

Math

Colorado Sample Graduation Competencies and Evidence Outcomes

Math Graduation Competency 1

Number Sense, Properties, and Operations

Reason and model quantitatively, using units and number systems to solve problems.

Elementary School

- a. Use number names and the count sequence (CCSS: K.CC).
- b. Count to determine the number of objects (CCSS: K.CC).
- c. Apply the relationship between numbers and quantities and connect counting to cardinality (CCSS: K.CC.4).
- d. Use place value and properties of operations to add and subtract (CCSS: 1.NBT).
- e. Use place value and properties of operations to perform multi-digit arithmetic (CCSS:3.NBT).
- f. Generalize place value understanding for multi-digit whole numbers (CCSS: 4.NBT).
- g. Use decimal notation to express fractions, and compare decimal fractions (CCSS: 4.NF).
- h. Use place value understanding to round decimals to any place (CCSS: 5.NBT.4).

Middle School

- a. Analyze proportional relationships and use them to solve real-world and mathematical problems (CCSS:7.RP).
- b. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units (CCSS: 7.RP.1).
- c. Identify and represent proportional relationships between quantities (CCSS:7.RP.2).
- d. Use proportional relationships to solve multistep ratio and percent problems (CCSS: 7.RP.3).
- e. Estimate and compute unit cost of consumables (to include unit conversions if necessary) sold in quantity to make purchase decisions based on cost and practicality (PFL).

High School

- a. Extend the properties of exponents to rational exponents (CCSS: N-RN).
- b. Use properties of rational and irrational numbers (CCSS: N-RN).
- c. Perform arithmetic operations with complex numbers (CCSS: N-CN).
- d. Use complex numbers in polynomial identities and equations (CCSS: N-CN).
- e. Reason quantitatively and use units to solve problems (CCSS HSN.Q.A).
- f. Describe factors affecting take-home pay and calculate the impact (PFL).
- g. Design and use a budget, including income (net take home pay) and expenses (mortgage, car loans, and living expenses) to demonstrate how living within your means is essential for a secure financial future (PFL).



Elementary School

- i. Convert like measurement system units within a given measurement (CCSS: 5.MD).
- j. Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers. [i] (CCSS: 5.NF.3).
- k. Solve real world problems involving multiplication of fractions and mixed numbers (CCSS: 5.NF.6).
- l. Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions (CCSS: 5.NF.7c).

Middle School

- f. Solve problems involving percent of a number, discounts, taxes, simple interest, percent increase, and percent decrease (PFL).
- g. Apply understanding of multiplication and division and of fractions to multiple and divide rational numbers including integers (CCSS: 7.NS.1).
- h. Apply and extend previous understanding of multiplication and division and of fractions to multiply and divide rational numbers including integers (CCSS: 7.NS.2).
- i. Solve real-world and mathematical problems involving the four operations with rational numbers (CCSS: 7.NS.3).
- j. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (CCSS: 8.NS.2).
- k. Apply the properties of integer exponents to generate equivalent numerical expressions (CCSS: 8.EE.2).
- l. Evaluate square roots of small perfect squares and cube roots of small perfect cubes (CCSS: 8.EE.2).
- m. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used (CCSS: 8.EE.4).

High School



Math Graduation Competency 2

Patterns, Functions, and Algebraic Structures

Make sound predictions and generalizations based on patterns and relationships that arise from numbers, shapes, symbols, and data.

Elementary School	Middle School	High School
<ul style="list-style-type: none">a. Represent and solve problems involving addition and subtraction (CCSS: 2.OA).b. Use equal groups of objects to gain foundations for multiplication (CCSS: 2.OA).c. Solve problems involving the four operations, and identify and explain patterns in arithmetic (CCSS: 3.OA).d. Use place value understanding and properties of operations to perform multi-digit arithmetic. (CCSS: 4.NBT).e. Use the four operations with whole numbers to solve problems (CCSS: 4.OA).f. Fluently multiply multi-digit whole numbers using standard algorithms (CCSS: 5.NBT.5).g. Write and interpret numerical expressions (CCSS: 5.OA).h. Find whole number quotients of whole numbers (CCSS: 5.NBT.6).i. Use equivalent fractions as a strategy to add and subtract fractions (CCSS: 5.NF).	<ul style="list-style-type: none">a. Define, evaluate, and compare functions (CCSS: 8.F).b. Use functions to model relationships between quantities (CCSS: 8.F).c. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically (CCSS: 7.EE.3).d. Apply properties of operations to calculate with numbers in any form, convert between forms as appropriate, and assess the reasonableness of answers using mental computation and estimation strategies (CCSS: 7.EE.3).e. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities (CCSS: 7.EE.4).	<ul style="list-style-type: none">a. Formulate the concept of a function and use function notation (CCSS: F-IF).b. Interpret functions that arise in applications in terms of the context (CCSS: F-IF).c. Analyze functions using different representations (CCSS: F-IF).d. Build a function that models a relationship between two quantities (CCSS: F-BF).e. Build new functions from existing functions (CCSS: F-BF).f. Extend the domain of trigonometric functions using the unit circle (CCSS: F-TF).g. Construct and compare linear, quadratic, and exponential models and solve problems (CCSS: F-LE).h. Interpret expressions for function in terms of the situation they model (CCSS: F-LE).i. Model periodic phenomena with trigonometric functions (CCSS: F-TF).



Elementary School

- j. Explain, extend, and use patterns and relationships in solving problems, including those involving saving and checking accounts such as understanding that spending more means saving less (PFL).

Middle School

High School

- j. Model personal financial situations (PFL).



Math Graduation Competency 3

Patterns, Functions, and Algebraic Structures

Understand that equivalence is a foundation of mathematics represented in numbers, shapes, measures, expressions, and equations.

Elementary School	Middle School	High School
<ul style="list-style-type: none">a. Develop understanding of fractions as numbers (CCSS: 3.NF).b. Use ideas of fraction equivalence and ordering (CCSS: 4.NF).c. Build fractions from unit fractions by applying understandings of operations on whole numbers (CCSS: 4.NF).d. Multiply a fraction by a whole number (CCSS: 4.NF.4).	<ul style="list-style-type: none">a. Use properties of operations to generate equivalent expressions (CCSS: 7.EE).b. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients (CCSS: 7.EE.1).c. “Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically (CCSS: 7.EE.3).d. Describe the connections between proportional relationships, lines, and linear equations (CCSS: 8.EE).e. Graph proportional relationships, interpreting the unit rate as the slope of the graph (CCSS: 8.EE.5).f. Compare two different proportional relationships represented in different ways (CCSS: 8.EE.5).g. Solve linear equations in one variable (CCSS: 8.EE.7).	<ul style="list-style-type: none">a. Interpret the structure of expressions (CCSS: A-SSE).b. Write expressions in equivalent forms to solve problems (CCSS: A-SSE).c. Perform arithmetic operations on polynomials (CCSS: A-APR).d. Understand the relationship between zeros and factors of polynomials (CCSS: A-APR).e. Use polynomial identities to solve problems (CCSS: A-APR).f. Rewrite rational expressions (CCSS: A-APR).g. Rewrite simple rational expressions in different forms [vii] (CCSS: A-APR.6).h. Create equations that describe numbers or relationships (CCSS: A-CED).i. Understand solving equations as a process of reasoning and explain the reasoning (CCSS: A-REI).j. Solve equations and inequalities in one variable (CCSS: A-REI).



Elementary School

Middle School

- h. Analyze and solve pairs of simultaneous linear equations (CCSS: 8.EE.8).

High School

- k. Solve systems of equations (CCSS: A-REI)
- l. Represent and solve equations and inequalities graphically (CCSS: A-REI).



Math Graduation Competency 4

Data Analysis, Statistics, and Probability

Solve problems and make decisions that depend on understanding, explaining, and quantifying the variability in data

Elementary School	Middle School	High School
<ul style="list-style-type: none">a. Organize, represent, and interpret data with up to three categories (CCSS: 1.MD.4).b. Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units (CCSS: 2.MD.9).c. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories (CCSS: 2.MD.10).d. Solve simple put together, take-apart, and compare problems using information presented in picture and bar graphs (CCSS: 2.MD.10).e. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories (CCSS: 3.MD.3).	<ul style="list-style-type: none">a. Use random sampling to draw inferences about a population (CCSS: 7.SP).b. Draw informal comparative inferences about two populations (CCSS: 7.SP).c. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability (CCSS: 7.SP.6).d. Develop a probability model and use it to find probabilities of events (CCSS: 7.SP.7).e. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation (CCSS: 7.SP.8).f. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities (CCSS: 8.SP.1).	<ul style="list-style-type: none">a. Summarize, represent, and interpret data on a single count or measurement variable (CCSS: S-ID).b. Summarize, represent, and interpret data on two categorical and quantitative variables (CCSS: S-ID).c. Interpret linear models. (CCSS: S-ID).d. Distinguish between correlation and causation (CCSS: S-ID.9).e. Understand and evaluate random processes underlying statistical experiments (CCSS: S-IC).f. Understand independence and conditional probability and use them to interpret data (CCSS: S-CP).g. Use the rules of probability to compute probabilities of compound events in a uniform probability model (CCSS: S-CP).h. Analyze the cost of insurance as a method to offset the risk of a situation (PFL) Make inferences and justify conclusions from sample surveys, experiments, and observational studies (CCSS HSS.IC.B).



Elementary School

- f. Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters (CCSS: 3.MD.4).
- g. Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$) (CCSS: 4.MD.4).
- h. Solve problems involving addition and subtraction of fractions by using information presented in line plots (CCSS: 4.MD.4).
- i. Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$) (CCSS: 5.MD.2).

Middle School

- g. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association (CCSS: 8.SP.1).
- h. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line (CCSS: 8.SP.2).
- i. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept (CCSS: 8.SP.3).
- j. Explain patterns of association seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table (CCSS: 8.SP.4).

High School



Math Graduation Competency 5

Shape, Dimension, and Geometric Relationships

Make claims about relationships among numbers, shapes, symbols, and data and defend those claims by relying on the properties that are the structure of mathematics

Elementary School

- a. Model and describe addition as putting together and adding to, and subtraction as taking apart taking from, using objects or drawings (CCSS: K.OA).
- b. Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces (CCSS: 2.G.1).
- c. Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres) (CCSS: K.G).
- d. Analyze, compare, create, and compose shapes (CCSS: K.G).
- e. Build and draw shapes to possess defining attributes (CCSS: 1.G.1).
- f. Partition circles and rectangles into two and four equal shares and describe shares using appropriate words (CCSS: 1.G.3).
- g. Reason with shapes and their attributes (CCSS: 3.G).

Middle School

- a. Verify experimentally the properties of rotations, reflections, and translations (CCSS: 8.G.1).
- b. Draw construct, and describe geometrical figures and describe the relationships between them (CCSS: 7.G).
- c. Solve real-world and mathematical problems involving area, surface area, volume, and angle measure (CCSS 6.G.A, 7.G.B).
- d. Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres (CCSS 8.G.C).
- e. Understand congruence and similarity using physical models, transparencies, or geometry software (CCSS 8.G.A).
- f. Understand and apply Pythagorean Theorem (CCSS 8.G.B).
- g. Verify experimentally the properties of rotations, reflections, and translations (CCSS: 8.G.1).

High School

- a. Experiment with transformations in the plane. (CCSS: G-CO) . Understand congruence in terms of rigid motions (CCSS: G-CO).
- b. Prove geometric theorems (CCSS: G-CO).
- c. Make geometric constructions (CCSS: G-CO).
- d. Express Geometric Properties with Equations (CCSS: G-GPE).
- e. Use coordinates to prove simple geometric theorems algebraically (CCSS: G-GPE).
- f. Explain volume formulas and use them to solve problems (CCSS: G-GMD).
- g. Visualize relationships between two-dimensional and three-dimensional objects (CCSS: G-GMD).
- h. Understand similarity in terms of similarity transformations (CCSS: G-SRT).
- i. Prove theorems involving similarity (CCSS: G-SRT).



Elementary School

- h. Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines (CCSS: 4.G.).
- i. Classify and identify two-dimensional figures according to attributes of line relationships or angle size (CCSS: 4.G.2).
- j. Identify a line of symmetry for a two-dimensional figure (CCSS: G.3).
- k. Graph points on the coordinate plane to solve real world and mathematical problems (CCSS: 5.G).
- l. Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation (CCSS: 5.G.2).
- m. Classify two-dimensional figures into categories based on their properties (CCSS: 5.G).
- n. Find volume of rectangular prisms using a variety of methods and use these techniques to solve real world and mathematical problems (CCSS: 5.MD.5a).

Middle School

- h. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates (CCSS: 8.G.3).
- i. Demonstrate that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations (CCSS: 8.G.2).
- j. Given two congruent figures, describe a sequence of transformations that exhibits the congruence between them (CCSS: 8.G.2).
- k. Demonstrate that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations (CCSS: 8.G.4).
- l. Given two similar two-dimensional figures, describe a sequence of transformations that exhibits the similarity between them (CCSS: 8.G.4).
- m. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles (CCSS: 8.G.5).

High School

- j. Define trigonometric ratios and solve problems involving right triangles (CCSS: G-SRT).
- k. Prove and apply trigonometric identities (CCSS: F-TF).
- l. Understand and apply theorems about circles (CCSS: G-C).
- m. Find arc lengths and areas of sectors of circles (CCSS: G-C).
- n. Apply geometric concepts in modeling situations (CCSS: G-MG).

