

Sixth Grade Math Standards

The standards for middle school continue the work started in elementary grades in these four strands: Data, Probability, and Statistical Reasoning (DPSR); Measurement, Geometry, Spatial Reasoning (MGSR); Numerical Reasoning (NR); and Patterns, Algebra, and Functional Reasoning (PAFR). Woven throughout all four strands are concepts building on students' understanding of problem solving to provide context to the problems they are solving, which will foster critical thinking and collaboration skills.

In DPSR, sixth graders will analyze data sets to identify their statistical elements. They will create graphs and plots to represent data sets, along with interpreting measures of center and spread for those data sets. They will be introduced to probability with simple and complementary events and learn that probabilities can be written as a fraction, decimal, or percent.

In MGSR, sixth graders will use the characteristics of two-dimensional and three-dimensional shapes learned in earlier grades to help them calculate area, surface area, and volume using models, nets, and formulas. Students will use angle measures to find and identify complementary or supplementary angles, along with exploring angles using a protractor. They will be introduced to all four quadrants of the coordinate plane and begin plotting and graphing ordered pairs in all four quadrants, to include graphing lines and polygons.

In NR, sixth graders will utilize multiple representations of real numbers to translate, simplify, and solve problems using mathematical and real-world applications. Students will use their prior knowledge of whole numbers to expand into operations with integers and positive rational numbers. They will deepen their understanding of fractions, decimals, and percentages through ordering, sorting, and finding absolute value. The emphasis will be on understanding negative numbers.

In PAFR, sixth graders will expand their understanding of algebraic concepts, being introduced to functions. They will learn the correct terminology related to algebraic expressions, equations, and inequalities, along with distinguishing between expressions and equations, and equations and inequalities. One-step simple equations and inequalities will be used to solve a variety of problems using positive rational numbers. Students will also be introduced to ratios and rates, and how to use them in real-world situations.

Mathematical Process Standards

Standard	Indicator	Indicator Insight
PROBLEM SOLVING	MPS.PS.1 Make sense of problems and persevere in solving them strategically.	Experience problems that are interesting and relevant to students' lives, demonstrating the impact of mathematics. Interpret the meaning of a problem by imagining the situation, considering multiple entry points, making a plan, and choosing a solution pathway. Demonstrate flexibility in approaching the problem. When the solution pathway does not lead to a solution, look for another way. Recognize that multiple representations (concrete models, drawings, expressions, equations, verbal descriptions, tables, diagrams, and graphs) are related to each other and can help students solve the problem. Compare other students' approaches to solving the problem and understand there can be multiple ways to solve a problem. To find a correct solution, consider simpler forms of the original problem. Have students continually ask themselves if a solution is reasonable.
REPRESENTATION & COMMUNICATION	MPS.RC.1 Explain ideas using precise and contextually appropriate mathematical language, tools, and models.	Engage in mathematical discourse to explain or justify a conjecture. Solve problems collaboratively. Collaborate with others by posing clarifying questions that help deepen overall understanding of the concept. Be specific with explanations by using objects, drawings, pictures, and symbolic representations. Use a variety of forms to present results to an audience. Use properties of operations to justify the equivalence of expressions. Make decisions about which tools are necessary to use, or not use, in specific situations. Demonstrate proficiency in choosing technology tools that will aid in understanding a concept or formulating a solution to the problem. Attend to precision when checking work and labeling measurements, along with making revisions as needed.
CONNECTIONS	MPS.C.1 Demonstrate a deep and flexible conceptual understanding of mathematical ideas, operations, and relationships while making real-world connections.	Make connections applying number sense with real-world contexts. Understand that fractions, decimals, and percentages are rational numbers. Make sense of missing numbers in equations by using the relationships among addition, subtraction, multiplication, and division. Understand that a complex problem is made up of many smaller problems needing to be solved to get to a "final solution." Have students generate their own mathematical problems using the world around them.

Standard	Indicator	Indicator Insight
ANALYZE & JUSTIFY	MPS.AJ.1 Use critical thinking skills to reason both abstractly and quantitatively.	Compare arguments, determine if the logic used is reasonable, and be able to explain any errors or flaws found. Construct written and verbal arguments using objects, numbers, drawings, diagrams, mathematical activities, and mathematical symbols. Make sense of both symbols and numbers. Reason inductively about data, making reasonable arguments that consider the context from which the data arose. Have students review their position as new evidence is presented and revise their position if necessary.
	MPS.SP.1 Identify and apply regularity in repeated reasoning to make generalizations.	Recognize complex mathematical objects and situations as being composed of multiple parts. Apply a variety of strategies to find solutions for a problem in context. Notice patterns and structure in repeated calculations and look for generalizations, general methods, and shortcuts. Check for reasonableness and needed adjustments in strategies while solving problems.

Data, Probability, and Statistical Reasoning

6.DPSR.1. Analyze data sets to identify their statistical elements.

Indicator #	Indicator	Indicator Insight
6.DPSR.1.1	Identify the sample size for a numerical set of data in mathematical and real-world situations.	This is the introduction to the term <i>sample size</i> .
6.DPSR.1.2	Create box plots to represent numerical data sets in mathematical and real-world situations.	This is the first exposure to box plots. Use the terms <i>upper extreme</i> and <i>lower extreme</i> rather than maximum and minimum. Teach using data displays, not just numerical sets. Make connections between the second quartile and the median.
6.DPSR.1.3	Use the shape of the graph to determine whether median or mode best describes the data set.	This indicator introduces spread and center. The shape includes right skew, left skew, symmetric, uniform, bimodal (two modes), and outliers. This is the introduction to outliers. Discuss how outliers affect the data.
6.DPSR.1.4	Calculate and interpret the median, mode, range, interquartile range in mathematical and real-world situations.	Compare differences between median and mode. Include positive rational numbers in the data sets.

6.DPSR.2. Calculate and interpret probability.

Indicator #	Indicator	Indicator Insight
6.DPSR.2.1	Given the probability of a random event, expressed as a number from 0 to 1, state the likelihood of the event occurring.	Likelihood is defined as: certain (probability of 1), impossible (probability of 0), likely, equally likely, or unlikely. Probabilities closer to 1 being likely, and those closer to 0 being unlikely events. Probability can be written as a fraction, decimal, or percent. <i>Likelihood</i> was introduced in third grade.
6.DPSR.2.2	Find the probability of simple events in mathematical and real-world situations. Limit denominators to 2, 4, 5, 8, 10, 20, 25, 50, 100, and 200.	In Grade 5, finding probabilities of simple events (as fractions only) was introduced. Probability can be written as a fraction, decimal, or percent.
6.DPSR.2.3	Given the probability of an event, identify and calculate the complement of that event.	The probabilities of complementary events add up to 1.

Measurement, Geometry, and Spatial Reasoning**6.MGSR.1. Determine the measurements of geometric figures.**

Indicator #	Indicator	Indicator Insight
6.MGSR.1.1	Find the area of a triangle, square, rectangle, parallelogram, and trapezoid.	Use composition and decomposition of the shapes as well as applications of properties and formulas. Find actual measurements using rulers to continue the practice from elementary grades. A trapezoid is defined as a quadrilateral with exactly one pair of parallel sides.
6.MGSR.1.2	Create nets to represent three-dimensional shapes.	Include prisms and pyramids. Some examples should include labeled side measures.
6.MGSR.1.3	Calculate the surface area of right rectangular prisms, right triangular prisms, right rectangular pyramids, and right triangular pyramids using two-dimensional nets.	Connect through patterns to the formula for surface area. Procedural use of the formula is not an expectation of this indicator. Find actual measurements of some nets using rulers to continue the practice from elementary grades.
6.MGSR.1.4	Find the area of composite figures by decomposing them into triangles and rectangles to solve mathematical and real-world situations.	In fifth grade, students found perimeter and area of composite figures composed of rectangles.

<i>Indicator #</i>	<i>Indicator</i>	<i>Indicator Insight</i>
6.MGSR.1.5	Calculate the volume of a right rectangular prism using the formula ($V = Bh$) in mathematical and real-world situations.	In fifth grade, students explored volume conceptually by filling right rectangular prisms with unit cubes and multiplying the number of unit cubes in the lowest layer (area of the base) by the number of layers of cubes (height of the prism). In sixth grade, students are deepening and applying their understanding of volume.

6.MGSR.2. Determine angle and/or side relationships.

<i>Indicator #</i>	<i>Indicator</i>	<i>Indicator Insight</i>
6.MGSR.2.1	Determine if two angles are complementary or supplementary.	Relate supplementary angles to the measure of straight angles and the measure of complementary angles to right angles. This is the students' first exposure to <i>complementary</i> and <i>supplementary</i> .
6.MGSR.2.2	Determine the measure of angles using a protractor.	Include straight angles when addressing this indicator. This is the students' first time using a protractor.

6.MGSR.3. Graph on the coordinate plane.

<i>Indicator #</i>	<i>Indicator</i>	<i>Indicator Insight</i>
6.MGSR.3.1	Plot ordered pairs in all four quadrants and identify points on a graph by writing ordered pairs.	This is the students' first introduction to all four quadrants. The first quadrant of the coordinate plane was introduced in fifth grade. Label quadrants using Roman numerals. Given a point on the graph, students need to be able to identify the ordered pair as well as graph the ordered pairs.
6.MGSR.3.2	Graph a polygon on a coordinate plane given the coordinates of the vertices.	Include the use of a table (horizontal and vertical) when graphing points (x , y).

Numerical Reasoning

6.NR.1. Translate among multiple representations of rational numbers.

<i>Indicator #</i>	<i>Indicator</i>	<i>Indicator Insight</i>
6.NR.1.1	Convert positive rational numbers into equivalent forms among terminating decimals, fractions (including mixed numbers), and percentages. Limit fractions to denominators of 2, 4, 5, 8, 10, 20, 25, 50, 100, and 200.	The expectation of this indicator excludes the conversion of repeating decimals to fractions. This indicator is students' first introduction to percentages.

6.NR.2. Utilize rational numbers in mathematical and real-world situations.

Indicator #	Indicator	Indicator Insight
6.NR.2.1	Compare two positive rational numbers and write statements using the symbols for <i>is equal to</i> ($=$), <i>is not equal to</i> ($\neq$), <i>is less than</i> ($<$), and/or <i>is greater than</i> ($>$) in mathematical and real-world situations. Limit fractions to denominators of 2, 4, 5, 8, 10, 20, 25, 50, 100, and 200.	Comparisons should include real-world situations.
6.NR.2.2	Sort a set of positive rational numbers in ascending and/or descending order in mathematical and real-world situations. Limit sets to no more than 5 numbers. Limit fractions to denominators of 2, 4, 5, 8, 10, 20, 25, 50, 100, and 200.	Use number lines to help students visualize placing positive rational numbers in order.
6.NR.2.3	Represent quantities with integers in real-world situations and explain the meaning of zero.	This is an introduction to the understanding of negative numbers and zero. Explain how integers and rational numbers fit into the Real Number System. Model integers using concrete materials, drawings, number lines (horizontal and vertical), symbols, and words.
6.NR.2.4	Identify and compare the opposite value and absolute value of positive and negative rational numbers.	Use horizontal and vertical number lines to explain concepts of opposite and absolute value. Represent opposite and absolute value numbers with real-world situations such as temperature, financial literacy, and distances. This is the introduction to absolute value.

Patterns, Algebra, and Functional Reasoning**6.PAFR.1. Use tables, graphs, verbal descriptions, or equations to represent a function.**

Indicator #	Indicator	Indicator Insight
6.PAFR.1.1	Use tables, graphs, verbal descriptions, and equations to represent the relationship between independent and dependent variables of functions.	This is an introduction to <i>functions</i> and the relationship between <i>independent (input)</i> and <i>dependent (output)</i> variables. Fifth grade introduced function tables as input/output tables.
6.PAFR.1.2	Identify the independent and dependent variable of a function in mathematical and real-world situations.	Use multiple representations of functions. Connect <i>independent variables</i> to <i>input</i> and <i>dependent variables</i> to <i>output</i> (from <i>input/output tables</i>).

6.PAFR.2. Write, simplify, and evaluate algebraic expressions; write and solve algebraic equations and inequalities.

Indicator #	Indicator	Indicator Insight
6.PAFR.2.1	Identify parts of an algebraic expression using the mathematical terms <i>sum, difference, term, variable, product, factor, quotient, coefficient, and constant</i> .	This indicator is the introduction to terms associated with algebraic expressions.
6.PAFR.2.2	Write and evaluate numerical expressions containing powers. Limit to positive whole number bases and positive whole number exponents.	This indicator extends the understanding of exponents beyond powers of 10 introduced in fifth grade. Identify the parts of a power.
6.PAFR.2.3	Evaluate numerical expressions with positive whole number bases and positive whole number exponents using the Order of Operations.	This is where students are formally introduced to the Order of Operations. Grouping symbols such as brackets and parentheses should be used in the expressions. Only parentheses were used in fifth grade. Provide opportunities to build conceptual understanding of the process, not just an acronym like GEMDAS.
6.PAFR.2.4	Write and evaluate expressions using variables to represent quantities in mathematical and real-world situations.	Discuss the difference between an expression and an equation. Be careful of leaning on key words and phrases too much. The mathematical meaning can change based on the placement of key words and phrases.
6.PAFR.2.5	Write and solve one-step equations and inequalities with one variable involving positive rational numbers in mathematical and real-world situations.	Discuss why inequalities have a set of solutions, and how to graph them. Connect to 6.PAFR.3.1. Fifth graders only used substitution to find a solution to an equation.
6.PAFR.2.6	Interpret the concept of a ratio as the relationship between two quantities, including part-to-part and part-to-whole.	Determine ratios using concrete models, drawings, and words. Use the following notations: $\frac{a}{b}$, a to b, a:b and explain that all read “a to b.” This is students’ introduction to ratios and ratio reasoning.
6.PAFR.2.7	Explain the relationship between ratios and rates, including unit rates.	Rates should be kept in context.
6.PAFR.2.8	Solve ratio and rate problems in real-world situations.	Use models to build conceptual understanding of proportionality before moving to the percent proportion and equation.
6.PAFR.2.9	Use one-step dimensional analysis to convert units within the metric or customary systems.	Include mass, weight, length, and liquid measures.

6.PAFR.3. Apply mathematical patterns, properties, and algorithms to the set of rational numbers to find sums, differences, products, and quotients and to write equivalent expressions.

<i>Indicator #</i>	<i>Indicator</i>	<i>Indicator Insight</i>
6.PAFR.3.1	Represent the solutions of inequalities on a number line and explain that the solution set may contain an infinite number of solutions. Limited to the symbols for <i>is less than</i> ($<$) and <i>is greater than</i> ($>$).	Students solve inequalities in 6.PAFR.2.5.
6.PAFR.3.2	Identify the multiplicative inverse of a number and multiply multiplicative inverses to find their product is equal to 1.	Allow students to discover this property through multiple examples that are given in context. This is students' first exposure to the <i>Multiplicative Inverse Property</i> .
6.PAFR.3.3	Identify the additive inverse of a number and add additive inverses to find their sum is equal to zero.	Allow students to discover this property through multiple examples that are given in context. Manipulatives can be used to help explain how positives and negatives create zero pairs. This is the students' first exposure to the <i>Additive Inverse Property</i> .
6.PAFR.3.4	Apply the properties of operations to create equivalent algebraic expressions and justify the properties used. Limit properties to the <i>Identity, Inverse, Commutative, Associative, and Distributive Properties</i> .	Students were introduced to the <i>Distributive Property</i> in fifth grade.
6.PAFR.3.5	Add, subtract, multiply, and divide integers in mathematical and real-world situations.	Develop generalizations through multiple examples with models and finding patterns. This is an introduction to integer rules. Help students discover the rules through the use of manipulatives and strategies, including, but not limited to, human number line, two-color counters, algebra tiles. Include multi-digit integers for all operations.
6.PAFR.3.6	Add, subtract, multiply, and divide positive fractions, including mixed numbers in mathematical and real-world situations.	Division of a fraction by a fraction is new to students in sixth grade. Strategies should make the connection from models in fifth grade.
6.PAFR.3.7	Add, subtract, multiply, and divide multi-digit positive decimals, up to the thousandths place, to solve problems in mathematical and real-world situations.	Strategies should make the connection from models in fifth grade to a standard algorithm.