. Each of the cubic units in the model is $\frac{1}{2}$ in^3**.** Students work with the model to illustrate 3/2 x 5/2 x 5/2 = (3 x 5 x 5) x 1/8. Students reason that a small cube has volume 1/8 because 8 of them fit in a unit cube. 

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels

• division of fractions
• computation of multi-digit decimals
• solve problems
  ○ models
  ○ equations
  ○ standard algorithm
• volume
	• INTERPRET (quotients of fractions)
	• COMPUTE (quotients of fractions)
	• SOLVE (word problems involving division of fractions by fractions)
	• REPRESENT (problems using models and equations)
	• USE a standard algorithm to:
	  ○ ADD (multi-digit decimals)
	  ○ SUBTRACT (multi-digit decimals)
	  ○ MULTIPLY (multi-digit decimals)
	  ○ DIVIDE (multi-digit decimals)
	• FIND (volume of rectangular prisms)
	  ○ USE cubes
	  ○ APPLY formula
		4
		3
		4
		2
		3
		
		1
		3
		4

Essential Questions	Big Ideas
How do we use decimals to solve real-life problems? How can we make reasonable estimates of problems involving decimals?	Mathematics requires proficiency with basic facts and computations. This facilitates the ability to solve or generalize authentic/real world problems in context and across settings. Estimation strategies can be utilized to reasonably anticipate and evaluate mathematical results in everyday life.

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

Optional assessments:

- **Am I Ready?** (found at the beginning of chapters 3 and 4 – identifies foundational skills needed to be successful in these units)
- **Curriculum-based assessment: Ledyard End of Unit 1 assessment** (found in Unit 1 appendix)

Learning Activities*:*
COMPUTATION WITH DECIMALS

1. Using a graphic organizer such as a vocabulary map, students define a rational number (a number that can be expressed as a ratio of two integers) and give examples (such as 5, -2, ¼, .15, etc.)

2. Students review previous understanding of decimals (read, write, compare, round) See appendix for leveled materials from *Math Connects*.

3. Students add and subtract decimals. GM 3-1

4. Students estimate the products of decimals and judge the reasonableness of the results. GM 3-2

5. Students find products of decimals and whole numbers. GM 3-3

6. Students multiply decimals by decimals investigate multiplying by powers of 10. GM 3-4

7. Students investigate multiplying by powers of 10. Inquiry Lab GM pgs. 209-210

8. Students solve problems by using the strategy Look for a Pattern. Problem Solving Investigation GM pgs 211-213

9. Student review algorithms (both the traditional algorithm and the alternative algorithm using multiples of 10) for division of a multi-digit number by a one-digit number. (see appendix for an example of the alternative algorithm).

10. Students find quotients of problems involving multi-digit numbers. GM 3-5

11. Students estimate quotients of decimals and judge the reasonableness of the results. GM 3-6

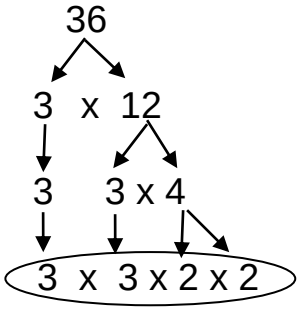
12. Students divide decimals by whole numbers. GM 3-7

13. Students divide decimals by decimals. GM 3-8

Learning Activities:
GREATEST COMMON FACTOR AND LEAST COMMON MULTIPLE

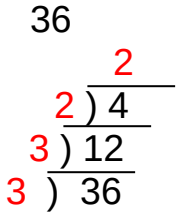
14. Students find the GCF and LCM. GM 1-1
Teacher note: another strategy to find prime factorization is dividing by primes. Students should be introduced to both strategies.
Example: find the prime factorization of 36.

Strategy: factor tree



$3^2 \times 2^2$

Strategy: divide by primes



3 x 3 x 2 x 2

$3^2 \times 2^2$

Additional activities if needed:

- Students use multiple strategies to find the greatest common factor of two or more numbers. See appendix for leveled materials from *Math Connects*. MC 4-1
- Students use multiple strategies find the least common multiple of two or more numbers. See appendix for leveled materials from *Math Connects*.MC 4-5
- Students use the distributive property to find factors. MCCC Lesson 3 pg. 15

Learning Activities:
MULTIPLICATION AND DIVISION OF FRACTIONS

15. Students multiply fractions and whole numbers. GM 4-2

16. Students multiply fractions. GM 4-3

17. Students multiply mixed numbers. GM 4-4

18. Students solve problems by drawing a bar diagram. Problem Solving Investigation GM pg. 297-299

19. Students investigate dividing a whole number by a fraction. Inquiry Lab GM pg. 301-304

20. Students divide a whole number by a fraction. GM 4-6

21. Students investigate using models to divide fractions. Inquiry Lab GM pg. 313-316

22. Students divide fractions. GM 4-7

23. Students divide mixed numbers. GM 4-8

VOLUME OF RECTANGULAR PRISMS with fractional sides

24. Students investigate using models to find the volume of rectangular prisms. Inquiry Lab GM pg. 735-738

25. Students find the volume of rectangular prisms. GM 10-1

Teacher note:

- Students can explore the connection between filling a box with unit cubes and the volume formula using interactive applets such as the Cubes Tool on NCTM's Illuminations (http://illuminations.nctm.org/ActivityDetail.aspx?ID=6).

NOTE ON PERFORMANCE TASKS: Each unit of study contains a performance task. Although each performance task is listed as optional, students should engage in at least 3 performance tasks during the year.

OPTIONAL:

- ✓ Performance Task Power Up! Road Trip GM pg 337

UNIT 1 VOCABULARY
algorithm, denominator, distributive property, dividend, divisor, exponent, factor, formula, fraction, greatest common factor, least common multiple, numerator, product, quotient, rational number, reciprocals, rectangular prism
http://www.graniteschools.org/depart/teachinglearning/curriculuminstruction/math/Pages/MathematicsVocabulary.aspx choose vocabulary cards 6th grade.

Differentiated Instruction:
Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

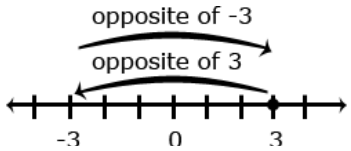
Instructional Strategies: See appendix A for research-based Instructional and Differentiated Strategies

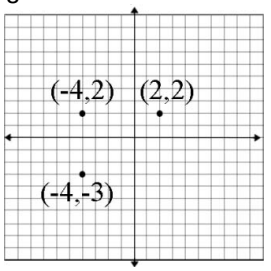
21st Century Learning Skills: See appendix A for explanations.

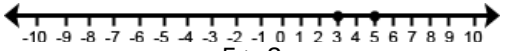
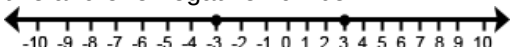
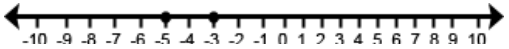
Electronic Resources:
(http://illuminations.nctm.org/ActivityDetail.aspx?ID=6). Students can explore the connection between filling a box with unit cubes and the volume formula using interactive applets such as the Cubes Tool on NCTM's Illuminations

Unit 2: Understanding Positive and Negative Numbers **Pacing: 15 days + 3 days for reteaching/enrichment**
In this unit, students apply and expend understandings of numbers to the system of rational numbers.

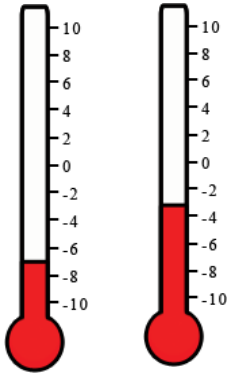
DOMAINS and standards: THE NUMBER SYSTEM

Priority and Supporting Common Core State Standards	Explanation and Examples
Students will apply and extend previous understandings of numbers to the system of rational numbers. **6.NS. 6. UNDERSTAND a rational number as a point on the number line. EXTEND number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.** **a. RECOGNIZE opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; RECOGNIZE that the opposite of the opposite of a number is the number itself, e.g., –(–3) = 3, and that 0 is its own opposite.** **b. UNDERSTAND signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; RECOGNIZE that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.** **c. FIND and POSITION integers and other rational numbers on a horizontal or vertical number line diagram; FIND and POSITION pairs of integers and other rational numbers on a coordinate plane.**	**6.NS. 6.** Number lines can be used to show numbers and their opposites. Both 3 and -3 are 3 units from zero on the number line. Graphing points and reflecting across zero on a number line extends to graphing and reflecting points across axes on a coordinate grid. The use of both horizontal and vertical number line models facilitates the movement from number lines to coordinate grids.  Example: • Graph the following points in the correct quadrant of the coordinate plane. If you reflected each point across the x-axis, what are the coordinates of the reflected points? What similarities do you notice between coordinates of the original point and the reflected point? (½, -3½) (½, -3) (0.25, -0.75)

Priority and Supporting Common Core State Standards	Explanation and Examples
6.NS.5. UNDERSTAND that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); USE positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.	.
6.NS.8 SOLVE real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.	6.NS.8 Example: If the points on the coordinate plane below are the three vertices of a rectangle, what are the coordinates of the fourth vertex? How do you know? What are the length and width of the rectangle?  To determine the distance along the x-axis between the point (-4, 2) and (2, 2) a student must recognize that -4 is $\lvert -4 \rvert$ or 4 units to the left of 0 and 2 is $\lvert 2 \rvert$ or 2 units to the right of zero, so the two points are total of 6 units apart along the x-axis. Students should represent this on the coordinate grid and numerically with an absolute value expression, $\lvert -4 \rvert + \lvert 2 \rvert$.

Priority and Supporting Common Core State Standards	Explanation and Examples
6.NS.7. UNDERSTAND ordering and absolute value of rational numbers. **a. INTERPRET statements of inequality as statements about the relative position of two numbers on a number line diagram.** *For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.* **b. WRITE, INTERPRET and EXPLAIN statements of order for rational numbers in real-world contexts.** *For example, write –3 C > – 7 C to express the fact that –3 C is warmer than – 7 C.* **c. UNDERSTAND the absolute value of a rational number as its distance from 0 on the number line; INTERPRET absolute value as magnitude for a positive or negative quantity in a real-world situation.** *For example, for an account balance of -30 dollars, write /-30/ = 30 to describe the size of the debt in dollars.* **d. DISTINGUISH comparisons of absolute value from statements about order.** *For example, recognize that an account balance less than – 30 dollars represents a debt greater than 30 dollars.*	**6.NS.7.** Common models to represent and compare integers include number line models, temperature models and the profit-loss model. On a number line model, the number is represented by an arrow drawn from zero to the location of the number on the number line; the absolute value is the length of this arrow. The number line can also be viewed as a thermometer where each point of on the number line is a specific temperature. In the profit-loss model, a positive number corresponds to profit and the negative number corresponds to a loss. Each of these models is useful for examining values but can also be used in later grades when students begin to perform operations on integers. In working with number line models, students internalize the order of the numbers; larger numbers on the right or top of the number line and smaller numbers to the left or bottom of the number line. They use the order to correctly locate integers and other rational numbers on the number line. By placing two numbers on the same number line, they are able to write inequalities and make statements about the relationships between the numbers. Case 1: Two positive numbers  5 > 3 5 is greater than 3 Case 2: One positive and one negative number  3 > -3 positive 3 is greater than negative 3 negative 3 is less than positive 3 Case 3: Two negative numbers  -3 > -5 negative 3 is greater than negative 5 negative 5 is less than negative 3 continued on next page

Comparative statements generate informal experience with operations and lay the foundation for formal work with operations on integers in grade 7.
Example:
• One of the thermometers shows -3°C and the other shows -7°C. Which thermometer shows which temperature? Which is the colder temperature? How much colder? Write an inequality to show the relationship between the temperatures and explain how the model shows this relationship.



Students recognize the distance from zero as the absolute value or magnitude of a rational number. Students need multiple experiences to understand the relationships between numbers, absolute value, and statements about order.
Example:
• The Great Barrier Reef is the world's largest reef system and is located off the coast of Australia. It reaches from the surface of the ocean to a depth of 150 meters. Students could represent this value as less than -150 meters or a depth no greater than 150 meters below sea level.

Grade 6

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels
• rational numbers ○ integers ○ opposites ○ absolute value ○ order for rational numbers in real-world contexts • number line diagrams ○ relative position of two numbers on a number line diagram ○ distance from 0 on the number line • coordinate plane ○ quadrants ○ ordered pairs/coordinates ○ reflections	UNDERSTAND ○ (rational numbers as points on numbers lines) ○ (ordered pairs as locations in coordinate plane) ○ (absolute value as distance on number line) REPRESENT (points on number lines and coordinate plane) RECOGNIZE (opposites) FIND/POSITION (points on number lines and coordinate planes) UNDERSTAND (ordering of rational numbers) WRITE and EXPLAIN (statements of order/real world context) INTERPRET (relative position on number line)	2 2 1 2 2 2,3 2

Essential Questions	Big Ideas
When do we use positive and negative integers in real-life?	Algebraic skills and concepts allow us to describe real world situations symbolically and graphically to model quantitative change.

Mathematical Practices UNIT 2

Practices in bold are to be emphasized in the unit.

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

Optional assessments:

- **Am I Ready?** (found at the beginning of the chapter 5 – identifies foundational skills needed to be successful in this unit)
- **Curriculum-based assessment: Ledyard End of Unit 2 assessment** (found in Unit 2 appendix)

Learning Activities*:*

1. Students investigate using counters to represent integers. Inquiry Lab GM pg. 343-344

2. Using Algebra Tiles, students model positive and negative integers. *Working With Algebra Tiles* pgs. 2 and 4, Activity 1.1

3. Using Algebra Tiles, students represent the opposite of an integer. *Working With Algebra Tiles* pgs. 2 and 5, Activity 1.2

4. Students use integers to represent real world situations. GM 5-1
   Additional Activity if needed: "A whale, a submarine and a seagull" (see Appendix)

5. Students investigate using a number line to explore the absolute value of an integer. Inquiry Lab GM pg. 353-354

6. Students find the absolute value of an integer. GM 5-2

7. Students compare and order integers. GM 5-3

8. Students solve problems using the Work Backward strategy. Problem Solving Investigation GM pg.371-373

9. Students investigate modeling rational numbers. Inquiry Lab GM pg.375-378

10. Students write positive and negative fractions as decimals. GM 5-4

11. Students compare and order rational numbers. GM 5-5

12. Students graph ordered pairs on the coordinate plane. GM 5-6 and GM 5-7

13. Students investigate finding distance between two points on the coordinate plane. Inquiry Lab GM pg. 411-414

OPTIONAL:

- ✓ Interdisciplinary research project (Social Studies, Science, Math and ELA) May complete anytime throughout the year GM pg.421-422
- ✓ Performance Task Power Up! City Grid GM pg 419

UNIT 2 VOCABULARY
absolute value, axis (axes), coordinate plane, coordinates, integers, negative numbers, number line, ordered pairs, origin, positive numbers, quadrants, rational number, reflect, x-axis, x-coordinate, y-axis, y-coordinate
http://www.graniteschools.org/depart/teachinglearning/curriculuminstruction/math/Pages/MathematicsVocabulary.aspx choose vocabulary cards 6th grade.

Differentiated Instruction:
Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See appendix A for research-based Instructional and Differentiated Strategies

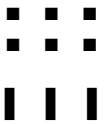
21st Century Learning Skills: See appendix A for explanations.

Electronic Resources:
www.ctcorestandards.org teacher site for lessons and activities aligned to standards, also contains a family and community resource

Unit 3: Using Expressions and Equations **Pacing: 30 days + 5 days for reteaching/enrichment**
In this unit, students use expressions and equations to solve problems.

DOMAINS and standards: EXPRESSIONS AND EQUATIONS

Priority and Supporting Common Core State Standards	Explanation and Examples
The student will apply and extend previous understandings of arithmetic to algebraic expressions . **6.EE.2 WRITE, READ and EVALUATE expressions in which letters stand for numbers.** ***a.*** **WRITE expressions that record operations with numbers and with letters standing for numbers.** *For example, express the calculation "Subtract y from 5" as 5 – y.* ***b.*** **IDENTIFY parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity.** *For example, describe the expression 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms.* ***c.*** **EVALUATE expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).** *For example, use the formulas $V = s^3$ and $A = 6 s^2$ to find the volume and surface area of a cube with sides of lengths = 1/2.*	**6.EE.2** It is important for students to read algebraic expressions in a manner that reinforces that the variable represents a number. • r + 21 as "some number plus 21 as well as "r plus 21" • n • 6 as "some number times 6 as well as "n times 6" • and s ÷ 6 as "as some number divided by 6" as well as "s divided by 6" *s*6 Students should identify the parts of an algebraic expression including variables, coefficients, constants, and the names of operations (sum, difference, product, and quotient). Development of this common language helps students to understand the structure of expressions and explain their process for simplifying expressions. Terms are the parts of a sum. When the term is an explicit number, it is called a constant. When the term is a product of a number and a variable, the number is called the coefficient of the variable. Variables are letters that represent numbers. There are various possibilities for the number they can represent; Students can substitute these possible numbers for the letters in the expression for various different purposes. Consider the following expression: $x^2 + 5y + 3x + 6$ The variables are x and y. There are 4 terms, x^2, 5y, 3x, and 6. There are 3 variable terms, x^2, 5y, 3x. They have coefficients of 1, 5, and 3 respectively. The coefficient of x^2 is 1, since $x^2 = 1\ x^2$. The term 5y represent 5 y's or 5 ● y. There is one constant term, 6. The expression shows a sum of all four terms. Examples: • 7 more than 3 times a number (Solution: 3*x* + 7) • 3 times the sum of a number and 5 (Solution: 3(*x* + 5)) • 7 less than the product of 2 and a number (Solution: 2*x* – 7) • Twice the difference between a number and 5 (Solution: 2(*z* – 5)) • Evaluate *5(n* + 3) – 7*n*, when *n* = $\frac{1}{2}$ • The expression c + 0.07c can be used to find the total cost of an item with 7% sales tax, where *c* is the pre-tax cost of the item. Use the expression to find the total cost of an item that cost $25. • The perimeter of a parallelogram is found using the formula *p* = 2*l* + 2*w.* What is the

Priority and Supporting Common Core State Standards	Explanation and Examples
6.EE.1. WRITE and EVALUATE numerical expressions involving whole-number exponents.	**6.EE.1**. Examples: • Write the following as a numerical expressions using exponential notation. o The area of a square with a side length of 8 m (Solution: $8^2 m^2$) o The volume of a cube with a side length of 5 ft: (Solution: 5^3 ft^3) o Yu-Lee has a pair of mice. The mice have 2 babies. The babies grow up and have two babies of their own: (Solution: 2^3 mice) • Evaluate: o 4^3 (Solution: 64) o $5 + 2^4 \bullet 6$ (Solution: 101) o $7^2 – 24 \div 3 + 25$ (Solution: 66)
6.EE.3. APPLY the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.*	**6.EE.3.** Students use their understanding of multiplication to interpret *3 (2 + x). For example, 3 groups of (2 + x).* They use a model to represent x, and make an array to show the meaning of *3(2 + x).* They can explain why it makes sense that *3(2 + x)* is equal to *6 + 3x.* An array with 3 columns and *x* + 2 in each column:  Students interpret *y* as referring to one *y.* Thus, they can reason that one *y* plus one *y* plus one *y* ***must be*** *3y.* They also use the distributive property, the multiplicative identity property of 1, and the commutative property for multiplication to prove that $y + y + y = 3y$: $y + y + y = y \times 1 + y \times 1 + y \times 1 = y \times (1 + 1 + 1) = y \times 3 = 3y$

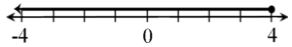
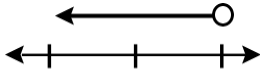
Priority and Supporting Common Core State Standards	Explanation and Examples
6.EE.4. IDENTIFY when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.*	6.EE.4.Students connect their experiences with finding and identifying equivalent forms of whole numbers and can write expressions in various forms. Students generate equivalent expressions using the associative, commutative, and distributive properties. They can prove that the expressions are equivalent by simplifying each expression into the same form. Example: • Are the expressions equivalent? How do you know? *4m + 8* *4(m+2)* *3m + 8 + m* *2 + 2m + m + 6 + m* Solution:

Expression	Simplifying the Expression	Explanation
$4m + 8$	$4m + 8$	Already in simplest form
$4(m + 2)$	$4(m + 2)$ $4m + 8$	Distributive Property
$3m + 8 + m$	$3m + 8 + m$ $3m + m + 8$ $4m + 8$	Combined like terms
$2 + 2m + m + 6 + m$	$2 + 2m + m + 6 + m$ $2 + 6 + 2m + m + m$ $(2 + 6) + (2m + m + m)$ $8 + 4m$ $4m + 8$	Combined like terms

Priority and Supporting Common Core State Standards	Explanation and Examples
The student will reason about and solve one-variable equations and inequalities. **6.EE.7. SOLVE real-world and mathematical problems by writing and solving equations of the form *x* + *p* = *q* and *px* = *q* for cases in which *p*, *q* and *x* are all nonnegative rational numbers.**	**6.EE.7.** Students create and solve equations that are based on real world situations. It may be beneficial for students to draw pictures that illustrate the equation in problem situations. Solving equations using reasoning and prior knowledge should be required of students to allow them to develop effective strategies. Example: • Meagan spent $56.58 on three pairs of jeans. If each pair of jeans costs the same amount, write an algebraic equation that represents this situation and solve to determine how much one pair of jeans cost. $56.58 / J / J / J Sample Solution: Students might say: "I created the bar model to show the cost of the three pairs of jeans. Each bar labeled *J* is the same size because each pair of jeans costs the same amount of money. The bar model represents the equation 3*J* = $56.58. To solve the problem, I need to divide the total cost of 56.58 between the three pairs of jeans. I know that it will be more than $10 each because 10 x 3 is only 30 but less than $20 each because 20 x 3 is 60. If I start with $15 each, I am up to $45. I have $11.58 left. I then give each pair of jeans $3. That's $9 more dollars. I only have $2.58 left. I continue until all the money is divided. I ended up giving each pair of jeans another $0.86. Each pair of jeans costs $18.86 (15+3+0.86). I double check that the jeans cost $18.86 each because $18.86 x 3 is $56.58." • Julio gets paid $20 for babysitting. He spends $1.99 on a package of trading cards and $6.50 on lunch. Write and solve an equation to show how much money Julio has left. (Solution: 20 = 1.99 + 6.50 + *x*, *x* = $11.51) 20 / 1.99 / 6.50 / Money left over (m)

Priority and Supporting Common Core State Standards	Explanation and Examples
6. EE.6 USE variables to represent numbers and WRITE expressions when solving a real-world or mathematical problem; UNDERSTAND that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.	6. EE.6 Connecting writing expressions with story problems and/or drawing pictures will give students a context for this work. It is important for students to read algebraic expressions in a manner that reinforces that the variable represents a number. Examples: • Maria has three more than twice as many crayons as Elizabeth. Write an algebraic expression to represent the number of crayons that Maria has. (Solution: $2c + 3$ where c represents the number of crayons that Elizabeth has.) • An amusement park charges $28 to enter and $0.35 per ticket. Write an algebraic expression to represent the total amount spent. (Solution: $28 + 0.35t$ where t represents the number of tickets purchased) • Andrew has a summer job doing yard work. He is paid $15 per hour and a $20 bonus when he completes the yard. He was paid $85 for completing one yard. Write an equation to represent the amount of money he earned. (Solution: $15h + 20 = 85$ where h is the number of hours worked) • Describe a problem situation that can be solved using the equation $2c + 3 = 15$; where c represents the cost of an item • Bill earned $5.00 mowing the lawn on Saturday. He earned more money on Sunday. Write an expression that shows the amount of money Bill has earned. (Solution: $5.00 + n$) • The commutative property can be represented by $a + b = b + a$ where a and b can be any rational number. .

Priority and Supporting Common Core State Standards	Explanation and Examples
6.EE.5. UNDERSTAND solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? USE substitution to determine whether a given number in a specified set makes an equation or inequality true.	. 6.EE.5. Beginning experiences in solving equations should require students to understand the meaning of the equation as well as the question being asked. Solving equations using reasoning and prior knowledge should be required of students to allow them to develop effective strategies such as using reasoning, fact families, and inverse operations. Students may use balance models in representing and solving equations and inequalities. Consider the following situation: Joey had 26 papers in his desk. His teacher gave him some more and now he has 100. How many papers did his teacher give him? This situation can be represented by the equation 26 + *n* = 100 where *n* is the number of papers the teacher gives to Joey. This equation can be stated as "some number was added to 26 and the result was 100". Students ask themselves "What number was added to 26 to get 100?" to help them determine the value of the variable that makes the equation true. Students could use several different strategies to find a solution to the problem. o Reasoning: 26 + 70 is 96. 96 + 4 is 100, so the number added to 26 to get 100 is 74. o Use knowledge of fact families to write related equations: *n* + 26 = 100, 100 - *n* = 26, 100 - 26 = *n*. Select the equation that helps you find *n* easily. o Use knowledge of inverse operations: Since subtraction "undoes" addition then subtract 26 from 100 to get the numerical value of *n* o Scale model: There are 26 blocks on the left side of the scale and 100 blocks on the right side of the scale. All the blocks are the same size. 74 blocks need to be added to the left side of the scale to make the scale balance. o Bar Model: Each bar represents one of the values. Students use this visual representation to demonstrate that 26 and the unknown value together make 100. **100** **26** | ***n*** Examples: • The equation 0.44*s* = 11 where *s* represents the number of stamps in a booklet. The booklet of stamps costs 11 dollars and each stamp costs 44 cents. How many stamps are in the booklet? Explain the strategies you used to determine your answer. Show that your solution is correct using substitution. • Twelve is less than 3 times another number can be shown by the inequality 12 < 3*n*. What numbers could possibly make this a true statement?

Priority and Supporting Common Core State Standards	Explanation and Examples
6.EE.8. WRITE an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. RECOGNIZE that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; REPRESENT solutions of such inequalities on number line diagrams.	. 6.EE.8.Examples: • Graph $x \leq 4$.  • Jonas spent more than $50 at an amusement park. Write an inequality to represent the amount of money Jonas spent. What are some possible amounts of money Jonas could have spent? Represent the situation on a number line. • Less than $200.00 was spent by the Flores family on groceries last month. Write an inequality to represent this amount and graph this inequality on a number line.  Solution*:* 200 > *x*

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels

• expressions
• mathematical terms
  ○ sum
  ○ term
  ○ product
  ○ factor
  ○ quotient
  ○ coefficient
• Order of Operations
• properties of operations
• equivalent expressions
• problems solving strategies
• equations
• variables
• inequalities
	• WRITE(expressions and equations)
	• READ(expressions)
	• EVALUATE (expressions)
	• IDENTIFY (mathematical terms)
	• PERFORM (Order of Operations)
	• APPLY (properties of operations)
	• GENERATE equivalent expressions
	• SOLVE (equations)
	• SOLVE (real-world and mathematical problems)
	• WRITE (inequalities)
	• GRAPH (inequalities)
		3
		2
		3
		1
		3
		3
		4
		3
		4
		3
		4

Essential Questions	Big Ideas
How can expressions and equations be used to model and solve problems?	Algebraic skills and concepts allow us to describe real world situations symbolically and graphically to model quantitative change. Mathematics is based on number patterns and number relationships with a defined set of rules which interconnect and explain math concepts and natural phenomena.

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

NOTE: When working with expressions and equations, use only positive integers. The use of negative integers is an expectation in Grade 7.

Optional assessments:

- **Am I Ready?** (found at the beginning of chapters 6 and 7– identifies foundational skills needed to be successful in these units)
- **Curriculum-based assessment: Ledyard End of Unit 3 assessment** (found in Unit 3 appendix)

Learning Activities: EXPRESSIONS

1. Students investigate parts of an expression. Inquiry Lab GM pg. 429-432

2. Students represent numbers using exponents. GM 6-1

3. Students find the value of expressions using order of operations. GM 6-2

4. Students evaluate algebraic expressions. GM 6-3

5. Students investigate using models to write expressions. Inquiry Lab GM pg. 457-460

6. Students write verbal phrases as simple algebraic expressions. GM 6-4

Additional Activity if needed:

- In cooperative groups, students play a matching game involving expressions. *Polly Wants a Matching Pair!* (see appendix) This activity deals with both expressions and equations. You may wish to pull out just the expressions, or use this activity after introducing equations. The appendix provides both a list of the expressions and equations and an answer key.

7. Using Algebra Tiles, students translate from a word description of an algebraic expression to a model. *Working With Algebra Tiles* pg. 34 and 37, Activity 3.1.(SKIP # 2, 4, 5 as they deal with negative numbers)

   Teacher note: At this time, introduce only the positive yellow unit square and the positive green tile (x). (refer to *Working With Algebra Tiles* pg. 2 for introduction notes.)

8. Students solve problems using the Act It Out strategy. Problem Solving Investigation GM pg. 469-471

9. Students use properties to simplify expressions. GM 6-5

10. Students investigate how to model the distributive property. Inquiry Lab GM pg. 481-484

Additional Activity if needed:

- Students model the distributive property using Algebra Tiles. *Working With Algebra Tiles* pgs. 35 and 50, Activity 3.6
  Teacher note: You may skip #10 at this time as it deals with negative numbers

11. Students use the distributive property to compute multiplication problems mentally. GM 6-6

12. Students investigate models to simplify algebraic expressions. Inquiry Lab GM pg. 493-494

13. Students use properties to simplify expressions. GM 6-7

Additional Activities if needed:

- Students use tables to describe and predict patterns. MS Crossing the River pgs. 328-329
- Students use variables and expressions to describe patterns. MS Letter Perfect pgs. 332-333
- Students describe patterns with multiple expressions. MS Tiling Garden Beds pgs. 334-335

OPTIONAL:

- ✓ Performance Task Power Up! Cross Country Tryouts GM pg 507

Learning Activities:
EQUATIONS

14. Students solve equations by using mental math and the Guess, Check and Revise strategy. GM 7-1

15. Students investigate using models to solve addition equations. Inquiry Lab GM pg. 521-524

16. Students solve and write addition equations. GM 7-2

17. Students investigate using models to solve subtraction equations. Inquiry Lab GM pg. 533-534

18. Students solve and write subtraction equations. GM 7-3

19. Students solve problems using the Guess, Check and Revise strategy. Problem Solving Investigation GM pg. 543-545

20. Students investigate using models to solve multiplication equations. Inquiry Lab GM pg. 547-550

21. Students solve and write division equations. GM 7-5

OPTIONAL:

- ✓ Performance Task Power Up! Study Buddies GM pg 573

Learning Activities:

INEQUALITIES

22. Students investigate inequalities by using a bar diagram. Inquiry Lab GM pg. 615-616

23. Students solve inequalities by using mental math and the Guess, Check and Revise strategy. GM 8-5

24. Students write and graph inequalities. GM 8-6

25. Students investigate using a model to solve one-step addition and subtraction inequalities. Inquiry Lab GM pg. 633-6-34

26. Students solve one-step inequalities. GM 8-7

UNIT 3 VOCABULARY

algebraic expression**,** coefficient, constant, distributive property, equation, equivalent expression, evaluate, exponent, factor, inequality, numerical expression, order of operations, prime factorization, product, substitution, term, variable, verbal expression
http://www.graniteschools.org/depart/teachinglearning/curriculuminstruction/math/Pages/MathematicsVocabulary.aspx choose vocabulary cards 6th grade.

Differentiated Instruction:

Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

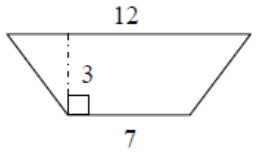
Instructional Strategies: See appendix A for research-based Instructional and Differentiated Strategies

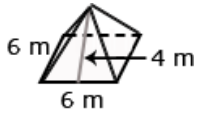
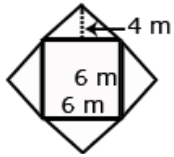
21st Century Learning Skills: See appendix A for explanations.

Electronic Resources: www.ctcorestandards.org teacher site for lessons and activities aligned to standards, also contains a family and community resource

Unit 4: Applications of Geometry **Pacing: 15 days + 5 days for reteaching/enrichment**
In this unit, students solve problems involving area, surface area and volume.

DOMAINS and standards: Geometry

Priority and Supporting Common Core State Standards	Explanation and Examples
The student will solve real-world and mathematical problems involving area, surface area and volume. **6.G.1. FIND the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; APPLY these techniques in the context of solving real-world and mathematical problems.**	**6. G.1.**Special quadrilaterals include rectangles, squares, parallelograms, trapezoids, rhombi, and kites. Students can use tools such as the Isometric Drawing Tool on NCTM's Illuminations site to shift, rotate, color, decompose and view figures in 2D or 3D (http://illuminations.nctm.org/ActivityDetail.aspx?ID=125) Examples: • Find the area of a triangle with a base length of three units and a height of four units. • Find the area of the trapezoid shown below using the formulas for rectangles and triangles.  • A rectangle measures 3 inches by 4 inches. If the lengths of each side double, what is the effect on the area? • The area of the rectangular school garden is 24 square units. The length of the garden is 8 units. What is the length of the fence needed to enclose the entire garden?

Priority and Supporting Common Core State Standards	Explanation and Examples
6.G.3. DRAW polygons in the coordinate plane given coordinates for the vertices; USE coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. APPLY these techniques in the context of solving real-world and mathematical problems. 6.G.4. REPRESENT three-dimensional figures using nets made up of rectangles and triangles, and use the nets to FIND the surface area of these figures. APPLY these techniques in the context of solving real-world and mathematical problems.	6.G.3. Example: • On a map, the library is located at (-2, 2), the city hall building is located at (0, 2), and the high school is located at (0, 0). Represent the locations as points on a coordinate grid with a unit of 1 mile. o What is the distance from the library to the city hall building? The distance from the city hall building to the high school? How do you know? o What shape is formed by connecting the three locations? The city council is planning to place a city park in this area. How large is the area of the planned park? 6.G.4. Students construct models and nets of three dimensional figures, describing them by the number of edges, vertices, and faces. Solids include rectangular and triangular prisms. Students are expected to use the net to calculate the surface area. Students can create nets of 3D figures with specified dimensions using the Dynamic Paper Tool on NCTM's Illuminations (http://illuminations.nctm.org/ActivityDetail.aspx?ID=205). Students also describe the types of faces needed to create a three-dimensional figure. Students make and test conjectures by determining what is needed to create a specific three-dimensional figure. Examples: • Describe the shapes of the faces needed to construct a rectangular pyramid. Cut out the shapes and create a model. Did your faces work? Why or why not? • Create the net for a given prism or pyramid, and then use the net to calculate the surface area.  

Concepts **What Students Need to Know**	**Skills** **What Students Need To Be Able To Do**	**Bloom's Taxonomy** **Levels**

• Area of polygons
  ○ triangles
  ○ special quadrilaterals
• Problems
  with and without context
	FIND area of polygons
	  ○ COMPOSE (into rectangles)
	  ○ DECOMPOSE (into triangles and other shapes)
	DRAW (polygons in coordinate plane)
	  ○ Use coordinates
	REPRESENT (3D figures with nets)
	FIND (surface area)
	SOLVE/APPLY (problems with and without context)
		3
		3
		3
		3
		
		2
		3
		4

Essential Questions	**Big Ideas**
How can nets help us to find surface area? Why do we need to be able to find area in a real world context? Why is spatial reasoning an important skill to have?	Shapes and structures can be analyzed, visualized, measured and transformed using a variety of strategies, tools and technologies. Spatial reasoning is necessary to appreciate the world around us. This involves an understanding of mathematical manipulation of two and three dimensions.

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

Optional assessments:

- **Am I Ready?** (found at the beginning of the chapters 9 and 10– identifies foundational skills needed to be successful in this unit)
- **Curriculum-based assessment: Ledyard End of Unit 4 assessment** (found in Unit 4 appendix)

Learning Activities*:*

AREA

1. Students investigate a model to find the area formula for parallelograms. Inquiry Lab GM 657-660

2. Students find the area of parallelograms. GM 9-1

3. Students investigate a model to find the area formula for triangles. Inquiry Lab GM pg. 669-672

Teacher note:

- Students can use tools such as the Isometric Drawing Tool on NCTM's Illuminations site to shift, rotate, color, decompose and view figures in 2D or 3D (http://illuminations.nctm.org/ActivityDetail.aspx?ID=125)

4. Students find the areas and missing dimensions of triangles. GM 9-2

5. Students investigate the area of trapezoids. Inquiry Lab GM pg. 681-684

6. Students find the area of trapezoids. GM 9-3

7. Students solve problems using the Draw a Diagram strategy. Problem Solving Investigation GM pg. 693-695

8. Students determine how changes in dimensions affect perimeter and area. GM 9-4

9. Students draw polygons in the coordinate plane and use coordinates to find length. GM 9-5

Additional activity if needed:

- Students graph coordinates in all four quadrants of the coordinate plane and describe in writing the path of a line. MS Gridpoint Pictures pg. 340

10. Students investigate how to estimate the area of an irregular figure. Inquiry Lab GM pg. 713-716

11. Students find the areas of composite figures. GM 9-6

. OPTIONAL:

- ✓ Performance Task Power Up! Family Land GM pg 729

Learning Activities*:*
SURFACE AREA

12. Students investigate finding the surface area of rectangular prisms using models and nets. Inquiry Lab GM pg. 759-762

Teacher note:

- Introduce Lateral Area Sets (3D models that unfold to nets).

13. Students find the surface area of rectangular prisms. GM 10-3

14. Students investigate using nets to find surface area of triangular prisms. Inquiry Lab GM pg. 771-772

15. Students find surface area of triangular prisms. GM 10-4

16. Students investigate using nets to find the surface area of square pyramids. Inquiry Lab GM 781-782

17. Students find the surface area of pyramids. GM 10-5

OPTIONAL:

- ✓ Performance Task Power Up! Moving Time GM pg 795

UNIT 4 VOCABULARY
acute, adjacent, altitude, area, attribute, base, compose, composite, cube, decompose, edge, equilateral triangle, face, formula, height, isosceles triangle, kite, net, obtuse triangle, polygon, prism, pyramid, quadrilateral, rectangle, rectangular prism, right triangle, scalene triangle, solid figure, square-based pyramid, surface area, three-dimensional, triangular prism, triangular-based pyramid, vertex

Differentiated Instruction:
Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See appendix A for research-based Instructional and Differentiated Strategies

21st Century Learning Skills: See appendix A for explanations.

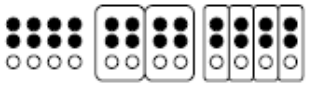
Electronic Resources:

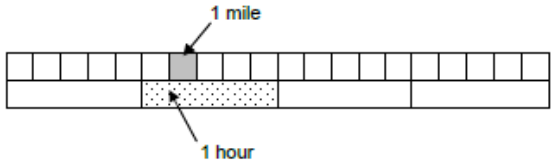
- Students can use tools such as the Isometric Drawing Tool on NCTM's Illuminations site to shift, rotate, color, decompose and view figures in 2D or 3D (http://illuminations.nctm.org/ActivityDetail.aspx?ID=125
- www.ctcorestandards.org teacher site for lessons and activities aligned to standards, also contains a family and community resource

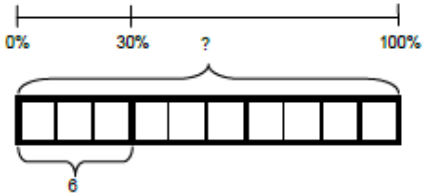
Unit 5: Ratios and Rates **Pacing: 20 days + 5 days for reteaching/enrichment**

In this unit, students apply their understanding of rates and proportional reasoning to solve problems.

DOMAINS and standards: RATIOS and PROPORTIONAL REASONING

Priority and Supporting Common Core State Standards	Explanation and Examples
The student will understand ratio concepts and use ratio reasoning to solve problems. **6.RP.1. UNDERSTAND the concept of a ratio and use ratio language to DESCRIBE a ratio relationship between two quantities.** *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."*	**6.RP.1.** A ratio is a comparison of two quantities which can be written as *a* to *b*, $\frac{a}{b}$, or *a:b*. A rate is a ratio where two measurements are related to each other. When discussing measurement of different units, the word rate is used rather than ratio. Understanding rate, however, is complicated and there is no universally accepted definition. When using the term rate, contextual understanding is critical. Students need many opportunities to use models to demonstrate the relationships between quantities before they are expected to work with rates numerically. A comparison of 8 black circles to 4 white circles can be written as the ratio of 8:4 and can be regrouped into 4 black circles to 2 white circles (4:2) and 2 black circles to 1 white circle (2:1).  Students should be able to identify all these ratios and describe them using "For every…., there are …"

Priority and Supporting Common Core State Standards	Explanation and Examples
6.RP.2. UNDERSTAND the concept of a unit rate *a*/*b* associated with a ratio *a:b* with *b* ≠0, and USE rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger." (Expectations for unit rates in this grade are limited to non-complex fractions.)*	6.RP.2. A unit rate compares a quantity in terms of one unit of another quantity. Students will often use unit rates to solve missing value problems. Cost per item or distance per time unit are common unit rates, however, students should be able to flexibly use unit rates to name the amount of either quantity in terms of the other quantity. Students will begin to notice that related unit rates are reciprocals as in the first example. It is not intended that this be taught as an algorithm or rule because at this level, students should primarily use reasoning to find these unit rates. In Grade 6, students are not expected to work with unit rates expressed as complex fractions. Both the numerator and denominator of the original ratio will be whole numbers. Examples: • On a bicycle you can travel 20 miles in 4 hours. What are the unit rates in this situation, (the distance you can travel in 1 hour and the amount of time required to travel 1 mile)? Solution: You can travel 5 miles in 1 hour written as $\frac{5mi}{1hr}$ and it takes $\frac{1}{5}$ of a hour to travel each mile written as $\frac{1}{\frac{5hr}{1mi}}$ Students can represent the relationship between 20 miles and 4 hours.  • A simple modeling clay recipe calls for 1 cup corn starch, 2 cups salt, and 2 cups boiling water. How many cups of corn starch are needed to mix with each cup of salt?

Priority and Supporting Common Core State Standards	Explanation and Examples
6.RP.3. Use ratio and rate reasoning to SOLVE real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. **a. MAKE tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and PLOT the pairs of values on the coordinate plane. USE tables to compare ratios.** **b. SOLVE unit rate problems including those involving unit pricing and constant speed.** *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours?(20) At what rate were lawns being mowed?(*$\frac{4}{7}$ *lawn per hour)* **c. FIND a percent of a quantity as a rate per 100 (e.g., 30 percent of a quantity means 30/100 times the quantity); SOLVE problems involving finding the whole, given a part and the percent.** **d. USE ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.**	**6.RP.3.** Examples: • Using the information in the table, find the number of yards in 24 feet. <table><tr><td>Feet</td><td>3</td><td>6</td><td>9</td><td>15</td><td>24</td></tr><tr><td>Yards</td><td>1</td><td>2</td><td>3</td><td>5</td><td>?</td></tr></table> There are several strategies that students could use to determine the solution to this problem. o Add quantities from the table to total 24 feet (9 feet and 15 feet); therefore the number of yards must be 8 yards (3 yards and 5 yards). o Use multiplication to find 24 feet: 1) 3 feet x 8 = 24 feet; therefore 1 yard x 8 = 8 yards, or 2) 6 feet x 4 = 24 feet; therefore 2 yards x 4 = 8 yards. • Compare the number of black to white circles. If the ratio remains the same, how many black circles will you have if you have 60 white circles?  <table><tr><td>Black</td><td>4</td><td>40</td><td>20</td><td>60</td><td>?</td></tr><tr><td>White</td><td>3</td><td>30</td><td>15</td><td>45</td><td>60</td></tr></table> • If 6 is 30% of a value, what is that value? (Solution: 20)  • A credit card company charges 17% interest on any charges not paid at the end of the month. Make a ratio table to show how much the interest would be for several amounts. If your bill totals $450 for this month, how much interest would you have to pay if you let the balance carry to the next month? Show the relationship on a graph and use the graph to predict the interest charges for a $300 balance. <table><tr><td>Charges</td><td>$1</td><td>$50</td><td>$100</td><td>$200</td><td>$450</td></tr><tr><td>Interest</td><td>$0.17</td><td>$8.50</td><td>$17</td><td>$34</td><td>?</td></tr></table>

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels

• ratios and rates
  ○ tables of equivalent ratios
  ○ tape diagram
  ○ double number line diagram
  ○ missing values in tables
  ○ equations
• pairs of values on a coordinate plane
• unit rate
  ○ unit pricing
  ○ constant speed
• percent
  ○ a quantity as a rate per 100
  ○ finding the whole, given a part and the percent
• measurement units
	• UNDERSTAND (ratios/the concept of a unit rate)
	• DESCRIBE (ratio relationship)
	• USE (ratio and rate reasoning/language)
	• SOLVE (with and without context)
	• MAKE (tables of equivalent ratios)
	• FIND (missing values in tables)
	• PLOT (pairs of values on the coordinate plane)
	• SOLVE (unit rate problems)
	• FIND (percent of a quantity as a rate per 100)
	• SOLVE (problems finding the whole, given a part and the percent)
	• CONVERT (measurement units)
		2
		2
		3
		4
		3
		3
		2
		4
		3
		3
		4
		3

Essential Questions	Big Ideas
How can ratios and proportions be used to find unknown quantities?	Ratios and proportional relationships are used to express how quantities are related and how quantities change in relation to each other.

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

Optional assessments:

- **Am I Ready?** (found at the beginning of chapters 1 and 2– identifies foundational skills needed to be successful in these units)
- **Curriculum-based assessment: Ledyard End of Unit 5 assessment** (found in Unit 5 appendix)

Learning Activities*:*

RATIOS

1. Students investigate ratios using concrete models. Inquiry Lab GM pg. 15-18

2. Students give examples of ratios as fractions and use ratios to compare quantities. GM 1-2
   Additional Activity if needed:
   - Students use tape diagram to model ratios. http://www.mathplayground.com/NewThinkingBlocks/thinking_blocks_ratios.html

3. Students investigate using models to find unit rates. Inquiry Lab GM pg. 27-30

4. Students give examples of rates and write rates as unit rates. GM 1-3

5. Students use tables to solve problems involving ratios and rates. GM 1-4

6. Students use graphs to represent problems involving ratios and rates. GM 1-5

7. Students find equivalent ratios and rates by using unit rates and equivalent fractions. GM 1-6
   Additional Activity if needed:
   - Students compare items and generate equivalent ratios. Gr. 6 *Groundworks: Algebra Puzzles and Problems* Smart Shopping pgs. 17-23 (see appendix)

8. Students investigate using models to solve real-world problems involving ratios and rates. Inquiry Lab GM pg. 67-70

9. Students solve problems involving ratios and rates. GM 1-7

OPTIONAL:

- ✓ Performance Task Power Up! Community Party GM pg 83

Learning Activities*:*
FRACTIONS, DECIMALS and PERCENTS

10. Students write decimals as fractions or mixed numbers and vice versa. GM 2-1

11. Students investigate representing percents with concrete models. Inquiry Lab GM pg. 97-100

12. Students write per cents as fractions and vice versa. GM 2-2

13. Students write per cents as decimals and vice versa. GM 2-3
Additional Activity if needed:
- Students write equivalent fractions, decimals and percents. MS Moving to Percents pgs. 232-233

14. Students estimate the percent of a number. GM 2-6

15. Students investigate modeling the per cent of a number. Inquiry Lab GM pg. 145-146

16. Students find the per cent of a number. GM 2-7

17. Students solve per cent problems to find the whole. GM 2-8
Additional Activities if needed:
- Students solve problems involving finding the whole, given a part and the percent. MCCC Lesson 2 pg. 11
- Students represent common percents. MS Working with Common Percents pgs. 234-235
- Students calculate percents. MS Percent Power pgs. 236-237

Learning Activities*:*
CONVERT MEASUREMENT UNITS

18. Students change units of measure in the customary system. GM 4-5

UNIT 5 VOCABULARY
double number line, equivalent, equivalent ratio, percent, proportion, rate, ratio, ratio table, tape diagram, unit rate
http://www.graniteschools.org/depart/teachinglearning/curriculuminstruction/math/Pages/MathematicsVocabulary.aspx choose vocabulary cards 6th grade.

Differentiated Instruction:
Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

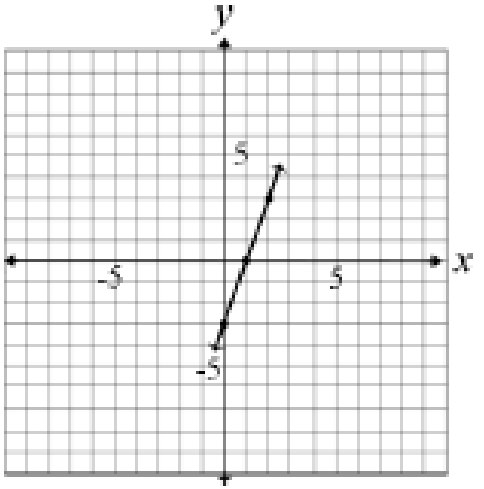
Instructional Strategies: See appendix A for research-based Instructional and Differentiated Strategies

21st Century Learning Skills: See appendix A for explanations.

Electronic Resources: www.ctcorestandards.org teacher site for lessons and activities aligned to standards, also contains a family and community resource

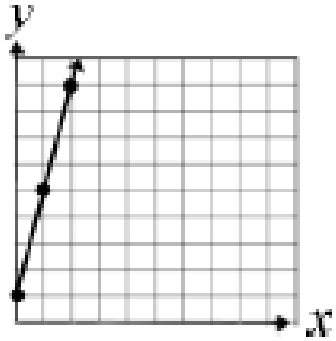
Unit 6: Algebraic Reasoning **Pacing: 10 days + 5 days for reteaching/enrichment**
In this unit, students will describe algebraic relationships in multiple ways (including language, tables, equations and graphs).

DOMAINS and standards: EQUATIONS AND EXPRESSIONS

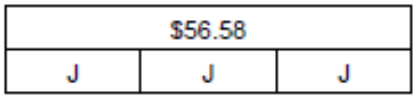
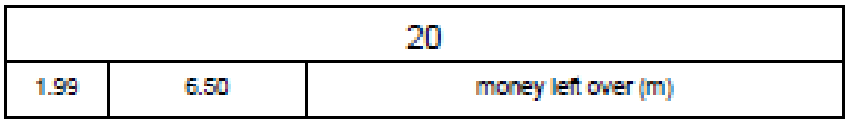
Priority and Supporting Common Core State Standards	Explanation and Examples
The students will represent and analyze quantitative relationships between dependent and independent variables. **6.EE.9. USE variables to represent two quantities in a real-world problem that change in relationship to one another; WRITE an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. ANALYZE the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.** *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.*	6.EE.9 Students can use many forms to represent relationships between quantities. Multiple representations include describing the relationship using language, a table, an equation, or a graph. Translating between multiple representations helps students understand that each form represents the same relationship and provides a different perspective on the function. Examples: • What is the relationship between the two variables? Write an expression that illustrates the relationship. (*2.5x*) x | 1 | 2 | 3 | 4 y | 2.5 | 5 | 7.5 | 10 • Use the graph below to describe the change in *y* as *x* increases by 1.  Continued on next page

	• Susan started with $1 in her savings. She plans to add $4 per week to her savings. Use an equation, table and graph to demonstrate the relationship between the number of weeks that pass and the amount in her savings account. o Language: Susan has $1 in her savings account. She is going to save $4 each week. o Equation: $y = 4x + 1$ o Table: o Graph:

x	y
0	1
1	5
2	9



Priority and Supporting Common Core State Standards	Explanation and Examples
The students will reason about and solve one-variable equations and inequalities. 6.EE.6. USE variables to represent numbers and WRITE expressions when solving a real-world or mathematical problem; UNDERSTAND that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.	**6.EE.6.** Connecting writing expressions with story problems and/or drawing pictures will give students a context for this work. It is important for students to read algebraic expressions in a manner that reinforces that the variable represents a number. Examples: • Maria has three more than twice as many crayons as Elizabeth. Write an algebraic expression to represent the number of crayons that Maria has. (Solution: 2*c* + 3 where *c* represents the number of crayons that Elizabeth has.) • An amusement park charges $28 to enter and $0.35 per ticket. Write an algebraic expression to represent the total amount spent. (Solution: 28 + 0.35*t* where *t* represents the number of tickets purchased) • Andrew has a summer job doing yard work. He is paid $15 per hour and a $20 bonus when he completes the yard. He was paid $85 for completing one yard. Write an equation to represent the amount of money he earned. (Solution: 15*h* + 20 = 85 where *h* is the number of hours worked) • Describe a problem situation that can be solved using the equation 2*c* + 3 = 15; where *c* represents the cost of an item. • Bill earned $5.00 mowing the lawn on Saturday. He earned more money on Sunday. Write an expression that shows the amount of money Bill has earned. (Solution: $5.00 + *n)* • The commutative property can be represented by *a* + *b* = *b* + *a* where *a* and *b* can be any rational number.

Priority and Supporting Common Core State Standards	Explanation and Examples
6.EE.7. SOLVE real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.	6.EE.7. Students create and solve equations that are based on real world situations. It may be beneficial for students to draw pictures that illustrate the equation in problem situations. Solving equations using reasoning and prior knowledge should be required of students to allow them to develop effective strategies. Example: • Meagan spent $56.58 on three pairs of jeans. If each pair of jeans costs the same amount, write an algebraic equation that represents this situation and solve to determine how much one pair of jeans cost.  Sample Solution: Students might say: "I created the bar model to show the cost of the three pairs of jeans. Each bar labeled *J* is the same size because each pair of jeans costs the same amount of money. The bar model represents the equation $3J = \$56.58$. To solve the problem, I need to divide the total cost of 56.58 between the three pairs of jeans. I know that it will be more than $10 each because 10 x 3 is only 30 but less than $20 each because 20 x 3 is 60. If I start with $15 each, I am up to $45. I have $11.58 left. I then give each pair of jeans $3. That's $9 more dollars. I only have $2.58 left. I continue until all the money is divided. I ended up giving each pair of jeans another $0.86. Each pair of jeans costs $18.86 (15+3+0.86). I double check that the jeans cost $18.86 each because $18.86 x 3 is $56.58." • Julio gets paid $20 for babysitting. He spends $1.99 on a package of trading cards and $6.50 on lunch. Write and solve an equation to show how much money Julio has left. (Solution: $20 = 1.99 + 6.50 + x$, $x = \$11.51$) 

Concepts What Students Need to Know	Skills What Students Need To Be Able To Do	Bloom's Taxonomy Levels

• Variable
• Two quantities that change in relationship to one another
  ○ Dependent variable
  ○ Independent variable
• Expression
• Equation
• Graph
• Table
	• USE (variables)
	• REPRESENT (dependent and independent variables)
	• WRITE (expressions and equations)
	• ANALYZE (relationships)
	• USE (graphs and tables)
	• RELATE (to the equation)
	• REPRESENT (numbers)
	• SOLVE (problems by writing and solving equations of the form $x + p = q$ and $px = q$ (p,q and $x \geq 0$)
		3
		2
		2
		4
		3
		3
		2
		4

Essential Questions	Big Ideas
How can expressions and equations be used to model and solve problems?	Algebraic skills and concepts allow us to describe real world situations symbolically and graphically to model quantitative change. Mathematics is based on number patterns and number relationships with a defined set of rules which interconnect and explain math concepts and natural phenomena.

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

Optional assessments:

- **Am I Ready?** (found at the beginning of the chapter 8 – identifies foundational skills needed to be successful in this unit)
- **Curriculum-based assessment: Ledyard End of Unit 6 assessment** (found in Unit 6 appendix)

Learning Activities*:*

1. Students complete function tables for given function rules. GM 8-1

2. Students extend and describe sequences using algebraic expressions. GM 8-2

3. Students construct and analyze different verbal, tabular, graphical and algebraic representations of functions. GM 8-3 and GM 8-4

Additional Activity if needed:

- Student work in groups to solve a real world problem and use a table, graph, and equation to represent the problem. *Navigating through Algebra gr 6-8* Pledge Plans (see appendix)

4. Students solve problems using the Make a Table strategy. Problem Solving Investigation GM pg. 611-613

Additional Activities if needed:

- Students may discuss the task in pairs, but work individually to solve a problem by producing a table of values, a graph, and a written analysis of a comparison of which job pays better MS Payday at Planet Adventure pg. 344

. OPTIONAL:

- ✓ Performance Task Power Up! Remodeling Project GM pg 647

UNIT 6 VOCABULARY

algebraic expression, axis (axes), coordinates, dependent variable, equation, function table, independent variable, origin, plot, substitution, variable, x-axis, y-axis

http://www.graniteschools.org/depart/teachinglearning/curriculuminstruction/math/Pages/MathematicsVocabulary.aspx choose vocabulary cards 6th grade.

Differentiated Instruction:

Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See appendix A for research-based Instructional and Differentiated Strategies

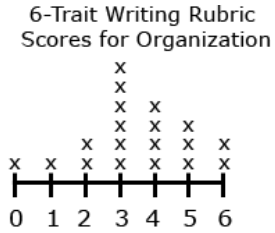
21st Century Learning Skills: See appendix A for explanations.

Electronic Resources: www.ctcorestandards.org teacher site for lessons and activities aligned to standards, also contains a family and community resource

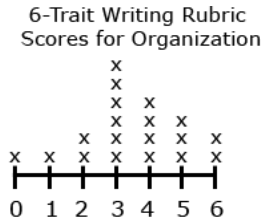
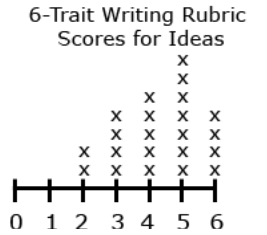
Unit 7: Statistics and Distributions **Pacing: 20 days + 3 days for reteaching/enrichment**

In this unit, students develop an understanding how to ask a statistical question, describe the data collected, and display the numerical data plots on a number line, including dot plots, histograms, and box plots.

DOMAINS and standards: STATISTICS and PROBABILITY

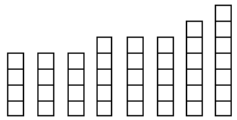
Priority and Supporting Common Core State Standards	Explanation and Examples
The student will develop an understanding of statistical variability. **6.SP.3. RECOGNIZE that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.**	**6.SP.3.** When using measures of center (mean, median, and mode) and range, students are describing a data set in a single number. The range provides a single number that describes how the values vary across the data set. The range can also be expressed by stating the minimum and maximum values. Example: • Consider the data shown in the dot plot of the six trait scores for organization for a group of students. o How many students are represented in the data set? o What are the mean, median, and mode of the data set? What do these values mean? How do they compare? o What is the range of the data? What does this value mean? 

Priority and Supporting Common Core State Standards	Explanation and Examples
6.SP.1. RECOGNIZE a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages.*	6.SP.1. Statistics are numerical data relating to an aggregate of individuals; statistics is also the name for the science of collecting, analyzing and interpreting such data. A statistical question anticipates an answer that varies from one individual to the next and is written to account for the variability in the data. Data are the numbers produced in response to a statistical question. Data are frequently collected from surveys or other sources (i.e. documents). Questions can result in a narrow or wide range of numerical values. For example, asking classmates "How old are the students in my class in years?" will result in less variability than asking "How old are the students in my class in months?" Students might want to know about the fitness of the students at their school. Specifically, they want to know about the exercise habits of the students. So rather than asking "Do you exercise?" they should ask about the amount of exercise the students at their school get per week. A statistical question for this study could be: "How many hours per week on average do students at Jefferson Middle School exercise?" To collect this information, students might design a survey question that anticipates variability by providing a variety of possible anticipated responses that have numerical answers, such as: 3 hours per week, 4 hours per week, and so on. Be sure that students ask questions that have specific numerical answers.

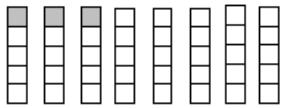
Priority and Supporting Common Core State Standards	Explanation and Examples
6.SP.2. UNDERSTAND that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.	6.SP.2. The two dot plots show the 6-trait writing scores for a group of students on two different traits, organization and ideas. The center, spread and overall shape can be used to compare the data sets. Students consider the context in which the data were collected and identify clusters, peaks, gaps, and symmetry. Showing the two graphs vertically rather than side by side helps students make comparisons. For example, students would be able to see from the display of the two graphs that the ideas scores are generally higher than the organization scores. One observation students might make is that the scores for organization are clustered around a score of 3 whereas the scores for ideas are clustered around a score of 5.  

Priority and Supporting Common Core State Standards	Explanation and Examples
The student will summarize and describe distributions. **6.SP.5. SUMMARIZE numerical data sets in relation to their context, such as by:** **a. Reporting the number of observations.** **b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.** **c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.** **d. relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.**	6.SP.5. Students summarize numerical data by providing background information about the attribute being measured, methods and unit of measurement, the context of data collection activities, the number of observations, and summary statistics. Summary statistics include quantitative measures of center, spread, and variability including extreme values (minimum and maximum), mean, median, mode, range, quartiles, interquartile ranges, and mean absolute deviation. The measure of center that a student chooses to describe a data set will depend upon the shape of the data distribution and context of data collection. • The mode is the value in the data set that occurs most frequently. The mode is the least frequently used as a measure of center because data sets may not have a mode, may have more than one mode, or the mode may not be descriptive of the data set. • The mean is a very common measure of center computed by adding all the numbers in the set and dividing by the number of values. The mean can be affected greatly by a few data points that are very low or very high. In this case, the median or middle value of the data set might be more descriptive. In data sets that are symmetrically distributed, the mean and median will be very close to the same. In data sets that are skewed, the mean and median will be different, with the median frequently providing a better overall description of the data set. <u>Understanding the Mean</u> The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students develop understanding of what the mean represents by redistributing data sets to be level or fair. The leveling process can be connected to and used to develop understanding of the computation of the mean. For example, students could generate a data set by measuring the number of jumping jacks they can perform in 5 seconds, the length of their feet to the nearest inch, or the number of letters in their names. It is best if the data generated for this activity are 5 to 10 data points which are whole numbers between 1 and 10 that are easy to model with counters or stacking cubes. Continued on next page Students generate a data set by drawing eight student names at random from the

popsicle stick cup. The number of letters in each of the names is used to create the data set. If the names drawn were Carol, Mike, Maria, Luis, Monique, Sierra, John, and Karen there would be 3 names with 4 letters each, 3 names with 5 letters each, 1 name with 6 letters and 1 name with 7 letters.
This data set could be represented with stacking cubes.



Students can model the mean by "leveling" the stacks or distributing the blocks so the stacks are "fair". Students are seeking to answer the question "If all of the students had the same number of letters in their name, how many letters would each person have?" One block from the stack of six and two blocks from the stack of 7 can be moved down to the stacks of 4 and then all the stacks have five blocks. If all students had the same number of letters in their name, they would have five letters. The mean number of letters in a name in this data set is 5.

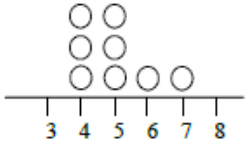


If it was not possible to make the stacks exactly even, students could begin to consider what part of the extra blocks each stack would have.

<u>Understanding Mean Absolute Deviation</u>

The use of mean absolute deviation in 6th grade is mainly exploratory. The intent is to build a deeper understanding of variability. Students would understand the mean distance between the pieces of data and the mean of the data set expresses the spread of the data set. Students can see that the larger the mean distance, the greater the variability. Comparisons can be made between different data sets.

In the previous data set, the names drawn were Carol, Mike, Maria, Luis, Monique, Sierra, John, and Karen. There were 3 names with 4 letters each, 3 names with 5 letters each, 1 name with 6 letters and 1 name with 7 letters. This data can be represented on a dot plot. The mean of the data set is 5.



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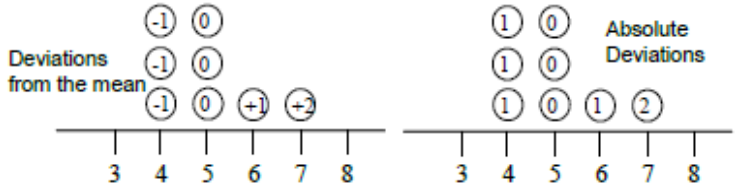
To find the mean absolute deviation, students examine each of the data points and its difference from the mean. This analysis can be represented on the dot plot itself or in a table. Each of the names with 4 letters has one fewer letter than the mean, each of the names with 5 letters has zero difference in letters as compared to the mean, each of the names with 6 letters has one more letter than the mean, and each of the names with 7 letters has two more letters than the mean. The absolute deviations are the absolute value of each difference.



Name	Number of letters in a name	Deviation from the Mean	Absolute Deviation from the Mean
John	4	-1	1
Luis	4	-1	1
Mike	4	-1	1
Carol	5	0	0
Maria	5	0	0
Karen	5	0	0
Sierra	6	+1	1
Monique	7	+2	2
Total	40	0	6

The mean of the absolute deviations is found by summing the absolute deviations and dividing by the number of data points. In this case, the mean absolute deviation would be 6 ÷ 8 or ¾ or 0.75. The mean absolute deviation is a small number, indicating that there is little variability in the data set.

Consider a different data set also containing 8 names. If the names were Sue, Joe, Jim, Amy, Sabrina, Monique, Timothy, and Adelita. Summarize the data set and its variability. How does this compare to the first data set?

Continued on next page
The mean of this data set is still 5.

$$\frac{(3+3+3+3+7+7+7)}{8} = \frac{40}{8} = 5$$

Name	Number of letters in a name	Deviation from the Mean	Absolute Deviation from the Mean
Sue	3	-2	2
Joe	3	-2	2
Jim	3	-2	2
Amy	3	-2	2
Sabrina	7	+2	2
Timothy	7	+2	2
Adelita	7	+2	2
Monique	7	+2	2
Total	40	0	16

Consider a different data set also containing 8 names. If the names were Sue, Joe, Jim, Amy, Sabrina, Monique, Timothy, and Adelita. Summarize the data set and its variability. How does this compare to the first data set?
The mean of this data set is still 5.

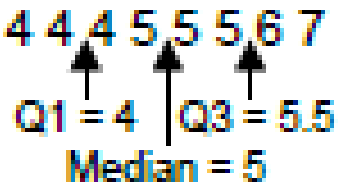
$$\frac{(3+3+3+3+7+7+7)}{8} = \frac{40}{8} = 5$$

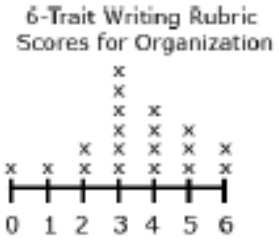
Name	Number of letters in a name	Deviation from the Mean	Absolute Deviation from the Mean
Sue	3	-2	2
Joe	3	-2	2
Jim	3	-2	2
Amy	3	-2	2
Sabrina	7	+2	2
Timothy	7	+2	2
Adelita	7	+2	2
Monique	7	+2	2
Total	40	0	16

The mean deviation of this data set is 16 ÷ 8 or 2. Although the mean is the same, there is much more variability in this data set.

Continued on next page

Understanding Medians and Quartiles

	Students can also summarize and describe the center and variability in data sets using the median and a five number summary consisting of the minimum, quartiles, and maximum as seen in the box plot example in 6.SP.4. The median is the middle number of the data set with half the number below the median and half the numbers above the median. The quartiles partition the data set into four parts by dividing each of the halves of the data set into half again. Quartile 1 (Q1 or the lower quartile) is the middle value of the lower half of the data set and quartile 3 (Q3 or the upper quartile) is the middle value of the upper half of the data set. The median can also be referred to as quartile 2 (Q2). The range of the data is the difference between the minimum and maximum values. The interquartile range of the data is the difference between the lower and upper quartiles (Q3 – Q1). The interquartile range is a measure of the dispersion or spread of the data set: a small value indicates values that are clustered near the median whereas a larger value indicates values that are more distributed. Consider the first data set again. Recall that the names drawn were Carol, Mike, Maria, Luis, Monique, Sierra, John, and Karen. The data set can be represented in a numerical list. To find the median and quartile, the values are placed in order from least to greatest. 5 4 5 4 7 6 4 5 → 4 4 4 5 5 5 6 7 The middle value in the ordered data set is the median. If there are an even number of values, the median is the mean of the middle two values. In this case, the median would be 5 because 5 is the average of the 4th and 5th values which are both 5. Students find quartile 1 (Q1) by examining the lower half of the data. Again there are 4 values which is an even number of values. Q1 would be the average of the 2nd and 3rd value in the data set or 4. Students find quartile 3 (Q3) by examining the upper half of the data. Q3 would be the average of the 6th and 7th value in the data set or 5.5. The mean of the data set was 5 and the median is also 5, showing that the values are probably clustered close to the mean. The interquartile range is 1.5 (5.5 – 4). The interquartile range is small, showing little variability in the data. 

Priority and Supporting Common Core State Standards	Explanation and Examples
6.SP.4. DISPLAY numerical data in plots on a number line, including dot plots (line plot), histograms, and box plots (box-and-whisker plot).	6.SP.4. In order to display numerical data in dot plots, histograms or box plots, students need to make decisions and perform calculations. Students are expected to display data graphically in a format appropriate for that data set as well as reading data from graphs generated by others students or contained in reference materials. Students can use applets to create data displays. Examples of applets include the Box Plot Tool and Histogram Tool on NCTM's Illuminations. Box Plot Tool - http://illuminations.nctm.org/ActivityDetail.aspx?ID=77 Histogram Tool -- http://illuminations.nctm.org/ActivityDetail.aspx?ID=78 Dot plots are simple plots on a number line where each dot represents a piece of data in the data set. Dot plots are suitable for small to moderate size data sets and are useful for highlighting the distribution of the data including clusters, gaps, and outliers. In most real data sets, there is a large amount of data and many numbers will be unique. A graph (such as a dot plot) that shows how many ones, how many twos, etc. would not be meaningful; however, a histogram can be used. Students bin the data into convenient ranges and use these intervals to generate a frequency table and histogram. Note that changing the size of the bin changes the appearance of the graph and the conclusions you may draw from it. Box plots are another useful way to display data and are plotted horizontally or vertically on a number line. Box plots are generated from the five number summary of a data set consisting of the minimum, maximum, median, and two quartile values. Students can readily compare two sets of data if they are displayed with side by side box plots on the same scale. Box plots display the degree of spread of the data and the skewness of the data. Examples: • Nineteen students completed a writing sample that was scored using the six traits rubric. The scores for the trait of organization were 0, 1, 2, 2, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 6, 6. Create a data display. What are some observations that can be made from the data display?  Continued on next page • Grade 6 students were collecting data for a math class project. They decided

they would survey the other two grade 6 classes to determine how many DVDs each student owns. A total of 48 students were surveyed. The data are shown in the table below in no specific order. Create a data display. What are some observations that can be made from the data display?

11	21	5	12	10	31	19	13	23	33
10	11	25	14	34	15	14	29	8	5
22	26	23	12	27	4	25	15	7	
2	19	12	39	17	16	15	28	16	

A histogram using 5 bins (0-9, 10-19, …30-39) to organize the data is displayed below.

• Ms. Wheeler asked each student in her class to write their age in months on a sticky note. The 28 students in the class brought their sticky note to the front of the room and posted them in order on the white board. The data set is listed below in order from least to greatest. Create a data display. What are some observations that can be made from the data display?

130	130	131	131	132	132	132	133	134	136
137	137	138	139	139	139	140	141	142	142
142	143	143	144	145	147	149	150		

Five number summary

Minimum – 130 months
Quartile 1 (Q1) – (132 + 133) ÷ 2 = 132.5 months
Median (Q2) – 139 months
Quartile 3 (Q3) – (142 + 143) ÷ 2 = 142.5 months
Maximum – 150 months

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	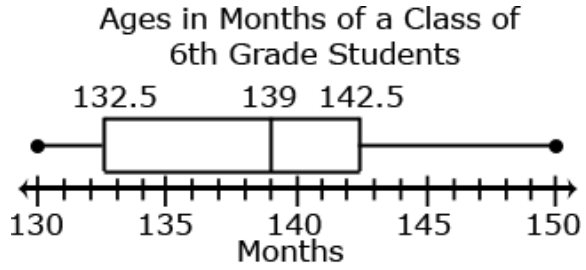 This box plot shows that • ¼ of the students in the class are from 130 to 132.5 months old • ¼ of the students in the class are from 142.5 months to 150 months old • ½ of the class are from 132.5 to 142.5 months old • the median class age is 139 months

Concepts **What Students Need to Know**	**Skills** **What Students Need To Be Able To Do**	**Bloom's Taxonomy Levels**
Measure of center ○ Median ○ Mean • Measure of variation ○ Range ○ Interquartile range ○ Mean absolute deviation • Numerical data sets ○ Observations ○ Attributes ○ Overall pattern ▪ Deviations from ○ Choice of measures of center and variability ○ Shape of the data distribution ▪ Center ▪ Spread ▪ Variability	• RECOGNIZE (measure of center and measure of variation) • SUMMARIZE (numerical data sets) • REPORT (observations) • DESCRIBE (attribute) • GIVE/FIND (measure of center and measure of variation) • DESCRIBE (overall pattern) • RELATE (choice of measure to shape of the data) • RECOGNIZE (a statistical question) • UNDERSTAND (data distribution is described by its center, spread, and overall shape) • DISPLAY (numerical data)	1 2 1 1 3 1 3 1 2 3

Essential Questions	Big Ideas
What are measures of central tendencies and how are they used to describe real-life data?	Quantitative data can be collected, organized and displayed utilizing principles of probability and statistics. Data can then be used to interpret situations and to make predictions.

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

Optional assessments:

- **Am I Ready?** (found at the beginning of chapters 11 and 12 – identifies foundational skills needed to be successful in these units)
- **Curriculum-based assessment: Ledyard End of Unit 7 assessment** (found in Unit 7 appendix)

Learning Activities*:*

STATISTICAL MEASURES

1. Students investigate statistical questions. Inquiry Lab GM pg. 805-808
2. Students summarize numerical data using the mean. GM 11-1
3. Students find and interpret the median and mode of a set of data. GM 11-2
4. Students find measures of variation. GM 11-3
5. Students explore mean absolute deviation for a data set. GM 11-4 (one class period only)
6. Students choose an appropriate measure of central tendency. GM 11-5

. OPTIONAL:

- ✓ Performance Task Power Up! Athletic Awards GM pg 857

Learning Activities*:*
STATISTICAL DISPLAYS

7. Students construct and analyze line plots. GM 12-1

8. Students construct and analyze histograms. GM 12-2
Additional Activity to incorporate technology:
- Histogram Tool -- http://illuminations.nctm.org/ActivityDetail.aspx?ID=78

9. Students display and interpret data in box plots (box and whiskers) GM 12-3
Additional Activity to incorporate technology:
- Students form a box and whiskers plot (see appendix) Human Box and Whiskers
- Box Plot Tool - http://illuminations.nctm.org/ActivityDetail.aspx?ID=77

10. Students use a graph to solve problems. Problem Solving Investigation GM pg. 887-889

11. Students describe a data distribution by its center, spread, and overall shape. GM 12-4

12. Students investigate collecting and displaying data. Inquiry Lab GM pg. 899-900

13. Students draw and interpret line graphs. GM 12-5

14. Students select an appropriate display for a set of data. GM 12-6

OPTIONAL:
- ✓ Students create a spreadsheet showing data in several ways: table, graph, calculate mean.
- ✓ Interdisciplinary Project: Unit Project GM pg. 925 incorporate with Health (nutrition), Math, ELA

UNIT 7 VOCABULARY
box plot (box and whiskers), cluster, data, distribution, dot plot (line plot), first quartile, graph, histogram, interquartile range, line plot, lower extreme, lower quartile, maximum, mean, mean absolute deviation, measure of center, measure of variation, median, minimum, outlier, range, spread, statistical variability, statistics, third quartile, upper extreme, upper quartile
http://www.graniteschools.org/depart/teachinglearning/curriculuminstruction/math/Pages/MathematicsVocabulary.aspx choose vocabulary cards 6th grade.

Differentiated Instruction:
Refer to suggestions and leveled lesson resources at the beginning of each lesson in *Math Connects.*

Instructional Strategies: See appendix A for research-based Instructional and Differentiated Strategies

21st Century Learning Skills: See appendix A for explanations.

Electronic Resources:

- Histogram Tool -- http://illuminations.nctm.org/ActivityDetail.aspx?ID=78
- Box Plot Tool - http://illuminations.nctm.org/ActivityDetail.aspx?ID=77
- www.ctcorestandards.org teacher site for lessons and activities aligned to standards, also contains a family and community resource

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