

K – 12 MATHEMATICS UNIFYING STANDARDS

- 1.0 Number Sense and Operations** – Students understand ways of representing numbers, relationships among numbers, and number systems. They understand the meaning of and relationships between operations and strategies, and they can estimate appropriately.
- 2.0 Patterns, Functions, and Algebra** – Students know and understand various types of patterns and functional relationships. They use symbolic forms and models to represent and analyze mathematical structures in both real and abstract contexts.
- 3.0 Measurement** – Students know and understand attributes, units and systems of measurement. They apply a variety of techniques, tools, and formulas for determining measurements.
- 4.0 Geometry and Spatial Sense** – Students know how to analyze characteristics and properties of two- and three- dimensional objects. They select and use different representational systems, including coordinate and graph theory. They understand the usefulness of transformations and symmetry in analyzing mathematical situations. They know how to visualize and to use spatial reasoning to solve problems that cross disciplines.
- 5.0 Data Analysis, Statistics, and Probability** – Students know how to pose questions and collect, organize, represent and interpret data in order to answer those questions. They use methods of exploratory data analysis to develop and evaluate inferences, predictions, and arguments that are based on data. They understand and know how to apply the notions of chance and probability.
- 6.0 Problem Solving** – Students know that they learn basic skills and concepts in order to use them to solve problems in and out of school. They solve routine and complex problems by drawing from a variety of strategies, including technology, while demonstrating an attitude of persistence and reflection in their approaches.
- 7.0 Processes: Reasoning, Communication, and Connections** – Students use reasoning to develop, analyze, draw conclusions, and validate conjectures and arguments. As they reason, they recognize and understand multiple representations of the same concept. They see the interconnections among math ideas, as well as in other disciplines. They know how to communicate their math thinking clearly and coherently to others, orally, graphically, and in writing, using precise language and symbols.

FOCUS GOALS ALGEBRA 3 - 4

1.0 Number Sense and Operations

- 1.1 Identify and use the properties of complex numbers.
- 1.2 Understand the concept of absolute value.
- 1.3 Know the laws of rational exponents.
- 1.4 Understand and use the basic properties of matrices.

2.0 Patterns, Functions, and Algebra

- 2.1 Simplify and evaluate algebraic expressions.
- 2.2 Solve a linear equation for any variable.
- 2.3 Analyze and apply linear functions.
- 2.4 Solve and graph linear and quadratic inequalities.
- 2.5 Solve systems of linear equations and inequalities (in two or three variables).
- 2.6 Solve and graph linear and quadratic equations.
- 2.7 Understand and use the concepts of a relation and a function.
- 2.8 Understand logarithmic and exponential functions.
- 2.9 Understand and analyze the laws of fractional exponents.

3.0 Measurement

- 3.1 Apply formulas, tools, and techniques to determine measurements.

4.0 Geometry and Spatial Sense

- 4.1 Understand and use coordinate geometry.
- 4.2 Understand triangle relationships.
- 4.3 Understand how to use conic sections.

5.0 Data Analysis, Statistics, and Probability

- 5.1 Organize, represent and interpret data sets that have one or more variables using traditional and technological tools.
- 5.2 Solve combination and permutation problems.
- 5.3 Apply a variety of strategies to determine probabilities.

6.0 Problem Solving

- 6.1 Make decisions about how to approach problems.
- 6.2 Apply a variety of strategies, skills, and concepts to find solutions.

7.0 Processes: Reasoning, Communication, and Connections

- 5.1 Communicate algebraic thinking and conclusions using words, graphs, and charts.
- 5.2 Explain how changing the components of a function changes its graph.
- 5.3 Use algebraic skills to solve problems and to make predictions.
- 5.4 Apply literacy skills when making mathematical connections.

MATH STANDARDS ALGEBRA 3 - 4

1.0 Number Sense and Operations - Students understand ways of representing numbers, relationships among numbers, and number systems. They understand the meaning of and relationships between operations and strategies, and they can estimate appropriately.

1.1 Identify and use the properties of complex numbers. (c/p)

- θ Use order of operations to simplify algebraic expressions including rationalizing monomial and binomial denominators. (c7/p9)
- θ Simplify radical expressions. (c15)
- θ Simplify powers of i and $(a+bi)^n$ for $n < 4$. (c6,20/p11)
- θ Simplify complex expressions including using the conjugate. (c6/p12)
- θ Apply sequences and series. (s)

1.2 Understand the concept of absolute value. (c/p)

- θ Relate absolute value to distance on a number line and to the formal definition. (c1/p9)
- θ Solve equations and inequalities involving absolute values. (c12)
- θ Solve enumerating problems. (s)

1.3 Know the laws of rational exponents. (c12/p11)

- θ Apply exponential functions involving growth and decay. (c12)

1.4 Understand and use the basic properties of matrices. (c/p)

- θ Apply the inverse of a 2×2 . (c/la9/p)
- θ Apply determinants of 2×2 and 3×3 . (c/la10/p)
- θ Solve simple matrix equations. (c2/p12)
- θ Add, subtract, and multiply matrices. (c2)
- θ Apply scalar multiplication. (c/la5)

2.0 Patterns, Functions, and Algebra – Students know and understand various types of patterns and functional relationships. They use symbolic forms and models to represent and analyze mathematical structures in both real and abstract contexts.

2.1 Simplify and evaluate algebraic expressions. (c)

- θ Simplify expressions with rational exponents. (c7/p9)
- θ Add, subtract, multiply and divide polynomials (including long division and synthetic division). (c3/p12)
- θ Factor higher degree polynomials, difference of two squares, perfect square trinomials, and sum/difference of two cubes. (c4/p11)
- θ Add, subtract, multiply, divide, reduce, and evaluate rational expressions with monomial and polynomial denominators, and simplify complicated rational expressions, including those with negative exponents in the denominator. (c7/p11/s)

- θ Use squares. (c8)
- θ Use the quadratic formula. (c9)

2.2 Solve a linear equation for any variable. (c/p)

- θ Use factoring. (c8/p12)
- θ Use logs. (c11/p12)

2.3 Analyze and apply linear functions. (c/p)

- θ Make the connection between a solution to a linear equation and a point on the graph. (c2/p9)
- θ Solve and graph linear equations from slope-intercept form, standard form, or when given a point and the slope. (p9)
- θ Write a linear equation: (p10)
 - Given 2 points
 - Given 1 point and the slope
 - Given a graph
 - That is parallel or perpendicular to a given line through a given point

2.4 Solve and graph linear and quadratic inequalities. (c/p)

- θ Solve and graph inequalities in one and two variables. (c2/p9,10)
- θ Solve and graph inequalities involving absolute value. (c1/p11)
- θ Given an inequality on a graph, manipulate correctly. (s)

2.5 Solve systems of linear equations and inequalities (in two or three variables).

- θ Use and apply substitution, with graphs, by elimination, or with matrices. (c2/p11)
- θ Solve a system of two linear and/or quadratic inequalities in two variables and sketch the solution sets. (c/p)
- θ Recognize how points in the shaded region of the sketch represent solutions for the system of inequalities. (p11)

2.6 Solve and graph linear and quadratic equations. (c/p)

- θ Know the quadratic formula. (c8/p9/s)
- θ Use the quadratic formula to find the roots of a second-degree polynomial and to solve quadratic equations. (c8/p9)
- θ Recognize quadratic form of higher order polynomials. (p)
- θ Understand the role of quadratic form when reducing and factoring higher level polynomials. (p)
- θ Find the value of the discriminant and tell the nature of the roots.*
- θ Demonstrate and explain the effect that changing a coefficient has on the graph of quadratic functions; that is, students can determine how the graph of a parabola changes as a, b, and c vary in the equation $y = a(x - b)^2 + c$. (c9/p12)
- θ Graph quadratic functions and determine the maxima, minima, and zeros of the function. (c10/p11/s)

2.7 Understand and use the concepts of a relation and a function. (c/p)

- θ Determine the domain of independent variables and the range of dependent variables defined by a graph, set of ordered pairs, or equation. (p)
- θ Determine whether a relation defined by a graph, set of ordered pairs, or a symbolic expression is a function and justify the conclusion. (p)
- θ Graph functions of the form $y = nx^2$, $y = nx^3$, and $y = a^x$ and their inverses. (p)
- θ Graph a function and its inverse (if it exists) and determine the relationship between the domain and range of the function and its inverse. (p)
- θ Solve problems involving functional concepts, such as composition, defining the inverse function and performing arithmetic operations on functions. (c24)
- θ Use properties from number systems to justify steps in combining and simplifying functions. (c25)

2.8 Understand logarithmic and exponential functions. (c)

- θ Know and apply the laws of logs. (c11.1,11.2/p12)
- θ Understand and use properties of logs to simplify logarithmic numeric expressions and solve logarithmic equations. (c14/p12)
- θ Use definition of logarithms to translate between logarithms in any base. (c13)

2.9 Understand and analyze the laws of fractional exponents. (c12)

- θ Explain exponential functions.
- θ Apply functions involving exponential growth and decay. (c12)

3.0 Measurement - Students know and understand attributes, units and systems of measurement. They apply a variety of techniques, tools, and formulas for determining measurements.

3.1 Apply formulas, tools, and techniques to determine measurements. (p)

- θ Use formulas to find surface area and volume of prisms and cylinders, and area and perimeter of circles, polygons, and irregular figures. (p9,10/s)
- θ Solve for a literal variable, such as solving for r when $V = \frac{4}{3}\pi r^3$ or $\frac{4}{3}(\pi r^3)$.*
- θ Determine the appropriate scale and unit of measure. (p/s)
- θ Calculate area of a triangle when given coordinate points of the vertices. (s)

4.0 Geometry and Spatial Sense - Students know how to analyze characteristics and properties of two- and three- dimensional objects. They select and use different representational systems, including coordinate and graph theory. They understand the usefulness of transformations and symmetry in analyzing mathematical situations. They know how to visualize and to use spatial reasoning to solve problems that cross disciplines.

4.1 Understand and use coordinate geometry. (c/p/s)

- θ Use the distance and midpoint formulas. (p9)
- θ Find the slope of a line.*

- θ Determine congruence, similarity, and regularity of polygons. (s)
- θ Find the midpoint of a line segment. (s)

4.2 Understand triangle relationships. (c/p)

- θ Use the Pythagorean Theorem to determine distance and find missing lengths of sides of right triangles. (p9/s)
- θ Determine the measure of objects indirectly using similar and right triangles. (p9/s)

4.3 Understand how to use conic sections. (c/p)

- θ Identify, explain, and graph the conic sections centered at origin (e.g., asymptotes, foci, eccentricity). (c16/p12)
- θ Given a quadratic equation of the form $ax^2 + by + cx^2 + dy + e = 0$, use the method of completing the square to put the equation into standard form and recognize whether the graph of the equation is a circle, ellipse, parabola, or hyperbola and graph the equation. (c17/p/a3-4)

5.0 Data Analysis, Statistics and Probability - Students know how to pose questions and collect, organize, represent, and interpret data in order to answer those questions. They use methods of exploratory data analysis to develop and evaluate inferences, predictions, and arguments that are based on data. They understand and know how to apply the notions of chance and probability.

5.1 Organize, represent, and interpret data sets that have one or more variables using traditional and technological tools. (p)

- θ Identify relationships among variables within a data set. (p)
- θ Identify the independent and dependent variable. (p)
- θ Display and interpret data in a scatter plot, frequency table, stem and leaf plot, and histogram. (p9/s)
- θ Describe the correlation between, and predict, compare, and make inference about outcomes of the data. (p-9/s)
- θ Find the equations of trend lines or lines of best fit. (p10/s)
- θ Use linear regression with math models. (s)

5.2 Solve combination and permutation problems. (c)

- θ Use fundamental counting principles to compute combinations and permutations. (c18/p12)
- θ Use combinations and permutations to compute probabilities. (c19/p12)

5.3 Apply a variety of strategies to determine probabilities.

- θ Use distribution (binomial, geometric, etc.). (s)
- θ Determine mean, median, and range when adding or omitting data. (s)

6.0 Problem Solving - Students know that they learn basic skills and concepts in order to use them to solve problems in and out of school. They solve routine and complex problems by drawing from a variety of strategies, including technology, while demonstrating an attitude of persistence and reflection in their approaches.

6.1 Make decisions about how to approach problems. (p9-12)

- θ Analyze problems by identifying relationships, identify relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns.
- θ Identify and utilize appropriate tools.
- θ Make generalizations based on prior knowledge and related examples.

6.2 Apply a variety of strategies, skills, and concepts to find solutions. (c/p)

- θ Apply algebraic techniques to solve rate and real world application problems. *
- θ Apply quadratic equations to physical problems, (such as the motion of an object under the force of gravity) and determine the maxima and minima of a function. (c10/p11)
- θ Use estimation to verify the reasonableness of calculated results. (p9-12)
- θ Make and test conjectures by using inductive and deductive reasoning. (p9-12)
- θ Find the general term and the sums of arithmetic series of both finite and infinite geometric series. (c22/p/a3-4)
- θ Derive summation formulas for arithmetic series and for both finite and infinite geometric series. (c23/p/a4)

7.0 Processes: Reasoning, Communication, and Connections - Students use reasoning to develop, analyze, draw conclusions, and validate conjectures and arguments. As they reason, they recognize and understand multiple representations of the same concept. They see the interconnections among math ideas, as well as in other disciplines. They know how to communicate their math thinking clearly and coherently to others, orally, graphically, and in writing, and using precise language and symbols.

7.1 Communicate algebraic thinking and conclusions using words, graphs, and charts. (p)

7.2 Explain how changing the components of a function changes its graph. (c/p)

- θ Describe how changing the slope of y-intercept of a linear function changes the graph. (p10)
- θ Demonstrate vertical and horizontal translations of lines, parabolas, circles, ellipses and hyperbolas. (c17/p12)
- θ Demonstrate and explain the effect that changing a coefficient has on the graph of quadratic functions; that is, students can determine how the graph of a parabola changes as a, b, and c vary in the equation $y=a(x-b)^2+c$. (c9/p/a3-4)
- θ Translate functions between graphs and tables. (s)

7.3 Use algebraic skills to solve problems and to make predictions.

- θ Draw a trend line and use it to justify predictions. (p10)
- θ Use systems to solve problems. (c2/p11)
- θ Use maximum and minimum values to choose best situations under given conditions. (c10/p11)
- θ Use exponential growth or decay functions and their graphs to make and justify predictions. (c12/p12/s)

7.4 Apply literacy skills when making mathematical connections. (p-language arts)

- θ Learn and use mathematics vocabulary encountered through reading. (R1.0)
- θ Use strategies to comprehend, analyze, and evaluate mathematics reading materials. (R2.0)
- θ Employ technology to organize, record, and interpret mathematics information. (R3.0)
- θ Write about mathematics to convey ideas logically and correctly. (W2.0)