

NEW MEXICO Grades 9-12 MATHEMATICS STANDARDS

Revised through the American Diploma Project and awaiting official approval

PROCESS STANDARDS

To help New Mexico students achieve the Content Standards enumerated below, teachers are encouraged to base instruction on the following Process Standards:

<p>Problem Solving</p> <ul style="list-style-type: none"> • Build new mathematical knowledge through problem solving • Solve problems that arise in mathematics and other contexts • Apply and adapt a variety of appropriate strategies to solve problems, and • Monitor and reflect on the process of problem solving. 	<ul style="list-style-type: none"> • Analyze and evaluate the mathematical thinking and strategies of others,- • Use the language of mathematics to express mathematical ideas precisely, and • Describe mathematical concepts using developmentally appropriate definitions.
<p>Reasoning and Proof</p> <ul style="list-style-type: none"> • Recognize reasoning and proof as fundamental aspects of mathematics, • Make and investigate mathematical conjectures, • Develop and evaluate mathematical arguments and proofs, and • Select and use various types of reasoning and methods of proof. 	<p>Connections</p> <ul style="list-style-type: none"> • Recognize and use connections among mathematical ideas, • Understand how mathematical ideas interconnect and build on one another to produce a coherent whole, and • Recognize and apply mathematics in contexts outside of mathematics.
<p>Communication</p> <ul style="list-style-type: none"> • Organize and consolidate their thinking through communication, • Communicate their mathematical thinking coherently and clearly to peers, teachers, and others, 	<p>Representation</p> <ul style="list-style-type: none"> • Create and use representations to organize, record, and communicate mathematical ideas, • Select, apply, and translate among mathematical representations to solve problems, and • Use representations to model and interpret physical, social, and mathematical phenomena.

CONTENT STANDARDS

Strand: ALGEBRA, FUNCTIONS, AND GRAPHS

Standard: Students will understand algebraic concepts and applications.

9-12 Benchmark.A.1: Represent and analyze mathematical situations and structures using algebraic symbols.

Performance Standards

9-12.A.1.1 Use the special symbols of mathematics correctly and precisely.

9-12.A.1.2 Classify and use equivalent representations of natural, whole, integer, rational, irrational numbers and complex numbers, and choose which type of number is appropriate in a given context.

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- 9-12.A.1.3 Determine the relative position on the number line and the relative magnitude of integers, decimals, rationals, irrationals, and numbers in scientific notation.
- 9-12.A.1.4 Explain that the distance between two numbers on the number line is the absolute value of their difference.
- 9-12.A.1.5 Use a variety of computational methods, recognize when an estimate or approximation is more appropriate than an exact answer, and understand the limits on precision of approximations.
- 9-12.A.1.6 Simplify numerical expressions using the order of operations, including integer exponents.
- 9-12.A.1.7 Translate verbal statements into algebraic expressions or equations.
- 9-12.A.1.8 Solve formulas for specified variables.
- 9-12.A.1.9 Solve quadratic equations in one variable.
- 9-12.A.1.10 Solve radical equations involving one radical.
- 9-12.A.1.11 Describe the properties of rational exponents and apply these properties to simplify algebraic expressions.
- 9-12.A.1.12 Explain and use equivalent representations for algebraic expressions (e.g., simplify using the distributive property).
- 9-12.A.1.13 Simplify rational expressions by factoring and reducing to lowest terms.
- 9-12.A.1.14 Evaluate polynomial, rational, radical, and absolute value expressions for one or more variables.
- 9-12.A.1.15 Compare and order polynomial expressions by degree.
- 9-12.A.1.16 Factor polynomials of various types (e.g., difference of squares, perfect square trinomials, sum and difference of cubes).
- 9-12.A.1.17 Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.
- 9-12.A.1.18 Use the four basic operations (+, -, \times , \div) with linear, polynomial, and rational expressions in contextual situations.
- 9-12.A.1.19 Use the four basic operations (+, -, \times , \div) in contextual situations with numbers in scientific notation, and express the results with the appropriate number of significant figures.

9-12 Benchmark A.2: Understand patterns, relations, functions, and graphs.

Performance Standards

- 9-12.A.2.1 Distinguish between the concept of a relation and a function.
- 9-12.A.2.2 Determine whether a relation defined by a graph, a set of ordered pairs, a table of values, an equation, or a rule is a function.
- 9-12.A.2.3 Translate among tabular, symbolic, and graphical representations of functions and relations.
- 9-12.A.2.4 Construct a linear function that represents a given graph.
- 9-12.A.2.5 Explain and use function notation in both abstract and contextual situations and evaluate a function at a specific point in its domain.
- 9-12.A.2.6 Graph a linear equation and demonstrate that it has a constant rate of change.
- 9-12.A.2.7 Graph a linear inequality in two variables.
- 9-12.A.2.8 Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph.
- 9-12.A.2.9 Graph exponential functions and identify their key characteristics as related to contextual situations.

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- 9-12.A.2.10** Identify and describe symmetries of graphs.
- 9-12.A.2.11** Use the quadratic formula and factoring techniques to determine whether the graph of a quadratic function will intersect the x -axis in zero, one, or two points (include quadratic functions that represent real phenomena).
- 9-12.A.2.12** Explain the meaning of the real and complex roots of quadratic functions in contextual situations.
- 9-12.A.2.13** Read information and draw conclusions from graphs, and identify properties of a graph that provide useful information about the original problem.
- 9-12.A.2.14** Understand the relationship between the coefficients of a linear equation and the slope and x - and y - intercepts of its graphs.
- 9-12.A.2.15** Evaluate estimated rate of change in a contextual situations.

9-12 Benchmark A.3: Use mathematical models to represent and understand quantitative relationships.

Performance Standards

- 9-12.A.3.1** Model real-world phenomena using linear equations and linear inequalities interpret resulting solutions, and use estimation to detect errors.
- 9-12.A.3.2** Model real-world phenomena using quadratic equations, interpret resulting solutions, and use estimation to detect errors.
- 9-12.A.3.3** Model real-world phenomena using exponential equations, interpret resulting solutions, and use estimation to detect errors.
- 9-12.A.3.4** Solve systems of linear equations in two variables algebraically and graphically
- 9-12.A.3.5** Solve applications involving systems of two equations in two variables.
- 9-12.A.3.6** Write an equation of the line that passes through two given points.
- 9-12.A.3.7** Verify that a point lies on a line, given an equation of the line, and be able to derive linear equations given a point and a slope.
- 9-12.A.3.8** Determine whether the graphs of two given linear equations are parallel, perpendicular, coincide or none of these.

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Strand: GEOMETRY AND TRIGONOMETRY

Standard: Students will understand geometric concepts and applications.

9-12 Benchmark G.1: Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.

Performance Standards

- 9-12.G.1.1** Understand that numerical values associated with measurements of physical quantities must be assigned units of measurement or dimensions; apply such units correctly in expressions, equations and problem solutions that involve measurements; and convert a measurement using one unit of measurement to another unit of measurement.
- 9-12.G.1.2** Find the area and perimeter of a geometric figure composed of a combination of two or more rectangles, triangles, and/or semicircles with just edges in common.
- 9-12.G.1.3** Draw three-dimensional objects and calculate the surface areas and volumes of these figures (e.g. prisms, cylinders, pyramids, cones, spheres) as well as figures constructed from unions of prisms with faces in common, given the formulas for these figures.
- 9-12.G.1.4** Identify the hypothesis and conclusion in examples of conditional statements.
- 9-12.G.1.5** Use definitions in making logical arguments.
- 9-12.G.1.6** Use counterexamples to show that an assertion is false and recognize that a single counterexample is sufficient to refute a universal statement.
- 9-12.G.1.7** Explain the difference between inductive and deductive reasoning and provide examples of each.
- 9-12.G.1.8** Explain why, for inductive reasoning, showing a statement is true for a finite number of examples does not show it is true for all cases unless the cases verified are all possible cases.
- 9-12.G.1.9** Write geometric proofs, including proofs by contradiction, and perform and explain basic geometric constructions related to: theorems involving the properties of parallel and perpendicular lines, circles, and polygons; theorems involving complementary, supplementary, and congruent angles; theorems involving congruence and similarity; and the Pythagorean theorem.
- 9-12.G.1.10** Recognize that there are geometries, other than Euclidean geometry, in which the parallel postulate is not true.

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9-12 Benchmark G.2: Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

Performance Standards

9-12.G.2.1 Identify the origin, coordinate axes, and four quadrants on the Cartesian coordinate plane, and draw and label them correctly.

9-12.G.2.2 Determine the midpoint and distance between two points within a coordinate system and relate these ideas to geometric figures in the plane (e.g., find the center of a circle given the two points of a diameter of the circle).

9-12.G.2.3 Use basic geometric ideas (e.g., the Pythagorean theorem, area and perimeter) in the context of the Cartesian coordinate plane (e.g., calculate the perimeter of a rectangle with integer coordinates and with sides parallel to the coordinate axes, and of a rectangle with sides not parallel).

9-12 Benchmark G.3: Apply transformations and use symmetry to analyze mathematical situations.

Performance Standards

9-12.G.3.1 Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent in a coordinate plane.

9-12.G.3.2 Sketch a planar figure that is the result of given transformations (i.e., translation, reflection, rotation, and/or dilation).

9-12.G.3.3 Identify similarity in terms of transformations.

9-12.G.3.4 Determine the effects of transformations on linear and area measurements of the original planar figure.

9-12 Benchmark G.4: Use visualization, spatial reasoning, and geometric modeling to solve problems.

Performance Standards

9-12.G.4.1 Solve contextual problems using congruence and similarity relationships of triangles (e.g., find the height of a pole given the length of its shadow).

9-12.G.4.2 Solve problems involving complementary, supplementary, and congruent angles.

9-12.G.4.3 Know that the effect of a scale factor k on length, area and volume is to multiply each by k , k^2 and k^3 , respectively.

9-12.G.4.4 Solve problems using the Pythagorean theorem.

9-12.G.4.5 Understand how similarity of right triangles allows the trigonometric functions sine, cosine and tangent to be defined as ratios of sides and be able to use these functions to solve problems.

9-12.G.4.6 Apply basic trigonometric functions to solve right-triangle problems.

9-12.G.4.7 Use angle and side relationships in problems with special right triangles (e.g., 30-, 60-, 90-, and 45-, 45-, 90- degree triangles).

9-12.G.4.8 Describe the intersections of a line and a plane, intersections of lines in the plane and in space, or of two planes in space.

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Strand: DATA ANALYSIS AND PROBABILITY

Standard: Students will understand how to formulate questions, analyze data, and determine probabilities.

9-12 Benchmark D.1: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

Performance Standards

- 9-12.D.1.1** Explain the differences between various methods of data collection.
- 9-12.D.1.2** Describe the characteristics of a well-designed and well-conducted survey by differentiating between sampling and census, and a biased and unbiased sample.
- 9-12.D.1.3** Describe the characteristics of a well-designed and well-conducted experiment by differentiating between experiments and observational studies, and recognizing the sources of bias in poorly designed experiments.
- 9-12.D.1.4** Explain the role of randomization in well-designed surveys and experiments.

9-12 Benchmark D.2: Select and use appropriate statistical methods to analyze data and make predictions.

Performance Standards

- 9-12.D.2.1** Distinguish measurement data from categorical data, and define the term *variable*.
- 9-12.D.2.2** Explain the meaning of *univariate* and *bivariate* data.
- 9-12.D.2.3** Display the distribution of univariate data, describe its shape using appropriate summary statistics, and understand the distinction between a statistic and a parameter.
- 9-12.D.2.4** Calculate and apply measures of variability (e.g., standard deviation).
- 9-12.D.2.5** Compare distributions of univariate data using back-to-back stem and leaf plots and parallel box and whisker plots.
- 9-12.D.2.6** Describe the characteristics of a normal distribution.
- 9-12.D.2.7** Compare and draw conclusions between two or more sets of univariate data using basic data analysis techniques and summary statistics.
- 9-12.D.2.8** Describe the shape of a scatterplot.
- 9-12.D.2.9** Use linear patterns in data to make predictions.
- 9-12.D.2.10** Use technological tools to find the line of best fit.
- 9-12.D.2.11** Describe the relationship between two variables and determine its strength with and without technological tools.
- 9-12.D.2.12** Explain why correlation does not imply a cause-and-effect relationship.
- 9-12.D.2.13** Use the results of simulations to explore the variability of sample statistics from a known population and construct sampling distributions.
- 9-12.D.2.14** Describe how sample statistics, including the law of large numbers, reflect the values of population parameters and use sampling distributions as the basis for informal inference.
- 9-12.D.2.15** Evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data

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analysis, and the validity of conclusions.

9-12 Benchmark D.3: Understand and apply basic concepts of probability.

Performance Standards

9-12.D.3.1 Explain the concept of a random variable.

9-12.D.3.2 Explain how the relative frequency of a specified outcome of an event can be used to estimate the probability of the outcome.

9-12.D.3.3 Use the results of simulations to compute the expected value and probabilities of random variables in simple cases.

9-12.D.3.4 Compute the probability of an event using the complement rule, addition rule for disjoint and joint events, multiplication rule for independent events, and rules for conditional probability.