Grade 6

In grade 6, instructional time will emphasize five areas:

(1) performing all four operations with integers, positive decimals and positive fractions with procedural fluency;
(2) exploring and applying concepts of ratios, rates and percent to solve problems;
(3) creating, interpreting and using expressions and equations;
(4) extending geometric reasoning to plotting points on the coordinate plane, area and volume of geometric figures and
(5) extending understanding of statistical thinking.

Number Sense and Operations

MA.6.NSO.1 Extend knowledge of numbers to negative numbers and develop an understanding of absolute value.

MA.6.NSO.1.1 Extend previous understanding of numbers to define rational numbers. Plot, order and compare rational numbers.

Benchmark Clarifications:
Clarification 1: Within this benchmark, the expectation is to plot, order and compare positive and negative rational numbers when given in the same form and to plot, order and compare positive rational numbers when given in different forms (fraction, decimal, percentage).
Clarification 2: Within this benchmark, the expectation is to use symbols (<, > or =).

MA.6.NSO.1.2 Given a mathematical or real-world context, represent quantities that have opposite direction using rational numbers. Compare them on a number line and explain the meaning of zero within its context.

Example: Jasmine is on a cruise and is going on a scuba diving excursion. Her elevations of 10 feet above sea level and 8 feet below sea level can be compared on a number line, where 0 represents sea level.

Benchmark Clarifications:
Clarification 1: Instruction includes vertical and horizontal number lines, context referring to distances, temperatures and finances and using informal verbal comparisons, such as, lower, warmer or more in debt.
Clarification 2: Within this benchmark, the expectation is to compare positive and negative rational numbers when given in the same form.

MA.6.NSO.1.3 Given a mathematical or real-world context, interpret the absolute value of a number as the distance from zero on a number line. Find the absolute value of rational numbers.

Benchmark Clarifications:
Clarification 1: Instruction includes the connection of absolute value to mirror images about zero and to opposites.
Clarification 2: Instruction includes vertical and horizontal number lines and context referring to distances, temperature and finances.

MA.6.NSO.1.4 Solve mathematical and real-world problems involving absolute value, including the comparison of absolute value.

Example: Michael has a lemonade stand which costs $10 to start up. If he makes $5 the first day, he can determine whether he made a profit so far by comparing $|-10|$ and $|5|$.

Benchmark Clarifications:
Clarification 1: Absolute value situations include distances, temperatures and finances.
Clarification 2: Problems involving calculations with absolute value are limited to two or fewer operations.
Clarification 3: Within this benchmark, the expectation is to use integers only.

MA.6.NSO.2 Add, subtract, multiply and divide positive rational numbers.

MA.6.NSO.2.1 Multiply and divide positive multi-digit numbers with decimals to the thousandths, including using a standard algorithm with procedural fluency.

Benchmark Clarifications:
Clarification 1: Multi-digit decimals are limited to no more than 5 total digits.

MA.6.NSO.2.2 Extend previous understanding of multiplication and division to compute products and quotients of positive fractions by positive fractions, including mixed numbers, with procedural fluency.

Benchmark Clarifications:
Clarification 1: Instruction focuses on making connections between visual models, the relationship between multiplication and division, reciprocals and algorithms.

MA.6.NSO.2.3 Solve multi-step real-world problems involving any of the four operations with positive multi-digit decimals or positive fractions, including mixed numbers.

Benchmark Clarifications:
Clarification 1: Within this benchmark, it is not the expectation to include both decimals and fractions within a single problem.

MA.6.NSO.3 Apply properties of operations to rewrite numbers in equivalent forms.

MA.6.NSO.3.1 Given a mathematical or real-world context, find the greatest common factor and least common multiple of two whole numbers.

Example: Middleton Middle School's band has an upcoming winter concert which will have several performances. The bandleader would like to divide the students into concert groups with the same number of flute players, the same number of clarinet players and the same number of violin players in each group. There are a total of 15 students who play the flute, 27 students who play the clarinet and 12 students who play the violin. How many separate groups can be formed?

Example: Adam works out every 8 days and Susan works out every 12 days. If both Adam and Susan work out today, how many days until they work out on the same day again?

Benchmark Clarifications:
Clarification 1: Within this benchmark, expectations include finding greatest common factor within 1,000 and least common multiple with factors to 25.
Clarification 2: Instruction includes finding the greatest common factor of the numerator and denominator of a fraction to simplify the fraction.

MA.6.NSO.3.2 Rewrite the sum of two composite whole numbers having a common factor, as a common factor multiplied by the sum of two whole numbers.

Benchmark Clarifications:
Clarification 1: Instruction includes using the distributive property to generate equivalent expressions.

MA.6.NSO.3.3 Evaluate positive rational numbers and integers with natural number exponents.

Benchmark Clarifications:
Clarification 1: Within this benchmark, expectations include using natural number exponents up to 5.

MA.6.NSO.3.4 Express composite whole numbers as a product of prime factors with natural number exponents.

MA.6.NSO.3.5 Rewrite positive rational numbers in different but equivalent forms including fractions, terminating decimals and percentages.

Example: The number $1\frac{5}{8}$ can be written equivalently as 1.625 or 162.5%

Benchmark Clarifications:
Clarification 1: Rational numbers include decimal equivalence up to the thousandths place.

MA.6.NSO.4 Extend understanding of operations with integers.

MA.6.NSO.4.1 Apply and extend previous understandings of operations with whole numbers to add and subtract integers with procedural fluency.

Benchmark Clarifications:
Clarification 1: Instruction begins with the use of manipulatives, models and number lines working towards becoming procedurally fluent by the end of grade 6.
Clarification 2: Instruction focuses on the inverse relationship between the operations of addition and subtraction. If p and q are integers, then $p - q = p + (-q)$ and $p + q = p - (-q)$.

MA.6.NSO.4.2 Apply and extend previous understandings of operations with whole numbers to multiply and divide integers with procedural fluency.

Benchmark Clarifications:
Clarification 1: Instruction includes the use of models and number lines and the inverse relationship between multiplication and division, working towards becoming procedurally fluent by the end of grade 6.
Clarification 2: Instruction focuses on the understanding that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers where $q \neq 0$, then $-\left(\frac{p}{q}\right) = \frac{-p}{q}$, $-\left(\frac{p}{q}\right) = \frac{p}{-q}$ and $\frac{p}{q} = \frac{-p}{-q}$.

Algebraic Reasoning

MA.6.AR.1 Apply previous understanding of arithmetic expressions to algebraic expressions.

MA.6.AR.1.1 Given a mathematical or real-world context, translate written descriptions into algebraic expressions and translate algebraic expressions into written descriptions.

Example: The algebraic expression $7.2x - 20$ can be used to describe the daily profit of a company who makes \$7.20 per product sold with daily expenses of \$20.

MA.6.AR.1.2 Translate a real-world written description into an algebraic inequality in the form of $x > a$, $x < a$, $x \geq a$ or $x \leq a$. Represent the inequality on a number line.

Example: Mrs. Anna told her class that they will get a pizza if the class has an average of at least 83 out of 100 correct questions on the semester exam. The inequality $g \geq 83$ can be used to represent the situation where students receive a pizza and the inequality $g < 83$ can be used to represent the situation where students do not receive a pizza.

Benchmark Clarifications:
Clarification 1: Variables may be on the left or right side of the inequality symbol.

MA.6.AR.1.3 Evaluate algebraic expressions using substitution and order of operations.

Example: Evaluate the expression $2a^2 - \frac{b}{5}$, where $a = -1$ and $b = 15$.

Benchmark Clarifications:
Clarification 1: Within this benchmark, the expectation is to perform all operations with integers.
Clarification 2: Refer to Properties of Operations, Equality and Inequality (Appendix D).

MA.6.AR.1.4 Apply the properties of operations to generate equivalent algebraic expressions with integer coefficients.

Example: The expression $5(3x + 1)$ can be rewritten equivalently as $15x + 5$.
Example: If the expression $2x + 3x$ represents the profit the cheerleading team can make when selling the same number of cupcakes, sold for \$2 each, and brownies, sold for \$3 each. The expression $5x$ can express the total profit.

Benchmark Clarifications:
Clarification 1: Properties include associative, commutative and distributive.
Clarification 2: Refer to Properties of Operations, Equality and Inequality (Appendix D).

MA.6.AR.2 Develop an understanding for solving equations and inequalities. Write and solve one-step equations in one variable.

MA.6.AR.2.1 Given an equation or inequality and a specified set of integer values, determine which values make the equation or inequality true or false.

Example: Determine which of the following values make the inequality $x + 1 < 2$ true: $-4, -2, 0, 1$.

Benchmark Clarifications:
Clarification 1: Problems include the variable in multiple terms or on either side of the equal sign or inequality symbol.

MA.6.AR.2.2 Write and solve one-step equations in one variable within a mathematical or real-world context using addition and subtraction, where all terms and solutions are integers.

Example: The equations $-35 + x = 17$, $17 = -35 + x$ and $17 - x = -35$ can represent the question "How many units to the right is 17 from -35 on the number line?"

Benchmark Clarifications:
Clarification 1: Instruction includes using manipulatives, drawings, number lines and inverse operations.
Clarification 2: Instruction includes equations in the forms $x + p = q$ and $p + x = q$, where x, p and q are any integer.
Clarification 3: Problems include equations where the variable may be on either side of the equal sign.

MA.6.AR.2.3 Write and solve one-step equations in one variable within a mathematical or real-world context using multiplication and division, where all terms and solutions are integers.

Benchmark Clarifications:
Clarification 1: Instruction includes using manipulatives, drawings, number lines and inverse operations.
Clarification 2: Instruction includes equations in the forms $\frac{x}{p} = q$, where $p \neq 0$, and $px = q$.
Clarification 3: Problems include equations where the variable may be on either side of the equal sign.

MA.6.AR.2.4 Determine the unknown decimal or fraction in an equation involving any of the four operations, relating three numbers, with the unknown in any position.

Example: Given the equation $\frac{9}{8} = x - \frac{1}{8}$, x can be determined to be $\frac{10}{8}$ because $\frac{10}{8}$ is $\frac{1}{8}$ more than $\frac{9}{8}$.

Benchmark Clarifications:
Clarification 1: Instruction focuses on using algebraic reasoning, drawings, and mental math to determine unknowns.
Clarification 2: Problems include the unknown and different operations on either side of the equal sign. All terms and solutions are limited to positive rational numbers.

MA.6.AR.3 Understand ratio and unit rate concepts and use them to solve problems.

MA.6.AR.3.1 Given a real-world context, write and interpret ratios to show the relative sizes of two quantities using appropriate notation: $\frac{a}{b}$, a to b, or $a:b$ where $b \neq 0$.

Benchmark Clarifications:
Clarification 1: Instruction focuses on the understanding that a ratio can be described as a comparison of two quantities in either the same or different units.
Clarification 2: Instruction includes using manipulatives, drawings, models and words to interpret part-to-part ratios and part-to-whole ratios.
Clarification 3: The values of a and b are limited to whole numbers.

MA.6.AR.3.2 Given a real-world context, determine a rate for a ratio of quantities with different units. Calculate and interpret the corresponding unit rate.

Example: Tamika can read 500 words in 3 minutes. Her reading rate can be described as $\frac{500\ words}{3\ minutes}$ which is equivalent to the unit rate of $166\frac{2}{3}$ words per minute.

Benchmark Clarifications:
Clarification 1: Instruction includes using manipulatives, drawings, models and words and making connections between ratios, rates and unit rates.
Clarification 2: Problems will not include conversions between customary and metric systems.

MA.6.AR.3.3 Extend previous understanding of fractions and numerical patterns to generate or complete a two- or three-column table to display equivalent part-to-part ratios and part-to-part-to-whole ratios.

Example: The table below expresses the relationship between the number of ounces of yellow and blue paints used to create a new color. Determine the ratios and complete the table.

Yellow (part)	1.5	3		9
Blue (part)	2	4		
New color (whole)			12	21

Benchmark Clarifications:
Clarification 1: Instruction includes using two-column tables (e.g., a relationship between two variables) and three-column tables (e.g., part-to-part-to-whole relationship) to generate conversion charts and mixture charts.

MA.6.AR.3.4 Apply ratio relationships to solve mathematical and real-world problems involving percentages using the relationship between two quantities.

Example: Gerald is trying to gain muscle and needs to consume more protein every day. If he has a protein shake that contain 32 grams and the entire shake is 340 grams, what percentage of the entire shake is protein? What is the ratio between grams of protein and grams of non-protein?

Benchmark Clarifications:

Clarification 1: Instruction includes the comparison of $\frac{part}{whole}$ to $\frac{percent}{100}$ in order to determine the percent, the part or the whole.

MA.6.AR.3.5 Solve mathematical and real-world problems involving ratios, rates and unit rates, including comparisons, mixtures, ratios of lengths and conversions within the same measurement system.

Benchmark Clarifications:

Clarification 1: Instruction includes the use of tables, tape diagrams and number lines.

Geometric Reasoning

MA.6.GR.1 Apply previous understanding of the coordinate plane to solve problems.

MA.6.GR.1.1 Extend previous understanding of the coordinate plane to plot rational number ordered pairs in all four quadrants and on both axes. Identify the x- or y-axis as the line of reflection when two ordered pairs have an opposite x- or y-coordinate.

MA.6.GR.1.2 Find distances between ordered pairs, limited to the same x-coordinate or the same y-coordinate, represented on the coordinate plane.

MA.6.GR.1.3 Solve mathematical and real-world problems by plotting points on a coordinate plane, including finding the perimeter or area of a rectangle.

Benchmark Clarifications:

Clarification 1: Instruction includes finding distances between points, computing dimensions of a rectangle or determining a fourth vertex of a rectangle.

Clarification 2: Problems involving rectangles are limited to cases where the sides are parallel to the axes.

MA.6.GR.2 Model and solve problems involving two-dimensional figures and three-dimensional figures.

MA.6.GR.2.1 Derive a formula for the area of a right triangle using a rectangle. Apply a formula to find the area of a triangle.

Benchmark Clarifications:
Clarification 1: Instruction focuses on the relationship between the area of a rectangle and the area of a right triangle.
Clarification 2: Within this benchmark, the expectation is to know from memory a formula for the area of a triangle.

MA.6.GR.2.2 Solve mathematical and real-world problems involving the area of quadrilaterals and composite figures by decomposing them into triangles or rectangles.

Benchmark Clarifications:
Clarification 1: Problem types include finding area of composite shapes and determining missing dimensions.
Clarification 2: Within this benchmark, the expectation is to know from memory a formula for the area of a rectangle and triangle.
Clarification 3: Dimensions are limited to positive rational numbers.

MA.6.GR.2.3 Solve mathematical and real-world problems involving the volume of right rectangular prisms with positive rational number edge lengths using a visual model and a formula.

Benchmark Clarifications:
Clarification 1: Problem types include finding the volume or a missing dimension of a rectangular prism.

MA.6.GR.2.4 Given a mathematical or real-world context, find the surface area of right rectangular prisms and right rectangular pyramids using the figure's net.

Benchmark Clarifications:
Clarification 1: Instruction focuses on representing a right rectangular prism and right rectangular pyramid with its net and on the connection between the surface area of a figure and its net.
Clarification 2: Within this benchmark, the expectation is to find the surface area when given a net or when given a three-dimensional figure.
Clarification 3: Problems involving right rectangular pyramids are limited to cases where the heights of triangles are given.
Clarification 4: Dimensions are limited to positive rational numbers.

Data Analysis and Probability

MA.6.DP.1 Develop an understanding of statistics and determine measures of center and measures of variability. Summarize statistical distributions graphically and numerically.

MA.6.DP.1.1 Recognize and formulate a statistical question that would generate numerical data.

Example: The question "How many minutes did you spend on mathematics homework last night?" can be used to generate numerical data in one variable.

MA.6.DP.1.2 Given a numerical data set within a real-world context, find and interpret mean, median, mode and range.

Example: The data set $\{15, 0, 32, 24, 0, 17, 42, 0, 29, 120, 0, 20\}$, collected based on minutes spent on homework, has a mode of 0.

Benchmark Clarifications:
Clarification 1: Numerical data is limited to positive rational numbers.

MA.6.DP.1.3 Given a box plot within a real-world context, determine the minimum, the lower quartile, the median, the upper quartile and the maximum. Use this summary of the data to describe the spread and distribution of the data.

Example: The middle 50% of the population can be determined by finding the interval between the upper quartile and the lower quartile.

Benchmark Clarifications:
Clarification 1: Instruction includes describing range, interquartile range, halves and quarters of the data.

MA.6.DP.1.4 Given a histogram or line plot within a real-world context, qualitatively describe and interpret the spread and distribution of the data, including any symmetry, skewness, gaps, clusters, outliers and the range.

Benchmark Clarifications:
Clarification 1: Refer to K-12 Mathematics Glossary (Appendix C).

MA.6.DP.1.5 Create box plots and histograms to represent sets of numerical data within real-world contexts.

Example: The numerical data set $\{15, 0, 32, 24, 0, 17, 42, 0, 29, 120, 0, 20\}$, collected based on minutes spent on homework, can be represented graphically using a box plot.

Benchmark Clarifications:
Clarification 1: Instruction includes collecting data and discussing ways to collect truthful data to construct graphical representations.
Clarification 2: Within this benchmark, it is the expectation to use appropriate titles, labels, scales and units when constructing graphical representations.
Clarification 3: Numerical data is limited to positive rational numbers.

MA.6.DP.1.6 Given a real-world scenario, determine and describe how changes in data values impact measures of center and variation.

Benchmark Clarifications:
Clarification 1: Instruction includes choosing the measure of center or measure of variation depending on the scenario.
Clarification 2: The measures of center are limited to mean and median. The measures of variation are limited to range and interquartile range.
Clarification 3: Numerical data is limited to positive rational numbers.
