

Grades 3-5	National Council of Teachers of Mathematics <i>Standards for School Mathematics</i>	Apangea Learning Citation	
Instructional programs from prekindergarten through grade 12 should enable all students to—	In grades 3-5 all students should—	Unit	Thread

Numbers and Operations			
Understand numbers, ways of representing numbers, relationships among numbers, and number systems	• understand the place-value structure of the base-ten number system and be able to represent and compare whole numbers and decimals;	Whole Numbers Decimals	Place Value Decimal Concepts
	• recognize equivalent representations for the same number and generate them by decomposing and composing numbers;	Number Sense Decimals Percentages	Factors and Multiples Fraction and Decimal Equivalents Fraction, Decimal, and Percent Equivalents
	• develop understanding of fractions as parts of unit wholes, as parts of a collection, as locations on number lines, and as divisions of whole numbers;	Fractions	Fraction Concepts Equivalent Fractions Comparing and Ordering Fractions
	• use models, benchmarks, and equivalent forms to judge the size of fractions;	Fractions	Fraction Concepts Equivalent Fractions Comparing and Ordering Fractions
	• recognize and generate equivalent forms of commonly used fractions, decimals, and percents;	Decimals Percentages	Fraction and Decimal Equivalents Fraction, Decimal, and Percent Equivalents
	• explore numbers less than 0 by extending the number line and through familiar applications;	Integers	Integer Concepts Integer Addition and Subtraction
	• describe classes of numbers according to characteristics such as the nature of their factors.	Standard not addressed	Standard not addressed
Understand meanings of operations and how they relate to one another	• understand various meanings of multiplication and division;	Whole Numbers	Whole Number Multiplication and Division Operations with Whole Numbers
	• understand the effects of multiplying and dividing whole numbers;	Whole Numbers	Whole Number Multiplication and Division Operations with Whole Numbers
	• identify and use relationships between operations, such as division as the inverse of multiplication, to solve problems;	Algebraic Problem Solving	Evaluating Expressions - one step Solving one step equations
	• understand and use properties of operations, such as the distributivity of multiplication over addition.	Algebraic Problem Solving	Evaluating Expressions - one step Solving one step equations

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Numbers and Operations (continued)			
Compute fluently and make reasonable estimates	• develop fluency with basic number combinations for multiplication and division and use these combinations to mentally compute related problems, such as 3050;	Whole Numbers	Whole Number Multiplication and Division Operations with Whole Numbers
	• develop fluency in adding, subtracting, multiplying, and dividing whole numbers;	Whole Numbers	Whole Number Addition and Subtraction Whole Number Multiplication and Division Operations with Whole Numbers
	• develop and use strategies to estimate the results of whole-number computations and to judge the reasonableness of such results;	Whole Numbers	Whole Number Addition and Subtraction Whole Number Multiplication and Division Operations with Whole Numbers
	• develop and use strategies to estimate computations involving fractions and decimals in situations relevant to students' experience;	Algebraic Problem Solving	Evaluation Expressions - one step
Compute fluently and make reasonable estimates	• use visual models, benchmarks, and equivalent forms to add and subtract commonly used fractions and decimals;	Fractions	Fraction Concepts Equivalent Fractions Comparing and Ordering Fractions
		Fraction Operations	Adding Fractions Subtracting Fractions
		Decimals	Decimal Concepts Fraction and Decimal Equivalents
• select appropriate methods and tools for computing with whole numbers from among mental computation, estimation, calculators, and paper and pencil according to the context and nature of the computation and use the selected method or tools.	Whole Numbers	Whole Number Addition and Subtraction Whole Number Multiplication and Division Operations with Whole Numbers	
		Embedded throughout the program	

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Algebra			
Understand patterns, relations, and functions	• describe, extend, and make generalizations about geometric and numeric patterns;	Patterns	Patterns Arithmetic Sequences - recursive form
	• represent and analyze patterns and functions, using words, tables, and graphs.	Patterns	Patterns Arithmetic Sequences - recursive form
Represent and analyze mathematical situations and structures using algebraic symbols	• identify such properties as commutativity, associativity, and distributivity and use them to compute with whole numbers;	Whole Numbers Algebraic Problem Solving	Whole Number Addition and Subtraction Whole Number Multiplication and Division Evaluating Expressions with the distributive property Solving equations with the distributive property
	• represent the idea of a variable as an unknown quantity using a letter or a symbol;	Algebraic Problem Solving Embedded throughout the program	Evaluating Expressions - one step
	• express mathematical relationships using equations.	Embedded throughout the program	Embedded throughout the program
Use mathematical models to represent and understand quantitative relationships	• model problem situations with objects and use representations such as graphs, tables, and equations to draw conclusions.	Data Analysis - Displays	Circle Graphs Bar Graphs and Histograms
Analyze change in various contexts	• investigate how a change in one variable relates to a change in a second variable;	Standard not addressed	Standard not addressed
	• identify and describe situations with constant or varying rates of change and compare them.	Standard not addressed	Standard not addressed

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Geometry			
Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships	• identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes;	Perimeter and Area Surface Area Volume	Perimeter and Circumference Parallelograms Triangles Rectangular Solids Rectangular Solids
	• classify two- and three-dimensional shapes according to their properties and develop definitions of classes of shapes such as triangles and pyramids;	Geometric Figures and Their Properties	Classifying Triangles Quadrilaterals
	• investigate, describe, and reason about the results of subdividing, combining, and transforming shapes;	Perimeter and Area	Composite Shapes
	• explore congruence and similarity;	Ratios and Proportions	Similar Figures
Specify locations and describe spatial relationships using coordinate geometry and other representational systems	• describe location and movement using common language and geometric vocabulary;	Geometry in the Coordinate Plane Transformations	Introduction to the Coordinate Plane Plotting Points Translations Reflections Rotations
	• make and use coordinate systems to specify locations and to describe paths;	Geometry in the Coordinate Plane	Introduction to the Coordinate Plane Plotting Points
	• find the distance between points along horizontal and vertical lines of a coordinate system.	Geometry in the Coordinate Plane	Introduction to the Coordinate Plane Plotting Points
Apply transformations and use symmetry to analyze mathematical situations	• predict and describe the results of sliding, flipping, and turning two-dimensional shapes;	Transformations	Translations Reflections Rotations
	• describe a motion or a series of motions that will show that two shapes are congruent;	Transformations	Composition of Transformations
	• identify and describe line and rotational symmetry in two- and three-dimensional shapes and designs.	Transformations	Reflections Rotations

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Geometry (continued)

Use visualization, spatial reasoning, and geometric modeling to solve problems	• build and draw geometric objects;		
	• create and describe mental images of objects, patterns, and paths;	Patterns	Patterns
	• identify and build a three-dimensional object from two-dimensional representations of that object;	Standard not addressed	Standard not addressed
	• identify and draw a two-dimensional representation of a three-dimensional object;	Standard not addressed	Standard not addressed
	• use geometric models to solve problems in other areas of mathematics, such as number and measurement;	Standard not addressed	Standard not addressed
	• recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.	Perimeter and Area Surface Area Volume	Perimeter and Circumference Parallelograms Triangles Rectangular Solids Rectangular Solids

Measurement

Understand measurable attributes of objects and the units, systems, and processes of measurement	• understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute;	Geometric Figures and Their Properties Perimeter and Area Surface Area Volume	Angles Angle Pairs Perimeter and Circumference Parallelograms Triangles Rectangular Solids Rectangular Solids
	• understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems;	Embedded throughout the program	Embedded throughout the program
	• carry out simple unit conversions, such as from centimeters to meters, within a system of measurement;	Ratio and Proportion	Unit Conversions
	• understand that measurements are approximations and how differences in units affect precision;	Standard not addressed	Standard not addressed
	• explore what happens to measurements of a two-dimensional shape such as its perimeter and area when the shape is changed in some way.	Standard not addressed	Standard not addressed

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Measurement			
Apply appropriate techniques, tools, and formulas to determine measurements	• develop strategies for estimating the perimeters, areas, and volumes of irregular shapes;	Perimeter and Area Volume	Composite Shapes Composite Shapes
	• select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles;	Geometric Figures and Their Properties Perimeter and Area Volume	Angles Angle Pairs Perimeter and Circumference Parallelograms Triangles Rectangular Solids
	• select and use benchmarks to estimate measurements;	Standard not addressed	Standard not addressed
	• develop, understand, and use formulas to find the area of rectangles and related triangles and parallelograms;	Perimeter and Area	Parallelograms Triangles
	• develop strategies to determine the surface areas and volumes of rectangular solids.	Surface Area Volume	Rectangular Solids Rectangular Solids

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Data Analysis and Probability			
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them	• design investigations to address a question and consider how data-collection methods affect the nature of the data set;	Standard not addressed	Standard not addressed
	• collect data using observations, surveys, and experiments;	Standard not addressed	Standard not addressed
	• represent data using tables and graphs such as line plots, bar graphs, and line graphs;	Data Analysis - Displays	Circle Graphs Bar Graphs and Histograms
	• recognize the differences in representing categorical and numerical data.	Standard not addressed	Standard not addressed
Select and use appropriate statistical methods to analyze data	• describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed;	Standard not addressed	Standard not addressed
	• use measures of center, focusing on the median, and understand what each does and does not indicate about the data set;	Data Analysis - Center and Spread	Measures of Center - mode Measures of Center - median Measures of Center - mean Measures of Spread - range
	• compare different representations of the same data and evaluate how well each representation shows important aspects of the data.	Standard not addressed	Standard not addressed
Develop and evaluate inferences and predictions that are based on data	• propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.	Standard not addressed	Standard not addressed
Understand and apply basic concepts of probability	• describe events as likely or unlikely and discuss the degree of likelihood using such words as certain, equally likely, and impossible;	Standard not addressed	Standard not addressed
	• predict the probability of outcomes of simple experiments and test the predictions;	Probability	Simple Probability
	• understand that the measure of the likelihood of an event can be represented by a number from 0 to 1.	Probability	Simple Probability

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Problem Solving			
	▪ build new mathematical knowledge through problem solving;	Embedded throughout the program	Embedded throughout the program
	▪ solve problems that arise in mathematics and in other contexts;	Embedded throughout the program	Embedded throughout the program
	▪ apply and adapt a variety of appropriate strategies to solve problems;	Embedded throughout the program	Embedded throughout the program
	▪ monitor and reflect on the process of mathematical problem solving.	Embedded throughout the program	Embedded throughout the program
Reasoning and Proof			
	▪ recognize reasoning and proof as fundamental aspects of mathematics;	Standard not addressed	Standard not addressed
	▪ make and investigate mathematical conjectures;	Embedded throughout the program	Embedded throughout the program
	▪ develop and evaluate mathematical arguments and proofs;	Standard not addressed	Standard not addressed
	▪ select and use various types of reasoning and methods of proof.	Standard not addressed	Standard not addressed
Communication			
	▪ organize and consolidate their mathematical thinking through communication;	Embedded throughout the program	Embedded throughout the program
	▪ communicate their mathematical thinking coherently and clearly to peers, teachers, and others;	Embedded throughout the program	Embedded throughout the program
	▪ analyze and evaluate the mathematical thinking and strategies of others;	Standard not addressed	Standard not addressed
	▪ use the language of mathematics to express mathematical ideas precisely.	Embedded throughout the program	Embedded throughout the program

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Connections			
	▪ recognize and use connections among mathematical ideas;	Embedded throughout the program	Embedded throughout the program
	▪ understand how mathematical ideas interconnect and build on one another to produce a coherent whole;	Embedded throughout the program	Embedded throughout the program
	▪ recognize and apply mathematics in contexts outside of mathematics.	Embedded throughout the program	Embedded throughout the program
Representations			
	▪ create and use representations to organize, record, and communicate mathematical ideas;	Embedded throughout the program	Embedded throughout the program
	▪ select, apply, and translate among mathematical representations to solve problems;	Embedded throughout the program	Embedded throughout the program
	▪ use representations to model and interpret physical, social, and mathematical phenomena.	Embedded throughout the program	Embedded throughout the program

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Numbers and Operations

Understand numbers, ways of representing numbers, relationships among numbers, and number systems	<ul style="list-style-type: none"> work flexibly with fractions, decimals, and percents to solve problems; 	Fraction Operations Decimals Percentages	Adding Fractions Subtracting Fractions Multiplying Fractions Dividing Fractions Operations with Fractions Adding and Subtracting Decimals Multiplying and Dividing Decimals Operations with Decimals Percent and Percent Change Calculations with Percent
	<ul style="list-style-type: none"> compare and order fractions, decimals, and percents efficiently and find their approximate locations on a number line; 	Decimals Percentages	Fraction and Decimal Equivalents Fraction, Decimal, and Percent Equivalents
	<ul style="list-style-type: none"> develop meaning for percents greater than 100 and less than 1; 	Standard not addressed	Standard not addressed
	<ul style="list-style-type: none"> understand and use ratios and proportions to represent quantitative relationships; 	Ratio and Proportion	Ratios Find Unit Rates Unit Conversions Proportions
	<ul style="list-style-type: none"> develop an understanding of large numbers and recognize and appropriately use exponential, scientific, and calculator notation; 	Exponents and Roots	Scientific Notation
	<ul style="list-style-type: none"> use factors, multiples, prime factorization, and relatively prime numbers to solve problems; 	Number Sense	Factors and Multiples Greatest Common Factor Least Common Multiple
	<ul style="list-style-type: none"> develop meaning for integers and represent and compare quantities with them. 	Integers	Integer Concepts

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Numbers and Operations (continued)			
Understand meanings of operations and how they relate to one another	<ul style="list-style-type: none"> understand the meaning and effects of arithmetic operations with fractions, decimals, and integers; 	Fraction Operations Decimals Integers	Adding Fractions Subtracting Fractions Multiplying Fractions Dividing Fractions Operations with Fractions Adding and Subtracting Decimals Multiplying and Dividing Decimals Operations with Decimals Integer Addition and Subtraction Integer Multiplication and Division Operations with Integers
	<ul style="list-style-type: none"> use the associative and commutative properties of addition and multiplication and the distributive property of multiplication over addition to simplify computations with integers, fractions, and decimals; 	Whole Numbers Algebraic Equations	Whole Number Addition and Subtraction Whole Number Multiplication and Division Evaluation Expressions - two step Solving two step equations Evaluating Expressions with the distributive property Solving equations with the distributive property
	<ul style="list-style-type: none"> understand and use the inverse relationships of addition and subtraction, multiplication and division, and squaring and finding square roots to simplify computations and solve problems. 	Exponents and Roots Algebraic Equations	Exponents and Roots Evaluation Expressions - two step Solving two step equations Evaluating Expressions with the distributive property Solving equations with the distributive property

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Numbers and Operations (continued)			
Compute fluently and make reasonable estimates	<ul style="list-style-type: none"> select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators or computers, and paper and pencil, depending on the situation, and apply the selected methods; 	Fraction Operations Decimals	Adding Fractions Subtracting Fractions Multiplying Fractions Dividing Fractions Operations with Fractions Adding and Subtracting Decimals Multiplying and Dividing Decimals Operations with Decimals
	<ul style="list-style-type: none"> develop and analyze algorithms for computing with fractions, decimals, and integers and develop fluency in their use; 	Fraction Operations Decimals Integers	Adding Fractions Subtracting Fractions Multiplying Fractions Dividing Fractions Operations with Fractions Adding and Subtracting Decimals Multiplying and Dividing Decimals Operations with Decimals Integer Addition and Subtraction Integer Multiplication and Division Operations with Integers

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Numbers and Operations (continued)			
(continued) Compute fluently and make reasonable estimates	<ul style="list-style-type: none"> develop and use strategies to estimate the results of rational-number computations and judge the reasonableness of the results; 	Fraction Operations Decimals Integers Ratio and Proportion Percentages Embedded throughout the program	Adding Fractions Subtracting Fractions Multiplying Fractions Dividing Fractions Operations with Fractions Adding and Subtracting Decimals Multiplying and Dividing Decimals Operations with Decimals Integer Addition and Subtraction Integer Multiplication and Division Operations with Integers Ratios Proportions Percent Concepts Fraction, Decimal, and Percent Equivalents
	<ul style="list-style-type: none"> develop, analyze, and explain methods for solving problems involving proportions, such as scaling and finding equivalent ratios. 	Ratio and Proportion	Ratios Find Unit Rates Unit Conversions Proportions

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Algebra			
Understand patterns, relations, and functions	• represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules;	Patterns	Patterns Arithmetic Sequences - recursive form Arithmetic Sequences - closed form
	• relate and compare different forms of representation for a relationship;	Linear Functions	Slope-Intercept Form Point-Slope Form Two-Point Form Parallel and Perpendicular Lines
	• identify functions as linear or nonlinear and contrast their properties from tables, graphs, or equations.	Linear Functions	Slope-Intercept Form Point-Slope Form
Represent and analyze mathematical situations and structures using algebraic symbols	• develop an initial conceptual understanding of different uses of variables;	Algebraic Problem Solving	Evaluating Expressions - one step
	• explore relationships between symbolic expressions and graphs of lines, paying particular attention to the meaning of intercept and slope;	Linear Functions	Slope Slope-Intercept Form Point-Slope Form
	• use symbolic algebra to represent situations and to solve problems, especially those that involve linear relationships;	Linear Functions	Slope Slope-Intercept Form Point-Slope Form
	• recognize and generate equivalent forms for simple algebraic expressions and solve linear equations	Linear Functions	Slope-Intercept Form Point-Slope Form
Use mathematical models to represent and understand quantitative relationships	• model and solve contextualized problems using various representations, such as graphs, tables, and equations.	Linear Functions	Slope-Intercept Form Point-Slope Form
Analyze change in various contexts	• use graphs to analyze the nature of changes in quantities in linear relationships.	Linear Functions	Slope-Intercept Form Point-Slope Form

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Geometry			
Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships	<ul style="list-style-type: none"> precisely describe, classify, and understand relationships among types of two- and three-dimensional objects using their defining properties; 	Perimeter and Area Surface Area Volume	Perimeter and Circumference Parallelograms Triangles Trapezoids Circles Composite Shapes Rectangular Solids Cylinders Pyramids Rectangular Solids Cylinders Pyramids and Cones
	<ul style="list-style-type: none"> understand relationships among the angles, side lengths, perimeters, areas, and volumes of similar objects; 	Geometric Figures and Their Properties Perimeter and Area Surface Area Volume	Angles Angle Pairs Perimeter and Circumference Parallelograms Triangles Trapezoids Circles Composite Shapes Rectangular Solids Cylinders Pyramids Cones Rectangular Solids Cylinders Pyramids and Cones
	<ul style="list-style-type: none"> create and critique inductive and deductive arguments concerning geometric ideas and relationships, such as congruence, similarity, and the Pythagorean relationship. 	Ratio and Proportion Right Triangles	Similar Figures Pythagorean Theorem: Hypotenuse Pythagorean Theorem: Legs Pythagorean Theorem: Mixed Problems

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Geometry (continued)			
Specify locations and describe spatial relationships using coordinate geometry and other representational systems	• use coordinate geometry to represent and examine the properties of geometric shapes;	Geometry in the Coordinate Plane	Introduction to the Coordinate Plane Plotting Points
	• use coordinate geometry to examine special geometric shapes, such as regular polygons or those with pairs of parallel or perpendicular sides.	Transformations	Translations Reflections Rotations Composition of Transformations
Apply transformations and use symmetry to analyze mathematical situations	• describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling;	Transformations	Translations Reflections Rotations Composition of Transformations
	• examine the congruence, similarity, and line or rotational symmetry of objects using transformations.	Transformations	Reflections Rotations Composition of Transformations
Use visualization, spatial reasoning, and geometric modeling to solve problems	• draw geometric objects with specified properties, such as side lengths or angle measures;	Standard not addressed	Standard not addressed
	• use two-dimensional representations of three-dimensional objects to visualize and solve problems such as those involving surface area and volume;	Surface Area Volume	Rectangular Solids Cylinders Pyramids Rectangular Solids Cylinders Pyramids and Cones
	• use visual tools such as networks to represent and solve problems;		
	• use geometric models to represent and explain numerical and algebraic relationships;	Surface Area Volume	Rectangular Solids Cylinders Pyramids Rectangular Solids Cylinders Pyramids and Cones
	• recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science, and everyday life.	Embedded throughout the program	Embedded throughout the program

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Measurement			
Understand measurable attributes of objects and the units, systems, and processes of measurement	• understand both metric and customary systems of measurement;	Ratio and Proportion	Unit Conversions
	• understand relationships among units and convert from one unit to another within the same system;	Ratio and Proportion	Unit Conversions
	• understand, select, and use units of appropriate size and type to measure angles, perimeter, area, surface area, and volume.	Geometric Figures and Their Properties Perimeter and Area Surface Area Volume	Angles Angle Pairs Perimeter and Circumference Parallelograms Triangles Trapezoids Circles Composite Shapes Rectangular Solids Cylinders Pyramids Rectangular Solids Cylinders Pyramids and Cones

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Measurement (continued)			
Apply appropriate techniques, tools, and formulas to determine measurements	<ul style="list-style-type: none"> use common benchmarks to select appropriate methods for estimating measurements; 	Standard not addressed	Standard not addressed
	<ul style="list-style-type: none"> select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision; 	Geometric Figures and Their Properties Perimeter and Area Volume	Angles Angle Pairs Perimeter and Circumference Parallelograms Triangles Trapezoids Circles Composite Shapes Rectangular Solids Cylinders Pyramids and Cones
	<ul style="list-style-type: none"> develop and use formulas to determine the circumference of circles and the area of triangles, parallelograms, trapezoids, and circles and develop strategies to find the area of more-complex shapes; 	Perimeter and Area	Perimeter and Circumference Parallelograms Trapezoids Circles Composite Shapes
	<ul style="list-style-type: none"> develop strategies to determine the surface area and volume of selected prisms, pyramids, and cylinders; 	Surface Area Volume	Rectangular Solids Cylinders Pyramids Rectangular Solids Cylinders Pyramids and Cones
	<ul style="list-style-type: none"> solve problems involving scale factors, using ratio and proportion; 	Ratio and Proportion	Unit Conversions
	<ul style="list-style-type: none"> solve simple problems involving rates and derived measurements for such attributes as velocity and density. 	Formulas	Evaluating: Distance Solving: Distance Evaluating: Simple Interest Solving: Simple Interest

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Data Analysis and Probability			
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them	• formulate questions, design studies, and collect data about a characteristic shared by two populations or different characteristics within one population;	Standard not addressed	Standard not addressed
	• select, create, and use appropriate graphical representations of data, including histograms, box plots, and scatterplots.	Data Analysis - Displays	Circle Graphs Bar Graphs and Histograms Stem-and-Leaf Plots Box and Whisker Plots
Select and use appropriate statistical methods to analyze data	• find, use, and interpret measures of center and spread, including mean and interquartile range;	Data Analysis - Center and Spread	Measures of Center - mode Measures of Center - median Measures of Spread - range Quartiles
	• discuss and understand the correspondence between data sets and their graphical representations, especially histograms, stem-and-leaf plots, box plots, and scatterplots.	Data Analysis - Displays	Circle Graphs Bar Graphs and Histograms Stem-and-Leaf Plots Box and Whisker Plots
Develop and evaluate inferences and predictions that are based on data	• use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken;	Standard not addressed	Standard not addressed
	• make conjectures about possible relationships between two characteristics of a sample on the basis of scatterplots of the data and approximate lines of fit;	Standard not addressed	Standard not addressed
	• use conjectures to formulate new questions and plan new studies to answer them.	Standard not addressed	Standard not addressed
Understand and apply basic concepts of probability	• understand and use appropriate terminology to describe complementary and mutually exclusive events;	Standard not addressed	Standard not addressed
	• use proportionality and a basic understanding of probability to make and test conjectures about the results of experiments and simulations;	Standard not addressed	Standard not addressed
	• compute probabilities for simple compound events, using such methods as organized lists, tree diagrams, and area models.	Probability	Simple Probability Compound Probability Making Predictions

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Problem Solving			
	▪ build new mathematical knowledge through problem solving;	Embedded throughout the program	Embedded throughout the program
	▪ solve problems that arise in mathematics and in other contexts;	Embedded throughout the program	Embedded throughout the program
	▪ apply and adapt a variety of appropriate strategies to solve problems;	Embedded throughout the program	Embedded throughout the program
	▪ monitor and reflect on the process of mathematical problem solving.	Embedded throughout the program	Embedded throughout the program
Reasoning and Proof			
	▪ recognize reasoning and proof as fundamental aspects of mathematics;	Standard not addressed	Standard not addressed
	▪ make and investigate mathematical conjectures;	Embedded throughout the program	Embedded throughout the program
	▪ develop and evaluate mathematical arguments and proofs;	Standard not addressed	Standard not addressed
	▪ select and use various types of reasoning and methods of proof.	Standard not addressed	Standard not addressed
Communication			
	▪ organize and consolidate their mathematical thinking through communication;	Embedded throughout the program	Embedded throughout the program
	▪ communicate their mathematical thinking coherently and clearly to peers, teachers, and others;	Embedded throughout the program	Embedded throughout the program
	▪ analyze and evaluate the mathematical thinking and strategies of others;	Standard not addressed	Standard not addressed
	▪ use the language of mathematics to express mathematical ideas precisely.	Embedded throughout the program	Embedded throughout the program

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Connections			
	▪ recognize and use connections among mathematical ideas;	Embedded throughout the program	Embedded throughout the program
	▪ understand how mathematical ideas interconnect and build on one another to produce a coherent whole;	Embedded throughout the program	Embedded throughout the program
	▪ recognize and apply mathematics in contexts outside of mathematics.	Embedded throughout the program	Embedded throughout the program
Representations			
	▪ create and use representations to organize, record, and communicate mathematical ideas;	Embedded throughout the program	Embedded throughout the program
	▪ select, apply, and translate among mathematical representations to solve problems;	Embedded throughout the program	Embedded throughout the program
	▪ use representations to model and interpret physical, social, and mathematical phenomena.	Embedded throughout the program	Embedded throughout the program

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Instructional programs from prekindergarten through grade 12 should enable all students to—	In grades 9-12 all students should—	Unit	Thread

Numbers and Operations			
Understand numbers, ways of representing numbers, relationships among numbers, and number systems	• develop a deeper understanding of very large and very small numbers and of various representations of them;	Exponents and Roots	Scientific Notation
	• compare and contrast the properties of numbers and number systems, including the rational and real numbers, and understand complex numbers as solutions to quadratic equations that do not have real solutions;	Standard not addressed	Standard not addressed
	• understand vectors and matrices as systems that have some of the properties of the real-number system;	Standard not addressed	Standard not addressed
	• use number-theory arguments to justify relationships involving whole numbers.	Standard not addressed	Standard not addressed
Understand meanings of operations and how they relate to one another	• judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities;	Exponents and Roots	Exponents and Roots Square and Cube Roots
	• develop an understanding of properties of, and representations for, the addition and multiplication of vectors and matrices;	Standard not addressed	Standard not addressed
	• develop an understanding of permutations and combinations as counting techniques.	Standard not addressed	Standard not addressed
Compute fluently and make reasonable estimates	• develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.	Standard not addressed	Standard not addressed
	• judge the reasonableness of numerical computations and their results.	Standard not addressed	Standard not addressed

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Algebra			
Understand patterns, relations, and functions	• generalize patterns using explicitly defined and recursively defined functions;	Patterns	Arithmetic Sequences - recursive form Arithmetic Sequences - closed form Geometric Sequences - recursive form Geometric Sequences - closed form
	• understand relations and functions and select, convert flexibly among, and use various representations for them;	Standard not addressed	Standard not addressed
	• analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior;	Linear Functions	Slope Slope-Intercept Form
	• understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions;	Standard not addressed	Standard not addressed
	• understand and compare the properties of classes of functions, including exponential, polynomial, rational, logarithmic, and periodic functions;	Standard not addressed	Standard not addressed
	• interpret representations of functions of two variables	Standard not addressed	Standard not addressed
Represent and analyze mathematical situations and structures using algebraic symbols	• understand the meaning of equivalent forms of expressions, equations, inequalities, and relations;	Standard not addressed	Standard not addressed
	• write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases;	Algebraic Problem Solving 2	Solving a System of Linear Equations by Graphing Solving a System of Linear Equations Algebraically
	• use symbolic algebra to represent and explain mathematical relationships;	Algebraic Problem Solving	Evaluation Expressions - one step
	• use a variety of symbolic representations, including recursive and parametric equations, for functions and relations;	Standard not addressed	Standard not addressed
	• judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology.	Standard not addressed	Standard not addressed

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Algebra (continued)

Use mathematical models to represent and understand quantitative relationships	• identify essential quantitative relationships in a situation and determine the class or classes of functions that might model the relationships;	Standard not addressed	Standard not addressed
	• use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts;	Standard not addressed	Standard not addressed
	• draw reasonable conclusions about a situation being modeled.	Embedded throughout the program	Embedded throughout the program
Analyze change in various contexts	• approximate and interpret rates of change from graphical and numerical data.	Linear Functions	Slope

Geometry

Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships	• analyze properties and determine attributes of two- and three-dimensional objects;	Perimeter and Area	Perimeter and Circumference Parallelograms Triangles Trapezoids Circles Composite Shapes
		Surface Area	Rectangular Solids Cylinders Pyramids Cones Spheres Composite Shapes
		Volume	Rectangular Solids Cylinders Pyramids and Cones Spheres Composite Shapes
	• explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them;	Ratio and Proportion	Similar Figures

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Geometry (continued)			
(continued) Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships	<ul style="list-style-type: none"> establish the validity of geometric conjectures using deduction, prove theorems, and critique arguments made by others; use trigonometric relationships to determine lengths and angle measures. 	Standard not addressed	Standard not addressed
		Right Triangles	Trigonometric Ratios: side measure Trigonometric Ratios: angle measure
Specify locations and describe spatial relationships using coordinate geometry and other representational systems	<ul style="list-style-type: none"> use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations; investigate conjectures and solve problems involving two- and three-dimensional objects represented with Cartesian coordinates. use various representations to help understand the effects of simple transformations and their compositions. 	Geometry in the Coordinate Plane	Introduction to the Coordinate Plane Plotting Points Midpoint
		Standard not addressed	Standard not addressed
		Transformations	Translations Reflections Rotations Composition of Transformations
Use visualization, spatial reasoning, and geometric modeling to solve problems	<ul style="list-style-type: none"> draw and construct representations of two- and three-dimensional geometric objects using a variety of tools; visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections; use vertex-edge graphs to model and solve problems; use geometric models to gain insights into, and answer questions in, other areas of mathematics; use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture. 	Standard not addressed	Standard not addressed
		Surface Area	Rectangular Solids Cylinders Pyramids Cones Spheres Composite Shapes
		Volume	Rectangular Solids Cylinders Pyramids and Cones Spheres Composite Shapes
		Standard not addressed	Standard not addressed
		Standard not addressed	Standard not addressed
		Standard not addressed	Standard not addressed

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Data Analysis and Probability			
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them	• understand the differences among various kinds of studies and which types of inferences can legitimately be drawn from each;	Standard not addressed	Standard not addressed
	• know the characteristics of well-designed studies, including the role of randomization in surveys and experiments;	Standard not addressed	Standard not addressed
	• understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable;	Standard not addressed	Standard not addressed
	• understand histograms, parallel box plots, and scatterplots and use them to display data;	Data Analysis - Displays	Circle Graphs Bar Graphs and Histograms Stem-and-Leaf Plots Box and Whisker Plots
	• compute basic statistics and understand the distinction between a statistic and a parameter.	Standard not addressed	Standard not addressed
Select and use appropriate statistical methods to analyze data	• for univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics;	Standard not addressed	Standard not addressed
	• for bivariate measurement data, be able to display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools;	Standard not addressed	Standard not addressed
	• display and discuss bivariate data where at least one variable is categorical;	Standard not addressed	Standard not addressed
	• recognize how linear transformations of univariate data affect shape, center, and spread;	Standard not addressed	Standard not addressed
	• identify trends in bivariate data and find functions that model the data or transform the data so that they can be modeled.	Standard not addressed	Standard not addressed
Develop and evaluate inferences and predictions that are based on data	• use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions;	Standard not addressed	Standard not addressed
	• understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference;	Standard not addressed	Standard not addressed
	• evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions;	Standard not addressed	Standard not addressed
	• understand how basic statistical techniques are used to monitor process characteristics in the workplace.	Standard not addressed	Standard not addressed

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Data Analysis and Probability (continued)			
Understand and apply basic concepts of probability	• understand the concepts of sample space and probability distribution and construct sample spaces and distributions in simple cases;	Standard not addressed	Standard not addressed
	• use simulations to construct empirical probability distributions;	Standard not addressed	Standard not addressed
	• compute and interpret the expected value of random variables in simple cases;	Standard not addressed	Standard not addressed
	• understand the concepts of conditional probability and independent events;	Probability	Simple Probability Compound Probability
	• understand how to compute the probability of a compound event.	Probability	Compound Probability
Problem Solving			
	• build new mathematical knowledge through problem solving;	Embedded throughout the program	Embedded throughout the program
	• solve problems that arise in mathematics and in other contexts;	Embedded throughout the program	Embedded throughout the program
	• apply and adapt a variety of appropriate strategies to solve problems;	Embedded throughout the program	Embedded throughout the program
	• monitor and reflect on the process of mathematical problem solving.	Embedded throughout the program	Embedded throughout the program
Reasoning and Proof			
	• recognize reasoning and proof as fundamental aspects of mathematics;	Standard not addressed	Standard not addressed
	• make and investigate mathematical conjectures;	Embedded throughout the program	Embedded throughout the program
	• develop and evaluate mathematical arguments and proofs;	Standard not addressed	Standard not addressed
	• select and use various types of reasoning and methods of proof.	Standard not addressed	Standard not addressed

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Communication			
	▪ organize and consolidate their mathematical thinking through communication;	Embedded throughout the program	Embedded throughout the program
	▪ communicate their mathematical thinking coherently and clearly to peers, teachers, and others;	Embedded throughout the program	Embedded throughout the program
	▪ analyze and evaluate the mathematical thinking and strategies of others;	Standard not addressed	Standard not addressed
	▪ use the language of mathematics to express mathematical ideas precisely.	Embedded throughout the program	Embedded throughout the program
Connections			
	▪ recognize and use connections among mathematical ideas;	Embedded throughout the program	Embedded throughout the program
	▪ understand how mathematical ideas interconnect and build on one another to produce a coherent whole;	Embedded throughout the program	Embedded throughout the program
	▪ recognize and apply mathematics in contexts outside of mathematics.	Embedded throughout the program	Embedded throughout the program
Representations			
	▪ create and use representations to organize, record, and communicate mathematical ideas;	Embedded throughout the program	Embedded throughout the program
	▪ select, apply, and translate among mathematical representations to solve problems;	Embedded throughout the program	Embedded throughout the program
	▪ use representations to model and interpret physical, social, and mathematical phenomena.	Embedded throughout the program	Embedded throughout the program