

Eighth 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, and Spatial Reasoning (MGSR); Numerical Reasoning (NR); and Patterns, Algebra, and Functional Reasoning (PAFR). Woven throughout all four strands are concepts building on students' understanding with problem solving to provide context to the problems they are solving, which will foster critical thinking and collaboration skills.

In DPSR, eighth graders will compare bivariate (two-variable) data. This is the first time that students will work with two variables simultaneously. They will use scatterplots to organize bivariate data from real-world situations. Students will describe associations among the data points in a scatterplot based on direction, form, and strength. Eighth graders will identify sample spaces and calculate and interpret the probability of compound events, using fractions, decimals, or percentages to report the probability of events.

In the MGSR strand, eighth graders will use technology to explore volume and other formulas to include the Pythagorean Theorem. The focus on right triangles will also include Pythagorean Triples and the relationship among the measures of triangles' interior and exterior angles and sums of angle measures of polygons decomposed into triangles. Eighth graders will study transformations and dilations of polygons graphed on or off the coordinate plane. Students will also study angle relationships of parallel lines. Students will also use proportional reasoning to determine congruence or similarity among polygons, finding the missing side lengths and identifying corresponding angles.

In the NR strand, eighth graders will convert any form of rational numbers to other forms, which—for the first time—includes translating repeating decimals to their fraction form. This strand also has students identify the subsets of real numbers and contrast rational and irrational numbers, which will include working with perfect squares and cubes and their roots. They will write equations and inequalities to compare real numbers given in real-world settings. Students will apply the Laws of Exponents learned in seventh grade to include algebraic expressions.

In the PAFR strand, eighth graders will concentrate on functions, learning the slope-intercept form of a linear function. Students connect proportionality and linear functions together so that the constant rate of change (slope) and y -intercept can be identified and interpreted. Students will analyze multiple representations of functions to determine if they represent a linear or nonlinear function or represent a non-function. For the first time, students compare two equations to determine if they represent functions with one solution, no solution, or infinite solutions. Also, for the first time, they solve one-variable multi-step equations and inequalities with the same variable on both sides.

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.
STRUCTURE & PATTERNS	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

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

Indicator #	Indicator	Indicator Insight
8.DPSR.1.1	Create and analyze scatterplots to represent numerical data sets in mathematical and real-world situations.	Analyze the correlation of bivariate data points to determine whether it is strong, weak, or has no correlation. Determine if there is a negative, positive, or no relationship.
8.DPSR.1.2	Draw inferences about two populations utilizing representative random samples of comparisons of the shape of the distribution, measures of center, and measures of variability. Limit measures to <i>mean, median, mode, range, mean absolute deviation, and interquartile range</i> .	Give examples of similarities and differences and usefulness of these measures of center and variability. Use visuals such as box plots or stem-and-leaf plots to compare two different populations. Draw inferences about data sets that contain outliers.
8.DPSR.1.3	Describe how adding and deleting data throughout the data set can affect the mean, median, mode, and distribution of the data set.	Include the effects of outliers in data set discussions.
8.DPSR.1.4	For two data sets (numerical or graphical), compare and interpret the centers, spreads, and overlap of data to draw inferences about data in mathematical and real-world situations. Limit displays to double line graphs, back-to-back stem-and-leaf plots, and double box plots.	Give a visual comparison between two data sets. This would be a good place to compare correlation versus causation.

8.DPSR.2. Calculate and interpret probability.

Indicator #	Indicator	Indicator Insight
8.DPSR.2.1	Determine the sample space for a compound event.	Use organized lists, tables, or tree diagrams.
8.DPSR.2.2	Calculate and interpret the probability of compound independent and dependent events.	Use organized lists, tables, and tree diagrams. Report probability as a fraction, decimal, or percentage. Include replacement when finding probability.

Measurement, Geometry, and Spatial Reasoning**8.MGSR.1. Determine the measurements of geometric figures.**

Indicator #	Indicator	Indicator Insight
8.MGSR.1.1	Given the geometric formulas, find the volume of cones, cylinders, and spheres in mathematical and real-world situations.	Show that the volume of a cone is $\frac{1}{3}$ the volume of a cylinder with congruent heights and bases through hands-on experiences. Express volume as both an approximation and an exact answer using π .
8.MGSR.1.2	Find the distance between any two points in the coordinate plane using the <i>Pythagorean Theorem</i> .	Use the <i>Pythagorean Theorem</i> to find the length of the diagonal line in the coordinate plane by drawing a right triangle.
8.MGSR.1.3	Given the <i>Pythagorean Theorem</i> , determine unknown side lengths in right triangles in mathematical and real-world situations.	Include three-dimensional situations. The <i>Pythagorean Theorem</i> can be used to find any side of the right triangle, not just the hypotenuse.
8.MGSR.1.4	Determine if a given set of sides forms a right triangle.	Identify the pattern in Pythagorean triples. Use <i>Converse of Pythagorean Theorem</i> .

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

Indicator #	Indicator	Indicator Insight
8.MGSR.2.1	Determine missing angle measurements created when parallel lines are cut by a transversal.	Consider complementary, supplementary, vertical, adjacent, corresponding, same side interior, alternate interior, and alternate exterior angles. Use examples with more than one transversal.
8.MGSR.2.2	Determine if two-dimensional figures are congruent or similar.	Use proportional reasoning to determine if figures are congruent or similar.
8.MGSR.2.3	Identify the congruent corresponding angles of similar polygons.	Use appropriate labeling and write congruence statements.

Indicator #	Indicator	Indicator Insight
8.MGSR.2.4	Discover and apply the <i>Exterior Angle Theorem</i> of triangles to find a missing angle.	Connect to the study of supplementary angles from seventh grade.
8.MGSR.2.5	Apply proportional reasoning to find the missing side lengths of two similar figures.	Given lengths of corresponding sides, use a proportion to solve for the missing side. Sides could include algebraic expressions limited to linear equations.

8.MGSR.3. Graph on a coordinate plane.

Indicator #	Indicator	Indicator Insight
8.MGSR.3.1	Identify the transformation as rotation, reflection, and/or translation. Limit rotations to multiples of 90 degrees centered on the origin.	Transformation can be on or off a coordinate plane. Given a preimage and image, name the transformation. Give attention to the congruence of the two images. Use a variety of methods including, but not limited to, manipulatives and technology.
8.MGSR.3.2	Identify congruent angles and congruent line segments of a preimage and its image.	Include single and/or multiple rigid transformations. Write congruence statements.
8.MGSR.3.3	Translate geometric figures vertically and/or horizontally.	Use verbal descriptions as well as ordered pairs to describe the translations. Use a variety of methods including, but not limited to, manipulatives and technology.
8.MGSR.3.4	Reflect geometric figures with respect to the x-axis and/or y-axis.	Focus only on reflections over the x-axis or y-axis, not over any other lines. Use a variety of methods including, but not limited to, manipulatives and technology.
8.MGSR.3.5	Rotate geometric figures 90, 180, and 270 degrees, both clockwise and counterclockwise, about the origin of a coordinate plane.	Identify rotational symmetry of two-dimensional figures. Use a variety of methods including, but not limited to, manipulatives and technology. This is students' introduction to symmetry.
8.MGSR.3.6	Create a dilation using a given scale factor and describe the effect of a dilation.	Dilation centered at origin. Name the scale factor. Use a variety of methods including, but not limited to, manipulatives and technology.

Indicator #	Indicator	Indicator Insight
8.MGSR.3.7	Describe the effect of a series of transformations, including <i>dilations</i> , <i>translations</i> , <i>rotations</i> , and <i>reflections</i> , on two-dimensional figures using coordinates on the coordinate plane.	Rotate in multiples of 90 degrees around the origin and dilate centered on origin. Translate geometric figures horizontally and vertically. Use ordered pairs to describe the translation. Given two figures, determine the sequence of transformations. Use a variety of methods including, but not limited to, manipulatives and technology.

Numerical Reasoning

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

Indicator #	Indicator	Indicator Insight
8.NR.1.1	Convert any form of a rational number to any other form including fractions (mixed numbers), decimals, and percentages.	Include the conversion of repeating decimals to fractions.

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

Indicator #	Indicator	Indicator Insight
8.NR.2.1	Compare real numbers and write statements using <i>is equal to</i> ($=$), <i>is not equal to</i> ($\neq$), <i>is less than</i> ($<$), <i>is greater than</i> ($>$), <i>is greater than or equal to</i> ($\geq$), or <i>is less than or equal to</i> ($\leq$).	Comparisons could include more than two numbers and should include problems based on real-world situations.
8.NR.2.2	Classify and order the subsets of real numbers in the number system including natural, whole, integer, rational, and irrational numbers.	Use different types of Venn diagrams to classify. Use a number line to locate and order numbers. Describe the difference between a rational and an irrational number. Classify and order simplified expressions.

Patterns, Algebra, and Functional Reasoning

8.PAFR.1. Determine if a table, graph, verbal description, or equation represents a function and describe its characteristics.

Indicator #	Indicator	Indicator Insight
8.PAFR.1.1	Define an equation in slope-intercept form ($y = mx + b$) as being a linear function.	Introduce the concept that slope-intercept form is a linear function.
8.PAFR.1.2	Identify and describe the constant rate of change and the y-intercept of a linear function.	Interpret the rate of change and y-intercept in context. Connect $y = kx$ (constant of proportionality) that was learned in seventh grade to constant rate of change.

Indicator #	Indicator	Indicator Insight
8.PAFR.1.3	Determine if a graph, table, mapping, or verbal description is a function (linear or nonlinear) or not a function.	Have students recognize that a table may not determine a function.
8.PAFR.1.4	Describe the key features of given functions, including <i>domain</i> , <i>range</i> , <i>intervals of increasing or decreasing</i> , <i>constant</i> , <i>discrete</i> , <i>continuous</i> , and <i>intercepts</i> .	Identify the domain and range as a list of numbers or as an inequality (could include compound inequalities). Describe whether the function is increasing, decreasing, or constant.
8.PAFR.1.5	Use multiple representations including mappings, tables, graphs, verbal description, and equations (only when linear) of two functions to compare the functions and draw conclusions.	Technology such as spreadsheets for tables and graphing tools for graphs is suggested.
8.PAFR.1.6	Translate among the multiple representations, including mappings, tables, graphs, verbal description, and equations (only when linear) of a function.	Draw the graph from a written description or write a description of the graphical representation. Technology such as spreadsheets for tables and graphing tools for graphs is suggested.

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

Indicator #	Indicator	Indicator Insight
8.PAFR.2.1	Solve multi-step one-variable equations and inequalities with variables on both sides with rational coefficients.	Utilize previously learned knowledge of writing and solving equations and inequalities as a foundation to introduce variables on both sides.
8.PAFR.2.2	Describe single-variable equations as having one solution, no solution, or an infinite number of solutions.	Students need to recognize the three types of possible solutions using tables, graphs, or equations.
8.PAFR.2.3	Identify the rate of change for a linear function as the slope of the line.	Give students a variety of experiences to build understanding that the slope is the same as the rate of change.
8.PAFR.2.4	Explain why the slope, m , is the same between any two distinct points on a linear graph.	Students need to understand that the distance between points on the line is always proportionally the same.
8.PAFR.2.5	Given a table or a graph, identify the slope and the y-intercept of a line and write a linear equation to express that line.	Include multiple representations and verbal descriptions.

8.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>
8.PAFR.3.1	Analyze patterns of perfect squares and perfect cubes to evaluate square roots and cube roots. Limit to square roots less than or equal to 400 and cube roots less than or equal to 1,000.	Look at patterns to make connections to geometric squares and cubes. Use tiles, unit cubes, and/or centimeter cubes to build geometric squares and cubes.
8.PAFR.3.2	Approximate non-perfect square roots and cube roots to nearest tenth. Limit to square roots less than or equal to 400 and cube roots less than or equal to 1,000.	Use a variety of strategies including, but not limited to, manipulatives and number lines, to help build student understanding.
8.PAFR.3.3	Apply laws of exponents to simplify algebraic expressions involving no more than three variables and integer exponents.	This indicator extends the laws of exponents from seventh grade where students are evaluating only numerical expressions.