Colorado's StandardS

CSAP Mathematics Assessment Framework

Grade 9

ASSESSMENT FRAMEWORK– *defines what will be assessed on the State's paper and pencil, standardized, timed assessment (CSAP). This document is organized as follows:*

Standard	*Indicates the broad knowledge and skills that all students should be acquiring in Colorado schools at grade level indicated. Each standard is assessed every year.*	
Benchmark	*Tactical description of the knowledge and skills students should acquire within each grade level range (i.e., K-4, 5-8, or 9-12).*	
Assessment Objectives	a	*Specific knowledge and skills measured by CSAP for each grade level assessed. Assessment Objectives are assessed on a cyclical basis.*

Note*: The appearance of an * behind a word or phrase indicates it appears in the glossary of the Colorado Model Content Standards for Mathematics.*

Standard 1	Students develop number sense* and use numbers and number relationships in problem-solving situations* and communicate the reasoning used in solving these problems.	
Benchmark 1	Demonstrate meanings for real numbers*, absolute value*, and scientific notation* using physical materials and technology in problem-solving situations*.	
Assessment Objectives	a	Compare and order sets of rational numbers* and common irrational numbers* ($\sqrt{2}$, $\sqrt{5}$, and π.).
	b	Recognize and use equivalent representations of rational numbers* and common irrational numbers* ($\sqrt{2}$, $\sqrt{5}$, and π.), including scientific notation*.
	c	Use very large and very small numbers in real life situations to solve problems (scientific notation*, powers).
Benchmark 2	Develop, test, and explain conjectures* about the properties of number systems and sets of numbers.	
Assessment Objectives	a	Verify and apply the properties of the operation "to the power of" (for example, 23 = 8, 22 = 4, 21= 2, 20 = ___, 2-1 = ___2-2 = ___).
Benchmark 3	Use number sense* to estimate and justify the reasonableness of solutions to problems involving real numbers*.	
Assessment Objectives	a	Use number sense* to estimate and justify the reasonableness of solutions to problems involving rational numbers* and common irrational numbers* (for example, circumference, area of a circle, and Pythagorean Theorem).

Standard 2	Students use algebraic methods* to explore, model*, and describe patterns* and functions* involving numbers, shapes, data, and graphs in problem-solving situations* and communicate the reasoning used in solving these problems.	
Benchmark 1	Model* real world phenomena (for example, distance-versus-time relationships, compound interest, amortization tables, mortality rates) using functions*, equations, inequalities, and matrices*.	
Assessment Objectives	a	Model* real world phenomena involving linear and non-linear relationships using multiple representations of rules that can take the form of recursive processes, functions*, equations, or inequalities.
Benchmark 2	Represent functional relationships using written explanations, tables, equations, and graphs and describe the connections among these representations.	
Assessment Objectives	a	Represent functional relationships using written explanations, tables, equations, and graphs, and describe the connections among these representations.
	b	Convert from one functional representation to another.
	c	Interpret a graphical representation of a real-world situation.
Benchmark 3	Solve problems involving functional relationships using graphing calculators and/or computers as well as appropriate paper-and-pencil techniques.	
Assessment Objectives	a	Solve problems involving functions* and relations using calculators, graphs, tables, and algebraic methods*.
	b	Solve simple systems of equations using algebraic, graphical or numeric methods.
	c	Solve equations with more than one variable* for a given variable* (for example, solve for p in 1= prt or for r in $C=2\pi r$).

Benchmark 4	Analyze and explain the behaviors, transformations*, and general properties of types of equations and functions* (for example, linear*, quadratic*, exponential*).	
Assessment Objectives	a	Identify and interpret x- and y- intercepts in the context of a problem.
	b	Using a graph, identify the maximum and minimum value within a given domain.
	c	Analyze the effects of change in the leading coefficient and/or the vertical translation* (for example, given $y = kx + c$ and $y = kx^2 + c$, how do changes in k and/or c affect the graphs?
Benchmark 5	Interpret algebraic equations and inequalities geometrically and describe geometric relationships algebraically.	
Assessment Objectives	a	Graph solutions to equations and inequalities in one-and two-dimensions and determine solutions.
	b	Express the perimeter, area and volume* relationships of geometric figures algebraically.

Standard 3	Students use data collection and analysis, statistics*, and probability* in problem-solving situations* and communicate the reasoning used in solving these problems.	
Benchmark 1	Design and conduct a statistical experiment to study a problem, and interpret and communicate the results using the appropriate technology (for example, graphing calculators, computer software).	
Assessment Objectives	a	Identify factors which may have affected the outcome of a survey (for example, biased questions or collection methods).
	b	Using large populations, formulate hypothesis, draw conclusions, and make convincing arguments based on data analysis.
	c	Select and use an appropriate display to represent and describe a set of data (for example, scatter plot, line graph and histogram).
Benchmark 2	Analyze statistical claims for erroneous conclusions or distortions.	
Assessment Objectives	a	Analyze a graph, table, or summary for misleading characteristics.
	b	Recognize the misuse of statistical data in written arguments.
	c	Describe how data can be interpreted in more than one way or be used to support more than one position in a debate.
Benchmark 3	Fit curves to scatter plots* using informal methods or appropriate technology to determine the strength of the relationship between two data sets and to make predictions.	
Assessment Objectives	a	Fit curves to scatter plots* using informal methods or appropriate technology to make predictions about the data.
	b	Fit curves to scatter plots* using informal methods or appropriate technology to determine the type (positive, negative, or non-existent) of relationship between two data sets.

Benchmark 4	Draw conclusions about distributions of data based on analysis of statistical summaries (for example, the combination of mean and standard deviation, and differences between the mean and median).	
Assessment Objectives	a	Determine, analyze, and use measure of central tendency* (such as mean, median, and mode) and measures of variability* (such as range and quartiles) in problem-solving situations*.
	b	Use averages (including averages per trial, expected value) to draw conclusions about distributions of data (for example, if there are 10 people with one five dollar bill and one dollar bill in their wallets and they each randomly place one of the bills in a donation box, what will be the average amount of money donated per person?).
Benchmark 5	Use experimental and theoretical probability* to represent and solve problems involving uncertainty (for example, the chance of playing professional sports if a student is a successful high school athlete).	
Assessment Objectives	a	Determine the probability* of an identified event using the sample space.
	b	Make predictions using theoretical probability* in real-world problems*.
	c	Use a model* (list, tree diagram, area model) to determine theoretical probabilities* to solve problems involving uncertainty.
Benchmark 6	Solve real-world problems* with informal use of combinations* and permutations* (for example, determining the number of possible meals at a restaurant featuring a given number of side dishes).	
Assessment Objectives	a	Solve real-world problems* with informal use of combinations* and permutations* (for example, determining the number of possible meals at a restaurant featuring a given number of side dishes).

Standard 4	Students use geometric concepts, properties, and relationships in problem-solving situations* and communicate the reasoning used in solving these problems.	
Benchmark 1	Find and analyze relationships among geometric figures using transformations* (for example, reflections*, translations*, rotations*, dilations*) in coordinate systems*.	
Assessment Objectives	a	Find and analyze relationships among geometric figures using transformation* (for example, reflections*, translation*, rotations*, dilation*) in coordinate systems*.
Benchmark 2	Derive and use methods to measure perimeter, area, and volume* of regular and irregular geometric figures.	
Assessment Objectives	a	Solve problems involving perimeter, area, and volume* of regular and irregular geometric figures.
	b	Use the Pythagorean theorem to solve real-world problems*.
Benchmark 3	Make and test conjectures* about geometric shapes and their properties, incorporating technology where appropriate.	
Assessment Objectives	a	Make and test conjectures* about geometric shapes and their properties (for example, parallelism, perpendicularity, similarity*, congruence*, symmetry*).
	b	Use coordinate geometry* to solve problems involving shapes and their properties.
Benchmark 4	Use trigonometric ratios* in problem-solving situations* (for example, finding the height of a building from a given point, if the distance to the building and the angle of elevation are known).	
Assessment Objectives	*No objectives assessed at this level.*	

Standard 5	Students use a variety of tools and techniques to measure, apply the results in problem-solving situations*, and communicate the reasoning used in solving these problems.	
Benchmark 1	Measure quantities indirectly using techniques of algebra*, geometry*, or trigonometry*.	
Assessment Objectives	a	Use appropriate measurements to solve problems indirectly (for example, find the height of a flagpole using similar triangles.
	b	Use measurement to solve real-world problems* involving rate of change (for example, distance traveled using rate and time).
	c	Describe how changing one attribute of a shape affects its angle measure, perimeter, circumference, area, surface area and volume*.
Benchmark 2	Select and use appropriate tools and techniques to measure quantities in order to achieve specified degrees of precision, accuracy and error (or tolerance) of measurements.	
Assessment Objectives	a	Select and use appropriate tools and techniques to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurements.
Benchmark 3	Determine the degree of accuracy of a measurement (for example, by understanding and using significant digits).	
Assessment Objectives	*No objectives assessed at this level.*	

Standard 6	Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic*, paper-and-pencil, calculators, and computers, in problem-solving situations* and communicate the reasoning used in solving these problems.	
Benchmark 1	Use ratios, proportions, and percents in problem-solving situations*.	
Assessment Objectives	a	Use ratios, proportions, and percents in problem-solving situations* that involve rational numbers*.
	b	Convert from one set of units to another using proportions (for example, feet/minute to miles/hour).
	c	Apply direct variation to problem-solving situations*.
Benchmark 2	Select and use appropriate algorithms* for computing with real numbers* in problem-solving situations* and determine whether the results are reasonable.	
Assessment Objectives	a	Apply appropriate computational methods to solve multi-step problems involving rational numbers*.
Benchmark 3	Describe the limitations of estimation and assessing the amount of error resulting from estimation within acceptable tolerance limits.	
Assessment Objectives	*No objectives assessed at this level.*	