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

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).

Middle School

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).

High School

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	Middle School	High 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).		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

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).

Middle School

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).

High School

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

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).

Middle School

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).

High School

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	Middle School	High 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 (1/2, 1/4, 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 (1/2, 1/4, 1/8) (CCSS: 5.MD.2).	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).	

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	Middle School	High School
h. Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines (CCSS: 4.G.).	h. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates (CCSS: 8.G.3).	j. Define trigonometric ratios and solve problems involving right triangles (CCSS: G-SRT).
i. Classify and identify two-dimensional figures according to attributes of line relationships or angle size (CCSS: 4.G.2).	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).	k. Prove and apply trigonometric identities (CCSS: F-TF).
j. Identify a line of symmetry for a two-dimensional figure (CCSS: G.3).	j. Given two congruent figures, describe a sequence of transformations that exhibits the congruence between them (CCSS: 8.G.2).	l. Understand and apply theorems about circles (CCSS: G-C).
k. Graph points on the coordinate plane to solve real world and mathematical problems (CCSS: 5.G).	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).	m. Find arc lengths and areas of sectors of circles (CCSS: G-C).
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).	l. Given two similar two-dimensional figures, describe a sequence of transformations that exhibits the similarity between them (CCSS: 8.G.4).	n. Apply geometric concepts in modeling situations (CCSS: G-MG).
m. Classify two-dimensional figures into categories based on their properties (CCSS: 5.G).	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).	
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).		