### **GRADE 6 MATHEMATICS**

### **Overview:**

Domains	Propo	os & rtional onships	The Numb	oer System	Expressions Equations		Geometry	Statistics and Probability
Clusters	concepts and use ratio reasoning to solve problems  previous ur multiplicati to divide fr fractions Compute multi-digit find comme multiples Apply and previous ur numbers to		Compute flumulti-digit number find common	rstandings of and division ions by lently with mbers and factors and extend erstandings of e system of	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 strategically.  5. Use appropriate tools structure.  6. Attend to precision.  7. Look for and make use of structure.  8. Look for and express regularity in repeated reasoning.						and express regularity
Major Thematic Grade 6 Units		English Language Arts: across the content areas  Reading Writing Speaking & Listening Language Won't Grow Up - What distinguishes childhood from adulthood? Blasts from the Past: Greek and Roman Mythology Courageous Characters: Bravery in the Face of Danger		<ul> <li>Earth Proc Minerals</li> <li>Weather ar</li> <li>Investigating Regional, a</li> </ul>	Socie  and Climate  ating Local, l, and Global Issues the Lang, Montana  Socie  The l  Reviv  The l		Social Studies  Humankind and the Development of Human stries Beginnings of Civilization-Mesopotamia and Egypt ew of Map Skills Foundation of Western Ideas-Ancient Hebrews Meets East-Early Civilizations of Indian and China Meets West-Greece and Rome	

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.

### **Domain: Ratios and Proportional Relationships**

### **6.RP**

### Cluster: Understand ratio concepts and use ratio reasoning to solve problems.

- 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."
  - I can use ratios to describe relationships between two quantities.
- 2. Understand the concept of a unit rate a/b associated with a ratio a:b with  $b \neq 0$ , 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." (Note: Expectations for unit rates in this grade are limited to non-complex fractions.)
  - I can use unit rate in the context of a ratio relationship.
- 3. Use ratio and rate reasoning to solve real-world and mathematical problems from a variety of cultural contexts, including those of Montana American Indians, 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.
  - I can make and compare tables of equivalent ratios.
  - I can plot the pairs of values from a ratio table on a coordinate plane.
  - 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? At what rate were lawns being mowed? As a contemporary American Indian example, it takes at least 16 hours to bead a Crow floral design on moccasins for two children. How many pairs of moccasins can be completed in 72 hours?
  - I can solve unit rate problems.
  - c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.
  - I can determine a percent of a quantity.
  - d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.
  - I can use ratios to convert units of measurement.

### **Domain: The Number System**

#### 0.1**\**3

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

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?

• I can compute and interpret quotients of fractions and solve word problems.

### Cluster: Compute fluently with multi-digit numbers and find common factors and multiples.

- 2. Fluently divide multi-digit numbers using the standard algorithm.
  - I can divide multi-digit numbers.
- 3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
  - I can add, subtract, multiply, and divide multi-digit decimals.
- 4. Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. For example, express 36 + 8 as 4 (9 + 2).
  - I can find the greatest common factor of two whole numbers less than or equal to 100.
  - I can find the least common multiple of two whole numbers less than or equal to 12.
  - I can use the distributive property.

## Cluster: Apply and extend previous understandings of numbers to the system of rational numbers.

- 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.
  - I can understand that positive and negative numbers have opposite values and apply it to real-world contexts.
- 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.
  - I can use a number line to recognize that numbers with opposite signs are located on opposite sides of zero.
  - 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.
  - I can determine the location in quadrants of the coordinate plane based on the signs of the numbers in ordered pairs.
  - I can recognize ordered pairs with opposite signs are reflections of each other.

- 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.
- I can represent integers and other rational numbers on horizontal and vertical number line diagrams and a coordinate plane.
- 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.
  - I can interpret inequalities using number line diagrams.
  - b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. For example, write  $-3 \, ^{\circ}C > -7 \, ^{\circ}C$  to express the fact that  $-3 \, ^{\circ}C$  is warmer than  $-7 \, ^{\circ}C$ .
  - I can write and explain real-world statements that compare rational numbers.
  - 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.
  - I can understand, interpret, and apply absolute value.
  - 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.
  - I can distinguish comparisons of absolute value.
- 8. Solve real-world and mathematical problems from a variety of cultural contexts, including those of Montana American Indians, 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.
  - I can solve real-world problems using points in all four quadrants to determine distances between points.

### **Domain: Expressions and Equations**

### **6.EE**

Cluster: Apply and extend previous understandings of arithmetic to algebraic expressions.

- 1. Write and evaluate numerical expressions involving whole-number exponents.
  - I can write and evaluate expressions with whole-number exponents.
- 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.
  - I can write expressions using variables.
  - a. 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.

- I can use mathematical terms to describe expressions.
- 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 length s = 1/2.
- I can use Order of Operations to evaluate expressions.
- 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.
  - I can apply properties of operations to generate equivalent expressions.
- 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.
  - I can identify when two expressions are equivalent.

### Cluster: Reason about and solve one-variable equations and inequalities.

- 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.
  - I can understand that solving an equation or inequality can be used to answer a question.
- 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.
  - I can write expressions using variables.
- 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.
  - I can solve real-world problems by writing and solving equations using variables.
- 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.
  - I can write an inequality to represent a real-world situation.

Cluster: Represent and analyze quantitative relationships between dependent and independent variables.

- 9. Use variables to represent two quantities in a real-world problem from a variety of cultural contexts, including those of Montana American Indians, 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.
  - I can write an equation that shows the relationship between an independent variable and a dependent variable.
  - I can analyze the relationship between dependent and independent variables using graphs and tables.

### **Domain: Geometry**

### **6.G**

Cluster: Solve real-world and mathematical problems involving area, surface area, and volume.

- 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 within cultural contexts, including those of Montana American Indians. For example, use Montana American Indian designs to decompose shapes and find the area.
  - I can find the area of polygons using the area of triangles and quadrilaterals.
- 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.
  - I can find the volume of a rectangular prism.
- 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.
  - I can use coordinate points to draw polygons on a coordinate plane.
  - I can use coordinates to find the lengths of the polygon's sides.
- 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 within cultural contexts, including those of Montana American Indians.
  - I can represent solids using nets made of rectangles and triangles.
  - I can determine the surface area of polygons using nets made of rectangles and triangles.

### **Domain: Statistics and Probability**

### **6.SP**

### Cluster: Develop understanding of statistical variability.

- 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.
  - I can recognize a statistical question that anticipates variability in the data.
- 2. Understand that a set of data collected (including Montana American Indian demographic data) to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
  - I can describe a statistical questions distribution by its center, spread, and overall shape.
- 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.
  - I can recognize the differences between the measures of center and the measures of variation for a numerical data set.

### Cluster: Summarize and describe distributions.

- 4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
  - I can display data using dot plots (line plot), histograms, and box plots (box and whisker plot).
- 5. Summarize numerical data sets in relation to their context, such as by:
  - a. Reporting the number of observations.
  - I can report the number of observations in a data set.
  - b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
  - I can describe the attributes of a data set.
  - 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.
  - I can use measures of center and variability to describe patterns and deviations in a data set.
  - 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.
  - I can choose which measure of center and variability best represents a data set.

Standards	Explanations and Examples					
Students are expected to:	The Standards for Mathematical Practice describe ways in which students ought to engage					
	with the subject matter as they grow in mathematical maturity and expertise.					
6.MP.1. Make sense of problems and persevere in solving them.	In grade 6, students solve problems involving ratios and rates and discuss how they solved them.  Students solve real world problems through the application of algebraic and geometric concepts.  Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, "What is the most efficient way to solve the problem?", "Does this make sense?", and "Can I solve the problem in a different way?"					
6.MP.2. Reason abstractly and quantitatively.	In grade 6, students represent a wide variety of real world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.					
6.MP.3. Construct viable arguments and critique the reasoning of others.	In grade 6, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e. box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like "How did you get that?", "Why is that true?" "Does that always work?" They explain their thinking to others and respond to others' thinking.					
6.MP.4. Model with mathematics.	In grade 6, students model problem situations symbolically, graphically, tabularly, and contextually. Students form expressions, equations, or inequalities from real world contexts and connect symbolic and graphical representations. Students begin to explore covariance and represent two quantities simultaneously. Students use number lines to compare numbers and represent inequalities. They use measures of center and variability and data displays (i.e. box plots and histograms) to draw inferences about and make comparisons between data sets. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context.					
6.MP.5. Use appropriate tools strategically.	Students consider available tools (including estimation and technology) when solving a mathematical problem and decide when certain tools might be helpful. For instance, students in grade 6 may decide to represent similar data sets using dot plots with the same scale to visually compare the center and variability of the data. Additionally, students might use physical objects or applets to construct nets and calculate the surface area of three-dimensional figures.					
6.MP.6. Attend to precision.	In grade 6, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to rates, ratios, geometric figures, data displays, and components of expressions, equations or inequalities.					
6.MP.7. Look for and make use of structure.	Students routinely seek patterns or structures to model and solve problems. For instance, students recognize patterns that exist in ratio tables recognizing both the additive and multiplicative properties. Students apply properties to generate equivalent expressions (i.e. $6 + 2x = 2(3 + x)$ by distributive property) and solve equations (i.e. $2c + 3 = 15$ , $2c = 12$ by subtraction property of equality; $c=6$ by division property of equality). Students compose and decompose two- and three-dimensional figures to solve real world problems involving area and volume.					
6.MP.8. Look for and express regularity in repeated reasoning.	In grade 6, students use repeated reasoning to understand algorithms and make generalizations about patterns. During multiple opportunities to solve and model problems, they may notice that $a/b \div c/d = ad/bc$ and construct other examples and models that confirm their generalization. Students connect place value and their prior work with operations to understand algorithms to fluently divide multi-digit numbers and perform all operations with multi-digit decimals. Students informally begin to make connections between covariance, rates, and representations showing the relationships between quantities.					

Standard	Grade 6 Montana Common Core Standards Vocabulary				
6.RP.1	ratio				
6.RP.2	ratio, rate, unit rate				
6.RP.3	ratio, equivalent ratio, rate, unit rate, percent, coordinate plane				
6.NS.1	quotient				
6.NS.2	none				
6.NS.3	none				
6.NS.4	factor, multiple, GCF, LCM, distributive property				
6.NS.5	positive, Negative, opposite				
6.NS.6	rational number, integer, opposite, coordinate plane, ordered pair, quadrant, reflection				
6.NS.7	absolute value, magnitude, rational number, positive, negative				
6.NS.8	coordinate plane, quadrant, coordinates, x-coordinate, y-coordinate, absolute value				
6.EE.1	base, exponent, evaluate				
6.EE.2	sum, difference, term, product, factor, quotient, coefficient, arithmetic, expression, algebraic expression, substitute, evaluate				
6.EE.3	equivalent expressions, commutative property, associative property, distributive property				
6.EE.4	equivalent expression				
6.EE.5	equation, inequality, substitute, solve, solution				
6.EE.6	variable, constant, algebraic expression				
6.EE.7	algebraic equation, solve				
6.EE.8	inequality				
6.EE.9	independent variable, dependent variable, coordinate plane				
6.G.1	polygon, triangle, right triangle, quadrilateral, parallelogram, trapezoid, area, square unit				
6.G.2	right rectangular prism, base, height, area, volume, cubic unit				
6.G.3	vertex/vertices, coordinate, polygon				
6.G.4	right rectangular prism, right triangular prism, right square pyramid, right tetrahedron, net, surface area				
6.SP.1	variability				
6.SP.2	distribution, center, spread, shape of data				
6.SP.3	measure of center, mean, median (Q2), mode, measure of variation, range, interquartile range, extremes, lower quartile (Q1), upper quartile (Q3), outlier, mean absolute deviation				
6.SP.4	line plot, dot plot, histogram, median (Q2), lower extreme, lower quartile (Q1), upper quartile (Q3), upper extreme, box plot, outlier				
6.SP.5	measure of center, mean, median, mode, measure of variability, range, interquartile range, mean absolute deviation (Q2), mode, measure of variation, range, interquartile range, extremes, lower quartile (Q1), upper quartile (Q3), outlier, mean absolute deviation				