Colorado Model Content Standards

Mathematics

Adopted 6-8-95
Amended 9-15-05

COLORADO STATE BOARD OF EDUCATION

PAMELA JO SUCKLA (R), Chairman Slickrock, Colorado	3rd Congressional District
JARED POLIS (D), Vice-Chairman Boulder, Colorado	Member-at-Large
RANDY DEHOFF(R), Littleton, Colorado	6th Congressional District
EVIE HUDAK (D) Arvada, Colorado	2nd Congressional District
PEGGY LITTLETON (R) Colorado Springs, Colorado	5th Congressional District
KAREN MIDDLETON (D) Aurora, Colorado	7th Congressional District
D. RICO MUNN (D) Denver, Colorado	1st Congressional District
CLAIR ORR (R) Kersey, Colorado	4th Congressional District

Colorado Model Content Standards

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.

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.

Standard 3

Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

Standard 4

Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

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.

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.

Colorado Model Content Standards for Mathematics

HISTORY

The Colorado Model Content Standards for Mathematics were developed by Colorado math teachers and adopted by the Colorado State Board of Education on June 8, 1995. Three questions guided the development of these standards:

- What is mathematics?
- What does it mean to know, use, and do mathematics?
- What mathematics should every Colorado student learn?

The Colorado Model Content Standards for Mathematics were reviewed by the Colorado Department of Education during the 2004-2005 school year concluding with the report titled *The State's Prime Numbers*. No changes to the Colorado Model Content Standards for Mathematics were recommended.

The Colorado State Board of Education reaffirmed the Colorado Model Content Standards for Mathematics on September 14, 2005 and amended the Benchmarks to Standard 6. Changes to the benchmarks are noted in bold/capitalized type below.

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.	
Grades 3 - 4	**Benchmark 3**	Demonstrate u~~nderstanding of and proficienc~~y **FLUENCY** with basic addition, subtraction, multiplication, and division facts without the use of a calculator.
	Benchmark 5	Select and use appropriate ~~methods~~ **ALGORITHMS** for computing with whole numbers in problem-solving situations ~~from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods.~~
Grades 5 - 8	**Benchmark 4**	Select and use appropriate ~~methods~~ **ALGORITHMS** for computing with commonly used fractions and decimals, percents, and integers in problem-solving situations ~~from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods~~ and determining whether the results are reasonable.
Grades 9 - 10	**Benchmark 2**	Select and use appropriate ~~methods~~ **ALGORITHMS** for computing with real numbers in problem-solving situations ~~from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods~~ and determining whether the results are reasonable.

HISTORY

Standards and Benchmarks

The state of Colorado's education system is operated **locally**. There are **state** standards and the commensurate benchmarks and assessment frameworks which articulate more specific areas of focus expected at grade levels. The annual state assessment is administered grades 3-10 in reading, writing, and math. In 2006, the state assessment will include 5th, 8th and 10th grade science. CSAP Assessment Frameworks exist for these specific areas.

The Colorado Model Content Standards for Mathematics indicate the broad knowledge and skills that all students should acquire in Colorado schools. In this document, standards are articulated into benchmarks that include tactical descriptions of the knowledge and skills students should acquire within each grade level range.

CSAP and Assessment Objectives

The Assessment Frameworks for the Colorado Student Assessment Program (CSAP) **outlines what is assessed on the state paper and pencil, standardized, and timed assessment**. Assessment objectives delineate the specific knowledge and skills measured by CSAP for each grade level and content area assessed. The CSAP Assessment Frameworks are available on the Colorado Department of Education website (http://www.cde.state.co.us).

Curriculum and Instructional Objectives

Colorado has no state curriculum. Local school districts in Colorado are responsible for determining the necessary curriculum and instructional scope and sequence to ensure that their students meet state standards.

The Colorado Department of Education provides a “resource bank” of curriculum, instruction and assessment tools acquired from Colorado schools that are achieving positive results in mathematics to be used by school districts at their discretion. The Colorado Math webpage provides: resources to address the needs of students performing at grade level, as well as struggling and advanced learners; model programs of instruction and assessment collected from school districts and organizations throughout the state and nation that have proven to be successful; and many resources that may assist Colorado’s mathematics educators in enhancing their teaching methods and improving student performance outcomes (http://www.cde.state.co.us/coloradomath/index.htm).

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.

RATIONALE

Numbers play a vital role in our daily lives. It is essential to know both the symbols for and the meanings of various kinds of numbers; whole numbers, fractions, decimals, percents, roots, exponents, logarithms, and scientific notation. Number sense is the capacity a child has to be flexible and mentally agile with numbers; to have a working knowledge for what numbers mean and an ability to perform mental mathematics.

Number sense enables a student to look at the world through the eyes of math and make comparisons and build new information (Case 1998). Developing number sense strengthens students' ability to acquire basic facts, to solve problems, and to determine the reasonableness of results.

BENCHMARKS

GRADES K-4

1. demonstrate meanings for whole numbers, and commonly-used fractions and decimals *(for example,* 1/3, 3/4, *0.5, 0.75),* and represent equivalent forms of the same number through the use of physical models, drawings, calculators, and computers;
2. read and write whole numbers and know place-value concepts and numeration through their relationships to counting, ordering, and grouping;
3. use numbers to count, to measure, to label, and to indicate location;
4. develop, test, and explain conjectures about properties of whole numbers, and commonly-used fractions and decimals *(for example,* 1/3, 3/4, *0.5, 0.75);* and
5. use number sense to estimate and justify the reasonableness of solutions to problems involving whole numbers, and commonly-used fractions and decimals *(for example,* 1/3, 3/4, *0.5, 0.75).*

GRADES 5-8

1. demonstrate meanings for integers, rational numbers, percents, exponents, square roots, and pi (π) use physical materials and technology in problem-solving situations;
2. read, write, and order integers, rational numbers, and common irrational numbers such as √2, √5, and π ;
3. apply number theory concepts (for example, primes, factors, multiples) to represent numbers in various ways;
4. use the relationships among fractions, decimals, and percents, include the concepts of ratio and proportion, in problem-solving situations;
5. develop, test, and explain conjectures about properties of integers and rational numbers; and
6. use number sense to estimate and justify the reasonableness of solutions to problems involving integers, rational numbers, and common irrational numbers such as √ 2, √ 5, and π .

GRADES 9-12

1. demonstrate meanings for real numbers, absolute value, and scientific notation using physical materials and technology in problem-solving situations;
2. develop, test, and explain conjectures about properties of number systems and sets of numbers; and
3. use number sense to estimate and justify the reasonableness of solutions to problems involving real numbers.

For students continuing their mathematics education beyond these standards, what they will know and are able to do may include:

- investigate limiting processes by examining infinite sequences and series; and
- explain relationships among real numbers, complex numbers, and vectors using models.

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.

RATIONALE

The study of patterns, functions, and helps learners to recognize and generalize patterns; identify and clarify functional relationships; and represent and manipulate these relationships verbally, numerically, symbolically, and graphically. Symbolic representation, including the many interpretations of the concept of a variable, is important but only one of many ways to represent patterns and functions. Students who are adept at identifying and classifying patterns and functional relationships are better able to use these relationships in real situations, both in and out of school.

Because the understandings developed through this standard are critical to success in mathematics and to the appropriate use of quantitative reasoning in other disciplines, students should explore and use the ideas of functions, patterns, and algebra from kindergarten through 12th grade.

BENCHMARKS

GRADES K-4

1. reproduce, extend, create, and describe patterns and sequences using a variety of materials (for example, beans, toothpicks, pattern blocks, calculators, unifix cubes, colored tiles);
2. describe patterns and other relationships using tables, graphs, and open sentences;
3. recognize when a pattern exists and use that information to solve a problem; and
4. observe and explain how a change in one quantity can produce a change in another (for example, the relationship between the number of bicycles and the numbers of wheels).

GRADES 5-8

1. represent, describe, and analyze patterns and relationships using tables, graphs, verbal rules, and standard algebraic notation;
2. describe patterns using variables, expressions, equations, and inequalities in problem-solving situations;
3. analyze functional relationships to explain how a change in one quantity results in a change in another (for example, how the area of a circle changes as the radius increases, or how a person's height changes over time);
4. distinguish between linear and nonlinear functions through informal investigations; and
5. solve simple linear equations in problem-solving situations using a variety of methods (informal, formal, graphical) and a variety of tools (physical materials, calculators, computers).

GRADES 9-12

1. model real-world phenomena (for example, distance-versus-time relationships, compound interest, amortization tables, mortality rates) using functions, equations, inequalities, and matrices;
2. represent functional relationships using written explanations, tables, equations, and graphs, and describing the connections among these representations;
3. solve problems involving functional relationships using graphing calculators and/or computers as well as appropriate paper-and-pencil techniques;
4. analyze and explain the behaviors, transformations, and general properties of types of equations and functions (for example, linear, quadratic, exponential); and
5. interpret algebraic equations and inequalities geometrically and describing geometric relationships algebraically.

For students continuing their mathematics education beyond these standards, what they know and are able to do may include:

- use rational, polynomial, trigonometric, and inverse functions to model real-world phenomena;
- represent and solve problems using linear programming and difference equations;
- solve systems of linear equations using matrices and vectors;
- describe the concept of continuity of a function;
- perform operations on and between functions; and
- make the connections between trigonometric functions and polar coordinates, complex numbers, and series.

Standard 3:
Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

RATIONALE

Statistics are used to understand how information is processed and translated into usable knowledge. Through the study of statistics, students learn to collect, organize, and summarize data. In addition, statistics requires students to use data to ask and answer questions. Students also need to know how to analyze data and make decisions based on their interpretations. Probability extends statistical analysis to predicting the likelihood of future events and outcomes. Students learn probability — the study of chance — so that numerical data can be used to predict future events as well as record the past.

BENCHMARKS

GRADES K-4

1. construct, read, and interpret displays of data including tables, charts, pictographs, and bar graphs;
2. interpret data using the concepts of largest, smallest, most often, and middle;
3. generate, analyze, and make predictions based on data obtained from surveys and chance devices; and
4. solve problems using various strategies for making combinations (for example, determining the number of different outfits that can be made using two blouses and three skirts).

GRADES 5-8

1. read and construct displays of data using appropriate techniques (for example, line graphs, circle graphs, scatter plots, box plots, stem-and-leaf plots) and appropriate technology;
2. display and use measures of central tendency, such as mean, median, and mode, and measures of variability, such as range and quartiles;
3. evaluate arguments that are based on statistical claims;
4. formulate hypotheses, draw conclusions, and make convincing arguments based on data analysis;
5. determine probabilities through experiments or simulations;
6. make predictions and compare results using both experimental and theoretical probability drawn from real-world problems; and
7. use counting strategies to determine all the possible outcomes from an experiment (for example, the number of ways students can line up to have their picture taken).

GRADES 9-12

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);
2. analyze statistical claims for erroneous conclusions or distortions;
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;
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);
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); and
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).

For students continuing their mathematics education beyond these standards, what they know and are able to do may include

- create and interpret discrete and continuous probability distributions, and understand their application to real-world situations (for example, insurance);
- test hypotheses using appropriate statistics;
- explore the effect of sample size on the results of statistical surveys using experiments and simulations; and
- solve real-world problems with formal use of combinations and permutations.

Standard 4:
Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

RATIONALE

The process of recording and analyzing shapes and their properties became the branch of mathematics called geometry. Students who understand the concepts and language of geometry are better prepared to learn number and measurement ideas as well as other advanced mathematical topics. Students' spatial capabilities frequently exceed their numerical skills and tapping these strengths can foster an interest in mathematics and improve number understandings and skills.

The goals of studying geometry include: understanding of shapes and of two- and three-dimensional relationships, how objects are located in a plane or in space, symmetry and rotation, and visualization from different perspectives.

Encouraging students to make and test hypotheses about geometric concepts can begin in the primary grades.

BENCHMARKS

GRADES K-4

1. recognize shapes and their relationships (for example, symmetry, congruence) using a variety of materials (for example, pasta, boxes, pattern blocks);
2. identify, describe, draw, compare classify, and build physical models of geometric figures;
3. relate geometric ideas to measurement and number sense;
4. solve problems using geometric relationships and spatial reasoning (for example, using rectangular coordinates to locate objects, constructing models of three-dimensional objects); and
5. recognize geometry in their world (for example, in art and in nature).

GRADES 5-8

1. construct two- and three-dimensional models using a variety of materials and tools;
2. describe, analyze, and reason informally about the properties (for example, parallelism, perpendicularity, congruence) of two- and three-dimensional figures ;
3. apply the concepts of ratio, proportion, and similarity in problem-solving situations;
4. solve problems using coordinate geometry;
5. solve problems involving perimeter and area in two dimensions, and involving surface area and volume in three dimensions; and
6. transform geometric figures using reflections, translations, and rotations to explore congruence.

GRADES 9-12

1. find and analyze relationships among geometric figures using transformations (for example, reflections, translations, rotations, dilations) in coordinate systems;
2. derive and use methods to measure perimeter, area, and volume of regular and irregular geometric figures;
3. make and test conjectures about geometric shapes and their properties, incorporating technology where appropriate; and
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).

For students continuing their mathematics education beyond these standards, what they know and are able to do may include:

- deduce properties of figures using vectors;
- apply transformations, coordinates, and vectors in problem-solving situations; and
- describe, analyze, and extend patterns produced by processes of geometric change (for example, limits and fractals).

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.

RATIONALE

Using agreed-upon units, such as inches, kilograms, heartbeats, paces, or degrees, we quantify the world in which we live. Measurement is one way to make numbers meaningful to students. Naturally, measurement is closely allied with geometry (for example, through angular, linear, area, and volume measurements), but measurement involves more than using a ruler and a protractor. Measuring diverse quantities involves making connections within mathematics and across the curriculum.

Students need to identify attributes they wish to measure and select the appropriate tools. Further, comparisons of attributes, estimation and approximation allow students to apply measurement to solving problems.

BENCHMARKS

GRADES K-4

1. know, use, describe, and estimate measures of length, perimeter, capacity, weight, time, and temperature;
2. compare and order objects according to measurable attributes (for example, longest to shortest, lightest to heaviest);
3. demonstrate the process of measuring and explain the concepts related to units of measurement;
4. use the approximate measures of familiar objects (for example, the width of your finger, the temperature of a room, the weight of a gallon of milk) to develop a sense of measurement; and
5. select and use appropriate standard and non-standard units of measurement in problem-solving situations.

GRADES 5-8

1. estimate, use, and describe measures of distance, perimeter, area, volume, capacity, weight, mass, and angle comparison;
2. estimate, make, and use direct and indirect measurements to describe and make comparisons;
3. read and interpret various scales including those based on number lines, graphs, and maps;
4. develop and use formulas and procedures to solve problems involving measurement;
5. describe how a change in an object's linear dimensions affects its perimeter, area, and volume; and
6. select and use appropriate units and tools to measure to the degree of accuracy required in a particular problem-solving situation.

GRADES 9-12

1. measure quantities indirectly using techniques of algebra, geometry, or trigonometry;
2. select and use appropriate techniques and tools to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurements; and
3. determine the degree of accuracy of a measurement (for example, by understanding and using significant digits).
4. demonstrate the meanings of area under a curve and length of an arc.

For students continuing their mathematics education beyond these standards, what they know and are able to do may include:

- demonstrate the meanings of area under a curve and length of an arc.

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.

RATIONALE

Computation is an indispensable part of mathematics and our daily lives. We use it to balance our checkbooks, figure our taxes, and make business decisions. The basic facts of addition, subtraction, multiplication, and division are similarly indispensable. Today's students must be able to effectively use a variety of computational tools and techniques including estimation, mental arithmetic, paper-and-pencil, calculators, and computers. Estimation and mental arithmetic serve a practical function in our daily lives, and help students develop meaning for numbers and understanding of number relationships.

Computational skill is related to "operation sense". Students build operation sense by modeling their understanding of number operations and their properties, by describing how number operations are related to one another, and by seeing how the use of a particular operation changes the value of the numbers involved.

BENCHMARKS

GRADES K-4

1. demonstrate conceptual meanings for the four basic arithmetic operations of addition, subtraction, multiplication, and division;
2. add and subtract commonly-used fractions and decimals using physical models (for example, 1/3, 3/4, 0.5, 0.75);
3. demonstrate fluency with basic addition, subtraction, multiplication, and division facts without the use of a calculator;
4. construct, use, and explain procedures to compute and estimate with whole numbers; and
5. select and use appropriate algorithms for computing with whole numbers in problem-solving situations.

GRADES 5-8

1. use models to explain how ratios, proportions, and percents can be used to solve real-world problems;
2. construct, use, and explain procedures to compute and estimate with whole numbers, fractions, decimals, and integers;
3. develop, apply, and explain a variety of different estimation strategies in problem-solving situations, and explain why an estimate may be acceptable in place of an exact answer; and
4. select and use appropriate algorithms for computing with commonly used fractions and decimals, percents, and integers in problem-solving and determine whether the results are reasonable.

GRADES 9-12

1. use ratios, proportions, and percents in problem-solving situations;
2. select and use appropriate algorithms for computing with real numbers in problem-solving situations and determine whether the results are reasonable; and
3. describe the limitations of estimation, and assess the amount of error resulting from estimation within acceptable limits.

For students continuing their mathematics education beyond these standards, what they know and are able to do may include:

- analyze and solve optimization problems;
- analyze different algorithms (for example, sorting) for efficiency;
- analyze and use critical path algorithms (for example, determining in which order to perform a set of tasks in a large project); and
- investigate problem situations that arise in connection with computer validation and the application of algorithms.

Colorado Model Content Standards for Mathematics

GLOSSARY

Absolute value — A number's distance from zero on a number line. The absolute value of -6, shown as |-6|, is 6, and the absolute value of 6, shown as |6|, is 6.

Algebra — The branch of mathematics that is the generalization of the ideas of arithmetic.

Algebraic methods — The use of symbols to represent numbers and signs to represent their relationships.

Algorithm — A step-by-step procedure.

Basic facts — Addition facts through 10 (0 + 0, 1 + 0, ... , 10 + 10), subtraction facts which are the inverses of the addition facts (20 - 10, ... , 1 - 0, 0 - 0), multiplication facts (1 x 1, 1 x 2, ... , 10 x 10), and division facts which are the inverses of the multiplication facts (1 ÷ 1, 2 ÷ 1, ... , 100 ÷ 10).

Benchmark - Tactical description of the knowledge and skills students should acquire within each grade level range (i.e., K-4, 5-8, 9-12).

Box plot (also called a box-and-whiskers plot) — A graphic method for showing a summary of data using median, quartiles, and extremes of data. A box plot makes it easy to see where the data are spread out and where they are concentrated. The longer the box, the more the data are spread out.

Capacity — The volume of a container given in units of liquid measure. The standard units of capacity are the liter and the gallon.

Combinations — Subsets chosen from a larger set of objects in which the order of the items doesn't matter (for example, the number of different committees of three that can be chosen from a group of twelve members).

Complex numbers — Numbers that can be written in the form a + bi, for example, -2.7 + 8.9i, where a and b are real numbers and $i = \sqrt{-1}$.

Congruent or the concept of congruence — Two figures are said to be congruent if they are the same size and shape.

Coordinate geometry — Geometry based on the coordinate system.

Coordinate system (also called rectangular coordinate system) — A method of locating points in the plane or in space by means of numbers. A point in a plane can be located by its distances from both a horizontal and a vertical line called the axes. The horizontal line is called the x-axis. The vertical line is called the y-axis. The pairs of numbers are called ordered pairs. The first number, called the x-coordinate, designates the distance along the horizontal axis. The second number, called the y-coordinate, designates the distance along the vertical axis. The point at which the two axes intersect has the coordinates (0,0) and is called the origin.

Conjecture — A statement that is to be shown true or false. A conjecture is usually developed by examining several specific situations.

Dilation — A transformation that either enlarges or reduces a geometric figure proportionally.

Exponent — A number used to tell how many times a number or variable is used as a factor. For example, 5^3 indicates that 5 is a factor 3 times, that is, 5 x 5 x 5. The value of 5^3 is 125.

Fractal — A geometric shape that is self-similar and has fractional dimensions. Natural phenomena such as the formation of snowflakes, clouds, mountain ranges, and landscapes involve patterns. Their pictorial representations are fractals and are usually generated by computers.

Function — A relationship between two sets of numbers (or other mathematical objects). Functions can be used to understand how one quantity varies in relation to another, for example, the relationship between the number of cars and the number of tires.

Geometry — A branch of mathematics that deals with the measurement, properties, and relationships of points, lines, angles, and two- and three-dimensional figures.

Integers — The set of numbers consisting of the counting numbers (that is, 1, 2, 3, 4, 5, ...), their opposites (that is, negative numbers, -1, -2, -3, ...), and zero.

Irrational numbers — The set of numbers which cannot be represented as fractions. Examples are $\sqrt{2}$, $3\sqrt{29}$, e , and π .

Linear function — A function that has a constant rate of change.

Logarithm — Alternate way to express an exponent. For example, $\log_2 8=3$ is equivalent to $2^3=8$.

Matrix (pl. matrices) — A rectangular array of numbers (or letters) arranged in rows and columns.

Measures of central tendency — Numbers which in some sense communicate the "center" or "middle" of a set of data. The mean, median, and mode of statistical data are all measures of central tendency.

Measures of variability — Numbers which describe how spread out a set of data is, for example, range and quartile.

Mental arithmetic — Performing computations in one's head without writing anything down. Mental arithmetic strategies include finding pairs that add up to 10 or 100, doubling, and halving.

Model — To make or construct a physical or mathematical representation.

Number sense — An understanding of number. This would include number meanings, number relationships, number size, and the relative effect of operations on numbers.

Open sentence — a statement that contains at least one unknown. It becomes true or false when a quantity is substituted for the unknown. For example, 3 + x = 5.

Optimization problems — Real-world problems in which, given a number of constraints, the best solution is determined. For example, finding the best number of nonstop flights from Denver to San Francisco given the cost of fuel, number of passengers, number of crew required, etc.

Patterns — Regularities in situations such as those in nature, events, shapes, designs, and sets of numbers (for example, spirals on pineapples, geometric designs in quilts, the number sequence 3,6,9,12,...).

GLOSSARY

Permutations — All possible arrangements of a given number of items in which the order of the items makes a difference. For example, the different ways that a set of four books can be placed on a shelf.

Prime number — A counting number that can only be evenly divided by two different numbers, 1 and the number itself. The first ten prime numbers are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29.

Probability — The likeliness or chance of an event occurring.

Problem solving — Refer to the introduction (page Mathematics - 4).

Problem-solving situations — Contexts in which problems are presented that apply mathematics to practical situations in the real world, or problems that arise from the investigation of mathematical ideas.

Quadratic function — A function that has an equation of the form y = ax2+bx+c, where a ≠ 0. These functions are used to describe the flight of a ball and the stream of water from a fountain.

Rational numbers — A number that can be expressed in the form a/b, where a and b are integers and b ≠ 0, for example, 3/4, 2/1, or 11/3. Every integer is a rational number, since it can be expressed in the form a/b, for example, 5 = 5/1. Rational numbers may be expressed as fractional or decimal numbers, for example, 3/4 or .75. Finite decimals, repeating decimals, and mixed numbers all represent rational numbers.

Real numbers — All rational and irrational numbers.

Real-world problems (also called real-world experiences) — Quantitative problems that arise from a wide variety of human experiences which may take into consideration contributions from various cultures (for example, Mayan or American pioneers), problems from abstract mathematics, and applications to various careers (for example, making change or calculating the sale price of an item).

Reflection (also called a flip) — A transformation which produces the mirror image of a geometric figure.

Rotation (also called a turn) — A transformation which turns a figure about a point a given number of degrees.

Scatter plots (also called scatter diagram or scattergram) — A graph of the points representing a collection of data.

Scientific notation — A short-hand way of writing very large or very small numbers. A number expressed in scientific notation is expressed as a decimal number between 1 and 10 multiplied by a power of 10, for example, 4.53 X 103 = 4350.

Similarity — Objects or figures that are the same shape are similar figures. They are not necessarily the same size. If two figures are similar, we say that there is similarity between the figures.

Spatial visualization (also called spatial reasoning) — A type of reasoning in which a person can draw upon one's understanding of relationships in space, the three-dimensional world. For example, spatial reasoning is demonstrated by one's ability to build a three-dimensional model of a building shown in a picture. A person who uses spatial visualization is said to have spatial sense.

Square root — That number which when multiplied by itself produces the given number. For example, 5 is the square root of 25, because 5 x 5 = 25.

Statistics — The branch of mathematics which is the study of the methods of collecting and analyzing data. The data are collected on samples from various populations of people, animals, or products. Statistics are used in many fields, such as biology, education, physics, psychology, and sociology.

Stem-and-leaf plot — A frequency distribution made by arranging data. It is one way of visually portraying data that is frequently used in newspapers and magazines because it provides an efficient way of showing information as well as comparing different sets of data.

Symmetry — The correspondence in size, form, and arrangement of parts on opposite sides of a plane, line, or point. For example, a figure that has line symmetry has two halves which coincide if folded along its line of symmetry.

Transformation — The process of changing one configuration or expression into another in accordance with a rule. Common geometric transformations include translations, rotations, and reflections.

Translation (also called a slide) — A transformation that moves a geometric figure by sliding. Each of the points of the geometric figure moves the same distance in the same direction.

Trigonometric ratios — The ratios of the lengths of pairs of sides in a right triangle. There are three basic trigonometric ratios used in trigonometry: sine (sin), cosine (cos), and tangent (tan).

Trigonometry — A branch of mathematics that combines arithmetic, algebra, and geometry. Trigonometry is used in surveying, navigation, and various sciences such as physics.

Variable — A quantity that may assume any one of a set of values. In the equation 2x + y = 9, x and y are variables.

Vector — A quantity which has both magnitude and direction. Vectors may be interpreted as physical quantities such as velocity and force.

Volume — The measure of the interior of a three-dimensional figure. A unit for measuring volume is the cubic unit.

Colorado Model Content Standards for Mathematics

Page Index: Mathematics Terms and Topics

Page Index: Mathematics Terms and Topics

Page Index: Mathematics Terms and Topics

Colorado Model Content Standards for Mathematics

Original 1995 Task Force

Fran Berry	Principal Investigator	CONNECT Colorado's Statewide Systemic Initiative
Glenn Bruckhart	Mathematics Teacher	Arapahoe High School / Littleton Public Schools
Annette Cooper	Associate Professor of Mathematics	Fort Lewis College
Ceri Dean	Mathematics/Science Associate	Eisenhower High Plains Consortium for Math & Science
Christine Delaney-Haynes	Mathematics/Science Teacher	Telluride Middle School Telluride Public Schools
Rosanne Fulton	Curriculum Specialist	Boulder Valley Schools
Janet Iona	Mathematics Curriculum Specialist	Adams Twelve Five Star Schools
Bill Juraschek	Associate Professor of Mathematics and Education	University of Colorado at Denver
Jean Klanica	Mathematics Educator	Eaglecrest High School Cherry Creek School District 5
Marge Lindskog	Elementary Teacher and Standards Council Member	Pueblo School District 60
Gale Nash	Professor of Mathematics	Western State College
Mattye Pollard-Cole	Mathematics Senior Consultant	School Effectiveness Unit Colorado Department of Education
Lew Romagnano	Assistant Professor of Mathematical Sciences	Metropolitan State College of Denver
Sherri Stephens-Carter	Mathematics Teacher-On-Special-Assignment	St. Vrain Valley School District
Mary Thurman	Executive Director and District Mathematics Coordinator	Academy School District 20
Diane Weaver	Mathematics Teacher	Morey Middle School Denver Public Schools
Art Wilson	Mathematics Teacher	Abraham Lincoln High School Denver Public Schools

OFFICE OF LEARNING AND RESULTS

Colorado Department of Education
201 East Colfax - Room 508
Denver. CO 80203
Phone 303.866.6852