STATE OF SOUTH CAROLINA
DEPARTMENT OF EDUCATION

Compacted Standards for Two High School Credits

Office of Assessment and Standards

November 2024

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Overview

The SCDE only recommends offering Geometry with Statistics to 8th grade students who show an aptitude for higher level math and critical thinking as expressed in the *Gifted and Talented Best Practices Guidelines: Curriculum and Instruction* manual. This document provides guidance for those districts who choose to offer two high school credit courses in middle school so that students do not skip vital content needed to scaffold future learning.

Compacted 6th and 7th Grade Mathematics

The compacted course for sixth grade is the first course in the accelerated middle school mathematics progression that allows for 2 high school credits in middle school. This course incorporates all the sixth-grade standards and specific seventh-grade standards that extend the learning from sixth grade. These standards continue the work started in elementary grades in these four strands: Data, Probability, and Statistical Reasoning (DPSR); Measurement, Geometric and Spatial Reasoning (MGSR); Numerical Reasoning (NR); and Patterns, Algebraic, 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 and learning about, which will foster critical thinking and collaboration skills.

In the DPSR strand, sixth graders taking this course will extend their analysis of data sets to include creating box plots, stem-and-leaf plots, and histograms. Students will calculate and interpret problems with experimental and theoretical probability. Since probability is only measured between 0 and 1, this makes for an easy connection to fractions, decimals, and percentages.

In the MGSR strand, sixth graders in this accelerated course will be working with two- and three-dimensional figures to solve problems involving area, surface area, and volume in mathematical and real-world situations. Students will identify congruent angles and solve equations relating to angles formed when lines intersect. Distance between points on the coordinate plane will be found and connected back to the area and perimeter of polygons.

In the NR strand, sixth graders taking this course will extend their understanding of operations with all rational numbers, promoting student understanding of how rational numbers are used in real-world situations. The accelerated pathway will extend the concept to include converting any form of a rational number to any other form. This will exclude the conversion of repeating decimals to fractions. Broadening the understanding of operations with all rational numbers is critical, as integer operations are now taught in sixth grade, while seventh grade includes operations with all rational numbers.

In PAFR, students will develop an understanding of ratios and proportional relationships in this accelerated course. They will represent algebraic concepts using tables, graphs, verbal descriptions, and equations. Students will distinguish proportional relationships from non-proportional relationships while making the connection between unit rate and constant of proportionality. The extension of this knowledge will lead to the ability to solve single- and multi-step problems while working with expressions and linear equations. Students will be provided with multiple opportunities to solve a variety of percentage problems. There will be an emphasis on creating and identifying equivalent linear expressions using the properties of operations.

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.

Standard	Indicator	Indicator Insight
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.
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 finding 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

67.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 *sample size*.

Indicator #	*Indicator*	*Indicator Insight*
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 *upper extreme* and *lower extreme* rather than maximum and minimum. Teach using data displays, not just numerical sets. Make connections between the second quartile and the median.
7.DPSR.1.1	Create stem-and-leaf plots to represent numerical data sets in mathematical and real-world situations.	Teach using data displays, not just numerical sets. This is the students' first exposure to stem-and-leaf plots.
7.DPSR.1.4	Create histograms to represent data sets and interpret histograms to answer questions or draw conclusions about data sets.	Connecting a stem-and-leaf plot to a histogram can be helpful for students.
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. 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.
7.DPSR.1.2	Use the shape of the graph to select the measure of center (*mean, median, or mode*) that best describes the data set.	This indicator continues the work with spread and center started in sixth grade. Shape includes *right skew, left skew, symmetric, uniform, bimodal* (two modes), and *outliers*. This is the students' introduction to mean.
7.DPSR.1.3	Calculate and interpret the measures of center (*mean, median, mode*) and spread (*mean absolute deviation, interquartile range, range*) in mathematical and real-world situations.	"*Measure of spread*" and "*measure of variability*" should be used interchangeably. Compare the difference between mean, median, and mode. Include all rational numbers in the data sets. This is the students' first exposure to mean absolute deviation.
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.

67.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 probable, 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. *Likelihood* 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, 25, 50, and 100.	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.
7.DPSR.2.1	Identify the sample space for a simple event.	Simple events were introduced in fifth grade. Distinguish between sample size (sixth grade) and sample space.
7.DPSR.2.2	Calculate and interpret the theoretical probability of a simple random event.	This is the students' introduction to theoretical probability. Include replacement when finding probability.
7.DPSR.2.3	Calculate and interpret the experimental probability of a random event related to a simple experiment.	Conduct actual probability experiments and interpret the results.
7.DPSR.2.4	Compare and contrast the experimental and theoretical probabilities for a simple experiment.	Simple experiments include randomly selecting a card from a deck, tossing a coin, rolling a die, spinning a spinner, randomly selecting a colored tile from a bag. Represent the probability as a fraction, decimal, or percent. Use P(event) notation. Have students determine if games are fair or unfair.

Measurement, Geometry, and Spatial Reasoning

67.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 rectangular prisms, right triangular prisms, 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.
7.MGSR.1.6	In mathematical and real-world situations, find the surface area of right prisms and right pyramids having triangular or quadrilateral bases.	Include trapezoidal bases. Find actual measurements of some figures 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.
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.

Indicator #	*Indicator*	*Indicator Insight*
7.MGSR.1.5	In mathematical and real-world situations, find the volume of right prisms and right pyramids having triangular or quadrilateral bases.	Include trapezoidal bases. The formula was discovered in sixth grade. A trapezoid is defined as a quadrilateral with exactly one pair of parallel sides.

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

Indicator #	*Indicator*	*Indicator Insight*
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 *complementary* and *supplementary*.
7.MGSR.2.3	Identify the relationships and measures among angles formed by two intersecting lines, given the measure of one angle. Limit to supplementary, complementary, vertical, and adjacent relationships.	Use given angle measurements to solve for unknown angle measurements.
7.MGSR.2.4	Write and solve equations to solve mathematical and real-world situations involving the relationships among angles formed by two intersecting lines. Limit to supplementary, complementary, vertical, and adjacent relationships.	Instead of a measurement of the angle, there is an algebraic expression that will be used to find the angle measurement. It is not the expectation of this indicator to have variables on both sides of the equation.
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.
7.MGSR.2.1	Determine the measure of the third angle given the measure of the other two angles of a triangle using the *Triangle Sum Theorem*.	The intent of this indicator is to develop a conceptual understanding of the angles inside of a triangle. Write equations to find the missing angle measure.

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

Indicator #	*Indicator*	*Indicator Insight*
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*).
7.MGSR.3.1	Find distances between ordered pairs on the coordinate plane, limited to the same x-coordinate or the same y-coordinate.	Connect to finding area and perimeter of polygons by calculating vertical and horizontal distances. Make connections to *absolute value.*

Numerical Reasoning

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

Indicator #	*Indicator*	*Indicator Insight*
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.
7.NR.1.1	Convert rational numbers into equivalent forms among fractions (including mixed numbers), decimals, and percentages. Exclude the conversion of repeating decimals to fractions.	In sixth grade, denominators were limited. There is no limit to denominators in this indicator.

67.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 *is equal to* (=), *is not equal to* (≠), *is less than* (<), and/or *is greater than* (>) in mathematical and real-world situations. Limit fractions to denominators of 2, 4, 5, 8, 10, 20, 25, 50, 100, and 200.	Include absolute value, which is introduced in 6.NR.2.4, and negative integers. Comparisons should include real-world situations.

Indicator #	*Indicator*	*Indicator Insight*
7.NR.2.1	Compare two rational numbers and write statements using *is equal to* (=), *is not equal to* (≠), *is less than* (<), *is greater than* (>), *is greater than or equal to* (≥), and/or *is less than or equal to* (≤) in mathematical and real-world situations.	Include negative rational numbers. Practice placing all rational numbers on a number line.
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

67.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 *functions* and the relationship between *independent (input)* and *dependent (output)* variables. Fifth grade introduced function tables as input/output tables.

Indicator #	*Indicator*	*Indicator Insight*
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 *independent variables* to *input* and *dependent variables* to *output* (from *input/output tables*).
7.PAFR.1.1	Apply proportional reasoning to solve problems in mathematical and real-world situations involving ratios and percentages.	Use a variety of situations, including, but not limited to, markups (percent increase), markdowns (percent decrease), tip, tax, coupons, discounts, commission, percent error, depreciation, and simple interest.
7.PAFR.1.2	Create a model with functions that address a proportional relationship in real- world situations.	Models should include tables, functions and their graphs, equations, diagrams, and verbal descriptions.
7.PAFR.1.3	Identify the constant of proportionality within proportional relationships.	The constant of proportionality is the unit rate. Use tables, graphs, and equations to identify the constant of proportionality. Introduce $y = kx$.

67.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 *sum*, *difference*, *term*, *variable*, *product*, *factor*, *quotient*, *coefficient*, and *constant*.	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.

Indicator #	*Indicator*	*Indicator Insight*
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.
7.PAFR.2.2	Write and evaluate expressions in one variable that model mathematical and real-world situations.	Include all rational numbers when writing and evaluating expressions.
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.
7.PAFR.2.1	Write and solve multi-step equations and inequalities in one variable involving rational numbers in mathematical and real-world situations.	Include a fraction bar as a grouping symbol. Combine like terms, but do not include variables on both sides; one side only.
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.
7.PAFR.2.3	Compute unit rates, including those involving complex fractions with like or different units.	Introduce *complex fractions* also known as *compound fractions*.
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.
7.PAFR.2.4	Use dimensional analysis to convert units between metric and customary systems.	Include problems with measures of mass, weight, length, and liquid. Convert from metric to customary and customary to metric systems.

67.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.

Indicator #	*Indicator*	*Indicator Insight*
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 *is less than* (<) and *is greater than* (>).	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 *Multiplicative Inverse Property*.
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 *Additive Inverse Property*.
6.PAFR.3.4	Apply the properties of operations to create equivalent algebraic expressions and justify the properties used. Limit properties to the *Identity, Inverse, Commutative, Associative,* and *Distributive Properties*.	Students were introduced to the *Distributive Property* in fifth grade.
7.PAFR.3.2	Identify linear expressions that are equivalent.	Combine like terms when needed to show equivalence.
7.PAFR.3.3	Recognize that algebraic expressions may have a variety of equivalent forms and determine an appropriate form for a given real-world situation.	Use the context to determine an equivalent expression that best matches the situation. Know that there can be multiple forms of the same expression.
7.PAFR.3.4	Factor linear expressions with integer coefficients using the greatest common factor (GCF).	Students learned GCF in fifth grade.

Indicator #	*Indicator*	*Indicator Insight*
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 to discover the rules through 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.
7.PAFR.3.5	Apply all operations with rational numbers to solve problems in mathematical and real-world situations.	Include positive and negative fractions and decimals. Develop generalizations through multiple examples with models to find patterns.

Seventh Grade, Eighth Grade, & Geometry Compacted Math Standards

Students taking this course are a part of the accelerated progression. This course will be a combination of some seventh grade, eighth grade, and all of the Geometry with Statistics (GS) indicators. The indicators from seventh grade and eighth grade that were chosen to be embedded in this course are those that align with the indicators for Geometry along with others that will help prepare students to be successful in this Geometry course. Standards and indicators from seventh grade, eighth grade, and GS are found in the same strands as in the original course: Data, Probability, and Statistical Reasoning (DPSR); Measurement, Geometry, and Spatial Reasoning (MGSR); Numerical Reasoning (NR); and Patterns, Algebra, and Functional Reasoning (PAFR).

GS is a newly designed course that builds on the students' experiences in the middle grades. It is the first of four required courses in high school mathematics, providing a common experience for all students entering high school-level mathematics. GS builds essential concepts necessary for students to meet their post-secondary goals (whether they pursue additional study or enter the workforce), to function as effective citizens, and to recognize the wonder, joy, and beauty of mathematics (NCTM, 2018). It is important because it develops mathematical knowledge and skills through visual representations prior to the more abstract development of algebra.

Beginning high school mathematics with GS skills, see the applicability of mathematics, and prepare more effectively for further studies in algebra. The course also focuses on statistics in analyzing data, which provides students with tools to describe, show, and summarize data in the world around them.

In GS, students incorporate knowledge and skills from several mathematics content areas, leading to a deeper understanding of fundamental relationships within the discipline and building a solid foundation for further study. In the content area of Geometry and Measurement, students build on and deepen prior understanding of transformations, congruence, similarity, and coordinate geometry concepts. Informal explorations of transformations provide a foundation for more formal considerations of congruence and similarity, including development of criteria for triangle congruence and similarity. An emphasis on reasoning throughout the content area promotes exploration, conjecture testing, and informal and formal justification. In the content area of Algebra and Functions, students perform algebraic calculations with specific applications to geometry that build on foundations of algebra from sixth and seventh grades. Probability is important because it educates one in the logic of uncertainty and randomness, which occur in almost every aspect of daily life. Therefore, studying probability structures will enhance students' ability to organize information and improve decision making.

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.

Standard	Indicator	Indicator Insight
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.
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 finding 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 scatter plots to represent numerical data sets in mathematical and real-world situations.	Analyze the correlation of the data points to determine whether it is strong, weak, or has no correlation. Determine if there is a negative, positive, or no relationship.

GS.DPSR.1. Summarize, represent, and interpret data on two categorical and quantitative variables.

Indicator #	*Indicator*	*Indicator Insight*
GS.DPSR.1.1	Represent data for two quantitative variables on a scatter plot and describe how the variables are related.	Include linear and nonlinear associations.
GS.DPSR.1.2	Use two representative points from the data to find an approximate line of fit and compare it to the line of best fit.	Use a low-tech approach to identify possible pairs of points for the approximate line of best fit.
GS.DPSR.1.3	Conduct an investigation for a statistical question, interpret statistical significance in the context of a situation, and answer investigative questions appropriately.	Distinguish statistical questions from other types of questions. Compose statistical questions to collect and analyze appropriate data to answer the statistical investigative question.

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.

GS.DPSR.2. Analyze and interpret models for two quantitative variables.

Indicator #	*Indicator*	*Indicator Insight*
GS.DPSR.2.1	Distinguish between correlation and causation.	Explore possible reasons for an association: • Predictor causes response, • Response causes predictor, • Lurking variable, or • Random occurrence.

GS.DPSR.3. Solve problems involving the probability of compound events in real-world situations.

Indicator #	*Indicator*	*Indicator Insight*
GS.DPSR.3.1	Describe categories of events as subsets of a sample space using unions, intersections, or complements of other events.	Consider using Venn Diagrams.
GS.DPSR.3.2	Apply the *Addition Rule* to find the probability of both mutually exclusive and not mutually exclusive events and interpret the answers in context.	Consider using Venn Diagrams.
GS.DPSR.3.3	Apply the *Multiplication Rule* to determine the probability of independent events and interpret the answers in context.	Give real-world examples of events occurring simultaneously. Consider using Venn Diagrams.

Measurement, Geometry, and Spatial Reasoning

GS.MGSR.1. Compute area and volume of figures by determining how the figure might be obtained from simpler figures by dissection and recombination.

Indicator #	*Indicator*	*Indicator Insight*
GS.MGSR.1.1	Apply area and volume formulas of two- and three-dimensional figures to solve real-world situations.	Use two-dimensional and three-dimensional irregular, regular, and composite figures.
GS.MGSR.1.2	Identify the shape of a two-dimensional cross-section of a three-dimensional figure.	Consider including comparison of the figures.
GS.MGSR.1.3	Use cross-sections of three-dimensional figures to model and solve mathematical and real-world situations.	Use dynamic geometry software to visualize cross-sections of three-dimensional figures.

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

Indicator #	*Indicator*	*Indicator Insight*
8.MGSR.3.1	Identify the transformation as a rotation, reflection, and/or translation. Limit rotations to multiples of 90 degrees centered on the origin.	Transformations 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.

Indicator #	*Indicator*	*Indicator Insight*
8.MGSR.3.2	Identify congruent angles and congruent line segments of a preimage and its image.	Include a 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 in 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.
8.MGSR.3.7	Describe the effect of a series of transformations, including dilations, translations, rotations, and reflections, 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.

GS.MGSR.2. Apply rigid geometric transformations to figures, describing their attributes and symmetries.

Indicator #	*Indicator*	*Indicator Insight*
GS.MGSR.2.1	Describe the results of transformations on a given figure using geometric terminology from the definitions of the transformations.	Apply rotations, reflections, and translations to figures using graph paper, tracing paper, and dynamic geometry software. Discuss orientation and what distinguishes the new figure from the original figure.
GS.MGSR.2.2	Describe and apply a sequence of transformations that maps a preimage onto its image.	Develop definitions of rotations, reflection, and translation in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

GS.MGSR.3. Determine that two figures are congruent by demonstrating that a rigid motion or a sequence of rigid motions maps one figure onto the other.

Indicator #	*Indicator*	*Indicator Insight*
GS.MGSR.3.1	Identify types of symmetry of polygons, including line, point, rotational, and self-congruence, and use symmetry to analyze mathematical situations.	Consider using areas and volumes to show similarity and symmetry.
GS.MGSR.3.2	Demonstrate that triangles and quadrilaterals are congruent by a combination of translations, rotations, and reflections.	Use dynamic geometry software to demonstrate congruence.
GS.MGSR.3.3	Recognize the criteria for showing triangles are congruent using a sequence of rigid motions that map one triangle to another and justify that the two triangles are congruent by applying the *Side-Side- Side, Side-Angle-Side, Angle-Side-Angle, Angle-Angle-Side, and Hypotenuse-Leg* congruence conditions.	Support justifications by sketches using dynamic geometry software.

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

Indicator #	*Indicator*	*Indicator Insight*
7.MGSR.2.2	Solve mathematical and real-world situations involving dimensions and areas of geometric figures including scale drawings and scale factors.	Find the scale factor of similar figures using both the sides and the areas.

Indicator #	*Indicator*	*Indicator Insight*
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.
8.MGSR.2.4	Discover and apply the *Exterior Angle Theorem* 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.

GS.MGSR.4. Determine that two figures are similar by demonstrating a similarity transformation or a sequence of similarity transformations that maps one figure onto the other.

Indicator #	*Indicator*	*Indicator Insight*
GS.MGSR.4.1	Demonstrate experimentally the properties of dilations given by a center and a scale factor.	Consider using dynamic geometry software to verify and determine similarity. Determine that two figures are similar by demonstrating a similarity transformation (dilation or composite of a dilation with a rigid motion) or equivalence (a sequence of similarity transformations that maps one figure onto the other).
GS.MGSR.4.2	Justify experimentally that a dilation of a line segment is longer or shorter, given the ratio.	Justify facts using specific examples. Explore the ratios.
GS.MGSR.4.3	Recognize that the criteria for showing triangles are similar using a similarity transformation that maps one figure to the other and justify the two triangles are similar by applying the *Angle-Angle, Side- Side-Side, and Side-Angle-Side* similarity conditions.	Consider using dynamic geometry software to verify and determine similarity. Determine that two figures are similar by demonstrating a similarity transformation (dilation or composite of a dilation with a rigid motion) or equivalence (a sequence of similarity transformations that maps one figure onto the other).

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, complementary, same side interior, alternate interior, and alternate exterior angles. Use examples with more than one transversal.

GS.MGSR.5. Demonstrate whether a conjecture or theorem is true or false using a variety of algebraic and geometric explanations.

Indicator #	*Indicator*	*Indicator Insight*
GS.MGSR.5.1	Justify and apply the attributes of angle relationships/lines in mathematical and real-world situations.	Proofs of theorems can sometimes be made with transformations, coordinates, or algebra; all approaches can be useful, and in some cases, one may provide a more accessible or understandable argument than another. Apply in mathematical and real-world contexts that: • vertical angles are congruent. • when a transversal crosses parallel lines, alternate interior angles are congruent, alternate exterior angles are congruent, and consecutive interior angles are supplementary. • any point on a perpendicular bisector of a line segment is equidistant from the endpoints of the segment. • perpendicular lines form four right angles. • base angles of isosceles triangles are congruent. Define *angle*, *perpendicular line*, *parallel line*, *line segment*, *ray*, *circle*, and *skew* in terms of the undefined notions of point, line, and plane.

Indicator #	*Indicator*	*Indicator Insight*
GS.MGSR.5.2	Apply the attributes of triangles in mathematical and real-world situations.	Apply in mathematical and real-world situations including, but not limited to: • segment joining midpoints of two sides of a triangle is parallel to the third side and half the length. • medians of a triangle meet at a point. Define *angle*, *perpendicular line*, *parallel line*, *line segment*, *ray*, *circle*, and *skew* in terms of the undefined notions of point, line, and plane. Use geometric figures, both physical and within geometry software, to model, represent, and describe real-world objects.
GS.MGSR.5.3	Apply the attributes of quadrilaterals, including diagonals, sides, and angles, to prove that a given quadrilateral is a parallelogram in mathematical and real- world situations.	Proofs of theorems can sometimes be made with transformations, coordinates, algebra, two-column, flow chart, or paragraph; all approaches can be useful, and in some cases, one may provide a more accessible or understandable argument than another. Verify and apply in mathematical and real-world situations that: • opposite sides of a parallelogram are congruent. • opposite angles of a parallelogram are congruent. • diagonals of a parallelogram bisect each other. • rectangles are parallelograms with congruent diagonals. • a parallelogram is a rhombus if and only if the diagonals are perpendicular.

8.MGSR.1. Determine the measurements of geometric figures.

Indicator #	*Indicator*	*Indicator Insight*
8.MGSR.1.2	Find the distance between any two points in the coordinate plane using the *Pythagorean Theorem*.	Use the *Pythagorean Theorem* to find the length of the diagonal line in the coordinate plane by drawing a right triangle.

Indicator #	*Indicator*	*Indicator Insight*
8.MGSR.1.3	Given the *Pythagorean Theorem*, determine unknown side lengths in right triangles in mathematical and real-world situations.	Include three-dimensional situations. The *Pythagorean Theorem* 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 *Converse of Pythagorean Theorem.*

GS.MGSR.6. Discover and apply relationships in similar right triangles.

Indicator #	*Indicator*	*Indicator Insight*
GS.MGSR.6.1	Discover and apply the converse of the *Pythagorean Theorem*.	Use visual proofs of the *Pythagorean Theorem*.
GS.MGSR.6.2	Discover and apply the constant ratios of the sides in 30-60-90 and 45-45-90 right triangles.	Use the *Pythagorean Theorem* to derive the constant ratios.
GS.MGSR.6.3	Define the trigonometric ratios using the properties of similar right triangles.	Use a proportion relating corresponding sides of right triangles to define *sine, cosine, and tangent*.
GS.MGSR.6.4	Determine the sine, cosine, and tangent of an acute angle in a right triangle in the context of mathematical and real-world situations.	Consider examples including, but not limited to, angle of elevation, angle of depression, and a ladder against a building.
GS.MGSR.6.5	Apply trigonometric ratios (sine, cosine, tangent) and the *Pythagorean Theorem* to solve right triangle problems in real-life situations.	Use trigonometric ratios and the *Pythagorean Theorem* as models of problems in real-world contexts.

78.MGSR.1. Determine the measurements of geometric figures.

Indicator #	*Indicator*	*Indicator Insight*
7.MGSR.1.1	Identify the parts of a circle. Limit parts to *center, radius, diameter,* and *chord*.	Understand the definition of a circle. Be able to distinguish between a diameter and other chords. Understand the relationship between radius and diameter.

Indicator #	*Indicator*	*Indicator Insight*
7.MGSR.1.2	Describe the relationship between the *radius, diameter*, and *circumference* of a circle.	Physically explore the attributes of the circumference of a circle as a measure of length using concrete materials. Identify π through a variety of patterns and relationships. These relationships are another application of proportional reasoning.
7.MGSR.1.3	Solve mathematical and real-world situations involving circumference or area of circles.	Practice finding the exact area or circumference of a circle using Pi. Find estimates of area and circumference using the approximations for π (**π** ≈ 3.14, **π** ≈ 3 or **π** ≈ $\frac{22}{7}$). Use the formulas to find missing parts in the circumference formula. Find the area from a given circumference. The expectation is not to find the radius or diameter when given the area because that involves finding the square root, and seventh grade indicators do not include finding square roots.
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.

GS.MGSR.7. Investigate and apply relationships among segments and angles in circles.

Indicator #	*Indicator*	*Indicator Insight*
GS.MGSR.7.1	Use angle and segment relationships in circles to solve mathematical and real- world situations.	Use dynamic geometry software to support investigations.
GS.MGSR.7.2	Investigate and apply relationships in circles, inscribed angles, radii, secants, and chords; among inscribed angles, central angles, and circumscribed angles; and between radii and tangents to circles.	Use dynamic geometry software to support investigations.

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 *is equal to* (=), *is not equal to* (≠), *is less than* (<), *is greater than* (>), *is greater than or equal to* (≥), or *is less than or equal to* (≤).	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.

GS.NR.1. Represent all points on the number line as irrational and rational numbers in the real number system.

Indicator #	*Indicator*	*Indicator Insight*
GS.NR.1.1	Rewrite numerical expressions of irrational and rational numbers involving radicals, including addition, subtraction, multiplication, and division, to recognize geometric patterns.	Include operations with radicals. This is students' introduction to simplifying radicals.

Patterns, Algebra, and Functional Reasoning

7.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.

Indicator #	*Indicator*	*Indicator Insight*
7.PAFR.3.1	Simplify numerical expressions that include integer exponents using the laws of exponents: the *Product of Powers, Quotient of Powers, Power of a Power, Power of a Product, Power of a Quotient, Zero Power, and Negative Exponent*.	Expose students to expressions and models to look for patterns to create a generalization through examples. Provide experiences to discover the rules.
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 the 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.

GS.PAFR.1. Analyze the structure of an equation or inequality to determine an efficient strategy to find a solution, if one exists, then justify the solution.

Indicator #	*Indicator*	*Indicator Insight*
GS.PAFR.1.1	Discover and apply the formulas for the length of an arc and the area of a sector in a circle to develop mathematical models and solve mathematical and real- world situations.	Use proportions and proportional reasoning to derive formulas.
GS.PAFR.1.2	Analyze and apply the derivations of the formulas for the circumference of a circle, area of a circle, and volume of a cylinder, pyramid, and cone to model real phenomena and solve mathematical and real-world situations.	This indicator builds on the laws of exponents students have learned in middle school.

GS.PAFR.2. Interpret the structure of expressions, equations, and inequalities to analyze and make predictions in different contexts.

Indicator #	*Indicator*	*Indicator Insight*
GS.PAFR.2.1	Apply surface area and volume formulas for prisms, cylinders, pyramids, cones, spheres, and/or compositions of figures to solve problems and justify results.	Include problems that involve algebraic expressions, composite figures/solids, geometric probability, and real-world applications as part of the mathematical modeling cycle.
GS.PAFR.2.2	Analyze slopes of lines to determine whether lines are parallel, perpendicular, or neither.	Address the occurrence of coincidental lines. Exploration of parallel and perpendicular lines outside of its connection to shapes and transversals is a new concept for students.
GS.PAFR.2.3	Determine the equation of a line passing through a given point that is parallel or perpendicular to a given line.	Use the slope-intercept form of a linear equation. Solve geometric and real-world situations involving lines and slopes.

GS.PAFR.3. Determine the exact or approximate solutions of equations and inequalities using graphs on the coordinate plane.

Indicator #	*Indicator*	*Indicator Insight*
GS.PAFR.3.1	Use coordinates to prove simple geometric theorems algebraically.	Focus on quadrilaterals, right triangles, and circles.
GS.PAFR.3.2	Determine distance and midpoint of segments in a coordinate plane to find areas of triangles and quadrilaterals, when given coordinates.	Eighth grade uses the *Pythagorean Theorem* to find distance in the coordinate plane. Use distance and midpoint formulas to find area in a coordinate plane.

Eighth Grade and Algebra 1 Compacted Standards

The third course of the compacted standards to allow middle school students to receive two high school credits consists of some eighth grade and all of the Algebra 1 indicators. The indicators were chosen because they were already a part of the Algebra 1 concepts or were necessary prerequisite skills for proficiency in Algebra 1. Many of those fell in the Patterns, Algebra, and Functional Reasoning (PAFR) strand.

Algebra 1 (A1) builds essential concepts necessary for students to meet their post-secondary goals (whether they pursue additional study or enter the workforce). This can result in helping students to function as effective citizens, and to recognize the wonder, joy, and beauty of mathematics (NCTM, 2018). Algebra is important and useful in most careers. It is one of the most common and malleable types of mathematics, because it is valuable in a range of activities from ordinary decision making to advanced training in scientific and technological fields. The ability to understand and apply algebraic thinking is a crucial steppingstone on a successful journey in life. Algebra is a collection of unifying concepts that enable one to solve problems flexibly. The standards and indicators in A1 are sorted within the strands of Data, Probability, and Statistical Reasoning (DPSR); Measurement, Geometry, and Spatial Reasoning (MGSR); Numerical Reasoning (NR); and Patterns, Algebra, and Functional Reasoning (PAFR).

The study of algebra is inextricably linked to the study of functions, which are fundamental objects in mathematics that model many life situations involving change. A1 provides experiences for students to see how mathematics can be used systematically to represent patterns and relationships among numbers and other objects, analyze change, and model everyday events and problems of life and society.

A1 emphasizes functions, including linear (as introduced in seventh and eighth grades), absolute value, quadratic, and exponential; and functions as explicit (relation between input and output) and recursive (relation between successive values). Properties of algebra are applied to convert between forms of expressions and to solve equations (factoring, completing the square, rules of powers, and radicals).

Graphing is a vital component of study in A1. Graphs of equations and inequalities consist of all points (discrete or continuous) whose ordered pairs satisfy the relationship within the domain and range. Students find points of intersection between two graphed functions that correspond to the solutions of the equations of the two functions, and transform graphs of functions (through translation, reflection, rotation, and dilation) by performing operations on the input or output.

A1 serves as a study of linear, quadratic, exponential, and absolute value functions. Equations and expressions with linear and quadratic terms are also studied to learn how algebraic expressions model real-world situations. Statistical reasoning is studied to learn how data are represented and interpreted and how models, particularly linear, can be used to make predictions.

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. Begin by identifying the meaning of a problem, utilizing appropriate tools, and clearly articulating the "what" of the question. Draw on prior knowledge and analyze given information, including constraints, relationships, and goals, to find entry points or pathways to a solution. Employ critical thinking skills to consider analogous problems, using special cases and simpler forms of the problem to gain additional insight into the solution. Explain similarities and differences between equations and expressions, including their graphical and tabular representations. Draw diagrams and graph data to clarify information, show relationships, and search for patterns and trends.
REPRESENTATION & COMMUNICATION	MPS.RC.1 Explain ideas using precise and contextually appropriate mathematical language, tools, and models.	Engage in discourse to explain reasoning and select tools, both physical and electronic, that are helpful to explore, model, and deepen students' understanding of mathematical concepts. Understand and use definitions and verbal/written information to construct arguments and prove conjectures. By actively listening to the mathematical ideas of other students while communicating their own, they can solve problems collaboratively. Compare two arguments, distinguish and explain the difference between correct and flawed logic, and explain what is flawed or correct and why. Present conclusions and results using a variety of ways, including, but not limited to, tables, graphs, formulas, diagrams, flowcharts, interactive models, and dynamic software. Collaborate with others utilizing joint thinking to solve problems. Utilize technology tools such as graphing utilities, dynamic geometry, spreadsheets, and computer algebra systems.

Standard	Indicator	Indicator Insight
CONNECTIONS	MPS.C.1 Demonstrate a deep and flexible conceptual understanding of mathematical ideas, operations, and relationships while making real-world connections.	Identify relevant quantities and apply what students know to solve problems related to everyday life situations. Identify important quantities in real-life situations and create a pathway representing relationships, applying appropriate tools, such as diagrams, two-way tables, graphs, flowcharts, and formulas as well as electronic tools such as graphing utilities, spreadsheets, computer algebra systems, and dynamic geometry. Have students confidently apply what they know, making assumptions and approximations to simplify complicated situations. Have students evaluate the reasonableness of their thinking and solution(s) and be willing to make revisions if necessary. Connect and apply the skills and prior knowledge from previous math concepts to solve real-world complex situations.
ANALYZE & JUSTIFY	MPS.AJ.1 Use critical thinking skills to reason both abstractly and quantitatively.	Make sense of quantities and their application to relationships in mathematical and real-world representations. Evaluate multiple sources of information from text, charts, tables, graphs, and other diverse media and formats. Have students write explanatory text that conveys their mathematical analyses and thinking. Apply concrete details, relevant facts, and coherent discussions of ideas to support thinking. Decontextualize by pulling information from a given situation, representing it symbolically, then manipulating the representing symbols as if they are their own entities, not necessarily relative to what the symbol stands for. Contextualize by pausing during the manipulation process to explore the meaning of symbols within the given situation.
STRUCTURE & PATTERNS	MPS.SP.1 Identify and apply regularity in repeated reasoning to make generalizations.	Examine, discern, and recognize patterns or structures as complex mathematical objects composed of more than one simple object. Have students attend to detail and continually evaluate the reasonableness of their results. Transform more complex structures into something students know. Discern and recognize regularity in repeated reasoning.

Data, Probability, and Statistical Reasoning

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

Indicator #	*Indicator*	*Indicator Insight*
8.DPSR.1.2	Draw inferences about data sets from two populations using the shape of the distribution, measures of center, and measures of variability. Limit measures to *mean, median, mode, range, mean absolute deviation, and interquartile range.*	Give examples of similarities and differences and usefulness of these measures of center and variability. Use a box plot 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.

A1.DPSR.1. Use statistical reasoning to summarize, represent, and interpret data on two categorical and quantitative variables.

Indicator #	*Indicator*	*Indicator Insight*
A1.DPSR.1.1	Summarize categorical data in two-way frequency tables, interpret relative frequencies in real-world situations, and informally determine possible associations and trends in the data.	Include joint, marginal, and conditional relative frequencies.
A1.DPSR.1.2	Summarize quantitative data in a table and on a scatter plot and describe how the variables are associated. Limit to linear data.	Description must include: Direction – positive or negative. Association – none, weak, moderate, or strong.
A1.DPSR.1.3	Find a linear function for a scatter plot that suggests a linear association.	Include instruction with and without technology to assist with finding the line of best fit for two quantitative variables. Use the given model, or choose a model suggested by the shape of the graph.

Indicator #	*Indicator*	*Indicator Insight*
A1.DPSR.1.4	For linear associations, use technology to determine the correlation coefficient, evaluate the strength of the association, and find the line of best fit.	Correlation applies to linear models only. Use technology or statistical software to assist in finding linear associations.

A1.DPSR.2. Analyze and interpret models for two categorical and quantitative variables.

Indicator #	*Indicator*	*Indicator Insight*
A1.DPSR.2.1	Use two-way frequency tables to make inferences and interpret the data in terms of real-world or mathematical situations.	Use relative frequencies to identify possible associations.
A1.DPSR.2.2	Interpret the slope and the intercept of a linear model in the context of the data.	Interpret slope as a unit rate of change (including units). For every one unit of increase in the x variable, the y variable will increase or decrease the amount and the direction of the slope. The y-intercept of a linear model may not make sense when interpreted within the context of the data.
A1.DPSR.2.3	Use a linear model to interpolate and extrapolate unknown values close to the data set.	Explore interpolation and extrapolation. Discuss the dangers of extrapolation. Use technology or statistical software.

Measurement, Geometry, and Spatial Reasoning

A1.MGSR.1. Use geometric concepts and measurement opportunities to model mathematical and real-world situations.

Indicator #	*Indicator*	*Indicator Insight*
A1.MGSR.1.1	Identify any limitations specific to a real- world situation.	Produce a graph for a contextual situation and determine a scale that shows key features of the graph. Limitations might include measuring to the nearest cent or dollar or whole unit (such as people or cars) when a fraction does not make sense.

Numerical Reasoning

A1.NR.1. Represent all points on the number line as irrational and rational numbers in the real number system.

Indicator #	*Indicator*	*Indicator Insight*
A1.NR.1.1	Rewrite numerical and algebraic expressions of irrational and rational numbers involving radicals, including addition, subtraction, multiplication, and division. Limit to square and cube roots.	Include all operations with algebraic expressions with emphasis on rational and radical terms.

A1.NR.2. Represent exponents and radical expressions in different ways.

Indicator #	*Indicator*	*Indicator Insight*
A1.NR.2.1	Translate between rational exponents and radical expressions of irrational and rational numbers. Use properties of addition, subtraction, multiplication, and division to simplify radical and rational expressions. Limit to square and cube roots.	Discuss when rational exponents or radical forms may be more useful given the mathematical or real-world context involved.

Patterns, Algebra, and Functional Reasoning

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.

Indicator #	*Indicator*	*Indicator Insight*
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.

A1.PAFR.1. Transform and/or solve equations and expressions in one variable that model real-world and mathematical situations, interpret the solutions, and determine whether they are reasonable.

Indicator #	*Indicator*	*Indicator Insight*
A1.PAFR.1.1	Transform an equation in one variable to create new equations that have the same solution as the original and justify the steps taken.	Single variable forms may have analogous two-variable forms. Analogous forms include for linear: standard, y-intercept, and point slope, for quadratic: vertex, standard, and factored. For exponential limit to the same bases.

Indicator #	*Indicator*	*Indicator Insight*
A1.PAFR.1.2	Solve literal equations and formulas for a specified variable including equations and formulas that arise in a variety of disciplines.	The process of solving literal equations should incorporate similar strategies used in solving for unknown numerical quantities.
A1.PAFR.1.3	Solve mathematical and real-world situations using linear, quadratic, exponential (same bases), and linear absolute value equations in one variable.	The steps used for solving an equation should be identified as a justification for the solution process.
A1.PAFR.1.4	Add, subtract, and multiply polynomials with initial terms up to a degree of 2.	When performing operations with polynomials, relate to the properties of equality.

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.	This is the students' introduction to equations and inequalities with 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 are 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 symbolic representations.

A1.PAFR.2. Create, solve, and transform equations and inequalities in two or more variables to represent relationships between quantities and graph the equations on coordinate axes using appropriate labels, units, and scales.

Indicator #	*Indicator*	*Indicator Insight*
A1.PAFR.2.1	Transform linear, quadratic, exponential, and linear absolute value functions to equivalent forms to identify slope and *y*- intercept for linear, vertex, and roots (if any) for quadratic and linear absolute value, and *y*-intercept for exponential.	Determine which form of a function is used to identify the information. Fluently transform linear functions into multiple forms. Linear forms include standard, intercept, *y*-intercept, and point-slope. Fluently transform quadratic functions into multiple forms. Quadratic forms include vertex, standard, and factored. Fluently transform exponential functions using growth and decay models. Limit exponential to the same bases.
A1.PAFR.2.2	Solve quadratic equations by completing the square, factoring, and the quadratic formula, explaining the connection between the zeros of the function derived from the equation, its linear factors (if it factors), the *x*-intercepts of its graph (if they exist), and the solutions (if any) to the corresponding quadratic equation.	Completing the square may include a visual model such as algebra tiles. Quadratic equations that result in negative numbers underneath the square root are determined to have no solutions in the real number system.
A1.PAFR.2.3	Solve and graph linear, quadratic, exponential, and linear absolute value equations given in tabular, symbolic, and/or verbal forms using intercepts, domain and range, intervals of increasing and decreasing, vertex (maximum and minimum), end-behavior, and symmetry, and interpret these in terms of mathematical and real-world situations.	Tabular form should involve a spreadsheet.
A1.PAFR.2.4	Create, solve, and graph linear inequalities in two variables.	Inequalities are used to solve contextual problems.
A1.PAFR.2.5	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	Use contextual situations and sets of ordered pairs to create functions to describe relationships.

Indicator #	*Indicator*	*Indicator Insight*
A1.PAFR.2.6	Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.	When given an addition/subtraction pattern or a multiplication/division sequence, generalize an arithmetic or geometric sequence; create both explicit and recursive functions for the pattern. Connect linear functions and arithmetic sequences. Connect exponential functions and geometric sequences.
A1.PAFR.2.7	Use graphs to obtain exact and/or approximate solutions of equations, inequalities, and systems of linear equations in two variables (given or obtained by using technology).	A possible strategy to use successive approximations as a method to solve the system $y = f(x)$ and $y = g(x)$ to find approximate solutions with graphs and tables.
A1.PAFR.2.8	Solve an equation of the form $f(x) = g(x)$ graphically by identifying the x-coordinate(s) of the point(s) of intersection of the graphs of $y = f(x)$ and $y = g(x)$.	The x-coordinate(s) of the point(s) where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solution(s) of the equation $f(x) = g(x)$.
A1.PAFR.2.9	Solve systems of linear equations algebraically and graphically.	Solving algebraically means using linear combinations (elimination) and substitution. Teachers are encouraged to teach solving equations collectively, not in isolation.
A1.PAFR.2.10	Analyze the growth/decay rate between linear and exponential functions specifically between consecutive integers.	Demonstrate that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals. Use graphs and tables to recognize that a quantity increasing exponentially eventually exceeds a quantity increasing linearly.

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.

Indicator #	*Indicator*	*Indicator Insight*
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.
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 *domain, range, intervals of increasing or decreasing, constant, discrete, continuous,* and *intercepts*.	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.

A1.PAFR.3. Represent and interpret functions symbolically and graphically.

Indicator #	*Indicator*	*Indicator Insight*
A1.PAFR.3.1	Recognize that $f(x)$ denotes the output of function f that corresponds to the input x, and this corresponds to the set of all the ordered pairs (x, y) that satisfy the equation $y = f(x)$ both tabularly and graphically.	Function notation reveals both the input and output in a single statement. Connect the statements "the graph of *f*" and "the graph of $y = f(x)$."
A1.PAFR.3.2	Use the definition of a function to analyze the domain and range of a function in relation to its graph, mapping, table, verbal, and/or symbolic description and, where applicable, using interval and set notation.	Tabular representation may be done using a spreadsheet.

Indicator #	*Indicator*	*Indicator Insight*
A1.PAFR.3.3	Translate among graphical, tabular, verbal, and symbolic representations in function notation, to identify intercepts, intervals where the function is increasing, decreasing, constant, maximums and minimums, and symmetries and explain their meanings in real-world and mathematical situations.	A computer algebra system may be used for translating among the different representations.
A1.PAFR.3.4	Interpret how lead coefficients impact the shape of a function's graph.	Relate the value of the coefficients to geometric transformations.

A1.PAFR.4. Reason with parent functions in varying representations to find families of functions that all have similar distinguishing attributes common to the family and use common characteristics to aid in rewriting and identifying linear, linear absolute value, quadratic, and exponential functions.

Indicator #	*Indicator*	*Indicator Insight*
A1.PAFR.4.1	Identify the effect on the graph of replacing $f(x)$ by $kf(x)$, $f(x) + k$, $f(x - k)$, $f(kx)$ for any real number k including multiple transformations; write an equation of a transformed parent function given its graph. Extend to equations involving rational, polynomial, radical, exponential, and piecewise.	Use technology with a parent function to explore the results when different transformations are applied – translations, reflections, and dilations.
A1.PAFR.4.2	Given a real-world or mathematical situation, determine the parent graph that best models the situation.	Consider rates of change, graphs, context, or a table of values to determine the parent function.
A1.PAFR.4.3	Given different representations of two different functions, compare key features including intercepts, domain and range, intervals of increasing and decreasing, constant, average rate of change, and maximum and minimum values.	Flexibly use different representations of functions (graphs, tables, verbal, and symbols) to compare key features of the functions.