

Mathematics Standards

GRADE: K

Big Idea 1: BIG IDEA 1

Represent, compare, and order whole numbers and join and separate sets.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.K.A.1.1 | Represent quantities with numbers up to 20, verbally, in writing, and with manipulatives. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.K.A.1.2 | Solve problems including those involving sets by counting, by using cardinal and ordinal numbers, by comparing, by ordering, and by creating sets up to 20. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.K.A.1.3 | Solve word problems involving simple joining and separating situations. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Big Idea 2: BIG IDEA 2

Describe shapes and space.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.K.G.2.1 | Describe, sort and re-sort objects using a variety of attributes such as shape, size, and position. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.K.G.2.2 | Identify, name, describe and sort basic two-dimensional shapes such as squares, triangles, circles, rectangles, hexagons, and trapezoids. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.K.G.2.3 | Identify, name, describe, and sort three-dimensional shapes such as spheres, cubes and cylinders. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.K.G.2.4 | Interpret the physical world with geometric shapes, and describe it with corresponding vocabulary. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.K.G.2.5 | Use basic shapes, spatial reasoning, and manipulatives to model objects in the environment and to construct more complex shapes. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Big Idea 3: BIG IDEA 3

Order objects by measurable attributes.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.K.G.3.1 | Compare and order objects indirectly or directly using measurable attributes such as length, height, and weight. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 4: Algebra

Algebra

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.K.A.4.1 | Identify and duplicate simple number and non-numeric repeating and growing patterns. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 5: Geometry and Measurement

Geometry and Measurement

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.K.G.5.1 | Demonstrate an understanding of the concept of time using identifiers such as morning, afternoon, day, week, month, year, before/after, shorter/longer. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

GRADE: 1

Big Idea 1: BIG IDEA 1

Develop understandings of addition and subtraction strategies for basic addition facts and related subtraction facts.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.1.A.1.1 | Model addition and subtraction situations using the concepts of "part-whole," "adding to," "taking away from," "comparing," and missing addend." <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.1.A.1.2 | Identify, describe, and apply addition and subtraction as inverse operations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.1.A.1.3 | Create and use increasingly sophisticated strategies, and use properties such as Commutative, Associative and Additive Identity, to add whole numbers. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.1.A.1.4 | Use counting strategies, number patterns, and models as a means for solving basic addition and subtraction fact problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Big Idea 2: BIG IDEA 2

Develop an understanding of whole number relationships, including grouping by tens and ones.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.1.A.2.1 | Compare and order whole numbers at least to 100. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.1.A.2.2 | Represent two digit numbers in terms of tens and ones. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.1.A.2.3 | Order counting numbers, compare their relative magnitudes, and represent numbers on a number line. |

Cognitive Complexity/Depth of Knowledge Rating: Moderate

Big Idea 3: BIG IDEA 3

Compose and decompose two dimensional and three dimensional geometric shapes.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.1.G.3.1 | Use appropriate vocabulary to compare shapes according to attributes and properties such as number and lengths of sides and number of vertices. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.1.G.3.2 | Compose and decompose plane and solid figures, including making predictions about them, to build an understanding of part-whole relationships and properties of shapes. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 4: Algebra

Algebra

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.1.A.4.1 | Extend repeating and growing patterns, fill in missing terms, and justify reasoning. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 5: Geometry and Measurement

Geometry and Measurement

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.1.G.5.1 | Measure by using iterations of a unit, and count the unit measures by grouping units. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.1.G.5.2 | Compare and order objects according to descriptors of length, weight, and capacity. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 6: Number and Operations

Number and Operations

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.1.A.6.1 | Use mathematical reasoning and beginning understanding of tens and ones, including the use of invented strategies, to solve two-digit addition and subtraction problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.1.A.6.2 | Solve routine and non-routine problems by acting them out, using manipulatives, and drawing diagrams. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

GRADE: 2

Big Idea 1: BIG IDEA 1

Develop an understanding of base ten numerations system and place value concepts.

| BENCHMARK CODE | BENCHMARK |
|----------------|-----------|
|----------------|-----------|

| | |
|------------|---|
| MA.2.A.1.1 | Identify relationships between the digits and their place values through the thousands, including counting by tens and hundreds. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.A.1.2 | Identify and name numbers through thousands in terms of place value, and apply this knowledge to expanded notation. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.2.A.1.3 | Compare and order multi-digit numbers through the thousands. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 2: BIG IDEA 2

Develop quick recall of addition facts and related subtraction facts and fluency with multi digit addition and subtraction.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.2.A.2.1 | Recall basic addition and related subtraction facts. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.2.A.2.2 | Add and subtract multi-digit whole numbers through three digits with fluency by using a variety of strategies, including invented and standard algorithms and explanations of those procedures. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.A.2.3 | Estimate solutions to multi-digit addition and subtraction problems through three digits. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.A.2.4 | Solve addition and subtraction problems that involve measurement and geometry. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Big Idea 3: BIG IDEA 3

Develop an understanding of linear measurement and facility in measuring lengths.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.2.G.3.1 | Estimate and use standard units, including inches and centimeters, to partition and measure lengths of objects. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.G.3.2 | Describe the inverse relationship between the size of a unit and number of units needed to measure a given object. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.G.3.3 | Apply the Transitive Property when comparing lengths of objects. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.G.3.4 | Estimate, select an appropriate tool, measure, and/or compute lengths to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 4: Algebra

Algebra

| BENCHMARK CODE | BENCHMARK |
|----------------|-----------|
|----------------|-----------|

| | |
|------------|---|
| MA.2.A.4.1 | Extend number patterns to build a foundation for understanding multiples and factors – for example, skip counting by 2's, 5's, 10's. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.A.4.2 | Classify numbers as odd or even and explain why. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.A.4.3 | Generalize numeric and non-numeric patterns using words and tables. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.2.A.4.4 | Describe and apply equality to solve problems, such as in balancing situations. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.2.A.4.5 | Recognize and state rules for functions that use addition and subtraction. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 5: Geometry and Measurement

Geometry and Measurement

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.2.G.5.1 | Use geometric models to demonstrate the relationships between wholes and their parts as a foundation to fractions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.G.5.2 | Identify time to the nearest hour and half hour. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.2.G.5.3 | Identify, combine, and compare values of money in cents up to \$1 and in dollars up to \$100, working with a single unit of currency. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.2.G.5.4 | Measure weight/mass and capacity/volume of objects. Include the use of the appropriate unit of measure and their abbreviations including cups, pints, quarts, gallons, ounces (oz), pounds (lbs), grams (g), kilograms (kg), milliliters (mL) and liters (L). <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |

Supporting Idea 6: Number and Operations

Number and Operations

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.2.A.6.1 | Solve problems that involve repeated addition. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

GRADE: 3

Big Idea 1: BIG IDEA 1

Develop understandings of multiplication and division and strategies for basic multiplication facts and related division facts.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.3.A.1.1 | Model multiplication and division including problems presented in context: repeated |

| | |
|------------|---|
| | addition, multiplicative comparison, array, how many combinations, measurement, and partitioning. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.3.A.1.2 | Solve multiplication and division fact problems by using strategies that result from applying number properties. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.3.A.1.3 | Identify, describe, and apply division and multiplication as inverse operations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 2: BIG IDEA 2

Develop an understanding of fractions and fraction equivalence.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.3.A.2.1 | Represent fractions, including fractions greater than one, using area, set, and linear models. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.3.A.2.2 | Describe how the size of the fractional part is related to the number of equal sized pieces in the whole. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.3.A.2.3 | Compare and order fractions, including fractions greater than one, using models and strategies. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.3.A.2.4 | Use models to represent equivalent fractions, including fractions greater than 1, and identify representations of equivalence. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 3: BIG IDEA 3

Describe and analyze properties of two dimensional shapes.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.3.G.3.1 | Describe, analyze, compare, and classify two-dimensional shapes using sides and angles - including acute, obtuse, and right angles - and connect these ideas to the definition of shapes. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.3.G.3.2 | Compose, decompose, and transform polygons to make other polygons, including concave and convex polygons with three, four, five, six, eight, or ten sides. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.3.G.3.3 | Build, draw, and analyze two-dimensional shapes from several orientations in order to examine and apply congruence and symmetry. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 4: Algebra

Algebra

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.3.A.4.1 | Create, analyze, and represent patterns and relationships using words, variables, tables, and graphs. |

| | |
|--|---|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
|--|---|

Supporting Idea 5: Geometry and Measurement

Geometry and Measurement

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.3.G.5.1 | Select appropriate units, strategies, and tools to solve problems involving perimeter. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.3.G.5.2 | Measure objects using fractional parts of linear units such as 1/2, 1/4, and 1/10. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.3.G.5.3 | Tell time to the nearest minute and to the nearest quarter hour, and determine the amount of time elapsed. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 6: Number and Operations

Number and Operations

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.3.A.6.1 | Represent, compute, estimate, and solve problems using numbers through hundred thousands. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.3.A.6.2 | Solve non-routine problems by making a table, chart ,or list and searching for patterns. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 7: Data Analysis

Data Analysis

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.3.S.7.1 | Construct and analyze frequency tables, bar graphs, pictographs, and line plots from data, including data collected through observations, surveys, and experiments. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

GRADE: 4

Big Idea 1: BIG IDEA 1

Develop quick recall of multiplication facts and related division facts and fluency with whole number multiplication.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.4.A.1.1 | Use and describe various models for multiplication in problem-solving situations, and demonstrate recall of basic multiplication and related division facts with ease. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.A.1.2 | Multiply multi-digit whole numbers through four digits fluently, demonstrating understanding of the standard algorithm, and checking for reasonableness of results, including solving real-world problems. |

Cognitive Complexity/Depth of Knowledge Rating: High

Big Idea 2: BIG IDEA 2

Develop an understanding of decimals, including the connection between fractions and decimals.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.4.A.2.1 | Use decimals through the thousandths place to name numbers between whole numbers. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.4.A.2.2 | Describe decimals as an extension of the base-ten number system. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.4.A.2.3 | Relate equivalent fractions and decimals with and without models, including locations on a number line. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.A.2.4 | Compare and order decimals, and estimate fraction and decimal amounts in real-world problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 3: BIG IDEA 3

Develop an understanding of area and determine the area of two dimensional shapes.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.4.G.3.1 | Describe and determine area as the number of same-sized units that cover a region in the plane, recognizing that a unit square is the standard unit for measuring area. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.G.3.2 | Justify the formula for the area of the rectangle "area = base x height". <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.G.3.3 | Select and use appropriate units, both customary and metric, strategies, and measuring tools to estimate and solve real-world area problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 4: Algebra

Algebra

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.4.A.4.1 | Generate algebraic rules and use all four operations to describe patterns, including nonnumeric growing or repeating patterns. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.4.A.4.2 | Describe mathematics relationships using expressions, equations, and visual representations. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.4.A.4.3 | Recognize and write algebraic expressions for functions with two operations. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 5: Geometry and Measurement

Geometry and Measurement

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.4.G.5.1 | Classify angles of two-dimensional shapes using benchmark angles (45° , 90° , 180° , and 360°) <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.4.G.5.2 | Identify and describe the results of translations, reflections, and rotations of 45, 90, 180, 270, and 360 degrees, including figures with line and rotational symmetry. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.G.5.3 | Identify and build a three-dimensional object from a two-dimensional representation of that object and vice versa. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 6: Number and Operations

Number and Operations

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.4.A.6.1 | Use and represent numbers through millions in various contexts, including estimation of relative sizes of amounts or distances. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.A.6.2 | Use models to represent division as: <ul style="list-style-type: none">• the inverse of multiplication• as partitioning• as successive subtraction <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.A.6.3 | Generate equivalent fractions and simplify fractions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.A.6.4 | Determine factors and multiples for specified whole numbers. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.A.6.5 | Relate halves, fourths, tenths, and hundredths to decimals and percents. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.4.A.6.6 | Estimate and describe reasonableness of estimates; determine the appropriateness of an estimate versus an exact answer. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

GRADE: 5

Big Idea 1: BIG IDEA 1

Develop an understanding of and fluency with division of whole numbers.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.5.A.1.1 | Describe the process of finding quotients involving multi-digit dividends using models, |

| | |
|------------|--|
| | place value, properties, and the relationship of division to multiplication. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.1.2 | Estimate quotients or calculate them mentally depending on the context and numbers involved. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.1.3 | Interpret solutions to division situations including those with remainders depending on the context of the problem. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.5.A.1.4 | Divide multi-digit whole numbers fluently, including solving real-world problems, demonstrating understanding of the standard algorithm and checking the reasonableness of results. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Big Idea 2: BIG IDEA 2

Develop an understanding of and fluency with addition and subtraction of fractions and decimals.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.5.A.2.1 | Represent addition and subtraction of decimals and fractions with like and unlike denominators using models, place value, or properties. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.2.2 | Add and subtract fractions and decimals fluently, and verify the reasonableness of results, including in problem situations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.2.3 | Make reasonable estimates of fraction and decimal sums and differences, and use techniques for rounding. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.2.4 | Determine the prime factorization of numbers. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 3: BIG IDEA 3

Describe three dimensional shapes and analyze their properties, including volume and surface area.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.5.G.3.1 | Analyze and compare the properties of two-dimensional figures and three-dimensional solids (polyhedra), including the number of edges, faces, vertices, and types of faces. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.5.G.3.2 | Describe, define, and determine surface area and volume of prisms by using appropriate units and selecting strategies and tools. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 4: Algebra

Algebra

| BENCHMARK CODE | BENCHMARK |
|----------------|-----------|
|----------------|-----------|

| | |
|------------|--|
| MA.5.A.4.1 | Use the properties of equality to solve numerical and real world situations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.4.2 | Construct and describe a graph showing continuous data, such as a graph of a quantity that changes over time. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 5: Geometry and Measurement

Geometry and Measurement

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.5.G.5.1 | Identify and plot ordered pairs on the first quadrant of the coordinate plane. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.5.G.5.2 | Compare, contrast, and convert units of measure within the same dimension (length, mass, or time) to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.G.5.3 | Solve problems requiring attention to approximation, selection of appropriate measuring tools, and precision of measurement. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.5.G.5.4 | Derive and apply formulas for areas of parallelograms, triangles, and trapezoids from the area of a rectangle. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 6: Number and Operations

Number and Operations

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.5.A.6.1 | Identify and relate prime and composite numbers, factors, and multiples within the context of fractions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.6.2 | Use the order of operations to simplify expressions which include exponents and parentheses. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.6.3 | Describe real-world situations using positive and negative numbers. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.6.4 | Compare, order, and graph integers, including integers shown on a number line. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.5.A.6.5 | Solve non-routine problems using various strategies including “solving a simpler problem” and “guess, check, and revise”. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 7: Data Analysis

Data Analysis

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.5.S.7.1 | Construct and analyze line graphs and double bar graphs. |

| | |
|------------|--|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.5.S.7.2 | Differentiate between continuous and discrete data, and determine ways to represent those using graphs and diagrams. |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

GRADE: 6

Big Idea 1: BIG IDEA 1

Develop an understanding of and fluency with multiplication and division of fractions and decimals.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.6.A.1.1 | Explain and justify procedures for multiplying and dividing fractions and decimals. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.A.1.2 | Multiply and divide fractions and decimals efficiently. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.6.A.1.3 | Solve real-world problems involving multiplication and division of fractions and decimals. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Big Idea 2: BIG IDEA 2

Connect ratio and rates to multiplication and division.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.6.A.2.1 | Use reasoning about multiplication and division to solve ratio and rate problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.6.A.2.2 | Interpret and compare ratios and rates. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 3: BIG IDEA 3

Write, interpret, and use mathematical expressions and equations.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.6.A.3.1 | Write and evaluate mathematical expressions that correspond to given situations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.A.3.2 | Write, solve, and graph one- and two- step linear equations and inequalities. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.A.3.3 | Work backward with two-step function rules to undo expressions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.A.3.4 | Solve problems given a formula. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.A.3.5 | Apply the Commutative, Associative, and Distributive Properties to show that two expressions are equivalent. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.A.3.6 | Construct and analyze tables, graphs, and equations to describe linear functions and |

| | |
|--|--|
| | other simple relations using both common language and algebraic notation. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
|--|--|

Supporting Idea 4: Geometry and Measurement

Geometry and Measurement

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.6.G.4.1 | Understand the concept of Pi, know common estimates of Pi (3.14; 22/7) and use these values to estimate and calculate the circumference and the area of circles. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.G.4.2 | Find the perimeters and areas of composite two-dimensional figures, including non-rectangular figures (such as semicircles) using various strategies. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.G.4.3 | Determine a missing dimension of a plane figure or prism given its area or volume and some of the dimensions, or determine the area or volume given the dimensions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 5: Number and Operations

Number and Operations

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.6.A.5.1 | Use equivalent forms of fractions, decimals, and percents to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.A.5.2 | Compare and order fractions, decimals, and percents, including finding their approximate location on a number line. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.6.A.5.3 | Estimate the results of computations with fractions, decimals, and percents, and judge the reasonableness of the results. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 6: Data Analysis

Data Analysis

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.6.S.6.1 | Determine the measures of central tendency (mean, median, mode) and variability (range) for a given set of data. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.6.S.6.2 | Select and analyze the measures of central tendency or variability to represent, describe, analyze, and/or summarize a data set for the purposes of answering questions appropriately. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

GRADE: 7

Big Idea 1: BIG IDEA 1

Develop an understanding of and apply proportionality, including similarity.

| BENCHMARK CODE | BENCHMARK |
|-----------------------|--|
| MA.7.A.1.1 | Distinguish between situations that are proportional or not proportional, and use proportions to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.7.A.1.2 | Solve percent problems, including problems involving discounts, simple interest, taxes, tips, and percents of increase or decrease. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.7.A.1.3 | Solve problems involving similar figures. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.7.A.1.4 | Graph proportional relationships and identify the unit rate as the slope of the related linear function. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.7.A.1.5 | Distinguish direct variation from other relationships, including inverse variation. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.7.A.1.6 | Apply proportionality to measurement in multiple contexts, including scale drawings and constant speed. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 2: BIG IDEA 2**Develop an understanding of and use formulas to determine surface areas and volumes of three dimensional shapes.**

| BENCHMARK CODE | BENCHMARK |
|-----------------------|--|
| MA.7.G.2.1 | Justify and apply formulas for surface area and volume of pyramids, prisms, cylinders, and cones. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.7.G.2.2 | Use formulas to find surface areas and volume of three-dimensional composite shapes. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 3: BIG IDEA 3**Develop an understanding of operations on all rational numbers and solving linear equations.**

| BENCHMARK CODE | BENCHMARK |
|-----------------------|--|
| MA.7.A.3.1 | Use and justify the rules for adding, subtracting, multiplying, dividing, and finding the absolute value of integers. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.7.A.3.2 | Add, subtract, multiply, and divide integers, fractions, and terminating decimals, and perform exponential operations with rational bases and whole number exponents including solving problems in everyday contexts. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.7.A.3.3 | Formulate and use different strategies to solve one-step and two-step linear equations, including equations with rational coefficients. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

| | |
|------------|---|
| MA.7.A.3.4 | Use the properties of equality to represent an equation in a different way and to show that two equations are equivalent in a given context. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
|------------|---|

Supporting Idea 4: Geometry and Measurement

Geometry and Measurement

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.7.G.4.1 | Determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures, and apply these relationships to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.7.G.4.2 | Predict the results of transformations, and draw transformed figures with and without the coordinate plane. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.7.G.4.3 | Identify and plot ordered pairs in all four quadrants of the coordinate plane. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.7.G.4.4 | Compare, contrast, and convert units of measure between different measurement systems (US customary or metric (SI)), dimensions, and derived units to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 5: Number and Operations

Number and Operations

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.7.A.5.1 | Express rational numbers as terminating or repeating decimals. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.7.A.5.2 | Solve non-routine problems by working backwards. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 6: Data Analysis

Data Analysis

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.7.S.6.1 | Evaluate the reasonableness of a sample to determine the appropriateness of generalizations made about the population. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.7.S.6.2 | Construct and analyze histograms, stem-and-leaf plots, and circle graphs. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 7: Probability

Probability

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.7.P.7.1 | Determine the outcome of an experiment and predict which events are likely or unlikely, and if the experiment is fair or unfair. |

| | |
|------------|--|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.7.P.7.2 | Determine, compare, and make predictions based on experimental or theoretical probability of independent or dependent events, <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

GRADE: 8

Big Idea 1: BIG IDEA 1

Analyze and represent linear functions, and solve linear equations and systems of linear equations.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.8.A.1.1 | Create and interpret tables, graphs, and models to represent, analyze, and solve problems related to linear equations, including analysis of domain, range, and the difference between discrete and continuous data. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.8.A.1.2 | Interpret the slope and the x- and y-intercepts when graphing a linear equation for a real-world problem. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.8.A.1.3 | Use tables, graphs, and models to represent, analyze, and solve real-world problems related to systems of linear equations. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.8.A.1.4 | Identify the solution to a system of linear equations using graphs. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.8.A.1.5 | Translate among verbal, tabular, graphical, and algebraic representations of linear functions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.8.A.1.6 | Compare the graphs of linear and non-linear functions for real-world situations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 2: BIG IDEA 2

Analyze two and three dimensional figures by using distance and angle.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.8.G.2.1 | Use similar triangles to solve problems that include height and distances. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.8.G.2.2 | Classify and determine the measure of angles, including angles created when parallel lines are cut by transversals. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.8.G.2.3 | Demonstrate that the sum of the angles in a triangle is 180-degrees and apply this fact to find unknown measure of angles and the sum of angles in polygons. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.8.G.2.4 | Validate and apply Pythagorean Theorem to find distances in real world situations or between points in the coordinate plane. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Big Idea 3: BIG IDEA 3

Analyze and summarize data sets.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.8.S.3.1 | Select, organize and construct appropriate data displays, including box and whisker plots, scatter plots, and lines of best fit to convey information and make conjectures about possible relationships. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.8.S.3.2 | Determine and describe how changes in data values impact measures of central tendency. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 4: Algebra

Algebra

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.8.A.4.1 | Solve literal equations for a specified variable. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.8.A.4.2 | Solve and graph one- and two-step inequalities in one variable. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Supporting Idea 5: Geometry and Measurement

Geometry and Measurement

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.8.G.5.1 | Compare, contrast, and convert units of measure between different measurement systems (US customary or metric (SI)) and dimensions including temperature, area, volume, and derived units to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Supporting Idea 6: Number and Operations

Number and Operations

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.8.A.6.1 | Use exponents and scientific notation to write large and small numbers and vice versa and to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.8.A.6.2 | Make reasonable approximations of square roots and mathematical expressions that include square roots, and use them to estimate solutions to problems and to compare mathematical expressions involving real numbers and radical expressions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.8.A.6.3 | Simplify real number expressions using the laws of exponents. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.8.A.6.4 | Perform operations on real numbers (including integer exponents, radicals, percents, scientific notation, absolute value, rational numbers, and irrational numbers) using multi-step and real world problems. |

GRADE: 912

Body of Knowledge: ALGEBRA**Standard 1: Real and Complex Number Systems**

Expand and deepen understanding of real and complex numbers by comparing expressions and performing arithmetic computations, especially those involving square roots and exponents. Use the properties of real numbers to simplify algebraic expressions and equations, and convert between different measurement units using dimensional analysis.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.A.1.1 | Know equivalent forms of real numbers (including integer exponents and radicals, percents, scientific notation, absolute value, rational numbers, irrational numbers). <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.1.2 | Compare real number expressions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.1.3 | Simplify real number expressions using the laws of exponents. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.1.4 | Perform operations on real numbers (including integer exponents, radicals, percents, scientific notation, absolute value, rational numbers, irrational numbers) using multi-step and real-world problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.1.5 | Use dimensional (unit) analysis to perform conversions between units of measure, including rates. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.1.6 | Identify the real and imaginary parts of complex numbers and perform basic operations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.1.7 | Represent complex numbers geometrically. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.1.8 | Use the zero product property of real numbers in a variety of contexts to identify solutions to equations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 2: Relations and Functions

Draw and interpret graphs of relations. Understand the notation and concept of a function, find domains and ranges, and link equations to functions.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.A.2.1 | Create a graph to represent a real-world situation. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.2.2 | Interpret a graph representing a real-world situation. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.2.3 | Describe the concept of a function, use function notation, determine whether a given |

| | |
|---------------|---|
| | relation is a function, and link equations to functions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.2.4 | Determine the domain and range of a relation. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.2.5 | Graph absolute value equations and inequalities in two variables. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.2.6 | Identify and graph common functions (including but not limited to linear, rational, quadratic, cubic, radical, absolute value). <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.2.7 | Perform operations (addition, subtraction, division, and multiplication) of functions algebraically, numerically, and graphically. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.2.8 | Determine the composition of functions. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.2.9 | Recognize, interpret, and graph functions defined piece-wise with and without technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.2.10 | Describe and graph transformations of functions <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.2.11 | Solve problems involving functions and their inverses. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.A.2.12 | Solve problems using direct, inverse, and joint variations. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.A.2.13 | Solve real-world problems involving relations and functions. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

| Standard 3: Linear Equations and Inequalities | |
|---|---|
| Solve linear equations and inequalities. | |
| BENCHMARK CODE | BENCHMARK |
| MA.912.A.3.1 | Solve linear equations in one variable that include simplifying algebraic expressions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.2 | Identify and apply the distributive, associative, and commutative properties of real numbers and the properties of equality. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.3 | Solve literal equations for a specified variable. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.4 | Solve and graph simple and compound inequalities in one variable and be able to justify each step in a solution. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.5 | Symbolically represent and solve multi-step and real-world applications that involve linear equations and inequalities. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

| | |
|---------------|---|
| MA.912.A.3.6 | Solve and graph the solutions of absolute value equations and inequalities with one variable. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.7 | Rewrite equations of a line into slope-intercept form and standard form. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.3.8 | Graph a line given any of the following information: a table of values, the x- and y-intercepts, two points, the slope and a point, the equation of the line in slope-intercept form, standard form, or point-slope form . <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.9 | Determine the slope, x-intercept, and y-intercept of a line given its graph, its equation, or two points on the line. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.10 | Write an equation of a line given any of the following information: two points on the line, its slope and one point on the line, or its graph. Also, find an equation of a new line parallel to a given line, or perpendicular to a given line, through a given point on the new line. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.11 | Write an equation of a line that models a data set, and use the equation or the graph to make predictions. Describe the slope of the line in terms of the data, recognizing that the slope is the rate of change. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.A.3.12 | Graph a linear equation or inequality in two variables with and without graphing technology. Write an equation or inequality represented by a given graph. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.13 | Use a graph to approximate the solution of a system of linear equations or inequalities in two variables with and without technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.14 | Solve systems of linear equations and inequalities in two and three variables using graphical, substitution, and elimination methods. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.3.15 | Solve real-world problems involving systems of linear equations and inequalities in two and three variables. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 4: Polynomials

Perform operations on polynomials. Find factors of polynomials, learning special techniques for factoring quadratics. Understand the relationships among the solutions of polynomial equations, the zeros of a polynomial function, the x-intercepts of a graph, and the factors of a polynomial.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.A.4.1 | Simplify monomials and monomial expressions using the laws of integral exponents. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.4.2 | Add, subtract, and multiply polynomials. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.4.3 | Factor polynomial expressions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

| | |
|---------------|--|
| MA.912.A.4.4 | Divide polynomials by monomials and polynomials with various techniques, including synthetic division. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.4.5 | Graph polynomial functions with and without technology and describe end behavior. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.4.6 | Use theorems of polynomial behavior (including but not limited to the Fundamental Theorem of Algebra, Remainder Theorem, the Rational Root Theorem, Descartes' Rule of Signs, and the Conjugate Root Theorem) to find the zeros of a polynomial function. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.4.7 | Write a polynomial equation for a given set of real and/or complex roots. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.4.8 | Describe the relationships among the solutions of an equation, the zeros of a function, the x-intercepts of a graph, and the factors of a polynomial expression with and without technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.4.9 | Use graphing technology to find approximate solutions for polynomial equations. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.4.10 | Use polynomial equations to solve real-world problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.4.11 | Solve a polynomial inequality by examining the graph with and without the use of technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.4.12 | Apply the Binomial Theorem. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

| Standard 5: Rational Expressions and Equations | |
|---|---|
| Simplify rational expressions and solve rational equations using what has been learned about factoring polynomials. | |
| BENCHMARK CODE | BENCHMARK |
| MA.912.A.5.1 | Simplify algebraic ratios. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.5.2 | Add, subtract, multiply, and divide rational expressions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.5.3 | Simplify complex fractions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.5.4 | Solve algebraic proportions. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.5.5 | Solve rational equations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.5.6 | Identify removable and non-removable discontinuities, and vertical, horizontal, and oblique asymptotes of a graph of a rational function, find the zeros, and graph the function. |

| | |
|--------------|--|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.5.7 | Solve real-world problems involving rational equations (mixture, distance, work, interest, and ratio). |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 6: Radical Expressions and Equations

Simplify and perform operations on radical expressions and equations. Rationalize square root expressions and understand and use the concepts of negative and rational exponents. Add, subtract, multiply, divide, and simplify radical expressions and expressions with rational exponents. Solve radical equations and equations with terms that have rational exponents.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.A.6.1 | Simplify radical expressions <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.6.2 | Add, subtract, multiply, and divide radical expressions (square roots and higher). <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.6.3 | Simplify expressions using properties of rational exponents. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.6.4 | Convert between rational exponent and radical forms of expressions. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.6.5 | Solve equations that contain radical expressions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 7: Quadratic Equations

Draw graphs of quadratic functions. Solve quadratic equations and solve these equations by factoring, completing the square, and by using the quadratic formula. Use graphing calculators to find approximate solutions of quadratic equations.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.A.7.1 | Graph quadratic equations with and without graphing technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.7.2 | Solve quadratic equations over the real numbers by factoring and by using the quadratic formula. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.7.3 | Solve quadratic equations over the real numbers by completing the square. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.7.4 | Use the discriminant to determine the nature of the roots of a quadratic equation. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.7.5 | Solve quadratic equations over the complex number system. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.7.6 | Identify the axis of symmetry, vertex, domain, range and intercept(s) for a given parabola. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.7.7 | Solve non-linear systems of equations with and without using technology. |

| | |
|---------------|---|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.A.7.8 | Use quadratic equations to solve real-world problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.7.9 | Solve optimization problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.A.7.10 | Use graphing technology to find approximate solutions of quadratic equations. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |

Standard 8: Logarithmic and Exponential Functions

Understand the concepts of logarithmic and exponential functions. Graph exponential functions, and solve problems of growth and decay. Understand the inverse relationship between exponents and logarithms, and use it to prove laws of logarithms and to solve equations. Convert logarithms between bases, and simplify logarithmic expressions.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.A.8.1 | Define exponential and logarithmic functions and determine their relationship <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.8.2 | Define and use the properties of logarithms to simplify logarithmic expressions and to find their approximate values. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.8.3 | Graph exponential and logarithmic functions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.8.4 | Prove laws of logarithms. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.A.8.5 | Solve logarithmic and exponential equations. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.8.6 | Use the change of base formula. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.A.8.7 | Solve applications of exponential growth and decay. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 9: Conic Sections

Write equations and draw graphs of conic sections (circle, ellipse, parabola, and hyperbola), thus relating an algebraic representation to a geometric one.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.A.9.1 | Write the equations of conic sections in standard form and general form, in order to identify the conic section and to find its geometric properties (foci, asymptotes, eccentricity, etc.). <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.9.2 | Graph conic sections with and without using graphing technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.9.3 | Solve real-world problems involving conic sections <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 10: Mathematical Reasoning and Problem Solving

In a general sense, all of mathematics is problem solving. In all of mathematics, use problem-solving skills, choose how to approach a problem, explain the reasoning, and check the results.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.A.10.1 | Use a variety of problem-solving strategies, such as drawing a diagram, making a chart, guessing- and-checking, solving a simpler problem, writing an equation, working backwards, and creating a table. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.A.10.2 | Decide whether a solution is reasonable in the context of the original situation. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.A.10.3 | Decide whether a given statement is always, sometimes, or never true (statements involving linear or quadratic expressions, equations, or inequalities, rational or radical expressions, or logarithmic or exponential functions). <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.A.10.4 | Use counterexamples to show that statements are false. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Body of Knowledge: CALCULUS

Standard 1: Limits and Continuity

Develop an understanding of the concept of limit by estimating limits graphically and numerically and evaluating limits analytically. Extend the idea of a limit to one-sided limits and limits at infinity. Use limits to define and understand the concept of continuity, decide whether a function is continuous at a point, and find types of discontinuities. Understand and apply continuity theorems.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.C.1.1 | Understand the concept of limit and estimate limits from graphs and tables of values. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.1.2 | Find limits by substitution. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.C.1.3 | Find limits of sums, differences, products, and quotients. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.C.1.4 | Find limits of rational functions that are undefined at a point. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.C.1.5 | Find one-sided limits. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.C.1.6 | Find limits at infinity. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.1.7 | Decide when a limit is infinite and use limits involving infinity to describe asymptotic behavior. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

| | |
|---------------|---|
| MA.912.C.1.8 | $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ <p>Find special limits such as</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.1.9 | <p>Understand continuity in terms of limits.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p> |
| MA.912.C.1.10 | <p>Decide if a function is continuous at a point.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p> |
| MA.912.C.1.11 | <p>Find the types of discontinuities of a function.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.1.12 | <p>Understand and use the Intermediate Value Theorem on a function over a closed interval.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.1.13 | <p>Understand and apply the Extreme Value Theorem: If $f(x)$ is continuous over a closed interval, then f has a maximum and a minimum on the interval.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |

Standard 2: Differential Calculus

Develop an understanding of the derivative as an instantaneous rate of change, using geometrical, numerical, and analytical methods. Use this definition to find derivatives of algebraic and transcendental functions and combinations of these functions (using, for example, sums, composites, and inverses). Find second and higher order derivatives. Understand and use the relationship between differentiability and continuity. Understand and apply the Mean Value Theorem. Find derivatives of algebraic, trigonometric, logarithmic, and exponential functions. Find derivatives of sums, products, and quotients, and composite and inverse functions. Find derivatives of higher order, and use logarithmic differentiation and the Mean Value Theorem.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.C.2.1 | <p>Understand the concept of derivative geometrically, numerically, and analytically, and interpret the derivative as an instantaneous rate of change or as the slope of the tangent line.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p> |
| MA.912.C.2.2 | <p>State, understand, and apply the definition of derivative.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.2.3 | <p>Find the derivatives of functions, including algebraic, trigonometric, logarithmic, and exponential functions.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Low</i></p> |
| MA.912.C.2.4 | <p>Find the derivatives of sums, products, and quotients.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Low</i></p> |
| MA.912.C.2.5 | <p>Find the derivatives of composite functions using the Chain Rule.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.2.6 | <p>Find the derivatives of implicitly-defined functions.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.2.7 | <p>Find derivatives of inverse functions.</p> |

| | |
|---------------|--|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.2.8 | Find second derivatives and derivatives of higher order. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.C.2.9 | Find derivatives using logarithmic differentiation. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.2.10 | Understand and use the relationship between differentiability and continuity. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.2.11 | Understand and apply the Mean Value Theorem. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 3: Applications of Derivatives

Apply knowledge about derivatives to find slopes of curves and the related tangent lines. Analyze and graph functions, finding where they are increasing or decreasing, their maximum and minimum points, their points of inflection, and their concavity. Solve optimization problems, find average and instantaneous rates of change (including velocities and accelerations), and model rates of change. Find slopes and equations of tangent lines, maximum and minimum points, and points of inflection. Solve optimization problems, and find rates of change.

| BENCHMARK CODE | BENCHMARK |
|-----------------------|---|
| MA.912.C.3.1 | Find the slope of a curve at a point, including points at which there are vertical tangent lines and no tangent lines. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.3.2 | Find an equation for the tangent line to a curve at a point and a local linear approximation. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.3.3 | Decide where functions are decreasing and increasing. Understand the relationship between the increasing and decreasing behavior of f and the sign of f' . <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.3.4 | Find local and absolute maximum and minimum points. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.3.5 | Find points of inflection of functions. Understand the relationship between the concavity of f and the sign of f'' . Understand points of inflection as places where concavity changes. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.3.6 | Use first and second derivatives to help sketch graphs. Compare the corresponding characteristics of the graphs of f , f' , and f'' . <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.C.3.7 | Use implicit differentiation to find the derivative of an inverse function. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.3.8 | Solve optimization problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.3.9 | Find average and instantaneous rates of change. Understand the instantaneous rate of change as the limit of the average rate of change. Interpret a derivative as a rate of change in applications, including velocity, speed, and acceleration. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

| | |
|---------------|--|
| MA.912.C.3.10 | Find the velocity and acceleration of a particle moving in a straight line. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.3.11 | Model rates of change, including related rates problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.C.3.12 | Solve problems using the Newton-Raphson method. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 4: Integral Calculus

Understand that integration is used to find areas, and evaluate integrals using rectangular approximations. From this, develop the idea that integration is the inverse operation to differentiation — the Fundamental Theorem of Calculus. Use this result to find definite and indefinite integrals, including using the method of integration by substitution. Apply approximate methods, such as the Trapezoidal Rule, to find definite integrals. Define integrals using Riemann sums, use the Fundamental Theorem of Calculus to find integrals using antiderivatives, and use basic properties of integrals. Integrate by substitution, and find approximate integrals.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.C.4.1 | Use rectangle approximations to find approximate values of integrals. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.C.4.2 | Calculate the values of Riemann Sums over equal subdivisions using left, right, and midpoint evaluation points. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.C.4.3 | Interpret a definite integral as a limit of Riemann sums. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.4.4 | Interpret a definite integral of the rate of change of a quantity over an interval as the change of the quantity over the interval. That is, $\int_a^b f'(x) dx = f(b) - f(a)$ (Fundamental Theorem of Calculus). <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.C.4.5 | Use the Fundamental Theorem of Calculus to evaluate definite and indefinite integrals and to represent particular antiderivatives. Perform analytical and graphical analysis of functions so defined. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.C.4.6 | Use these properties of definite integrals: <ul style="list-style-type: none"> • $\int_a^b [f(x) + g(x)] dx = \int_a^b f(x) dx + \int_a^b g(x) dx$ • $\int_a^b k \cdot f(x) dx = k \int_a^b f(x) dx$ • $\int_a^a f(x) dx = 0$ • $\int_a^b f(x) dx = - \int_b^a f(x) dx$ • $\int_a^b f(x) dx + \int_b^c f(x) dx = \int_a^c f(x) dx$ |

| | |
|--------------|--|
| | <ul style="list-style-type: none"> If $f(x) \leq g(x)$ on $[a, b]$, then $\int_a^b f(x)dx \leq \int_a^b g(x)dx$ <p><i>Cognitive Complexity/Depth of Knowledge Rating: Low</i></p> |
| MA.912.C.4.7 | <p>Use integration by substitution (or change of variable) to find values of integrals.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.4.8 | <p>Use Riemann Sums, the Trapezoidal Rule, and technology to approximate definite integrals of functions represented algebraically, geometrically, and by tables of values.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |

Standard 5: Applications of Integration

Apply knowledge about integrals to finding velocities from accelerations, solving separable differential equations, and finding areas and volumes. Apply integration to model, and solve problems in physics, biology, economics, etc. Find velocity functions and position functions from their derivatives, solve separable differential equations, and use definite integrals to find areas and volumes.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.C.5.1 | <p>Find specific antiderivatives using initial conditions, including finding velocity functions from acceleration functions, finding position functions from velocity functions, and solving applications related to motion along a line.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.5.2 | <p>Solve separable differential equations, and use them in modeling.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.5.3 | <p>Solve differential equations of the form $\frac{dy}{dt} = ky$ as applied to growth and decay problems.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.5.4 | <p>Use slope fields to display a graphic representation of the solution to a differential equation, and locate particular solutions to the equation.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.5.5 | <p>Use definite integrals to find the area between a curve and the x-axis or between two curves.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.C.5.6 | <p>Use definite integrals to find the average value of a function over a closed interval.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Low</i></p> |
| MA.912.C.5.7 | <p>Use definite integrals to find the volume of a solid with known cross-sectional area, including solids of revolution.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p> |
| MA.912.C.5.8 | <p>Apply integration to model, and solve problems in physical, biological, and social sciences.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |

Body of Knowledge: DISCRETE MATHEMATICS

Standard 1: Recursion

Understand and apply recursive methods to solve problems, including the use of finite differences.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.D.1.1 | Use recursive and iterative thinking to solve problems, including identification of patterns, population growth and decline, and compound interest. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.1.2 | Use finite differences to solve problems and to find explicit formulas for recurrence relations. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.D.1.3 | Use mathematical induction to prove various concepts in number theory (such as sums of infinite integer series, divisibility statements, and parity statements), recurrence relations, and other applications. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 2: Graph Theory

Understand how graphs of vertices joined by edges can model relationships and can be used to solve various problems with relation to directed graphs, weighted graphs, networks, tournaments, transportation flows, matching, and coverage.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.D.2.1 | Use Euler and Hamilton cycles and paths in graphs to solve routing problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.D.2.2 | Use critical path analysis to solve scheduling problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.D.2.3 | Use graph coloring techniques to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.2.4 | Use spanning trees, rooted trees, binary trees, and decision trees to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.2.5 | Use bin-packing techniques to solve problems concerning optimizing resource usage. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 3: Social Choice

Analyze election data to evaluate different election methods, and use weighted voting techniques to decide voting power within a group. Understand and use fair division techniques to solve apportionment problems.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.D.3.1 | Use election theory techniques to analyze election data. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.3.2 | Use weighted voting techniques to decide voting power within a group. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.3.3 | Use fair division techniques to divide continuous objects. |

| | |
|--------------|---|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.3.4 | Use fair division techniques to solve apportionment problems. |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

| | |
|--|---|
| Standard 4: Linear Programming | |
| Understand how to use linear programming and coordinate geometry to solve simple linear optimization problems. | |
| BENCHMARK CODE | BENCHMARK |
| MA.912.D.4.1 | Solve maximal profit/minimal cost problems. |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

| | |
|--|---|
| Standard 5: Game Theory | |
| Understand and use game theory methods to solve strictly determined games and non-strictly determined games. | |
| BENCHMARK CODE | BENCHMARK |
| MA.912.D.5.1 | Use game theory to solve strictly determined games. |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.D.5.2 | Use game theory to solve non-strictly determined games. |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

| | |
|---|--|
| Standard 6: Logic | |
| Develop an understanding of the fundamentals of propositional logic, arguments, and methods of proof. | |
| BENCHMARK CODE | BENCHMARK |
| MA.912.D.6.1 | Use truth tables to determine truth values of propositional statements. |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.6.2 | Find the converse, inverse, and contrapositive of a statement |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.6.3 | Determine whether two propositions are logically equivalent. |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.6.4 | Use methods of direct and indirect proof and determine whether a short proof is logically valid. |
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.6.5 | Identify and give examples of : <ul style="list-style-type: none"> • undefined terms; • axioms; • theorems; • inductive and deductive proofs; and, • inductive and deductive reasoning. |

| | |
|--------------|--|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.D.6.6 | Construct logical arguments using laws of detachment (modus ponens), syllogism, tautology, and contradiction; judge the validity of arguments, and give counterexamples to disprove statements. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.D.6.7 | Use applications of the universal and existential quantifiers to propositional statements. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |

Standard 7: Set Theory

Operate with sets, and use set theory to solve problems.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.D.7.1 | Perform set operations such as union and intersection, complement, and cross product. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.D.7.2 | Use Venn diagrams to explore relationships and patterns and to make arguments about relationships between sets. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 8: Matrices

Understand how matrices can be used to store and organize data and to solve systems of equations. Use matrices to solve Markov chain problems that link present events to future events using probabilities.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.D.8.1 | Use matrices to organize and store data. Perform matrix operations (addition, subtraction, scalar multiplication, multiplication) <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.D.8.2 | Use matrix operations to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.8.3 | Use row-reduction techniques to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.8.4 | Find the inverse of a matrix, and use the inverse to solve problems with and without the use of technology. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.D.8.5 | Use determinants of 2 x 2 and 3 x 3 matrices as well as higher order matrices with and without the use of technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.D.8.6 | Use matrices to solve Markov chain problems that link present events to future events using probabilities. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 9: Vectors

Recognize vectors in both two- and three-dimensions. Recognize that vectors are represented geometrically and algebraically. Perform basic operations on vectors, including addition, scalar multiplication, dot product, and cross product. Solve problems using vectors.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.D.9.1 | Demonstrate an understanding of the geometric interpretation of vectors and vector operations including addition, scalar multiplication, dot product, and cross product in the plane and in three-dimensional space. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.9.2 | Demonstrate an understanding of the algebraic interpretation of vectors and vector operations including addition, scalar multiplication, dot product, and cross product in the plane and in three-dimensional space. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.9.3 | Use vectors to model and solve application problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 10: Parametric Equations

Use parametric equations in two dimensions to model time dependant situations, and convert parametric equations to rectangular coordinates and vice-versa.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.D.10.1 | Sketch the graph of a curve in the plane represented parametrically, indicating the direction of motion. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.10.2 | Convert from a parametric representation of a plane curve to a rectangular equation and vice-versa. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.D.10.3 | Use parametric equations to model applications of motion in the plane. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 11: Sequences and Series

Define and use arithmetic and geometric sequences and series.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.D.11.1 | Define arithmetic and geometric sequences and series. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.D.11.2 | Use sigma notation to describe series. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.D.11.3 | Find specified terms of arithmetic and geometric sequences. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.D.11.4 | Find partial sums of arithmetic and geometric series, and find sums of infinite convergent geometric series. Use Sigma notation where applicable. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.D.11.5 | Explore and use other sequences found in nature such as the Fibonacci sequence and the golden ratio. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 1: Simple and Compound Interest

Simple and Compound Interest

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.F.1.1 | Explain the difference between simple and compound interest. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.1.2 | Solve problems involving compound interest. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.F.1.3 | Demonstrate the relationship between simple interest and linear growth. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.1.4 | Demonstrate the relationship between compound interest and exponential growth. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 2: Net Present and Net Future Value (NPV and NFV)

Net Present and Net Future Value (NPV and NFV)

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.F.2.1 | Calculate the future value of a given amount of money with and without technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.2.2 | Calculate the present value of a certain amount of money for a given length of time in the future with and without technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.2.3 | Use a consumer price index to express dollars in constant terms with and without technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.2.4 | Calculate the present value of an income stream with and without technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 3: Loans and Financing

Become familiar with and describe the advantages and disadvantages of short-term purchases, long-term purchases, and mortgages.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.F.3.1 | Compare the advantages and disadvantages of using cash versus a credit card. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.F.3.2 | Analyze credit scores and reports. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.3.3 | Calculate the finance charges and total amount due on a credit card bill. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.F.3.4 | Compare the advantages and disadvantages of deferred payments. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.F.3.5 | Calculate deferred payments. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.3.6 | Calculate total cost of purchasing consumer durables over time given different down |

| | |
|---------------|--|
| | <p>payments, financing options, and fees.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.F.3.7 | <p>Calculate the following fees associated with a mortgage:</p> <ul style="list-style-type: none"> • discount points • origination fee • maximum brokerage fee on a net or gross loan • documentary stamps • prorated expenses (interest, county and/or city property taxes, and mortgage on an assumed mortgage) <p><i>Cognitive Complexity/Depth of Knowledge Rating: Low</i></p> |
| MA.912.F.3.8 | <p>Substitute to solve a variety of mortgage formulas, including but not limited to Front End Ratio, Total Debt-to-Income Ratio, Loan-to-Value Ratio (LTV), Combined Loan-to-Value Ratio (CLTV), and Amount of Interest Paid Over the Life of a Loan.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Low</i></p> |
| MA.912.F.3.9 | <p>Calculate the total amount to be paid over the life of a fixed rate loan.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.F.3.10 | <p>Calculate the effects on the monthly payment in the change of interest rate based on an adjustable rate mortgage.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.F.3.11 | <p>Calculate the final pay out amount for a balloon mortgage.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.F.3.12 | <p>Compare the cost of paying a higher interest rate and lower points versus a lower interest rate and more points.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.F.3.13 | <p>Calculate the total amount paid for the life of a loan for a house including the down payment, points, fees, and interest.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.F.3.14 | <p>Compare the total cost for a set purchase price using a fixed rate, adjustable rate, and a balloon mortgage.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.F.3.15 | <p>Interpret the legal description using the metes and bounds; lot and block (plat); government survey; and monument methods.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.F.3.16 | <p>Estimate real property value using the sales comparison approach, cost-depreciation approach, or the income capitalization approach.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i></p> |
| MA.912.F.3.17 | <p>Compare interest rate calculations and annual percentage rate calculations to distinguish between the two rates.</p> <p><i>Cognitive Complexity/Depth of Knowledge Rating: High</i></p> |

Standard 4: Individual Financial Planning

Individual Financial and Investment Planning

| BENCHMARK CODE | BENCHMARK |
|-----------------------|--|
| MA.912.F.4.1 | Develop personal budgets that fit within various income brackets. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.4.2 | Explain cash management strategies including debit accounts, checking accounts, and savings accounts. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.4.3 | Calculate net worth. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.F.4.4 | Establish a plan to pay off debt. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.F.4.5 | Develop and apply a variety of strategies to use tax tables, and to determine, calculate, and complete yearly federal income tax. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.4.6 | Compare different insurance options and fees. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.F.4.7 | Compare and contrast the role of insurance as a device to mitigate risk and calculate expenses of various options. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.4.8 | Collect, organize, and interpret data to determine an effective retirement savings plan to meet personal financial goals. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.4.9 | Calculate, compare, and contrast different types of retirement plans, including IRAs, ROTH accounts, and annuities. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.F.4.10 | Analyze diversification in investments. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.F.4.11 | Purchase stock with a set amount of money, and follow the process through gains, losses, and selling. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.4.12 | Compare and contrast income from purchase of common stock, preferred stock, and bonds. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.F.4.13 | Given current exchange rates be able to convert from one form of currency to another. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.F.4.14 | Use data to compare historical rates of return on investments with investment claims to make informed decisions and identify potential fraud. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 5: Economic Concepts

Economic Concepts

| BENCHMARK CODE | BENCHMARK |
|-----------------------|--|
| MA.912.F.5.1 | Demonstrate how price and quantity demanded relate, how price and quantity supplied relate, and how price changes or price controls affect distribution and allocation in the economy. |

| | |
|--------------|--|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.F.5.2 | Use basic terms and indicators associated with levels of economic performance and the state of the economy. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Body of Knowledge: GEOMETRY

Standard 1: Points, Lines, Angles, and Planes

Understand geometric concepts, applications, and their representations with coordinate systems. Find lengths and midpoints of line segments, slopes, parallel and perpendicular lines, and equations of lines. Using a compass and straightedge, patty paper, a drawing program or other techniques, construct lines and angles, explaining and justifying the processes used.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.G.1.1 | Find the lengths and midpoints of line segments in two-dimensional coordinate systems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.1.2 | Construct congruent segments and angles, angle bisectors, and parallel and perpendicular lines using a straight edge and compass or a drawing program, explaining and justifying the process used. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.1.3 | Identify and use the relationships between special pairs of angles formed by parallel lines and transversals. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.1.4 | Use coordinate geometry to find slopes, parallel lines, perpendicular lines, and equations of lines. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 2: Polygons

Identify and describe polygons (triangles, quadrilaterals, pentagons, hexagons, etc.), using terms such as regular, convex, and concave. Find measures of angles, sides, perimeters, and areas of polygons, justifying the methods used. Apply transformations to polygons. Relate geometry to algebra by using coordinate geometry to determine transformations. Use algebraic reasoning to determine congruence, similarity, and symmetry. Create and verify tessellations of the plane using polygons.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.G.2.1 | Identify and describe convex, concave, regular, and irregular polygons. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.2.2 | Determine the measures of interior and exterior angles of polygons, justifying the method used. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.2.3 | Use properties of congruent and similar polygons to solve mathematical or real-world problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.2.4 | Apply transformations (translations, reflections, rotations, dilations, and scale factors) to polygons. to determine congruence, similarity, and symmetry. Know that images formed by translations, reflections, and rotations are congruent to the original shape. Create |

| | |
|--------------|---|
| | and verify tessellations of the plane using polygons. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.2.5 | Explain the derivation and apply formulas for perimeter and area of polygons (triangles, quadrilaterals, pentagons, etc.). <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.2.6 | Use coordinate geometry to prove properties of congruent, regular and similar polygons, and to perform transformations in the plane. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.2.7 | Determine how changes in dimensions affect the perimeter and area of common geometric figures. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

| Standard 3: Quadrilaterals | |
|--|---|
| Classify and understand relationships among quadrilaterals (rectangle, parallelogram, kite, etc.). Relate geometry to algebra by using coordinate geometry to determine regularity, congruence, and similarity. Use properties of congruent and similar quadrilaterals to solve problems involving lengths and areas, and prove theorems involving quadrilaterals. | |
| BENCHMARK CODE | BENCHMARK |
| MA.912.G.3.1 | Describe, classify, and compare relationships among quadrilaterals including the square, rectangle, rhombus, parallelogram, trapezoid, and kite. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.3.2 | Compare and contrast special quadrilaterals on the basis of their properties. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.3.3 | Use coordinate geometry to prove properties of congruent, regular, and similar quadrilaterals. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.3.4 | Prove theorems involving quadrilaterals. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

| Standard 4: Triangles | |
|---|---|
| Identify and describe various kinds of triangles (right, acute, scalene, isosceles, etc.). Define and construct altitudes, medians, and bisectors, and triangles congruent to given triangles. Prove that triangles are congruent or similar and use properties of these triangles to solve problems involving lengths and areas. Relate geometry to algebra by using coordinate geometry to determine regularity, congruence, and similarity. Understand and apply the inequality theorems of triangles. | |
| BENCHMARK CODE | BENCHMARK |
| MA.912.G.4.1 | Classify, construct, and describe triangles that are right, acute, obtuse, scalene, isosceles, equilateral, and equiangular. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.4.2 | Define, identify, and construct altitudes, medians, angle bisectors, perpendicular bisectors, orthocenter, centroid, incenter, and circumcenter. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.4.3 | Construct triangles congruent to given triangles. |

| | |
|--------------|---|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.4.4 | Use properties of congruent and similar triangles to solve problems involving lengths and areas. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.4.5 | Apply theorems involving segments divided proportionally. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.4.6 | Prove that triangles are congruent or similar and use the concept of corresponding parts of congruent triangles. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.4.7 | Apply the inequality theorems: triangle inequality, inequality in one triangle, and the Hinge Theorem. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.4.8 | Use coordinate geometry to prove properties of congruent, regular, and similar triangles. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 5: Right Triangles

Apply the Pythagorean Theorem to solving problems, including those involving the altitudes of right triangles and triangles with special angle relationships. Use special right triangles to solve problems using the properties of triangles.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.G.5.1 | Prove and apply the Pythagorean Theorem and its converse. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.5.2 | State and apply the relationships that exist when the altitude is drawn to the hypotenuse of a right triangle. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.5.3 | Use special right triangles ($30^\circ - 60^\circ - 90^\circ$ and $45^\circ - 45^\circ - 90^\circ$) to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.5.4 | Solve real-world problems involving right triangles. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 6: Circles

Define and understand ideas related to circles (radius, tangent, chord, etc.). Perform constructions, and prove theorems related to circles. Find measures of arcs and angles related to them, as well as measures of circumference and area. Relate geometry to algebra by finding the equation of a circle in the coordinate plane.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.G.6.1 | Determine the center of a given circle. Given three points not on a line, construct the circle that passes through them. Construct tangents to circles. Circumscribe and inscribe circles about and within triangles and regular polygons. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.6.2 | Define and identify: circumference, radius, diameter, arc, arc length, chord, secant, tangent and concentric circles. |

| | |
|--------------|---|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.G.6.3 | Prove theorems related to circles, including related angles, chords, tangents, and secants. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.6.4 | Determine and use measures of arcs and related angles (central, inscribed, and intersections of secants and tangents). <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.6.5 | Solve real-world problems using measures of circumference, arc length, and areas of circles and sectors. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.6.6 | Given the center and the radius, find the equation of a circle in the coordinate plane or given the equation of a circle in center-radius form, state the center and the radius of the circle. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.6.7 | Given the equation of a circle in center-radius form or given the center and the radius of a circle, sketch the graph of the circle. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 7: Polyhedra and Other Solids

Describe and make regular and nonregular polyhedra (cube, pyramid, tetrahedron, octahedron, etc.). Explore relationships among the faces, edges, and vertices of polyhedra. Describe sets of points on spheres, using terms such as great circle. Describe symmetries of solids, and understand the properties of congruent and similar solids.

| BENCHMARK CODE | BENCHMARK |
|-----------------------|---|
| MA.912.G.7.1 | Describe and make regular, non-regular, and oblique polyhedra, and sketch the net for a given polyhedron and vice versa. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.7.2 | Describe the relationships between the faces, edges, and vertices of polyhedra. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.7.3 | Identify, sketch, find areas and/or perimeters of cross sections of solid objects. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.7.4 | Identify chords, tangents, radii, and great circles of spheres <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.G.7.5 | Explain and use formulas for lateral area, surface area, and volume of solids. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.7.6 | Identify and use properties of congruent and similar solids. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.7.7 | Determine how changes in dimensions affect the surface area and volume of common geometric solids. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 8: Mathematical Reasoning and Problem Solving

In a general sense, mathematics is problem solving. In all mathematics, use problem-solving

skills, choose how to approach a problem, explain the reasoning, and check the results. At this level, apply these skills to making conjectures, using axioms and theorems, constructing logical arguments, and writing geometric proofs. Learn about inductive and deductive reasoning and how to use counterexamples to show that a general statement is false.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.G.8.1 | Analyze the structure of Euclidean geometry as an axiomatic system. Distinguish between undefined terms, definitions, postulates, and theorems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.8.2 | Use a variety of problem-solving strategies, such as drawing a diagram, making a chart, guess-and-check, solving a simpler problem, writing an equation, and working backwards. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.8.3 | Determine whether a solution is reasonable in the context of the original situation. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.G.8.4 | Make conjectures with justifications about geometric ideas. Distinguish between information that supports a conjecture and the proof of a conjecture. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.8.5 | Write geometric proofs, including proofs by contradiction and proofs involving coordinate geometry. Use and compare a variety of ways to present deductive proofs, such as flow charts, paragraphs, two-column, and indirect proofs. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.G.8.6 | Perform basic constructions using straightedge and compass, and/or drawing programs describing and justifying the procedures used. Distinguish between sketching, constructing, and drawing geometric figures. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Body of Knowledge: PROBABILITY

Standard 1: Counting Principles

Understand the counting principle, permutations, and combinations, and use them to solve problems.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.P.1.1 | Use counting principles, including the addition and the multiplication principles, to determine size of finite sample spaces and probabilities of events in those spaces. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.P.1.2 | Use formulas for permutations and combinations to count outcomes and determine probabilities of events. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 2: Determine Probabilities

Develop rules for finding probabilities of combined and complementary events. Understand and use conditional probability and the related Bayes' Theorem.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.P.2.1 | Determine probabilities of complementary events, and calculate odds for and against the occurrence of events. |

| | |
|--------------|---|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.P.2.2 | Determine probabilities of independent events. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.P.2.3 | Understand and use the concept of conditional probability, including: understanding how conditioning affects the probability of events and finding conditional probabilities from a two-way frequency table. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 3: Probability Distributions

Investigate probability distributions, and calculate and interpret their means and variances. Use and apply the normal distribution, including using the central limit theorem.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.P.3.1 | Determine probabilities of events from distributions, including: <ul style="list-style-type: none"> • discrete uniform (all outcomes in a finite set equally likely) • binomial • normal • exponential <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.P.3.2 | Determine the mean and variance of distributions, including: <ul style="list-style-type: none"> • discrete uniform (all outcomes in a finite set equally likely) • binomial • normal • exponential <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.P.3.3 | Apply the properties of the normal distribution. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.P.3.4 | Apply the Central Limit Theorem to determine the probability that a sample mean will be in a certain interval. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Body of Knowledge: STATISTICS

Standard 1: Formulating Questions

Learn to define appropriate questions for research and to pose questions in a form that can be answered by collecting and analyzing data.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.S.1.1 | Formulate an appropriate research question to be answered by collecting data or performing an experiment. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.1.2 | Determine appropriate and consistent standards of measurement for the data to be |

| | |
|--|---|
| | collected in a survey or experiment. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
|--|---|

Standard 2: Data Collection

Learn key methods for collecting data and basic sampling principles.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.S.2.1 | Compare the difference between surveys, experiments, and observational studies and what types of questions can and cannot be answered by a particular design. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.2.2 | Apply the definition of random sample and basic types of sampling, including representative samples, stratified samples, censuses. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.S.2.3 | Identify sources of bias, including sampling and nonsampling errors. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 3: Summarizing Data (Descriptive Statistics)

Learn to work with summary measures of sets of data, including measures of the center, spread, and strength of relationship between variables. Learn to distinguish between different types of data and to select the appropriate visual form to present different types of data.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.S.3.1 | Read and interpret data presented in various formats. Determine whether data is presented in appropriate format, and identify possible corrections. Formats to include: <ul style="list-style-type: none"> • bar graphs • line graphs • stem and leaf plots • circle graphs • histograms • box and whiskers plots • scatter plots • cumulative frequency (ogive) graphs <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.S.3.2 | Collect, organize, and analyze data sets, determine the best format for the data and present visual summaries from the following: <ul style="list-style-type: none"> • bar graphs • line graphs • stem and leaf plots • circle graphs • histograms • box and whisker plots • scatter plots • cumulative frequency (ogive) graphs |

| | |
|--------------|---|
| | <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.3.3 | Calculate and interpret measures of the center of a set of data, including mean, median, and weighted mean, and use these measures to make comparisons among sets of data. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.S.3.4 | Calculate and interpret measures of variance and standard deviation. Use these measures to make comparisons among sets of data. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.S.3.5 | Calculate and interpret the range and quartiles of a set of data. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.S.3.6 | Use empirical rules such as the 68-95-99.7 rule to estimate spread of distributions and to make comparisons among sets of data. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.S.3.7 | Calculate the correlation coefficient of a set of paired data, and interpret the coefficient as a measure of the strength and direction of the relationship between the variables. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.S.3.8 | Determine whether a data distribution is symmetric or skewed based on an appropriate graphical presentation of the data. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.S.3.9 | Identify outliers in a set of data based on an appropriate graphical presentation of the data, and describe the effect of outliers on the mean, median, and range of the data. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 4: Analyzing Data

Learn to use simulations of standard sampling distributions to determine confidence levels and margins of error. Develop measures of association between two numerical or categorical variables. Use technological tools to find equations of regression lines and correlation coefficients.

| BENCHMARK CODE | BENCHMARK |
|-----------------------|--|
| MA.912.S.4.1 | Explain and interpret the concepts of confidence level and "margin of error." <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.4.2 | Use a simulation to approximate sampling distributions for the mean, using repeated sampling simulations from a given population. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.4.3 | Apply the Central Limit Theorem to solve problems. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.4.4 | Approximate confidence intervals for means using simulations of the distribution of the sample mean. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.4.5 | Find the equation of the least squares regression line for a set of data. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |

Standard 5: Interpreting Results

Gather data and determine confidence intervals to make inferences about means, and use hypothesis tests to make decisions. Learn to use data to approximate p-values and to determine whether correlations between variables are significant.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.S.5.1 | Analyze the relationship between confidence level, margin of error, and sample size. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.5.2 | Apply the general principles of hypothesis testing. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.5.3 | Explain and identify the following: null hypothesis, alternative hypotheses, Type I error, and Type II error. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.5.4 | Explain the meaning of p-value and its role in hypothesis testing. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.S.5.5 | Perform hypothesis tests of means and proportions for large samples, using simulations to determine whether a sample mean (proportion) has a low likelihood of occurring. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.5.6 | Interpret the results of hypothesis tests of means and proportions, and make decisions based on p-values of test. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.5.7 | Use simulations to approximate the p-value of a correlation coefficient, and use the results to determine whether the correlation between two variables is significant. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.S.5.8 | Use a regression line equation to make predictions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.S.5.9 | Interpret the coefficient of determination, r^2 , for a least-squares regression. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Body of Knowledge: TRIGONOMETRY

Standard 1: Trigonometric Functions

Extend the definitions of the trigonometric functions beyond right triangles using the unit circle, and measure angles in radians as well as degrees. Draw and analyze graphs of trigonometric functions (including finding period, amplitude, and phase shift), and use them to solve word problems. Define and graph inverse trigonometric functions, and determine values of both trigonometric and inverse trigonometric functions.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.T.1.1 | Convert between degree and radian measures. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.1.2 | Define and determine sine and cosine using the unit circle. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.1.3 | State and use exact values of trigonometric functions for special angles: multiples of $\frac{\pi}{6}$ |

| | |
|--------------|--|
| | $\frac{\pi}{4}$ and 4 (degree and radian measures). <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.T.1.4 | Find approximate values of trigonometric and inverse trigonometric functions using appropriate technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Low</i> |
| MA.912.T.1.5 | Make connections between right triangle ratios, trigonometric functions, and circular functions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.1.6 | Define and graph trigonometric functions using domain, range, intercepts, period, amplitude, phase shift, vertical shift, and asymptotes with and without the use of graphing technology. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.T.1.7 | Define and graph inverse trigonometric relations and functions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.1.8 | Solve real-world problems involving applications of trigonometric functions using graphing technology when appropriate. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 2: Trigonometry in Triangles

Understand how the trigonometric functions relate to right triangles, and solve word problems involving right and oblique triangles. Understand and apply the laws of sines and cosines. Use trigonometry to find the area of triangles.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.T.2.1 | Define and use the trigonometric ratios (sine, cosine, tangent, cotangent, secant, cosecant) in terms of angles of right triangles. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.2.2 | Solve real-world problems involving right triangles using technology when appropriate. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.T.2.3 | Apply the laws of sines and cosines to solve real-world problems using technology. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.T.2.4 | Use the area of triangles given two sides and an angle or three sides to solve real-world problems. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 3: Trigonometric Identities and Equations

Know basic trigonometric identities derived from definitions, and use them to prove other identities. Use the sum, difference, double-angle, and half-angle formulas. Solve trigonometric equations and word problems using trigonometry.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.T.3.1 | Verify the basic Pythagorean identities, such as $\sin^2 x + \cos^2 x = 1$, and show they are equivalent to the Pythagorean Theorem. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

| | |
|--------------|---|
| MA.912.T.3.2 | Use basic trigonometric identities to verify other identities and simplify expressions. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.3.3 | Use the sum and difference, half-angle and double-angle formulas for sine, cosine, and tangent, when formulas are provided. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.3.4 | Solve trigonometric equations and real-world problems involving applications of trigonometric equations using technology when appropriate. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |

Standard 4: Polar Coordinates and Trigonometric Form of Complex Numbers

Define, use polar coordinates, and relate them to Cartesian coordinates. Translate equations in terms of Cartesian coordinates into polar coordinates, and graph the resulting equations in the polar coordinate plane. Convert complex numbers from standard to trigonometric form, and vice-versa. Multiply complex numbers in trigonometric form, and use De Moivre's Theorem.

| BENCHMARK CODE | BENCHMARK |
|----------------|---|
| MA.912.T.4.1 | Define polar coordinates and relate polar coordinates to Cartesian coordinates with and without the use of technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.4.2 | Represent equations given in rectangular coordinates in terms of polar coordinates. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.4.3 | Graph equations in the polar coordinate plane with and without the use of graphing technology. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.4.4 | Define the trigonometric form of complex numbers, convert complex numbers to trigonometric form, and multiply complex numbers in trigonometric form. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.4.5 | Apply DeMoivre's Theorem to perform operations with complex numbers. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |

Standard 5: Mathematical Reasoning and Problem Solving

Use a variety of strategies to solve problems. Develop and evaluate mathematical arguments and proofs.

| BENCHMARK CODE | BENCHMARK |
|----------------|--|
| MA.912.T.5.1 | Use a variety of problem-solving strategies, such as drawing a diagram, guess-and-check, solving a simpler problem, examining simpler problems, and working backwards, using technology when appropriate. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |
| MA.912.T.5.2 | Decide whether a solution is reasonable in the context of the original situation. <i>Cognitive Complexity/Depth of Knowledge Rating: Moderate</i> |
| MA.912.T.5.3 | Determine whether a given trigonometric statement is always, sometimes, or never true. Use the properties of the real numbers, order of operations, and trigonometric identities to justify the steps involved in verifying identities and solving equations. <i>Cognitive Complexity/Depth of Knowledge Rating: High</i> |