Gwinnett’s curriculum for grades K–12 is called the Academic Knowledge and Skills (AKS). The AKS for each grade level spell out the essential things students are expected to know and be able to do in that grade or subject. The AKS offer a solid base on which teachers build rich learning experiences. Teachers use curriculum guides, textbooks, technology, and other materials to teach the AKS and to make sure every student is learning to his or her potential.

The Academic Knowledge and Skills (AKS) were developed by our teachers, with input from our parents and community, in response to Gwinnett County Public Schools’ mission statement:

*The mission of Gwinnett County Public Schools is to pursue excellence in academic knowledge, skills, and behavior for each student resulting in measured improvement against local, national, and world-class standards.*
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Kindergarten Mathematics

Mathematics

A - Counting and Cardinality
• count to 100 by ones and tens (CCGPS) (KMA_A2012-1/MCCK.CC.1)
• count forward by ones, beginning from a given number within the known sequence (instead of having to begin at 1) (CCGPS) (KMA_A2012-2/MCCK.CC.2)
• write numerals from 0 to 20 and represent a number of objects with a written numeral 0 - 20 with 0 representing a count of no objects (CCGPS) (KMA_A2012-3/MCCK.CC.3)
• demonstrate the relationship between numbers and quantities to 20; connect counting to cardinality (CCGPS) (KMA_A2012-4/MCCK.CC.4)
• count objects by stating number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object (CCGPS) (KMA_A2012-5/MCCK.CC.4_a)
• demonstrate that the last number name said tells the number of objects counted; the number of objects is the same regardless of their arrangement or the order in which they were counted (CCGPS) (KMA_A2012-6/MCCK.CC.4_b)
• demonstrate that each successive number name refers to a quantity that is one larger (CCGPS) (KMA_A2012-7/MCCK.CC.4_c)
• count to answer "how many?" questions about as many as 20 things arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration; given a number from 1-20, count out that many objects (CCGPS) (KMA_A2012-8/MCCK.CC.5)
• compare two sets of objects and identify which set is equal to, more than, or less than the other using matching and counting strategies (CCGPS) (KMA_A2012-10/MCCK.CC.6)
• compare two numbers between 1 and 10 presented as written numerals (CCGPS) (KMA_A2012-11/MCCK.CC.7)
• identify coins by name and value: pennies, nickels, dimes, quarters, and dollar bills (KMA_A2012-12)

B - Operations and Algebraic Thinking
• represent addition and subtraction with objects, fingers, mental images, drawings, sounds (e.g., claps) acting out situations, verbal explanations, expressions, or equations (CCGPS) (KMA_B2012-13/MCCK.OA.1)
• solve addition and subtraction word problems, and add and subtract within 10, e.g., by using objects or drawings, to represent the problem (CCGPS) (KMA_B2012-14/MCCK.OA.2)
• decompose numbers less than or equal to 10 into pairs in more than one way (e.g., by using objects or drawing), and record each decomposition by a drawing or equations (e.g., 5 = 2 + 3 and 5 = 4 + 1) (CCGPS) (KMA_B2012-15/MCCK.OA.3)
• find the number that makes 10 when added to the given number, for any number from 1 to 9 (e.g., by using objects or drawings, and record the answer with a drawing or equation) (CCGPS) (KMA_B2012-16/MCCK.OA.4)
• add and subtract within 5 fluently (CCGPS) (KMA_B2012-17/MCCK.OA.5)
• identify, create, extend, and transfer patterns from one representation to another using actions, objects, and geometric shapes (KMA_B2012-18)

C - Number and Operations in Base Ten
• compose and decompose numbers from 11 to 19 into ten ones and some further ones (e.g., by using objects or drawings), and record each composition or decomposition by a drawing or equation (e.g., 18 = 10 + 8); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones (CCGPS) (KMA_C2012-19/MCCK.NBT.1)
D - Measurement and Data

- describe several measureable attributes of an object, such as length or weight (CCGPS) (KMA_D2012-20/MCCK.MD.1)
- directly compare two objects on the basis of length (longer/shorter), capacity (more/less), height (taller/shorter), and weight (heavier/lighter) and describe the difference, e.g., directly compare the heights of two children and describe one child as taller/shorter (CCGPS) (KMA_D2012-21/MCCK.MD.2)
- classify objects into given categories; count the numbers of objects in each category and sort the categories by count(limit category counts to be less than or equal to 10) (CCGPS) (KMA_D2012-22/MCCK.MD.3)

E - Geometry

- describe objects in the environment using names of shapes and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to (CCGPS) (KMA_E2012-24/MCCK.G.1)
- name shapes correctly regardless of their orientations or overall size (CCGPS) (KMA_E2012-25/MCCK.G.2)
- classify shapes as two-dimensional (lying in a plane, "flat") or three-dimensional ("solid") (CCGPS) (KMA_E2012-26/MCCK.G.3)
- analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., number of sides and vertices/corners), and other attributes (e.g., having sides of equal length) (CCGPS) (KMA_E2012-27/MCCK.G.4)
- model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes (CCGPS) (KMA_E2012-28/MCCK.G.5)
- compose simple shapes to form larger shapes, e.g., "Can you join these two triangles with full sides touching to make a rectangle?" (CCGPS) (KMA_E2012-29/MCCK.G.6)
A - Operations and Algebraic Thinking

- use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing with unknowns in all positions (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem) (CCGPS) (1MA_A2012-1/MCC1.OA.1)
- solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20 (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem) (CCGPS) (1MA_A2012-2/MCC1.OA.2)
- explore and apply properties of operations as strategies to add and subtract (e.g., If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known (Commutative property of addition). To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12 (Associative property of addition) (CCGPS) (1MA_A2012-3/MCC1.OA.3)
- model and explain subtraction as an unknown-addend problem (e.g., subtract 10 - 8 by finding the number that makes 10 when added to 8) (CCGPS) (1MA_A2012-4/MCC1.OA.4)
- relate counting to addition and subtraction (e.g., by counting on 2 to add 2) (CCGPS) (1MA_A2012-5/MCC1.OA.5)
- add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 - 4 = 13 - 3 - 1 = 10 - 1 = 9); using the relationship between addition and subtraction (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13). (CCGPS) (1MA_A2012-6/MCC1.OA.6)
- model and explain the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. (e.g., which of the following equations are true and which are false? 6 = 6, 7 = 8 - 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2) (CCGPS) (1MA_A2012-7/MCC1.OA.7)
- determine the unknown whole number in an addition or subtraction equation relating to three whole numbers by using symbols (e.g., determine the unknown number that makes the equation true in each of the equations 8 + ? = 11; 5 = ___ - 3; 6 + 6 = ▲) (CCGPS) (1MA_A2012-9/MCC1.OA.8)

B - Number and Operations in Base Ten

- count to 120, starting at any number less than 120. In this range, read and write numerals and represent a number of objects with a written numeral (CCGPS) (1MA_B2012-10/MCC1.NBT.1)
- model and explain that a two-digit number represents amounts of tens and ones (CCGPS) (1MA_B2012-12/MCC1.NBT.2)
- explain that 10 can be thought of as a bundle of ten ones called a “ten” (CCGPS) (1MA_B2012-13/MCC1.NBT.2_a)
- model the numbers 11 to 19 showing they are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones (CCGPS) (1MA_B2012-14/MCC1.NBT.2_b)
- explain that the numbers 10, 20, 30, 40, 50, 60, 70, 80, and 90 refer to one, two, three, four, five, six, seven, eight, or nine tens and 0 ones (CCGPS) (1MA_B2012-15/MCC1.NBT.2_c)
- compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and < (CCGPS) (1MA_B2012-16/MCC1.NBT.3)
- add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten (CCGPS) (1MA_B2012-17/MCC1.NBT.4)
- using mental math strategies identify one more than, one less than, 10 more than, or 10 less than a given two-digit number explaining strategy used (CCGPS) (1MA_B2012-19/MCC1.NBT.5)
B - Number and Operations in Base Ten (continued)
• subtract multiples of 10 in the range 10 - 90 from multiples of 10 in the range 10 - 90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used (CCGPS) (1MA_B2012-20/MCC1.NBT.6)
• exchange equivalent quantities of coins by making fair trades involving combinations of pennies, nickels, dimes, and quarters and count out a combination needed to purchase items less than a dollar (1MA_B2012-21)

C - Measurement and Data
• order the length of three objects; compare the lengths of two objects by using direct comparison or a third object (CCGPS) (1MA_C2012-22/MCC1.MD.1)
• express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps (CCGPS) (1MA_C2012-23/MCC1.MD.2)
• tell and write time to the nearest hour and half-hour using analog and digital clocks (CCGPS) (1MA_C2012-24/MCC1.MD.3)
• organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another (CCGPS) (1MA_C2012-25/MCC1.MD.4)

D - Geometry
• distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes (CCGPS) (1MA_D2012-27/MCC1.G.1)
• compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape and to compose new shapes from the composite shape (CCGPS) (1MA_D2012-28/MCC1.G.2)
• partition circles and rectangles into two and four equal shares, describe the shares using the words halves, fourths, and quarters, and use the phrases half of, fourth of, and quarter of. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares (CCGPS) (1MA_D2012-29/MCC1.G.3)
A - Operations and Algebraic Thinking

- use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing with unknowns in all positions. (e.g., by using drawings and equations with a symbol for the unknown number to represent the problem) (CCGPS)
(2MA_A2012-1/MCC2.OA.1)

- fluently add and subtract within 20 using mental strategies. By the end of Grade 2, know from memory all sums of two one-digit numbers (CCGPS) (2MA_A2012-2/MCC2.OA.2)

- determine whether a group of objects (up to 20) has an odd or even number of members. e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends (CCGPS) (2MA_A2012-4/MCC2.OA.3)

- apply the use of repeated addition (skip counting), model arrays up to 5 rows and 5 columns to determine a total number of objects, and write an equation to express the total as a sum of two equal addends (CCGPS) (2MA_A2012-6/MCC2.OA.4)

B - Number and Operations in Base Ten

- explain that the three digits of a three-digit number represent amounts of hundreds, tens, and ones (e.g., 706 equals 7 hundreds, 0 tens, and 6 ones) (CCGPS) (2MA_B2012-7/MCC2.NBT.1)

- explain that 100 can be thought of as a bundle of ten tens, called a “hundred” (CCGPS)
(2MA_B2012-8/MCC2.NBT.1_a)

- explain the numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones) (CCGPS) (2MA_B2012-9/MCC2.NBT.1_b)

- count within 1000; skip-count by 5s, 10s, and 100s (CCGPS) (2MA_B2012-10/MCC2.NBT.2)

- read, write, and represent numbers to 1000 using a variety of models, diagrams and base ten numerals including standard and expanded form (CCGPS) (2MA_B2012-11/MCC2.NBT.3)

- compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >,=,and< symbols to record the results of comparisons (CCGPS) (2MA_B2012-12/MCC2.NBT.4)

- add and subtract fluently within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction (CCGPS) (2MA_B2012-13/MCC2.NBT.5)

- add up to four two-digit numbers using strategies based on place value and properties of operations (CCGPS) (2MA_B2012-14/MCC2.NBT.6)

- add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds (CCGPS) (2MA_B2012-15/MCC2.NBT.7)

- use mental math strategies to add and subtract 10 or 100 to a given number between 100-900 (CCGPS) (2MA_B2012-16/MCC2.NBT.8)

- explain why addition and subtraction strategies work using place value and the properties of operations (CCGPS) (2MA_B2012-17/MCC2.NBT.9)

C - Measurement and Data

- measure length by determining, selecting and using an appropriate tool (rulers, yardsticks, meter sticks, measuring tapes) and unit (in., ft., yd., cm, m) (CCGPS) (2MA_C2012-18/MCC2.MD.1)

- compare and explain the relationship of inches, feet, yards, centimeters and meters by measuring an object twice using different units (CCGPS) (2MA_C2012-19/MCC2.MD.2)

- estimate lengths using units of inches, feet, yards, centimeters and meters, then measure to determine if estimations were reasonable (CCGPS) (2MA_C2012-20/MCC2.MD.3)
C - Measurement and Data (continued)

- measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit (relate addition and subtraction to length) (CCGPS) (2MA_C2012-21/MCC2.MD.4)
- solve word problems using addition and subtraction within 100 involving lengths of like units by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem (CCGPS) (2MA_C2012-22/MCC2.MD.5)
- represent whole numbers as lengths from 0 on a number line with equally spaced points corresponding to the numbers 0, 1, 2, ..., and represent whole-number sums and differences within 100 on a number line diagram (CCGPS) (2MA_C2012-23/MCC2.MD.6)
- use analog and digital clocks to tell and write time to the nearest five minutes using AM and PM (CCGPS) (2MA_C2012-24/MCC2.MD.7)
- solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately (e.g., if you have 2 dimes and 3 pennies, how many cents do you have?) (CCGPS) (2MA_C2012-25/MCC2.MD.8)
- generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units (CCGPS) (2MA_C2012-26/MCC2.MD.9)
- draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph (CCGPS) (2MA_C2012-27/MCC2.MD.10)

D - Geometry

- recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces and identify triangles, quadrilaterals, pentagons, hexagons, and cubes (CCGPS) (2MA_D2012-29/MCC2.G.1)
- partition a rectangle into rows and columns of same-size squares and count to find the total number of them (CCGPS) (2MA_D2012-30/MCC2.G.2/MCC2.G.3)
- partition circles and rectangles into two, three, or four equal shares, describe the shares using the words halves, thirds, half of, a third of, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape (CCGPS) (2MA_D2012-31/MCC2.G.2)
Mathematics

A - Operations and Algebraic Thinking
• interpret products of whole numbers, [e.g., interpret 5 x 7 as the total number of objects in 5 groups of 7 objects each (e.g.,
describe a context in which a total number of objects can be expressed as 5 x 7)] (CCGPS)
(3MA_A2012-1/MCC3.OA.1)
• interpret whole-number quotients of whole numbers, e.g., interpret 56 ÷ 8 as the number of objects in each share when 56
objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8
objects each (e.g., describe a context in which a number of shares or a number of groups can be expressed as 56 ÷ 8) (CCGPS)
(3MA_A2012-2/MCC3.OA.2)
• apply multiplication and division (products or dividends 0 - 100) to solve word problems in situations involving equal groups,
arrays and measurement quantities (e.g., by using drawings and equations with a symbol for the unknown number to represent
the problem) (CCGPS) (3MA_A2012-3/MCC3.OA.3)
• determine the unknown whole number in a multiplication or division equation relating three whole numbers (e.g., determine
the unknown number that makes the equation true in each of the equations 8 x ? = 48; 5 = ■ ÷ 3, 6 x 6 = ▲) (CCGPS)
(3MA_A2012-4/MCC3.OA.4)
• apply commutative, associative, and distributive properties as strategies to multiply and divide (e.g., If 6 x 4 = 24 is known, then
4 x 6 = 24 is also known (commutative property of multiplication); 3 x 5 x 2 can be found by 3 x 5 = 15, then 15 x 2 = 30, or by 5
x 2 = 10, then 3 x 10 = 30 (Associative property of multiplication), knowing that 8 x 5 = 40 and 8 x 2 = 16, then one can find 8 x
7 as 8 x (5 + 2) = (8 x 5) + (8 x 2) = 40 + 16 = 56 (Distributive Property)) (CCGPS) (3MA_A2012-5/MCC3.OA.5)
• understand division as an unknown-factor problem (e.g., find 32 ÷ 8 by finding the number that makes 32 when multiplied by
8) (CCGPS) (3MA_A2012-6/MCC3.OA.6)
• fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g.,
knowing that 8 x 5 = 40, one knows 40 ÷ 5 = 8, or properties of operations) By the end of Grade 3, know from memory all
products of two one-digit numbers (CCGPS) (3MA_A2012-7/MCC3.OA.7)
• solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the
unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including
rounding (CCGPS) (3MA_A2012-8/MCC3.OA.8)
• identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties
of operation (e.g., observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two
equal addends) (CCGPS) (3MA_A2012-10/MCC3.OA.9)

B - Number and Operations in Base Ten
• use place value understanding to round whole numbers to the nearest 10 or 100 (CCGPS)
(3MA_B2012-12/MCC3.NBT.1)
• add and subtract fluently within 1000 using strategies and algorithms based on place value, properties of operations, and/or the
relationship between addition and subtraction (CCGPS) (3MA_B2012-13/MCC3.NBT.2)
• multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 x 80, 5 x 60) using strategies based on place value
and properties of operations (CCGPS) (3MA_B2012-14/MCC3.NBT.3)
3rd Grade Mathematics

C - Number and Operations: Fractions

• understand a fraction 1/b as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts of size 1/b (CCGPS) (3MA_C2012-15/MCC3.NF.1)

• recognize a fraction as a number on the number line; represent fractions on a number line diagram (CCGPS) (3MA_C2012-17/MCC3.NF.2)

• represent a fraction 1/b on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into “b” equal parts; recognize that each part has size 1/b and that the endpoint of the part based at 0 locates the number 1/b on the number line (CCGPS) (3MA_C2012-18/MCC3.NF.2_a)

• represent a fraction a/b on a number line diagram by marking off “a” lengths 1/b from 0 and recognize that the resulting interval has size a/b and that its endpoint locates the number a/b on the number line (CCGPS) (3MA_C2012-19/MCC3.NF.2_b)

• explain equivalence of fractions in special cases and compare fractions by reasoning about their size (CCGPS) (3MA_C2012-20/MCC3.NF.3)

• recognize two fractions as equivalent (equal) if they are the same size or the same point on a number line (CCGPS) (3MA_C2012-21/MCC3.NF.3_a)

• recognize and generate simple equivalent fractions (e.g., 1/2 = 2/4, 4/6 = 2/3); explain why the fractions are equivalent by using a visual fraction model (CCGPS) (3MA_C2012-22/MCC3.NF.3_b)

• express whole numbers as fractions and recognize fractions that are equivalent to whole numbers (e.g., express 3 in the form 3 = 3/1; recognize that 6/1 = 6; locate 4/4 and 1 at the same point of a number line diagram) (CCGPS) (3MA_C2012-23/MCC3.NF.3_c)

• compare two fractions with the same numerator or the same denominator by reasoning about their size; recognize that comparisons are valid only when the two fractions refer to the same whole and record the results of comparisons with the symbols >, =, or <, and justify the conclusions (e.g., by using a visual fraction model) (CCGPS) (3MA_C2012-24/MCC3.NF.3_d)

D - Measurement and Data

• tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram (CCGPS) (3MA_D2012-25/MCC3.MD.1)

• measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem (CCGPS) (3MA_D2012-27/MCC3.MD.2)

• draw a scaled picture graph and a scaled bar graph to represent a data set with several categories; solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs (e.g., draw a bar graph in which each square in the bar graph might represent 5 pets) (CCGPS) (3MA_D2012-29/MCC3.MD.5)

• generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units - whole numbers, halves, or quarters (CCGPS) (3MA_D2012-30/MCC3.MD.4)

• recognize area as an attribute of plane figures and understand concepts of area measurement (CCGPS) (3MA_D2012-32/MCC3.MD.5)

• use words, pictures and/or numbers to show that “unit square” is a square with a side length of 1 unit, has an area of one square unit, and can be used to measure area of plane figures (CCGPS) (3MA_D2012-33/MCC3.MD.5_a)

• demonstrate that a plane figure which can be covered without gaps or overlaps by “n” unit squares is said to have an area of “n” square units (CCGPS) (3MA_D2012-34/MCC3.MD.5_b)

• measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units) (CCGPS) (3MA_D2012-35/MCC3.MD.6)
3rd Grade Mathematics

**D - Measurement and Data (continued)**
- relate area to the operations of multiplication and addition (CCGPS) (3MA_D2012-36/MCC3.MD.7)
- find the area of a rectangle with whole-number side lengths by tiling it and show that the area is the same as would be found by multiplying the side lengths (CCGPS) (3MA_D2012-37/MCC3.MD.7_a)
- multiply side lengths to find areas of rectangles with whole number side lengths in the context of solving real world and mathematical problems and represent whole-number products as rectangular areas in mathematical reasoning (CCGPS) (3MA_D2012-38/MCC3.MD.7_b)
- use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and b + c is the sum of a x b and a x c; use area models to represent the distributive property in mathematical reasoning (CCGPS) (3MA_D2012-39/MCC3.MD.7_c)
- recognize area as additive; find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems (CCGPS) (3MA_D2012-40/MCC3.MD.7_d)
- solve real world and mathematical problems involving the perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeters and different areas or the same areas with different perimeters (CCGPS) (3MA_D2012-41/MCC3.MD.8)

**E - Geometry**
- understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories (CCGPS) (3MA_E2012-42/MCC3.G.1)
- partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole (e.g., partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape) (CCGPS) (3MA_E2012-44/MCC3.G.2)

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A - Operations and Algebraic Thinking

- explain a multiplication equation as a comparison and represent verbal statements of multiplicative comparisons as multiplication equations (e.g., interpret 35 = 5 x 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5) (CCGPS) (4MA_A2012-1/MCC4.OA.1)
- solve multiplication and division word problems involving multiplicative comparison using drawings and equations (e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison) (CCGPS) (4MA_A2012-2/MCC4.OA.2)
- solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding (CCGPS) (4MA_A2012-3/MCC4.OA.3)
- find all factor pairs for a whole number in the range 1 - 100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1 - 100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1 - 100 is prime or composite (CCGPS) (4MA_A2012-6/MCC4.OA.4)
- generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself (e.g., given the rule “Add 3” and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way) (CCGPS) (4MA_A2012-8/MCC4.OA.5)

B - Number and Operations in Base Ten

- explain that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right (e.g., recognize that 700 ÷ 70 = 10 by applying concepts of place value and division) (CCGPS) (4MA_B2012-9/MCC4.NBT.1)
- read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons (CCGPS) (4MA_B2012-10/MCC4.NBT.2)
- use place value understanding to round whole numbers to any place using tools such as a number line and/or charts (CCGPS) (4MA_B2012-12/MCC4.NBT.3)
- add and subtract multi-digit whole numbers fluently using the standard algorithm (CCGPS) (4MA_B2012-13/MCC4.NBT.4)
- multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain multiplication calculations by using equations, rectangular arrays, and/or area models (CCGPS) (4MA_B2012-14/MCC4.NBT.5)
- find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models (CCGPS) (4MA_B2012-16/MCC4.NBT.6)
C - Number and Operations: Fractions

- explain why a fraction a/b is equivalent to a fraction (n x a/n x b) by using visual fraction models with attention to how the number and size of the parts differ even though the two fractions themselves are the same size; use this principle to recognize and generate equivalent fractions (CCGPS) (4MA_C2012-18/MCC4.NF.1)
- compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model (CCGPS) (4MA_C2012-19/MCC4.NF.2)
- recognize that a fraction a/b with a > 1 as a sum of fractions 1/b (CCGPS) (4MA_C2012-21/MCC4.NF.3)
- model and explain addition and subtraction of fractions as joining and separating parts referring to the same whole (CCGPS) (4MA_C2012-22/MCC4.NF.3_a)
- decompose a fraction, by using a visual fraction model, into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation and justify reasoning using visual fraction models (e.g., 3/8 = 1/8 + 1/8 + 1/8; 3/8 = 1/8 + 2/8; 2 1/8 = 1 + 1 + 1/8; 8/8 = 7/8 + 1/8) (CCGPS) (4MA_C2012-23/MCC4.NF.3_b)
- add and subtract mixed numbers with like denominators (e.g., by replacing each mixed number with an equivalent fraction and/or by using properties of operations and the relationship between addition and subtraction) (CCGPS) (4MA_C2012-24/MCC4.NF.3_c)
- solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators by using visual fraction models and equations to represent the problem (CCGPS) (4MA_C2012-25/MCC4.NF.3_d)
- apply and extend previous understanding of multiplication to multiply a fraction by a whole number (CCGPS) (4MA_C2012-26/MCC4.NF.4)
- recognize a fraction a/b as a multiple of 1/b (e.g., use a visual fraction model to represent 5/4 as the product 5 x (1/4), recording the conclusion by the equation 5/4 = 5 x (1/4)) (CCGPS) (4MA_C2012-27/MCC4.NF.4_a)
- understand a multiple of a/b as a multiple of 1/b, and use this understanding to multiply a fraction by a whole number (e.g., use a visual fraction model to express 3 x (2/5) as 6 x (1/5), recognizing this product as 6/5; (In general, n x (a/b) = (n x a)/b)) (CCGPS) (4MA_C2012-28/MCC4.NF.4_b)
- solve word problems involving multiplication of a fraction by a whole number (e.g., by using visual fraction models and equations to represent the problem. For example, if each person at a party will eat 3/8 of a pound of roast beef and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?) (CCGPS) (4MA_C2012-29/MCC4.NF.4_c)
- express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100 (e.g., express 3/10 as 30/100 and add 3/10 + 4/100 = 34/100) (CCGPS) (4MA_C2012-30/MCC4.NF.5)
- use decimal notation for fractions with denominators 10 or 100 (e.g., rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram) (CCGPS) (4MA_C2012-31/MCC4.NF.6)
- compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual model (CCGPS) (4MA_C2012-32/MCC4.NF.7)
D - Measurement and Data
• know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec.
Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. (e.g., know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2,24), (3, 36),... (CCGPS) (4MA_D2012-33/MCC4.MD.1)
• use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale (CCGPS) (4MA_D2012-36/MCC4.MD.2)
• apply the area and perimeter formulas for rectangles in real world and mathematical problems (e.g., find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor) (CCGPS) (4MA_D2012-38/MCC4.MD.3)
• make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8) Solve problems involving addition and subtraction of fractions by using information presented in line plots (e.g., from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection) (CCGPS) (4MA_D2012-39/MCC4.MD.4)

E - Geometry
• recognize angles as geometric shapes that are formed wherever two rays share a common endpoint and understand concepts of angle measurement (CCGPS) (4MA_E2012-40/MCC4.MD.5)
• recognize that an angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle; an angle that turns through 1/360 of a circle is called a “one-degree angle”, and can be used to measure angles (CCGPS) (4MA_E2012-41/MCC4.MD.5_a)
• recognize that an angle that turns through “n” one-degree angles is said to have an angle measure of “n” degrees (CCGPS) (4MA_E2012-42/MCC4.MD.5_b)
• measure and draw angles using tools such as a protractor or angle ruler (CCGPS) (4MA_E2012-43/MCC4.MD.6)
• recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure (CCGPS) (4MA_E2012-44/MCC4.MD.7)
• draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines and identify these in two-dimensional figures (CCGPS) (4MA_E2012-46/MCC4.G.1)
• classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles (CCGPS) (4MA_E2012-47/MCC4.G.2)
• recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry (CCGPS) (4MA_E2012-49/MCC4.G.3)
A - Operations and Algebraic Thinking

• use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols (CCGPS) (5MA_A2012-1/MCC5.OA.1)

• write simple expressions that record calculations with numbers and interpret numerical expressions without evaluating them (e.g., express the calculation “add 8 and 7, then multiply by 2” as 2 x (8 + 7)) and recognize that 3 x (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product (CCGPS) (5MA_A2012-2/MCC5.OA.2)

• generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane (e.g., given the rule “Add 3” and the starting number 0, and given the rule “Add 6” and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so) (CCGPS) (5MA_A2012-3/MCC5.OA.3)

B - Number and Operations in Base Ten

• recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left (CCGPS) (5MA_B2012-4/MCC5.NBT.1)

• explain patterns in the number of zeros of the product when multiplying a number by powers of 10 and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10; use whole-number exponents to denote powers of 10 (CCGPS) (5MA_B2012-5/MCC5.NBT.2)

• read, write, order, and compare place value of decimals to thousandths using base ten numerals, number names, and expanded form (e.g., 347.392 = 3 x 100 + 4 x 10 + 7 x 1 + 3 x (1/10) + 9 x (1/100) + 2 x (1/1000)) (CCGPS) (5MA_B2012-6/MCC5.NBT.3a)

• compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons (CCGPS) (5MA_B2012-7/MCC5.NBT.3_b)

• use place value understanding to round decimals to any place (CCGPS) (5MA_B2012-8/MCC5.NBT.4)

• multiply multi-digit whole numbers fluently using the standard algorithm (CCGPS) (5MA_B2012-9/MCC5.NBT.5)

• find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models (CCGPS) (5MA_B2012-10/MCC5.NBT.6)

• add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used (CCGPS) (5MA_B2012-12/MCC5.NBT.7)
5th Grade Mathematics

C - Number and Operations: Fractions

- add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators (e.g., \(2/3 + 5/4 = 8/12 + 15/12 = 23/12\)) (CCGPS) (5MA_C2012-13/MCC5.NF.1)
- solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers (e.g., recognize an incorrect result \(2/5 + 1/2 = 3/7\), by observing that \(3/7 < 1/2\)) (CCGPS) (5MA_C2012-14/MCC5.NF.2)
- interpret a fraction as division of the numerator by the denominator \((a/b = a ÷ b)\). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem (e.g., interpret \(3/4\) as the result of dividing \(3\) by \(4\), noting that \(3/4\) multiplied by \(4\) equals \(3\), and that when \(3\) wholes are shared equally among \(4\) people each person has a share of size \(3/4\). If \(9\) people want to share a \(50\)-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?) (CCGPS) (5MA_C2012-16/MCC5.NF.3)
- apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction (CCGPS) (5MA_C2012-18/MCC5.NF.4)
- interpret the product \((a/b) \times q\) as a parts of a partition of \(q\) into \(b\) equal parts; equivalently, as the result of a sequence of operations \(a \times q ÷ b\) (e.g., use a visual fraction model to show \((2/3) \times 4 = 8/3\) and create a story context for this equation; do the same with \((2/3) \times (4/5) = 8/15\) (In general, \((a/b) \times (c/d) = ac/bd\)) (CCGPS) (5MA_C2012-19/MCC5.NF.4_a)
- find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas (CCGPS) (5MA_C2012-20/MCC5.NF.4_b)
- relate the principle of fraction equivalence, \(a/b = (n \times a)/(n \times b)\), to the effect of multiplying \(a/b\) by \(1\) (CCGPS) (5MA_C2012-21/MCC5.NF.5)
- interpret multiplication as scaling by comparing the size of the product to the sizes of the factors without multiplying (CCGPS) (5MA_C2012-22/MCC5.NF.5_a)
- explain why multiplying a given number by a fraction greater than \(1\) results in a product greater than the given number and why multiplying a given number by a fraction less than \(1\) results in a product smaller than the given number (CCGPS) (5MA_C2012-23/MCC5.NF.5_b)
- solve real world problems involving multiplication of fractions and mixed numbers by using visual fraction models or equations to represent the problem (CCGPS) (5MA_C2012-24/MCC5.NF.6)
- interpret division of a unit fraction by a non-zero whole number and compute such quotients (e.g., create a story context for \((1/3) ÷ 4\) and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that \((1/3) ÷ 4 = 1/12\) because \((1/12) \times 4 = 1/3\)) (CCGPS) (5MA_C2012-25/MCC5.NF.7_a)
- apply and extend previous understanding of division to interpret the quotient of a whole number by a unit fraction and compute such quotients (e.g., create a story context for \(4 ÷ (1/5)\) and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that \(4 ÷ (1/5) = 20\) because \(20 \times (1/5) = 4\)) (CCGPS) (5MA_C2012-26/MCC5.NF.7_b)
- solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions e.g., by using visual fraction models and equations to represent the problem. (For example, how much chocolate will each person get if \(3\) people share \(1/2\) lb of chocolate equally? How many \(1/3\)-cup servings are in \(2\) cups of raisins?) (CCGPS) (5MA_C2012-27/MCC5.NF.7_c)
D - Measurement and Data

- convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multi-step, real world problems (e.g., convert 5 cm to 0.05 m) (5MA_D2012-28/MCC5.MD.1)
- make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8) and solve problems using the line plot data, e.g., given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally (CCGPS) (5MA_D2012-29/MCC5.MD.2)
- use words, pictures, or numbers to show a cubic unit is represented by a cube in which each edge has a length of one unit (CCGPS) (5MA_D2012-30/MCC5.MD.3/MCC5.MD.3_a)
- apply concepts of volume measurement to explain volume as an attribute of solid figures packed without gaps or overlaps using “n” unit cubes (CCGPS) (5MA_D2012-31/MCC5.MD.3_b)
- measure volume as cubic centimeters, cubic meters, cubic inches, cubic feet and improvised units (CCGPS) (5MA_D2012-32/MCC5.MD.4)
- relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume (CCGPS) (5MA_D2012-33/MCC5.MD.5)
- find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base and represent threefold number products as volumes; associative property (CCGPS) (5MA_D2012-34/MCC5.MD.5_a)
- estimate, derive and apply the formula (V = l x w x h and V = b x h) for the volume of a cube and a right rectangular prism using manipulatives and relate volume to the operations of multiplication and addition to solve real world and mathematical problems (CCGPS) (5MA_D2012-35/MCC5.MD.5_b)
- recognize and calculate volume as additive when volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems (CCGPS) (5MA_D2012-36/MCC5.MD.5_c)

E - Geometry

- create, label, and use a coordinate grid system (CCGPS) (5MA_E2012-37/MCC5.G.1)
- represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation (CCGPS) (5MA_E2012-38/MCC5.G.2)
- demonstrate that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category (e.g., all rectangles have four right angles and squares are rectangles so all squares have four right angles) (CCGPS) (5MA_E2012-39/MCC5.G.3)
- classify two-dimensional figures in a hierarchy based on properties (CCGPS) (5MA_E2012-40/MCC5.G.4)
A - Ratio and Proportional Relationships

- explain the meaning of and use ratio language to describe a ratio relationship between two quantities (e.g., “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”) (CCGPS) (6MA_A2012-1/MCC6.RP.1)
- explain the concept of a unit rate a/b associated with a ratio a:b with b≠0, and use rate language in the context of a ratio relationship (e.g., “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar.” “We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger.”) (CCGPS) (6MA_A2012-2/MCC6.RP.2)
- use ratio and rate reasoning to solve real world and mathematical problems (e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations) (CCGPS) (6MA_A2012-3/MCC6.RP.3)
- make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane (use tables to compare ratios) (CCGPS) (6MA_A2012-4/MCC6.RP.3_a)
- solve unit rate problems including those involving unit pricing and constant speed (e.g., if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?) (CCGPS) (6MA_A2012-5/MCC6.RP.3_b)
- find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole given a part and the percent (CCGPS) (6MA_A2012-6/MCC6.RP.3_c)
- use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities (CCGPS) (6MA_A2012-7/MCC6.RP.3_d)

B - The Number System

- Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. (e.g., create a story context for (2/3)/(3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3)/(3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b)/(c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi? (CCGPS) (6MA_B2012-8/MCC6.NS.1)
- fluently divide multi-digit numbers using the standard algorithm (CCGPS) (6MA_B2012-9/MCC6.NS.2 MCC6.NS.3)
- find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1-100 with a common factor as a multiple of a sum of two whole numbers with no common factor; e.g., express 36 + 8 as 4(9 + 2) (CCGPS) (6MA_B2012-10/MCC6.NS.4)
- understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, debits/credits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation (CCGPS) (6MA_B2012-13/MCC6.NS.5)
- recognize that a rational number is a point on the number line; extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates (CCGPS) (6MA_B2012-15/MCC6.NS.6)
- recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself (e.g., -(-3) = 3, and that 0 is its own opposite) (CCGPS) (6MA_B2012-16/MCC6.NS.6_a)
B - The Number System (continued)

- Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes (CCGPS) (6MA_B2012-17/MCC6.NS.6_b)
- Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane (CCGPS) (6MA_B2012-18/MCC6.NS.6_c)
- Understand ordering and absolute value of rational numbers (CCGPS) (6MA_B2012-19/MCC6.NS.7)
- Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram (e.g., interpret -3 > -7 as a statement that -3 is located to the right of -7 on a number line oriented from left to right) (CCGPS) (6MA_B2012-20/MCC6.NS.7_a)
- Write, interpret, and explain statements of order for rational numbers in real-world contexts (e.g., write -3° C is warmer than -7° C) (CCGPS) (6MA_B2012-21/MCC6.NS.7_b)
- Recognize the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation (e.g., for an account balance of -30 dollars, write |-30| = 30 to describe the size of the debt in dollars) (CCGPS) (6MA_B2012-22/MCC6.NS.7_c)
- Distinguish comparisons of absolute value from statements about order (e.g., for an account balance of -30 dollars, write |-30| = 30 to describe the size of the debt in dollars) (CCGPS) (6MA_B2012-23/MCC6.NS.7_d)
- Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane; include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate (CCGPS) (6MA_B2012-24/MCC6.NS.8)
- Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation (CCGPS) (6MA_B2013-49/MCC6.NS.2/MCC6.NS.3)

C - Expressions and Equations

- Write and evaluate numerical expressions involving whole-number exponents by applying order of operations (CCGPS) (6MA_C2012-25/MCC6.EE.1)
- Write, read, and evaluate expressions in which letters stand for numbers (CCGPS) (6MA_C2012-26/MCC6.EE.2)
- Write expressions that record operations with numbers and with letters standing for numbers (e.g., express the calculation “Subtract y from 5” as 5 - y) (CCGPS) (6MA_C2012-27/MCC6.EE.2_a)
- Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity (e.g., describe the expression 2(8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms) (CCGPS) (6MA_C2012-28/MCC6.EE.2_b)
- Evaluate expressions at specific values for their variables (include expressions that arise from formulas in real-world problems; perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations) (e.g., use the formulas V = s^3 and A = 6s^2 to find the volume and surface area of a cube with sides of length s = 1/2) (CCGPS) (6MA_C2012-29/MCC6.EE.2_c)
- Apply the properties of operations to generate equivalent expressions e.g., apply the distributive property to the expression 3(2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6(4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y (CCGPS) (6MA_C2012-30/MCC6.EE.3)
C - Expressions and Equations (continued)

- identify when two expressions are equivalent (e.g., when the two expressions name the same number regardless of which value is substituted into them) (CCGPS) (6MA_C2012-31/MCC6.EE.4)
- understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true (CCGPS) (6MA_C2012-32/MCC6.EE.5)
- use variables to represent numbers and write expressions when solving a real world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set (CCGPS) (6MA_C2012-33/MCC6.EE.6)
- solve real world and mathematical problems by writing and solving equations of the form \( x + p = q \) and \( px = q \) for cases in which \( p, q \) and \( x \) are all nonnegative rational numbers (CCGPS) (6MA_C2012-34/MCC6.EE.7)
- write an inequality of the form \( x > c \) or \( x < c \) to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form \( x > c \) or \( x < c \) have infinitely many solutions; represent solutions of such inequalities on number line diagrams (CCGPS) (6MA_C2012-35/MCC6.EE.8)
- use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and related these to the equation (e.g., in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation \( d = 65t \) to represent the relationship between distance and time) (CCGPS) (6MA_C2012-37/MCC6.EE.9)

D - Geometry

- find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real world and mathematical problems (CCGPS) (6MA_D2012-38/MCC6.G.1)
- find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths and show that the volume is the same as would be found by multiplying the edge lengths of the prism; apply the formulas \( V = lwh \) and \( V = bh \) to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real world and mathematical problems (CCGPS) (6MA_D2012-39/MCC6.G.2)
- draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems (CCGPS) (6MA_D2012-40/MCC6.G.3)
- represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems (CCGPS) (6MA_D2012-42/MCC6.G.4)

E - Statistics and Probability

- recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers (e.g., “How old am I?” is not a statistical question, but “How old are the students in my school?” is a statistical question because one anticipates variability in students’ ages) (CCGPS) (6MA_E2012-44/MCC6.SP.1)
- describe and analyze a set of data collected to answer a statistical question based on measures of central tendency, identifying the center, spread, and overall shape of the distribution (CCGPS) (6MA_E2012-45/MCC6.SP.2)
- contrast a measure of center with a measure of variation for a numerical set (CCGPS) (6MA_E2012-46/MCC6.SP.3)
- display, read, and analyze data using appropriate graphs, including box-and-whisker plots, scatter plots, histograms, and line plots (CCGPS) (6MA_E2012-47/MCC6.SP.4)
E - Statistics and Probability (continued)

- summarize numerical data sets in relation to their context such as by reporting the number of observations; describing the nature of the attribute under investigation, including how it was measured and its units of measurement; giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation) as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data was gathered; relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data was gathered (CCGPS) (6MA_E2012-48/MCC6.SP.5)

6th Grade Accelerated Math

A - Ratio and Proportional Relationships

- explain the meaning of and use ratio language to describe a ratio relationship between two quantities (e.g., “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”) (CCGPS) (6MAS_A2012-1/MCC6.RP.1)
- explain the concept of a unit rate a/b associated with a ratio a:b with b≠0, and use rate language in the context of a ratio relationship (e.g., “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar.” “We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger.”) (CCGPS) (6MAS_A2012-2/MCC6.RP.2)
- use ratio and rate reasoning to solve real world and mathematical problems (e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations) (CCGPS) (6MAS_A2012-3/MCC6.RP.3)
- make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane (use tables to compare ratios) (CCGPS) (6MAS_A2012-4/MCC6.RP.3_a)
- solve unit rate problems including those involving unit pricing and constant speed (e.g., if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?) (CCGPS) (6MAS_A2012-5/MCC6.RP.3_b)
- find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole given a part and the percent (CCGPS) (6MAS_A2012-6/MCC6.RP.3_c)
- use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities (CCGPS) (6MAS_A2012-7/MCC6.RP.3_d)
- compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units (e.g., if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction (1/2)/(1/4) miles per hour, equivalently 2 miles per hour) (CCGPS) (6MAS_A2012-8/MCC7.RP.1)
- recognize and represent proportional relationships between quantities (CCGPS) (6MAS_A2012-9/MCC7.RP.2)
- determine whether two quantities are in a proportional relationship (e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin) (CCGPS) (6MAS_A2012-10/MCC7.RP.2_a)
- identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships (CCGPS) (6MAS_A2012-11/MCC7.RP.2_b)
- represent proportional relationships by equations (e.g., if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn) (CCGPS) (6MAS_A2012-12/MCC7.RP.2_c)
- explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate (CCGPS) (6MAS_A2012-13/MCC7.RP.2_d)
A - Ratio and Proportional Relationships (continued)

- use proportional relationships to solve multi-step ratio and percent problems (ex. simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error) (CCGPS) (6MAS_A2012-14/MCC7.RP.3)

B - The Number System

- interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. (e.g., create a story context for \((2/3)/(3/4)\) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that \((2/3)/(3/4) = 8/9\) because \(3/4 \times 8/9 = 2/3\). (In general, \((a/b)/(c/d) = ad/bc\).) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?) (CCGPS) (6MAS_B2012-15/MCC6.NS.1)
- fluently divide multi-digit numbers using the standard algorithm (CCGPS) (6MAS_B2012-16/MCC6.NS.2/MCC6.NS.3)
- find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1-100 with a common factor as a multiple of a sum of two whole numbers with no common factor; e.g., express 36 + 8 as 4(9 + 2) (CCGPS) (6MAS_B2012-17/MCC6.NS.4)
- understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, debits/credits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation (CCGPS) (6MAS_B2012-20/MCC6.NS.5)
- recognize that a rational number is a point on the number line; extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates (CCGPS) (6MAS_B2012-22/MCC6.NS.6)
- recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself (e.g., \(-(-3) = 3\), and that 0 is its own opposite) (CCGPS) (6MAS_B2012-23/MCC6.NS.6_a)
- understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes (CCGPS) (6MAS_B2012-24/MCC6.NS.6_b)
- find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane (CCGPS) (6MAS_B2012-25/MCC6.NS.6_c)
- understand ordering and absolute value of rational numbers (CCGPS) (6MAS_B2012-26/MCC6.NS.7)
- interpret statements of inequality as statements about the relative position of two numbers on a number line diagram (e.g., interpret \(-3 > -7\) as a statement that \(-3\) is located to the right of \(-7\) on a number line oriented from left to right) (CCGPS) (6MAS_B2012-27/MCC6.NS.7_a)
- write, interpret, and explain statements of order for rational numbers in real world contexts (e.g., write \(-3^\circ C\) is warmer than \(-7^\circ C\) (CCGPS) (6MAS_B2012-28/MCC6.NS.7_b)
- recognize the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation (e.g., for an account balance of \(-30\) dollars, write \(|-30| = 30\) to describe the size of the debt in dollars) (CCGPS) (6MAS_B2012-29/MCC6.NS.7_c)
- distinguish comparisons of absolute value from statements about order (e.g., for an account balance of \(-30\) dollars, write \(|-30| = 30\) to describe the size of the debt in dollars) (CCGPS) (6MAS_B2012-30/MCC6.NS.7_d)
- solve real world and mathematical problems by graphing points in all four quadrants of the coordinate plane; include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate (CCGPS) (6MAS_B2012-31/MCC6.NS.8)
B - The Number System (continued)

- apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram (CCGPS) (6MAS_B2012-32/MCC7.NS.1
- Describe situations in which opposite quantities combine to make 0 (e.g., a hydrogen atom has 0 charge because its two constituents are oppositely charged) (CCGPS) (6MAS_B2012-33/MCC7.NS.1_a)
- identify p + q as the number located a distance (|q|) from p, in the positive or negative direction depending on whether q is positive or negative; show that a number and its opposite have a sum of 0 (are additive inverses); interpret sums of rational numbers by describing real-world contexts (CCGPS) (6MAS_B2012-34/MCC7.NS.1_b)
- identify subtraction of rational numbers as adding the additive inverse, p - q = p + (-q); show that the distance between two rational numbers on the number line is the absolute value of their difference and apply this principle in real-world contexts (CCGPS) (6MAS_B2012-35/MCC7.NS.1_c)
- apply properties of operations as strategies to add and subtract rational numbers (CCGPS) (6MAS_B2012-36/MCC7.NS.1_d)
- apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers (CCGPS) (6MAS_B2012-37/MCC7.NS.2)
- recognize that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (-1)(-1) = 1 and the rules for multiplying signed numbers; interpret products of rational numbers by describing real-world contexts (CCGPS) (6MAS_B2012-38/MCC7.NS.2_a)
- recognize that integers can be divided, provided that the divisor is not zero and every quotient of integers (with non-zero divisor) is a rational number (if p and q are integers, then -(p/q) = (-p)/q = p/(-q)); interpret quotients of rational numbers by describing real world contexts (CCGPS) (6MAS_B2012-39/MCC7.NS.2_b)
- apply properties of operations as strategies to multiply and divide rational numbers (CCGPS) (6MAS_B2012-40/MCC7.NS.2_c)
- convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats (CCGPS) (6MAS_B2012-41/MCC7.NS.2_d)
- solve real-world and mathematical problems involving the four operations with rational numbers (CCGPS) (6MAS_B2012-42/MCC7.NS.3)
- fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation (CCGPS) (6MAS_B2013-76/MCC6.NS.2MCC6.NS.3)

C - Expressions and Equations

- write and evaluate numerical expressions involving whole-number exponents by applying order of operations (CCGPS) (6MAS_C2012-43/MCC6.EE.1)
- write, read, and evaluate expressions in which letters stand for numbers (CCGPS) (6MAS_C2012-44/MCC6.EE.2)
- write expressions that record operations with numbers and with letters standing for numbers (e.g., express the calculation “Subtract y from 5” as 5 - y) (CCGPS) (6MAS_C2012-45/MCC6.EE.2_a)
- identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity (e.g., describe the expression 2(8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms) (CCGPS) (6MAS_C2012-46/MCC6.EE.2_b)
- evaluate expressions at specific values for their variables (include expressions that arise from formulas in real-world problems; perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations) ( e.g., use the formulas V = s^3 and A = 6s^2 to find the volume and surface area of a cube with sides of length s = 1/2) (CCGPS) (6MAS_C2012-47/MCC6.EE.2_c)
apply the properties of operations to generate equivalent expressions e.g., apply the distributive property to the expression $3(2 + x)$ to produce the equivalent expression $6 + 3x$; apply the distributive property to the expression $24x + 18y$ to produce the equivalent expression $6(4x + 3y)$; apply properties of operations to $y + y + y$ to produce the equivalent expression $3y$ (CCGPS) (6MAS_C2012-48/MCC6.EE.3)

identify when two expressions are equivalent (e.g., when the two expressions name the same number regardless of which value is substituted into them) (CCGPS) (6MAS_C2012-49/MCC6.EE.4)

understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true (CCGPS) (6MAS_C2012-50/MCC6.EE.5)

use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set (CCGPS) (6MAS_C2012-51/MCC6.EE.6)

solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which $p$, $q$, and $x$ are all nonnegative rational numbers (CCGPS) (6MAS_C2012-52/MCC6.EE.7)

write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams (CCGPS) (6MAS_C2012-53/MCC6.EE.8)

use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and related these to the equation (e.g., in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time) (CCGPS) (6MAS_C2012-55/MCC6.EE.9)

apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients (CCGPS) (6MAS_C2012-56/MCC7.EE.1)

understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related (e.g., a + 0.05a means that “increase by 5%” is the same as “multiply by 1.05”) (CCGPS) (6MAS_C2012-57/MCC7.EE.2)

solve multi-step real life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations as strategies to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies (e.g., If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation) (CCGPS) (6MAS_C2012-58/MCC7.EE.3)

use variables to represent quantities in a real world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities (CCGPS) (6MAS_C2012-60/MCC7.EE.4)

solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where $p$, $q$, and $r$ are specific rational numbers and solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution identifying the sequence of the operations used in each approach (e.g., the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?) (CCGPS) (6MAS_C2012-61/MCC7.EE.4_a)

solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where $p$, $q$, $r$ are specific rational numbers; graph the solution set of the inequality and interpret it in the context of the problem (e.g., as a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions) (CCGPS) (6MAS_C2012-63/MCC7.EE.4_b)
D - Geometry

- find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real world and mathematical problems (CCGPS) (6MAS_D2012-64/MCC6.G.1)

- find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths and show that the volume is the same as would be found by multiplying the edge lengths of the prism; apply the formulas $V = lwh$ and $V = bh$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real world and mathematical problems (CCGPS) (6MAS_D2012-65/MCC6.G.2)

- draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems (CCGPS) (6MAS_D2012-66/MCC6.G.3)

- represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems (CCGPS) (6MAS_D2012-68/MCC6.G.4)

- solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale (CCGPS) (6MAS_D2012-70/MCC7.G.1)

E - Statistics and Probability

- recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers (e.g., “How old am I?” is not a statistical question, but “How old are the students in my school?” is a statistical question because one anticipates variability in students’ ages) (CCGPS) (6MAS_E2012-71/MCC6.SP.1)

- describe and analyze a set of data collected to answer a statistical question based on measures of central tendency, identifying the center, spread, and overall shape of the distribution (CCGPS) (6MAS_E2012-72/MCC6.SP.2)

- contrast a measure of center with a measure of variation for a numerical set (CCGPS) (6MAS_E2012-73/MCC6.SP.3)

- display, read, and analyze data using appropriate graphs, including box-and-whisker plots, scatter plots, histograms, and line plots (CCGPS) (6MAS_E2012-74/MCC6.SP.4)

- summarize numerical data sets in relation to their context such as by reporting the number of observations; describing the nature of the attribute under investigation, including how it was measured and its units of measurement; giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation) as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data was gathered; relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data was gathered (CCGPS) (6MAS_E2012-75/MCC6.SP.5)
A - Ratio and Proportional Relationships
- compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units (e.g., if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction (1/2)/(1/4) miles per hour, equivalently 2 miles per hour) (CCGPS) (7MA_A2012-1/MCC7.RP.1)
- recognize and represent proportional relationships between quantities (CCGPS) (7MA_A2012-2/MCC7.RP.2)
- determine whether two quantities are in a proportional relationship (e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin) (CCGPS) (7MA_A2012-3/MCC7.RP.2_a)
- identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships (CCGPS) (7MA_A2012-4/MCC7.RP.2_b)
- represent proportional relationships by equations (e.g., if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn) (CCGPS) (7MA_A2012-5/MCC7.RP.2_c)
- explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate (CCGPS) (7MA_A2012-6/MCC7.RP.2_d)
- use proportional relationships to solve multi-step ratio and percent problems (ex. simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error) (CCGPS) (7MA_A2012-7/MCC7.RP.3)

B - The Number System
- apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram (CCGPS) (7MA_B2012-8/MCC7.NS.1)
- Describe situations in which opposite quantities combine to make 0 (e.g., a hydrogen atom has 0 charge because its two constituents are oppositely charged) (CCGPS) (7MA_B2012-9/MCC7.NS.1_a)
- identify p + q as the number located a distance (|q|) from p, in the positive or negative direction depending on whether q is positive or negative; show that a number and its opposite have a sum of 0 (are additive inverses); interpret sums of rational numbers by describing real-world contexts (CCGPS) (7MA_B2012-10/MCC7.NS.1_b)
- identify subtraction of rational numbers as adding the additive inverse, p - q = p + (-q); show that the distance between two rational numbers on the number line is the absolute value of their difference and apply this principle in real-world contexts (CCGPS) (7MA_B2012-11/MCC7.NS.1_c)
- apply properties of operations as strategies to add and subtract rational numbers (CCGPS) (7MA_B2012-12/MCC7.NS.1_d)
- apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers (CCGPS) (7MA_B2012-13/MCC7.NS.2)
- recognize that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (-1)(-1) = 1 and the rules for multiplying signed numbers; interpret products of rational numbers by describing real-world contexts (CCGPS) (7MA_B2012-14/MCC7.NS.2_a)
- recognize that integers can be divided, provided that the divisor is not zero and every quotient of integers (with non-zero divisor) is a rational number (if p and q are integers, then - (p/q) = (-p)/q = p/(-q)); interpret quotients of rational numbers by describing real world contexts (CCGPS) (7MA_B2012-15/MCC7.NS.2_b)
- apply properties of operations as strategies to multiply and divide rational numbers (CCGPS) (7MA_B2012-16/MCC7.NS.2_c)
7th Grade Mathematics

B- The Number System (continued)
- convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats (CCGPS) (7MA_B2012-17/MCC7.NS.2_d)
- solve real-world and mathematical problems involving the four operations with rational numbers (CCGPS) (7MA_B2012-18/MCC7.NS.3)

C - Expressions and Equations
- apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients (CCGPS) (7MA_C2012-19/MCC7.EE.1)
- understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related (e.g., a + 0.05a means that “increase by 5%” is the same as “multiply by 1.05”) (CCGPS) (7MA_C2012-20/MCC7.EE.2)
- solve multi-step real life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations as strategies to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies (e.g., If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation) (CCGPS) (7MA_C2012-21/MCC7.EE.3)
- use variables to represent quantities in a real world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities (CCGPS) (7MA_C2012-23/MCC7.EE.4)
- solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers and solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution identifying the sequence of the operations used in each approach (e.g., the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?) (CCGPS) (7MA_C2012-24/MCC7.EE.4_a)
- solve word problems leading to inequalities of the form px + q > r or px + q < r, where p, q, r are specific rational numbers; graph the solution set of the inequality and interpret it in the context of the problem (e.g., as a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions) (CCGPS) (7MA_C2012-26/MCC7.EE.4_b)

D - Geometry
- solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale (CCGPS) (7MA_D2012-27/MCC7.G.1)
- draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle (CCGPS) (7MA_D2012-28/MCC7.G.2)
- describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids (CCGPS) (7MA_D2012-29/MCC7.G.3)
- know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle (CCGPS) (7MA_D2012-30/MCC7.G.4)
- write and solve equations for an unknown angle in a figure using facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem (CCGPS) (7MA_D2012-33/MCC7.G.5)
7th Grade Mathematics

D - Geometry (continued)

- solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms (CCGPS)
  (7MA_D2012-34/MCC7.G.6)

E - Statistics and Probability

- understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences (CCGPS) (7MA_E2012-36/MCC7.SP.1)
  - generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. Draw inferences from a random sample about a population with an unknown characteristic of interest. Compare and contrast multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions (e.g., estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be) (CCGPS) (7MA_E2012-37/MCC7.SP.2)
  - compare and contrast the degree of visual overlap of two numerical data distributions with similar variabilities, informally measuring the difference between the centers by expressing it as a multiple of a measure of variability (mean absolute deviation) (e.g., the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable) (CCGPS) (7MA_E2012-40/MCC7.SP.3)
  - use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations (e.g., decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book) (CCGPS) (7MA_E2012-41/MCC7.SP.4)
  - understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event (CCGPS) (7MA_E2012-42/MCC7.SP.5)
  - approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability (e.g., when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times) (CCGPS) (7MA_E2012-43/MCC7.SP.6)
  - develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy (CCGPS) (7MA_E2012-44/MCC7.SP.7)
  - develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events (e.g., if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected) (CCGPS) (7MA_E2012-46/MCC7.SP.7_a)
  - develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process (e.g., find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?) (CCGPS) (7MA_E2012-47/MCC7.SP.7_b)
  - determine the probability of compound simple events using organized lists, tables, tree diagrams, and simulation (CCGPS) (7MA_E2012-48/MCC7.SP.8)
  - explain that a compound event is the fraction of outcomes in the sample space for which the compound event occurs (CCGPS) (7MA_E2012-49/MCC7.SP.8_a)
  - represent sample spaces using tree diagrams, lists, simulations, and tables to identify the outcomes in the sample space which compose the event; for an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event (CCGPS) (7MA_E2012-50/MCC7.SP.8_b)
E - Statistics and Probability (continued)
• design and use simulation to generate frequencies for compound events (e.g., use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?) (CCGPS) (7MA_E2012-51/MCC7.SP.8_c)

7th Grade Accelerated Math

A - The Number System
• know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number (CCGPS) (7MAS_A2012-1/MCC8.NS.1)
• use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., $\pi^2$). For example, by truncating the decimal expansion of $\sqrt{2}$ (square root of 2), show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations (CCGPS) (7MAS_A2012-2/MCC8.NS.2)

B - Expressions and Equations
• apply and know the properties of integer exponents to generate equivalent numerical expressions e.g., $3^2 \times 3(-5) = 3(-³) = \frac{1}{3^3} = 1/27$ (CCGPS) (7MAS_B2012-3/MCC8.EE.1)
• use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where $p$ is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational (CCGPS) (7MAS_B2012-4/MCC8.EE.2)
• use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other (e.g., estimate the population of the United States as 3 x 108 and the population of the world as 7 x 109, and determine that the world population is more than 20 times larger) (CCGPS) (7MAS_B2012-5/MCC8.EE.3)
• perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Interpret and use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading) (Interpret scientific notation that has been generated by technology) (CCGPS) (7MAS_B2012-7/MCC8.EE.4)
• graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways (e.g., compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed) (CCGPS) (7MAS_B2012-9/MCC8.EE.5)
• determine the meaning of slope by using similar right triangles to explain why the slope $m$ is the same between any two distinct points on a non-vertical line in the coordinate plane. Derive and graph linear equations in slope intercept form $y = mx + b$ (CCGPS) (7MAS_B2012-11/MCC8.EE.6)
• derive and graph linear equations in slope intercept form $y = mx + b$ (CCGPS) (7MAS_B2012-12/MCC8.EE.6)
• give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where $a$ and $b$ are different numbers) (CCGPS) (7MAS_B2012-13/MCC8.EE.7_a)
• solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and combining like terms (CCGPS) (7MAS_B2012-14/MCC8.EE.7_b)
• analyze and solve pairs of simultaneous linear equations (CCGPS) (7MAS_B2012-15/MCC8.EE.8)
B – Expressions and Equations (continued)

- understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously (CCGPS) (7MAS_B2012-16/MCC8.EE.8_a)
- solve systems of two linear equations in two variables algebraically and estimate solutions by graphing the equations; solve simple cases by inspection (e.g., $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6) (CCGPS) (7MAS_B2012-17/MCC8.EE.8_b)
- solve real world mathematical problems leading to two linear equations in two variables (e.g., given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair) (CCGPS) (7MAS_B2012-18/MCC8.EE.8_c)

C - Functions

- understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output (CCGPS) (7MAS_C2012-19/MCC8.F.1)
- describe functions in a variety of representations, including the graph of a function that is the set of ordered pairs consisting of an input and the corresponding output (CCGPS) (7MAS_C2012-20/MCC8.F.1)
- compare properties of two functions each represented among verbal, tabular, graphic and algebraic representations of functions (CCGPS) (7MAS_C2012-21/MCC8.F.2)
- interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line; give examples of functions that are not linear (e.g., the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1, 1), (2, 4) and (3, 9), which are not on a straight line) (CCGPS) (7MAS_C2012-22/MCC8.F.3)
- construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two $(x,y)$ values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values (CCGPS) (7MAS_C2012-23/MCC8.F.4)
- describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally (CCGPS) (7MAS_C2012-25/MCC8.F.5)
- simplify, add, subtract, multiply, and divide radical expressions to include rationalizing denominators (7MAS_C2012-27)

D - Geometry

- construct (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions, including constructing triangles from three measures of angles or sides and determining which measurements produce a unique triangle, more than one triangle, or no triangle (CCGPS) (7MAS_D2012-28/MCC7.G.2)
- describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids (CCGPS) (7MAS_D2012-29/MCC7.G.3)
- know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle (CCGPS) (7MAS_D2012-30/MCC7.G.4)
- write and solve equations for an unknown angle in a figure using facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem (CCGPS) (7MAS_D2012-33/MCC7.G.5)
- solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms (CCGPS) (7MAS_D2012-34/MCC7.G.6)
D – Geometry (continued)
• verify experimentally the properties of rotations, reflections, and translations:
  o a. Lines are taken to lines, and line segments to line segments of the same length
  o b. Angles are taken to angles of the same measure
  o c. Parallel lines are taken to parallel lines (CCGPS) (7MAS_D2012-36/MCC8.G.1)
• understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections and translations; given two congruent figures, describe a sequence that exhibits the congruence between them (CCGPS) (7MAS_D2012-37/MCC8.G.2)
• describe the effect of dilations, translations, rotations and reflections on two-dimensional figures using coordinates (CCGPS) (7MAS_D2012-39/MCC8.G.3)
• understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them (CCGPS) (7MAS_D2012-40/MCC8.G.4)
• use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.( e.g., arrange three copies of the same triangle so that the three angles appear to form a line, and give an argument in terms of transversals why this is so) (CCGPS) (7MAS_D2012-42/MCC8.G.5)
• explain a proof of the Pythagorean Theorem and its converse (CCGPS) (7MAS_D2012-44/MCC8.G.6)
• apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions (CCGPS) (7MAS_D2012-45/MCC8.G.7)
• explain and apply the distance formula as an application of the Pythagorean Theorem (CCGPS) (7MAS_D2012-46/MCC8.G.8)
• solve real world and mathematical problems involving the volume of cylinders, cones and spheres (CCGPS) (7MAS_D2012-47/MCC8.G.9)

E - Statistics and Probability
• understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences (CCGPS) (7MAS_E2012-48/MCC7.SP.1)
• generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. Draw inferences from a random sample about a population with an unknown characteristic of interest. Compare and contrast multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions (e.g., estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be) (CCGPS) (7MAS_E2012-49/MCC7.SP.2)
• compare and contrast the degree of visual overlap of two numerical data distributions with similar variabilities, informally measuring the difference between the centers by expressing it as a multiple of a measure of variability (mean absolute deviation) (e.g., the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable) (CCGPS) (7MAS_E2012-52/MCC7.SP.3)
• use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations (e.g., decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book) (CCGPS) (7MAS_E2012-53/MCC7.SP.4)
• understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event (CCGPS) (7MAS_E2012-54/MCC7.SP.5)
E - Statistics and Probability (continued)

- explain how experimental probability approaches theoretical probability when the number of trials is large (e.g., when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times) (CCGPS) (7MAS_E2012-55/MCC7.SP.6)

- conduct trials/simulations and analyze the relationship between experimental and theoretical probability. Compare probabilities from a model to observed frequencies and explain possible sources of discrepancy, if present. (CCGPS) (7MAS_E2012-56/MCC7.SP.7)

- develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events (e.g., if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected) (CCGPS) (7MAS_E2012-58/MCC7.SP.7_a)

- develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process (e.g., find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?) (CCGPS) (7MAS_E2012-59/MCC7.SP.7_b)

- determine the probability of compound simple events using organized lists, tables, tree diagrams, and simulation (CCGPS) (7MAS_E2012-60/MCC7.SP.8)

- explain that a compound event is the fraction of outcomes in the sample space for which the compound event occurs (CCGPS) (7MAS_E2012-61/MCC7.SP.8_a)

- represent sample spaces using tree diagrams, lists, simulations, and tables to identify the outcomes in the sample space which compose the event; for an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space which compose the event (CCGPS) (7MAS_E2012-62/MCC7.SP.8_b)

- design and use simulation to generate frequencies for compound events (CCGPS) (7MAS_E2012-63/MCC7.SP.8_c)

- construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association (CCGPS) (7MAS_E2012-64/MCC8.SP.1)

- know that straight lines are widely used to model relationships between two quantitative variables.

- For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line (CCGPS) (7MAS_E2012-67/MCC8.SP.2)

- apply the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting slope and intercept (e.g., in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height) (CCGPS) (7MAS_E2012-68/MCC8.SP.3)

- recognize that patterns of association can be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables (e.g., collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?) (CCGPS) (7MAS_E2012-69/MCC8.SP.4)
Math 8

A - The Number System
- know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number (CCGPS) (8MA_A2012-1/MCC8.NS.1)
- use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (CCGPS) (8MA_A2012-2/MCC8.NS.2)

B - Expressions and Equations
- apply and know the properties of integer exponents to generate equivalent numerical expressions (CCGPS) (8MA_B2012-3/MCC8.EE.1)
- use square root and cube root symbols to represent solutions to equations of the form \( x^2 = p \) and \( x^3 = p \), where \( p \) is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that \( \sqrt{2} \) is irrational (CCGPS) (8MA_B2012-4/MCC8.EE.2)
- express and use numbers in scientific notation to estimate very large or very small numbers. Compare numbers in scientific notation and determine how many times greater one value is than the other (CCGPS) (8MA_B2012-5/MCC8.EE.3)
- perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Interpret and use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading) (Interpret scientific notation that has been generated by technology) (CCGPS) (8MA_B2012-7/MCC8.EE.4)
- graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways (e.g., compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed) (CCGPS) (8MA_B2012-9/MCC8.EE.5)
- determine the meaning of slope by using similar right triangles to explain why the slope \( m \) is the same between any two distinct points on a non-vertical line in the coordinate plane. Derive and graph linear equations in slope intercept form \( y = mx + b \) (CCGPS) (8MA_B2012-11/MCC8.EE.6)
- solve linear equations both algebraically and graphically, including examples of linear equations in one variable with one solution, infinitely many solutions or no solutions (e.g., equivalent equation of the form \( x = a \), \( a = a \), or \( a = b \) results (where \( a \) and \( b \) are different numbers)) (CCGPS) (8MA_B2012-13/MCC8.EE.7/MCC8.EE.7_a)
- solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and combining like terms (CCGPS) (8MA_B2012-14/MCC8.EE.7_b)
- solve systems of equations algebraically and estimate solutions by graphing the equations (CCGPS) (8MA_B2012-15/MCC8.EE.8)
- correspond points of intersection of graphs to solutions to a system of two linear equations in two variables because points of intersection satisfy both equations simultaneously (CCGPS) (8MA_B2012-16/MCC8.EE.8_a)
- solve systems of two linear equations in two variables algebraically and estimate solutions by graphing the equations; solve simple cases by inspection (e.g., \( 3x + 2y = 5 \) and \( 3x + 2y = 6 \) have no solution because \( 3x + 2y \) cannot simultaneously be 5 and 6) (CCGPS) (8MA_B2012-17/MCC8.EE.8_b)
- solve real world mathematical problems leading to two linear equations in two variables (e.g., given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair) (CCGPS) (8MA_B2012-18/MCC8.EE.8_c)
C - Functions

- understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output (CCGPS) (8MA_C2012-19/MCC8.F.1)

- compare properties of two functions each represented among verbal, tabular, graphic and algebraic representations of functions (e.g., given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change) (CCGPS) (8MA_C2012-21/MCC8.F.2)

- interpret the equation \( y = mx + b \) as defining a linear function whose graph is a straight line; give examples of functions that are not linear (e.g., the function \( A = s^2 \) giving the area of a square as a function of its side length is not linear because its graph contains the points \((1, 1), (2, 4)\) and \((3, 9)\), which are not on a straight line) (CCGPS) (8MA_C2012-22/MCC8.F.3)

- Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two \((x, y)\) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. (CCGPS) (8MA_C2012-23/MCC8.F.4)

- describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally (CCGPS) (8MA_C2012-25/MCC8.F.5)

- simplify, add, subtract, multiply, and divide radical expressions to include rationalizing denominators (8MA_C2012-27)

D - Geometry

- verify experimentally the properties of rotations, reflections, and translations:
  - a. Lines are taken to lines, and line segments to line segments of the same length
  - b. Angles are taken to angles of the same measure
  - c. Parallel lines are taken to parallel lines (CCGPS) (8MA_D2012-28/MCC8.G.1)

- understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections and translations; given two congruent figures, describe a sequence that exhibits the congruence between them (CCGPS) (8MA_D2012-29/MCC8.G.2)

- describe the effect of dilations, translations, rotations and reflections on two-dimensional figures using coordinates (CCGPS) (8MA_D2012-31/MCC8.G.3)

- recognize that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations and dilations. Describe a sequence of transformations, that when given, proves similarity between two figures (CCGPS) (8MA_D2012-32/MCC8.G.4)

- use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the three angles appear to form a line, and give an argument in terms of transversals why this is so (CCGPS) (8MA_D2012-34/MCC8.G.5)

- explain a proof of the Pythagorean Theorem and its converse (CCGPS) (8MA_D2012-36/MCC8.G.6)

- apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. (CCGPS) (8MA_D2012-37/MCC8.G.7)

- apply the Pythagorean Theorem to find the distance between two points in a coordinate system (CCGPS) (8MA_D2012-38/MCC8.G.8)

- solve real world and mathematical problems involving the volume of cylinders, cones and spheres (CCGPS) (8MA_D2012-39/MCC8.G.9)
**E - Statistics and Probability**

- construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association (CCGPS) (8MA_E2012-40/MCC8.SP.1)
- know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line (CCGPS) (8MA_E2012-43/MCC8.SP.2)
- apply the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting slope and intercept (e.g., in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height) (CCGPS) (8MA_E2012-44/MCC8.SP.3)
- recognize that patterns of association can be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables (e.g., collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?) (CCGPS) (8MA_E2012-45/MCC8.SP.4)

**8th Grade Algebra I**

**A - The Number System**

- know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number (CCGPS) (8MA1_A2012-1/MCC8.NS.1)
- use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π2) (e.g., by truncating the decimal expansion of √2 (square root of 2), show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations) (CCGPS) (8MA1_A2012-2/MCC8.NS.2)

**B - Expressions and Equations**

- apply and know the properties of integer exponents to generate equivalent numerical expressions e.g., 3² x 3(-5) = 3(-³) = 1/(3³)=1/27 (CCGPS) (8MA1_B2012-3/MCC8.EE.1)
- use square root and cube root symbols to represent solutions to equations of the form x² = p and x³ = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational (CCGPS) (8MA1_B2012-4/MCC8.EE.2)
- express and use numbers in scientific notation to estimate very large or very small numbers. Compare numbers in scientific notation and determine how many times greater one value is than the other (e.g., estimate the population of the United States as 3 x 108 and the population of the world as 7 x 109, and determine that the world population is more than 20 times larger) (CCGPS) (8MA1_B2012-5/MCC8.EE.3)
- perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Interpret and use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading) (Interpret scientific notation that has been generated by technology) (CCGPS) (8MA1_B2012-7/MCC8.EE.4)
B - Expressions and Equations (continued)

- Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented as verbal, tabular, graphic and algebraic representations of functions (e.g., compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed) (CCGPS) (8MA1_B2012-9/MCC8.EE.5)

- determine the meaning of slope by using similar right triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane. Derive and graph linear equations in slope intercept form $y = mx + b$ (CCGPS) (8MA1_B2012-11/MCC8.EE.6)

- solve linear equations both algebraically and graphically, including examples of linear equations in one variable with one solution, infinitely many solutions or no solutions [(e.g., equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where $a$ and $b$ are different numbers))] (CCGPS) (8MA1_B2012-13/MCC8.EE.7/MCC8.EE.7_a)

- solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and combining/collecting like terms (CCGPS) (8MA1_B2012-14/MCC8.EE.7_b)

- analyze and solve pairs of simultaneous linear equations (CCGPS) (8MA1_B2012-15/MCC8.EE.8)

- understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously (CCGPS) (8MA1_B2012-16/MCC8.EE.8_a)

- solve systems of two linear equations in two variables algebraically and estimate solutions by graphing the equations; solve simple cases by inspection (e.g., $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6) (CCGPS) (8MA1_B2012-17/MCC8.EE.8_b)

- solve real world mathematical problems leading to two linear equations in two variables (e.g., given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair) (CCGPS) (8MA1_B2012-18/MCC8.EE.8_c)

- rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations (Limit to formulas with a linear focus) e.g., rearrange Ohm’s law $V=IR$ to highlight resistance $R$ (CCGPS) (8MA1_B2012-19/MCC9-12.CED.4)

C - Functions

- understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output (CCGPS) (8MA1_C2012-20/MCC8.F.1)

- compare properties of two functions each represented among verbal, tabular, graphic and algebraic representations of functions (e.g., given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change) (CCGPS) (8MA1_C2012-22/MCC8.F.2)

- interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line; give examples of functions that are not linear (e.g., the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points $(1, 1), (2, 4)$ and $(3, 9)$, which are not on a straight line) (CCGPS) (8MA1_C2012-23/MCC8.F.3)

- construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two $(x, y)$ values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. (CCGPS) (8MA1_C2012-24/MCC8.F.4)

- describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally (CCGPS) (8MA1_C2012-26/MCC8.F.5)

- simplify, add, subtract, multiply, and divide radical expressions to include rationalizing denominators (CCGPS) (8MA1_C2012-28)
C – Functions (continued)

- understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range [(e.g., if f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x; the graph of f is the graph of the equation y = f(x). (Draw examples from linear and exponential functions.)] (CCGPS) (8MA1_C2012-29/MCC9-12.F.IF.1)
- evaluate functions for inputs in their domains using function notation and interpret statements that use function notation in terms of a context (Draw examples from linear and exponential functions) (CCGPS) (8MA1_C2012-30/MCC9-12.F.IF.2)
- calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval; estimate the rate of change from a graph (Focus on linear functions and intervals for exponential functions whose domain is a subset of the integers) (CCGPS) (8MA1_C2012-31/MCC9-12.F.IF.6)
- identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them (CCGPS) (8MA1_C2012-32/MCC9-12.BF.3)

D - Geometry

- verify experimentally the properties of rotations, reflections, and translations:
  a. Lines are taken to lines, and line segments to line segments of the same length
  b. Angles are taken to angles of the same measure
  c. Parallel lines are taken to parallel lines (CCGPS) (8MA1_D2012-33/MCC8.G.1)
- recognize a two-dimensional figure as congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations describe a sequence of transformations, that when given, proves congruences between two figures (CCGPS) (8MA1_D2012-34/MCC8.G.2)
- describe the effect of dilations, translations, rotations and reflections on two-dimensional figures using coordinates (CCGPS) (8MA1_D2012-36/MCC8.G.3)
- compute perimeters of polygons and areas of triangles and rectangles using coordinates including the use of the distance formula (CCGPS) (8MA1_D2012-37/MCC9-12.GPE.7)
- recognize that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations and dilations. Describe a sequence of transformations, that when given, proves similarity between two figures (CCGPS) (8MA1_D2012-38/MCC8.G.4)
- Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the three angles appear to form a line, and give an argument in terms of transversals why this is so (CCGPS) (8MA1_D2012-40/MCC8.G.5)
- explain a proof of the Pythagorean Theorem and its converse (CCGPS) (8MA1_D2012-42/MCC8.G.6)
- apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. (CCGPS) (8MA1_D2012-43/MCC8.G.7)
- apply the Pythagorean Theorem to find the distance between two points in a coordinate system (CCGPS) (8MA1_D2012-44/MCC8.G.8)
- solve real world and mathematical problems involving the volume of cylinders, cones and spheres (CCGPS) (8MA1_D2012-45/MCC8.G.9)
E - Statistics and Probability

• construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association (CCGSPS) (8MA1_E2012-46/MCC8.SP.1)

• know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line (CCGSPS) (8MA1_E2012-49/MCC8.SP.2)

• apply the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting slope and intercept (e.g., in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height) (CCGSPS) (8MA1_E2012-50/MCC8.SP.3)

• recognize that patterns of association can be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables (e.g., collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?) (CCGSPS) (8MA1_E2012-51/MCC8.SP.4)
A - Algebra

- interpret expressions that represent a quantity in terms of its context (Emphasis on linear expressions and exponential expressions with integer exponents.) (CCGPS) (MAL1_A2012-1/MCC9-12.SSE.1)
- interpret parts of an expression such as terms, factors, and coefficients (Emphasis on linear expressions and exponential expressions with integer exponents.) (CCGPS) (MAL1_A2012-2/MCC9-12.SSE.1_a)
- interpret complicated expressions by viewing one or more of their parts as a single entity (Emphasis on linear expressions and exponential expressions with integer exponents.) (CCGPS) (MAL1_A2012-3/MCC9-12.SSE.1_b)
- create equations and inequalities in one variable and use them to solve problems (Include equations arising from linear and exponential functions) (CCGPS) (MAL1_A2012-4/MCC9-12.CED.1)
- create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales (Limit to linear and exponential equations and in the case of exponential equations, limit to situations requiring evaluation of exponential functions at integer inputs) (CCGPS) (MAL1_A2012-5/MCC9-12.CED.2)
- represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context [e.g., represent inequalities describing nutritional and cost constraints on combinations of different foods (Limit to linear equations and inequalities.)] (CCGPS) (MAL1_A2012-6/MCC9-12.CED.3)
- rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations (Limit to formulas with a linear focus.) (CCGPS) (MAL1_A2012-7/MCC9-12.CED.4)
- explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution; construct a viable argument to justify a solution method. (Students should focus on and master linear equations and be able to extend and apply their reasoning to other types of equations in future courses.) (CCGPS) (MAL1_A2012-8/MCC9-12.REI.1)
- solve linear equations and inequalities in one variable, including equations with coefficients represented by letters (Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for. Include simple exponential equations that rely only on application of the laws of exponents, such as $5^a = 125$ or $2^a = 1/16$) (CCGPS) (MAL1_A2012-9/MCC9-12.REI.3)
- solve a system of two equations in two variables using elimination and substitution methods (Limit to linear systems.) (CCGPS) (MAL1_A2012-10/MCC9-12.REI.5)
- solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables (CCGPS) (MAL1_A2012-11/MCC9-12.REI.6)
- demonstrate that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line) (CCGPS) (MAL1_A2012-12/MCC9-12.REI.10)
- explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations; include cases where $f(x)$ and/or $g(x)$ are linear, exponential, functions (CCGPS) (MAL1_A2012-13/MCC9-12.REI.11)
- graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes (CCGPS) (MAL1_A2012-14/MCC9-12.REI.12)

B - Statistics and Probability

- create graphical representations of data on a number line (including dot plots, histograms, and box plots) (CCGPS) (MAL1_B2012-15/MCC9-12.ID.1)
- use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range) of two or more different data sets (CCGPS) (MAL1_B2012-16/MCC9-12.ID.2)
B - Statistics and Probability (continued)

- interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers) (CCGPS) (MAL1_B2012-17/MCC9-12.ID.3)
- interpret relative frequencies in context of the data including joint, marginal, and conditional relative frequencies (CCGPS) (MAL1_B2012-18/MCC9-12.ID.5)
- summarize categorical data for two categories in two-way frequency tables and recognize possible associations and trends in the data (CCGPS) (MAL1_B2012-19/MCC9-12.ID.5)
- represent data on two quantitative variables on a scatter plot and describe how the variables are related (CCGPS) (MAL1_B2012-20/MCC9-12.ID.6)
- fit a function to data; use functions fitted to data to solve problems in the context of the data emphasizing linear and exponential models (CCGPS) (MAL1_B2012-21/MCC9-12.ID.6_a)
- assess informally the fit of a function by plotting and analyzing residuals (CCGPS) (MAL1_B2012-22/MCC9-12.ID.6_b)
- fit a linear function for a scatter plot that suggests a linear association (CCGPS) (MAL1_B2012-23/MCC9-12.ID.6_c)
- determine and interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data (CCGPS) (MAL1_B2012-24/MCC9-12.ID.7)
- compute (using technology) and interpret the correlation coefficient of a linear fit (CCGPS) (MAL1_B2012-25/MCC9-12.ID.8)
- distinguish between correlation and causation in interpreting linear models (CCGPS) (MAL1_B2012-26/MCC9-12.ID.9)

C - Geometry

- use precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc (CCGPS) (MAL1_C2012-27/MCC9-12.CO.1)
- represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs; compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch) (CCGPS) (MAL1_C2012-28/MCC9-12.CO.2)
- employ properties of rectangles, parallelograms, trapezoids, and regular polygons to describe rotations and reflections that map a polygon onto itself (CCGPS) (MAL1_C2012-29/MCC9-12.CO.3)
- explain, apply, and experimentally verify definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments (CCGPS) (MAL1_C2012-30/MCC9-12.CO.4)
- given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software; specify a sequence of transformations that will carry a given figure onto another (CCGPS) (MAL1_C2012-31/MCC9-12.CO.5)
- prove simple geometric theorems algebraically using coordinates (CCGPS) (MAL1_C2012-32/MCC9-12.GPE.4)
- prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point) (CCGPS) (MAL1_C2012-33/MCC9-12.GPE.5)
- determine the point on a line segment between two given points that divides the segment in a given ratio (CCGPS) (MAL1_C2012-34/MCC9-12.GPE.6)
- compute perimeters of polygons and areas of triangles and rectangles using coordinates including the use of the distance formula (CCGPS) (MAL1_C2012-35/MCC9-12.GPE.7)
D - Functions

• understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range [(e.g., if f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x; the graph of f is the graph of the equation y = f(x). (Draw examples from linear and exponential functions.)) (CCGPS) (MAL1_D2012-36/MCC9-12.IF.1)]

• evaluate functions for inputs in their domains using function notation and interpret statements that use function notation in terms of a context (Draw examples from linear and exponential functions) (CCGPS) (MAL1_D2012-37/MCC9-12.IF.2)

• recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers (e.g., the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n > 1; draw connection to F.BF.2, which requires students to write arithmetic and geometric sequences) (CCGPS) (MAL1_D2012-38/MCC9-12.IF.3)

• interpret key features of graphs and tables for a function that models a relationship between two quantities in terms of the quantities for a function that models a relationship between two quantities, and sketch graphs showing key features given a verbal description of the relationship [(Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior) (Focus on linear and exponential functions.)] (CCGPS) (MAL1_D2012-39/MCC9-12.IF.4)

• relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes (Focus on linear and exponential functions) e.g., if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function (CCGPS) (MAL1_D2012-40/MCC9-12.IF.5)

• calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval; estimate the rate of change from a graph (Focus on linear functions and intervals for exponential functions whose domain is a subset of the integers) (CCGPS) (MAL1_D2012-41/MCC9-12.IF.6)

• graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases (Focus on linear and exponential functions. Include comparisons of two functions presented algebraically) (CCGPS) (MAL1_D2012-42/MCC9-12.IF.7)

• graph linear functions and show intercepts, maxima, and minima (CCGPS) (MAL1_D2012-43/MCC9-12.IF.7_a)

• graph exponential functions showing intercepts and end behavior (CCGPS) (MAL1_D2012-44/MCC9-12.IF.7_e)

• compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions) (e.g., given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum) (CCGPS) (MAL1_D2012-45/MCC9-12.IF.9)

• write a function that describes a relationship between two quantities (Limit a linear and exponential functions.) (CCGPS) (MAL1_D2012-46/MCC9-12.BF.1)

• determine an explicit expression, a recursive process, or steps for calculation from a context (Limit to linear and exponential functions.) (CCGPS) (MAL1_D2012-47/MCC9-12.BF.1_a)

• combine standard function types using arithmetic operations (Limit to linear and exponential functions.) e.g., build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model (CCGPS) (MAL1_D2012-48/MCC9-12.BF.1_b)

• write arithmetic and geometric sequences both recursively and with an explicit formula; use them to model situations, and translate between the two forms (CCGPS) (MAL1_D2012-49/MCC9-12.BF.2)

• identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them (CCGPS) (MAL1_D2012-50/MCC9-12.BF.3)

• distinguish between situations that can be modeled with linear functions and with exponential functions (CCGPS) (MAL1_D2012-51/MCC9-12.LE.1)

• prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals (CCGPS) (MAL1_D2012-52/MCC9-12.LE.1_a)
D – Functions (continued)
• recognize situations in which one quantity changes at a constant rate per unit interval relative to another (CCGPS) (MAL1_D2012-53/MCC9-12.LE.1_b)
• recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another (CCGPS) (MAL1_D2012-54/MCC9-12.LE.1_c)
• construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table) (CCGPS) (MAL1_D2012-55/MCC9-12.LE.2)
• show using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly (CCGPS) (MAL1_D2012-56/MCC9-12.LE.3)
• interpret the parameters in a linear or exponential function in terms of a context. (Limit exponential functions to those of the form f(a) = b^a + k) (CCGPS) (MAL1_D2012-57/MCC9-12.LE.5)

E - Numbers and Quantity
• use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays (CCGPS) (MAL1_E2012-58/MCC9-12.Q.1)
• determine appropriate quantities for the purpose of descriptive modeling (CCGPS) (MAL1_E2012-60/MCC9-12.Q.2)
• choose a level of accuracy appropriate to limitations on measurement when reporting quantities (CCGPS) (MAL1_E2012-61/MCC9-12.Q.3)

Accelerated Algebra I CC

A - Algebra
• interpret expressions that represent a quantity in terms of its context (Emphasis on linear expressions and exponential expressions with integer exponents.) (CCGPS) (MAAC_A2012-1/MCC9-12.SSE.1)
• interpret parts of an expression such as terms, factors, and coefficients (Emphasis on linear expressions and exponential expressions with integer exponents.) (CCGPS) (MAAC_A2012-2/MCC9-12.SSE.1_a)
• interpret complicated expressions by viewing one or more of their parts as a single entity (Emphasis on linear expressions and exponential expressions with integer exponents) (e.g., interpret P(1+r)n as the product of P and a factor not depending on P) (CCGPS) (MAAC_A2012-3/MCC9-12.SSE.1_b)
• create equations and inequalities in one variable and use them to solve problems (Include equations arising from linear and exponential functions) (CCGPS) (MAAC_A2012-4/MCC9-12.CED.1)
• create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales (Limit to linear and exponential equations and in the case of exponential equations, limit to situations requiring evaluation of exponential functions at integer inputs) (CCGPS) (MAAC_A2012-5/MCC9-12.CED.2)
• represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context (Limit to linear equations and inequalities) (e.g., represent inequalities describing nutritional and cost constraints on combinations of different foods) (CCGPS) (MAAC_A2012-6/MCC9-12.CED.3)
• rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations (Limit to formulas with a linear focus) e.g., rearrange Ohm’s law V=IR to highlight resistance R (CCGPS) (MAAC_A2012-7/MCC9-12.CED.4)
• solve linear equations and inequalities in one variable, including equations with coefficients represented by letters (Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for. Include simple exponential equations that rely only on application of the laws of exponents (CCGPS) (MAAC_A2012-8/MCC9-12.REI.3)
A – Algebra (continued)

- prove that given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions (Limit to linear systems) (CCGPS) (MAAC_A2012-9/MCC9-12.REI.5)
- solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables (CCGPS) (MAAC_A2012-10/MCC9-12.REI.6)
- demonstrate that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line) (CCGPS) (MAAC_A2012-11/MCC9-12.REI.10)
- explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution; construct a viable argument to justify a solution method. (Students should focus on and master linear equations and be able to extend and apply their reasoning to other types of equations in future courses.) (CCGPS) (MAAC_A2012-12/MCC9-12.REI.1)
- explain why the x-coordinates of the points where the graphs of the equations \( y = f(x) \) and \( y = g(x) \) intersect are the solutions of the equation \( f(x) = g(x) \); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where \( f(x) \) and/or \( g(x) \) are linear and exponential functions (CCGPS) (MAAC_A2012-13/MCC9-12.REI.11)
- graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes (CCGPS) (MAAC_A2012-14/MCC9-12.REI.12)

B - Statistics and Probability

- represent data with plots on the real number line (including dot plots, histograms, and box plots) (CCGPS) (MAAC_B2012-15/MCC9-12.ID.1)
- use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range) of two or more different data sets (CCGPS) (MAAC_B2012-16/MCC9-12.ID.2)
- interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers) (CCGPS) (MAAC_B2012-17/MCC9-12.ID.3)
- summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data (CCGPS) (MAAC_B2012-18/MCC9-12.ID.5)
- represent data on two quantitative variables on a scatter plot and describe how the variables are related (CCGPS) (MAAC_B2012-20/MCC9-12.ID.6)
- fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models (CCGPS) (MAAC_B2012-21/MCC9-12.ID.6_a)
- assess informally the fit of a function by plotting and analyzing residuals (CCGPS) (MAAC_B2012-22/MCC9-12.ID.6_b)
- fit a linear function for a scatter plot that suggests a linear association (CCGPS) (MAAC_B2012-23/MCC9-12.ID.6_c)
- determine and interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data (CCGPS) (MAAC_B2012-24/MCC9-12.ID.7)
- compute (using technology) and interpret the correlation coefficient of a linear fit (CCGPS) (MAAC_B2012-25/MCC9-12.ID.8)
- distinguish between correlation and causation (CCGPS) (MAAC_B2012-26/MCC9-12.ID.9)

C - Geometry

- use precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc (CCGPS) (MAAC_C2012-27/MCC9-12.CO.1)
- represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs; compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch) (CCGPS) (MAAC_C2012-28/MCC9-12.CO.2)
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C – Geometry (continued)

• employ properties of rectangles, parallelograms, trapezoids, and regular polygons to describe rotations and reflections that map a polygon onto itself (CCGPS) (MAAC_C2012-29/MCC9-12.CO.3)
• explain, apply and experimentally verify definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments (CCGPS) (MAAC_C2012-30/MCC9-12.CO.4)
• given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software; specify a sequence of transformations that will carry a given figure onto another (CCGPS) (MAAC_C2012-31/MCC9-12.CO.5)
• use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent (CCGPS) (MAAC_C2012-32/MCC9-12.CO.6)
• use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent (CCGPS) (MAAC_C2012-33/MCC9-12.CO.7)
• explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions (CCGPS) (MAAC_C2012-34/MCC9-12.CO.8)
• prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment’s endpoints (CCGPS) (MAAC_C2012-35/MCC9-12.CO.9)
• prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180 degrees; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point (CCGPS) (MAAC_C2012-36/MCC9-12.CO.10)
• prove theorems about parallelograms (Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals) (CCGPS) (MAAC_C2012-37/MCC9-12.CO.11)
• make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line (CCGPS) (MAAC_C2012-38/MCC9-12.CO.12)
• construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle (CCGPS) (MAAC_C2012-39/MCC9-12.CO.13)
• verify experimentally the properties of dilations given by a center and a scale factor (CCGPS) (MAAC_C2012-40/MCC9-12.SRT.1)
• recognize that a dilation takes a line not passing through the center of the dilation to a parallel line and leaves a line passing through the center unchanged (CCGPS) (MAAC_C2012-41/MCC9-12.SRT.1_a)
• recognize that the dilation of a line segment is longer or shorter in the ratio given by the scale factor (CCGPS) (MAAC_C2012-42/MCC9-12.SRT.1_b)
• given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides (CCGPS) (MAAC_C2012-43/MCC9-12.SRT.2)
• apply the properties of similarity transformations to establish the AA criterion for two triangles to be similar (CCGPS) (MAAC_C2012-44/MCC9-12.SRT.3)
• prove and apply theorems about triangles including a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity (CCGPS) (MAAC_C2012-45/MCC9-12.SRT.4)
• apply congruence and similarity criteria to solve problems and prove relationships in geometric figures (CCGPS) (MAAC_C2012-46/MCC9-12.SRT.5)
• demonstrate that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles (CCGPS) (MAAC_C2012-47/MCC9-12.SRT.6)
C – Geometry (continued)

- explain and apply relationships between the sine and cosine of complementary angles (CCGPS) (MAAC_C2012-48/MCC9-12.SRT.7)
- solve application problems using the trigonometric ratios and the Pythagorean Theorem (CCGPS) (MAAC_C2012-49/MCC9-12.SRT.8)
- prove that all circles are similar (CCGPS) (MAAC_C2012-50/MCC9-12.C.1)
- identify and describe relationships among inscribed angles, radii, and chords (include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle) (CCGPS) (MAAC_C2012-51/MCC9-12.C.2)
- construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle (CCGPS) (MAAC_C2012-52/MCC9-12.C.3)
- construct a tangent line from a point outside a given circle to the circle (CCGPS) (MAAC_C2012-54/MCC9-12.C.4)
- derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector (CCGPS) (MAAC_C2012-55/MCC9-12.C.5)
- use coordinates to prove simple geometric theorems algebraically (CCGPS) (MAAC_C2012-58/MCC9-12.GPE.4)
- prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point) (CCGPS) (MAAC_C2012-59/MCC9-12.GPE.5)
- determine the point on a line segment between two given points that divides the segment in a given ratio (CCGPS) (MAAC_C2012-60/MCC9-12.GPE.6)
- compute perimeters of polygons and areas of triangles and rectangles using coordinates including the use of the distance formula (CCGPS) (MAAC_C2012-61/MCC9-12.GPE.7)
- explain informally the formulas for circumference and area of a circle, volume of a cylinder, pyramid and cone, using dissection arguments, Cavalieri’s principle, and informal limit arguments (CCGPS) (MAAC_C2012-62/MCC9-12.GMD.1)
- explain informally Cavalieri’s Principle for the formulas for the volume of a sphere and other solid figures (CCGPS) (MAAC_C2012-63/MCC9-12.GMD.2)
- use volume formulas for cylinders, pyramids, cones, and spheres to solve problems (CCGPS) (MAAC_C2012-64/MCC9-12.GMD.3)

D - Functions

- understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range (e.g., if f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x; the graph of f is the graph of the equation y = f(x). (Draw examples from linear and exponential functions.)] (CCGPS) (MAAC_D2012-65/MCC9-12.IF.1)
- relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes (e.g., if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function) (Focus on linear and exponential functions.) (CCGPS) (MAAC_D2012-66/MCC9-12.IF.2)
- recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers (e.g., the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n > 1 (n is greater than or equal to 1); draw connection to F.BF.2, which requires students to write arithmetic and geometric sequences) (CCGPS) (MAAC_D2012-67/MCC9-12.IF.3)
- interpret key features of graphs and tables for a function that models a relationship between two quantities in terms of the quantities for a function that models a relationship between two quantities, and sketch graphs showing key features given a verbal description of the relationship [(Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior) (Focus on linear and exponential functions.)] (CCGPS) (MAAC_D2012-68/MCC9-12.IF.4)
D - Functions (continued)

• relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes (Focus on linear and exponential functions.) (CCGPS) (MAAC_D2012-69/MCC9-12.IF.5)

• calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval; estimate the rate of change from a graph (Focus on linear functions and intervals for exponential functions whose domain is a subset of the integers) (CCGPS) (MAAC_D2012-70/MCC9-12.IF.6)

• graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases (Focus on linear and exponential functions. Include comparisons of two functions presented algebraically) (CCGPS) (MAAC_D2012-71/MCC9-12.IF.7)

• graph linear functions and show intercepts, maxima, and minima (CCGPS) (MAAC_D2012-72/MCC9-12.IF.7_a)

• graph exponential functions showing intercepts and end behavior (CCGPS) (MAAC_D2012-73/MCC9-12.IF.7_e)

• compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions) (e.g., given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum) (CCGPS) (MAAC_D2012-74/MCC9-12.IF.9)

• write a function that describes a relationship between two quantities (Limit to linear and exponential functions.) (CCGPS) (MAAC_D2012-75/MCC9-12.BF.1)

• determine an explicit expression, a recursive process, or steps for calculation from a context (Limit to linear and exponential functions.) (CCGPS) (MAAC_D2012-76/MCC9-12.BF.1_a)

• combine standard function types using arithmetic operations (e.g., build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model) (Limit to linear and exponential functions.) (CCGPS) (MAAC_D2012-77/MCC9-12.BF.1_b)

• write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms (CCGPS) (MAAC_D2012-78/MCC9-12.BF.2)

• identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs; experiment with cases and illustrate an explanation of the effects on the graph using technology (Include recognizing even and odd functions from their graphs and algebraic expressions for them. Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y-intercept.) (CCGPS) (MAAC_D2012-79/MCC9-12.BF.3)

• distinguish between situations that can be modeled with linear functions and with exponential functions (CCGPS) (MAAC_D2012-80/MCC9-12.LE.1)

• prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals (CCGPS) (MAAC_D2012-81/MCC9-12.LE.1_a)

• recognize situations in which one quantity changes at a constant rate per unit interval relative to another (CCGPS) (MAAC_D2012-82/MCC9-12.LE.1_b)

• recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another (CCGPS) (MAAC_D2012-83/MCC9-12.LE.1_c)

• construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table) (CCGPS) (MAAC_D2012-84/MCC9-12.LE.2)

• show using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly (CCGPS) (MAAC_D2012-85/MCC9-12.LE.3)

• interpret the parameters in a linear or exponential function in terms of a context (Limit exponential functions to those of the form f(x) = bx + k) (CCGPS) (MAAC_D2012-86/MCC9-12.LE.5)
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E - Numbers and Quantity

- use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas (CCGPS) (MAAC_E2012-87/MCC9-12.Q.1)
- use the units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays (CCGPS) (MAAC_E2012-88/MCC9-12.Q.1)
- determine appropriate quantities for the purpose of descriptive modeling (CCGPS) (MAAC_E2012-89/MCC9-12.Q.2)
- choose a level of accuracy appropriate to limitations on measurement when reporting quantities (CCGPS) (MAAC_E2012-90/MCC9-12.Q.3)

Algebra II CC

A - Algebra

- interpret expressions that represent a quantity in terms of its context (CCGPS) (MAL2_A2013-1/MCC9-12.A.SSE.1)
- interpret parts of an expression such as terms, factors, and coefficients (CCGPS) (MAL2_A2013-2/MCC9-12.A.SSE.1a)
- interpret complicated expressions by viewing one or more of their parts as a single entity, e.g., interpret P(1+r)n as the product of P and a factor not depending on P (CCGPS) (MAL2_A2013-3/MCC9-12.A.SSE.1b)
- use the structure of an expression to identify ways to rewrite it (e.g., see x4 – y4 as (x²)² – (y²)², thus recognizing it as a difference of squares that can be factored as (x² – y²)(x² + y²)) (CCGPS) (MAL2_A2013-4/MCC9-12.A.SSE.2)
- choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression (CCGPS) (MAL2_A2013-5/MCC9-12.A.SSE.3)
- use the properties of exponents to transform expressions for exponential functions (e.g., the expression 1.15t can be rewritten as [1.15(1/12)](12t) ? 1.012(12t) to reveal the approximate equivalent monthly interest rate if the annual rate is 15%) (CCGPS) (MAL2_A2013-6/MCC9-12.A.SSE.3c)
- derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems (e.g., calculate mortgage payments) (CCGPS) (MAL2_A2013-7/MCC9-12.A.SSE.4)
- understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials (CCGPS) (MAL2_A2013-8/MCC9-12.A.APR.1)
- know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x) (CCGPS) (MAL2_A2013-9/MCC9-12.A.APR.2)
- identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial (CCGPS) (MAL2_A2013-10/MCC9-12.A.APR.3)
- prove polynomial identities and use them to describe numerical relationships (e.g., the polynomial identity (x² + y²)² = (x² – y²)² + (2xy)² can be used to generate Pythagorean triples) (CCGPS) (MAL2_A2013-11/MCC9-12.A.APR.4)
- know and apply that the Binomial Theorem gives the expansion of (x + y)n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal’s Triangle (the Binomial Theorem can be proved by mathematical induction) (CCGPS) (MAL2_A2013-12/MCC9-12.A.APR.5)
- rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system (CCGPS) (MAL2_A2013-13/MCC9-12.A.APR.6)
- understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions (CCGPS) (MAL2_A2013-14/MCC9-12.A.APR.7)
- create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions (CCGPS) (MAL2_A2013-15/MCC9-12.A.CED.1)
A – Algebra (continued)

- create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales (CCGPS) (MAL2_A2013-16/MCC9-12.A.CED.2)
- represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context (e.g., represent inequalities describing nutritional and cost constraints on combinations of different foods (CCGPS) (MAL2_A2013-17/MCC9-12.A.CED.3)
- rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations (e.g., rearrange Ohm’s law V = IR to highlight resistance R) (CCGPS) (MAL2_A2013-18/MCC9-12.A.CED.4)
- solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise (CCGPS) (MAL2_A2013-19/MCC9-12.A.REI.2)
- solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically (e.g., find the points of intersection between the line y = –3x and the circle x² + y² = 3) (CCGPS) (MAL2_A2013-20/MCC9-12.A.REI.7)
- explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, (e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions (CCGPS) (MAL2_A2013-21/MCC9-12.A.REI.11)

B - Statistics and Probability

- use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets (CCGPS) (MAL2_B2013-22/MCC9-12.S.ID.2)
- use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve (CCGPS) (MAL2_B2013-23/MCC9-12.S.ID.4)
- understand statistics as a process for making inferences about population parameters based on a random sample from that population (CCGPS) (MAL2_B2013-24/MCC9-12.S.IC.1)
- decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model? (CCGPS) (MAL2_B2013-25/MCC9-12.S.IC.2)
- recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each (CCGPS) (MAL2_B2013-26/MCC9-12.S.IC.3)
- use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling (CCGPS) (MAL2_B2013-27/MCC9-12.S.IC.4)
- use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant (CCGPS) (MAL2_B2013-28/MCC9-12.S.IC.5)
- evaluate reports based on data (CCGPS) (MAL2_B2013-29/MCC9-12.S.IC.6)

C - Geometry

- identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects (CCGPS) (MAL2_C2013-30/MCC9-12.G.GMD.4)
- use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder) (CCGPS) (MAL2_C2013-31/MCC9-12.G.GMD.1)
- apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot) (CCGPS) (MAL2_C2013-32/MCC9-12.G.GMD.2)
- apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios) (CCGPS) (MAL2_C2013-33/MCC9-12.G.GMD.3)
D - Functions

- for a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity (CCGPS) (MAL2_D2013-34/MCC9-12.F.IF.4)
- relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes (e.g., if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function) (CCGPS) (MAL2_D2013-35/MCC9-12.F.IF.5)
- calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph (CCGPS) (MAL2_D2013-36/MCC9-12.F.IF.6)
- graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases (CCGPS) (MAL2_D2013-37/MCC9-12.F.IF.7)
- graph linear and quadratic functions and show intercepts, maxima, and minima (CCGPS) (MAL2_D2013-38/MCC9-12.F.IF.7a)
- graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions (CCGPS) (MAL2_D2013-39/MCC9-12.F.IF.7b)
- graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior (CCGPS) (MAL2_D2013-40/MCC9-12.F.IF.7c)
- graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior (CCGPS) (MAL2_D2013-41/MCC9-12.F.IF.7d)
- graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude (CCGPS) (MAL2_D2013-42/MCC9-12.F.IF.7e)
- write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. (CCGPS) (MAL2_D2013-43/MCC9-12.F.IF.8)
- use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context (CCGPS) (MAL2_D2013-44/MCC9-12.F.IF.8a)
- use the properties of exponents to interpret expressions for exponential functions (e.g., identify percent rate of change in functions such as y = (1.02)t, y = (0.97)t, y = (1.01)(12t), y = (1.2)(t/10), and classify them as representing exponential growth and decay) (CCGPS) (MAL2_D2013-45/MCC9-12.F.IF.8b)
- compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions) (e.g., given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum) (CCGPS) (MAL2_D2013-46/MCC9-12.F.IF.9)
- write a function that describes a relationship between two quantities (CCGPS) (MAL2_D2013-47/MCC9-12.F.BF.1)
- determine an explicit expression, a recursive process, or steps for calculation from a context (CCGPS) (MAL2_D2013-48/MCC9-12.F.BF.1a)
- combine standard function types using arithmetic operations (e.g., build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model) (CCGPS) (MAL2_D2013-49/MCC9-12.F.BF.1b)
- compose functions (e.g., if T(t) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time) (CCGPS) (MAL2_D2013-50/MCC9-12.F.BF.1c)
- identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them (CCGPS) (MAL2_D2013-51/MCC9-12.F.BF.3)
- find inverse functions (CCGPS) (MAL2_D2013-52/MCC9-12.F.BF.4)
- solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse (e.g., f(x) = 2(x) or f(x) = (x+1)/(x-1) for x ≠ 1) (CCGPS) (MAL2_D2013-53/MCC9-12.F.BF.4a)
D – Functions (continued)
- verify by composition that one function is the inverse of another (CCGPS) (MAL2_D2013-54/MCC9-12.F.BF.4b)
- read values of an inverse function from a graph or a table, given that the function has an inverse (CCGPS) (MAL2_D2013-55/MCC9-12.F.BF.4c)
- understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents (CCGPS) (MAL2_D2013-56/MCC9-12.F.BF.5)
- for exponential models, express as a logarithm the solution to ab(ct) = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology (CCGPS) (MAL2_D2013-57/MCC9-12.F.LE.4)
- understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle (CCGPS) (MAL2_D2013-58/MCC9-12.F.TF.1)
- explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle (CCGPS) (MAL2_D2013-59/MCC9-12.F.TF.2)
- choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline (CCGPS) (MAL2_D2013-60/MCC9-12.F.TF.5)
- prove the Pythagorean identity (sin A)² + (cos A)² = 1 and use it to find sin A, cos A, or tan A, given sin A, cos A, or tan A, and the quadrant of the angle (CCGPS) (MAL2_D2013-61/MCC9-12.F.TF.8)

E - Numbers
- extend polynomial identities to the complex numbers (e.g., rewrite x² + 4 as (x + 2i)(x – 2i)) (CCGPS) (MAL2_E2013-62/MCC9-12.N.CN.8)
- know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials (CCGPS) (MAL2_E2013-63/MCC9-12.N.CN.9)

Geometry CC

A - Algebra
- interpret expressions that represent a quantity in terms of its context (CCGPS) (MAGE_A2013-1/MCC9-12.A.SSE.1)
- interpret parts of an expression such as terms, factors, and coefficients (CCGPS) (MAGE_A2013-2/MCC9-12.A.SSE.1a)
- interpret complicated expressions by viewing one or more of their parts as a single entity (e.g., interpret P(1+r)n as the product of P and a factor not depending on P) (CCGPS) (MAGE_A2013-3/MCC9-12.A.SSE.1b)
- use the structure of an expression to identify ways to rewrite it. (CCGPS) (MAGE_A2013-4/MCC9-12.A.SSE.2)
- choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression (CCGPS) (MAGE_A2013-5/MCC9-12.A.SSE.3)
- factor a quadratic expression to reveal the zeros of the function it defines (CCGPS) (MAGE_A2013-6/MCC9-12.A.SSE.3a)
- complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines (CCGPS) (MAGE_A2013-7/MCC9-12.A.SSE.3b)
- understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials (CCGPS) (MAGE_A2013-8/MCC9-12.A.APR.1)
- create equations and inequalities in one variable and use them to solve problems. Include equations arising from quadratic functions (CCGPS) (MAGE_A2013-9/MCC9-12.A.CED.1)
- create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales (CCGPS) (MAGE_A2013-10/MCC9-12.A.CED.2)
A – Algebra (continued)

• rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. e.g., rearrange Ohm’s law \( V = IR \) to highlight resistance \( R \) (CCGPS) (MAGE_A2013-11/MCC9-12.A.CED.4)

• solve quadratic equations in one variable (CCGPS) (MAGE_A2013-12/MCC9-12.A.REI.4)

• use the method of completing the square to transform any quadratic equation in \( x \) into an equation of the form \( (x - p)^2 = q \) that has the same solutions. Derive the quadratic formula from this form (CCGPS) (MAGE_A2013-13/MCC9-12.A.REI.4a)

• solve quadratic equations by inspection (e.g., for \( x^2 = 49 \)), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as \( a \pm bi \) for real numbers \( a \) and \( b \) (CCGPS) (MAGE_A2013-14/MCC9-12.A.REI.4b)

• solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically (e.g., find the points of intersection between the line \( y = -3x \) and the circle \( x^2 + y^2 = 3 \)) (CCGPS) (MAGE_A2013-15/MCC9-12.A.REI.7)

B - Statistics and Probability

• Represent data for two quantitative variables on a scatter plot, and describe how the variables are related. (CCGPS) (MAGE_B2013-16/MCC9-12.S.ID.6)

• fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize quadratic models (CCGPS) (MAGE_B2013-17/MCC9-12.S.ID.6a)

• describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”) (CCGPS) (MAGE_B2013-18/MCC9-12.S.CP.1)

• understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent (CCGPS) (MAGE_B2013-19/MCC9-12.S.CP.2)

• understand the conditional probability of A given B as \( P(A \text{ and } B)/P(B) \), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B (CCGPS) (MAGE_B2013-20/MCC9-12.S.CP.3)

• construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities (e.g., collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results) (CCGPS) (MAGE_B2013-21/MCC9-12.S.CP.4)

• recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations (e.g., compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer) (CCGPS) (MAGE_B2013-22/MCC9-12.S.CP.5)

• find the conditional probability of A given B as the fraction of B’s outcomes that also belong to A, and interpret the answer in terms of an appropriate model (CCGPS) (MAGE_B2013-23/MCC9-12.S.CP.6)

• apply the Addition Rule, \( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \), and interpret the answer in terms of the model (CCGPS) (MAGE_B2013-24/MCC9-12.S.CP.7)

C - Geometry

• use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent (CCGPS) (MAGE_C2013-25/MCC9-12.G.CO.6)

• use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent (CCGPS) (MAGE_C2013-26/MCC9-12.G.CO.7)

• explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions (CCGPS) (MAGE_C2013-27/MCC9-12.G.CO.8)
C – Geometry (continued)

- prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment’s endpoints (CCGPS) (MAGE_C2013-28/MCC9-12.G.CO.9)
- prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180 degrees; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point (CCGPS) (MAGE_C2013-29/MCC9-12.G.CO.10)
- prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals (CCGPS) (MAGE_C2013-30/MCC9-12.G.CO.11)
- make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line (CCGPS) (MAGE_C2013-31/MCC9-12.G.CO.12)
- construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle (CCGPS) (MAGE_C2013-32/MCC9-12.G.CO.13)
- verify experimentally the properties of dilations given by a center and a scale factor: a) a dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged b) the dilation of a line segment is longer or shorter in the ratio given by the scale factor (CCGPS) (MAGE_C2013-33/MCC9-12.G.SRT.1)
- given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides (CCGPS) (MAGE_C2013-34/MCC9-12.G.SRT.2)
- use the properties of similarity transformations to establish the AA criterion for two triangles to be similar (CCGPS) (MAGE_C2013-35/MCC9-12.G.SRT.3)
- prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity (CCGPS) (MAGE_C2013-36/MCC9-12.G.SRT.4)
- use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures (CCGPS) (MAGE_C2013-37/MCC9-12.G.SRT.5)
- understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles (CCGPS) (MAGE_C2013-38/MCC9-12.G.SRT.6)
- explain and use the relationship between the sine and cosine of complementary angles (CCGPS) (MAGE_C2013-39/MCC9-12.G.SRT.7)
- use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems (CCGPS) (MAGE_C2013-40/MCC9-12.G.SRT.8)
- prove that all circles are similar (CCGPS) (MAGE_C2013-41/MCC9-12.G.C.1)
- identify and describe relationships among inscribed angles, radii, and chords (include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle) (CCGPS) (MAGE_C2013-42/MCC9-12.G.C.2)
- construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle (CCGPS) (MAGE_C2013-43/MCC9-12.G.C.3)
- construct a tangent line from a point outside a given circle to the circle (CCGPS) (MAGE_C2013-44/MCC9-12.G.C.4)
- derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector (CCGPS) (MAGE_C2013-45/MCC9-12.G.C.5)
- derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation (CCGPS) (MAGE_C2013-46/MCC9-12.G.GPE.1)
- derive the equation of a parabola given a focus and directrix (CCGPS) (MAGE_C2013-47/MCC9-12.G.GPE.2)
C – Geometry (continued)

- use coordinates to prove simple geometric theorems algebraically. (CCGPS) (MAGE_C2013-48/MCC9-12.G.GPE.4)
- give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri’s principle, and informal limit arguments (CCGPS) (MAGE_C2013-49/MCC9-12.G.GMD.1)
- give an informal argument using Cavalieri’s principle for the formulas for the volume of a sphere and other solid figures (CCGPS) (MAGE_C2013-50/MCC9-12.G.GMD.2)
- use volume formulas for cylinders, pyramids, cones, and spheres to solve problems (CCGPS) (MAGE_C2013-51/MCC9-12.G.GMD.3)

D - Functions

- for a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior (CCGPS) (MAGE_D2013-52/MCC9-12.F.IF.4)
- relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. e.g., if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function (CCGPS) (MAGE_D2013-53/MCC9-12.F.IF.5)
- calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval; estimate the rate of change from a graph (CCGPS) (MAGE_D2013-54/MCC9-12.F.IF.6)
- graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases (CCGPS) (MAGE_D2013-55/MCC9-12.F.IF.7)
- graph quadratic functions and show intercepts, maxima, and minima (CCGPS) (MAGE_D2013-56/MCC9-12.F.IF.7a)
- write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function (CCGPS) (MAGE_D2013-57/MCC9-12.F.IF.8)
- use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context (CCGPS) (MAGE_D2013-58/MCC9-12.F.IF.8a)
- compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions) (e.g., given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum) (CCGPS) (MAGE_D2013-59/MCC9-12.F.IF.9)
- write a function that describes a relationship between two quantities (CCGPS) (MAGE_D2013-60/MCC9-12.F.BF.1)
- determine an explicit expression, a recursive process, or steps for calculation from a context (CCGPS) (MAGE_D2013-61/MCC9-12.F.BF.1a)
- combine standard function types using arithmetic operations (e.g., build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model) (CCGPS) (MAGE_D2013-62/MCC9-12.F.BF.1b)
- identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs; experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them (CCGPS) (MAGE_D2013-63/MCC9-12.F.BF.3)
- observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function (CCGPS) (MAGE_D2013-64/MCC9-12.F.LE.3)
**E - Numbers**

- explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents (CCGPS) (MAGE_E2013-65/MCC9-12.N.RN.1.)
- rewrite expressions involving radicals and rational exponents using the properties of exponents (CCGPS) (MAGE_E2013-66/MCC9-12.N.RN.2)
- explain why the sum or product of rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational (CCGPS) (MAGE_E2013-67/MCC9-12.N.RN.3)
- know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with $a$ and $b$ real (CCGPS) (MAGE_E2013-68/MCC9-12.N.CN.1)
- use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers (CCGPS) (MAGE_E2013-69/MCC9-12.N.CN.2)
- find the conjugate of a complex number; use conjugates to find quotients of complex numbers (CCGPS) (MAGE_E2013-70/MCC9-12.N.CN.3)
- solve quadratic equations with real coefficients that have complex solutions (CCGPS) (MAGE_E2013-71/MCC9-12.N.CN.7)

**Accelerated Geometry CC**

**A - Algebra**

- interpret expressions that represent a quantity in terms of its context (CCGPS) (MAGC_A2013-1/MCC9-12.A.SSE.1)
- interpret parts of an expression such as terms, factors, and coefficients (CCGPS) (MAGC_A2013-2/MCC9-12.A.SSE.1a)
- interpret complicated expressions by viewing one or more of their parts as a single entity (e.g. interpret $P(1+r)^n$ as the product of $P$ and a factor not depending on $P$) (CCGPS) (MAGC_A2013-3/MCC9-12.A.SSE.1b)
- use the structure of an expression to identify ways to rewrite it. (CCGPS) (MAGC_A2013-4/MCC9-12.A.SSE.2)
- choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression (CCGPS) (MAGC_A2013-5/MCC9-12.A.SSE.3)
- factor a quadratic expression to reveal the zeros of the function it defines (CCGPS) (MAGC_A2013-6/MCC9-12.A.SSE.3a)
- complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines (CCGPS) (MAGC_A2013-7/MCC9-12.A.SSE.3b)
- use the properties of exponents to transform expressions for exponential functions (CCGPS) (MAGC_A2013-8/MCC9-12.A.SSE.3c)
- derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems (e.g., calculate mortgage payments) (CCGPS) (MAGC_A2013-9/MCC9-12.A.SSE.4)
- understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials (CCGPS) (MAGC_A2013-10/MCC9-12.A.APR.1)
- know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number $a$, the remainder on division by $x – a$ is $p(a)$, so $p(a) = 0$ if and only if $(x – a)$ is a factor of $p(x)$ (CCGPS) (MAGC_A2013-11/MCC9-12.A.APR.2)
- identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial (CCGPS) (MAGC_A2013-12/MCC9-12.A.APR.3)
- prove polynomial identities and use them to describe numerical relationships (CCGPS) (MAGC_A2013-13/MCC9-12.A.APR.4)
A – Algebra (continued)

- know and apply that the Binomial Theorem gives the expansion of \((x + y)^n\) in powers of \(x\) and \(y\) for a positive integer \(n\), where \(x\) and \(y\) are any numbers, with coefficients determined for example by Pascal’s Triangle (the Binomial Theorem can be proved by mathematical induction) (CCGPS) (MAGC_A2013-14/MCC9-12.A.APR.5)
- rewrite simple rational expressions in different forms; write \(a(x)/b(x)\) in the form \(q(x) + r(x)/b(x)\), where \(a(x), b(x), q(x), \) and \(r(x)\) are polynomials with the degree of \(r(x)\) less than the degree of \(b(x)\), using inspection, long division, or, for the more complicated examples, a computer algebra system (CCGPS) (MAGC_A2013-15/MCC9-12.A.APR.6)
- understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions (CCGPS) (MAGC_A2013-16/MCC9-12.A.APR.7)
- create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions (CCGPS) (MAGC_A2013-17/MCC9-12.A.CED.1)
- create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales (CCGPS) (MAGC_A2013-18/MCC9-12.A.CED.2)
- represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. e.g., represent inequalities describing nutritional and cost constraints on combinations of different foods (CCGPS) (MAGC_A2013-19/MCC9-12.A.CED.3)
- rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. e.g., rearrange Ohm’s law \(V = IR\) to highlight resistance \(R\) (CCGPS) (MAGC_A2013-20/MCC9-12.A.CED.4)
- solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise (CCGPS) (MAGC_A2013-21/MCC9-12.A.REI.2)
- solve quadratic equations in one variable (CCGPS) (MAGC_A2013-22/MCC9-12.A.REI.4)
- use the method of completing the square to transform any quadratic equation in \(x\) into an equation of the form \((x – p)^2 = q\) that has the same solutions. Derive the quadratic formula from this form (CCGPS) (MAGC_A2013-23/MCC9-12.A.REI.4a)
- solve quadratic equations by inspection (e.g., for \(x^2 = 49\), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a \(± bi\) for real numbers \(a\) and \(b\) (CCGPS) (MAGC_A2013-24/MCC9-12.A.REI.4b)
- solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically (e.g., find the points of intersection between the line \(y = –3x\) and the circle \(x^2 + y^2 = 3\)) (CCGPS) (MAGC_A2013-25/MCC9-12.A.REI.7)
- explain why the x-coordinates of the points where the graphs of the equations \(y = f(x)\) and \(y = g(x)\) intersect are the solutions of the equation \(f(x) = g(x)\); find the solutions approximately, (e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where \(f(x)\) and/or \(g(x)\) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions) (CCGPS) (MAGC_A2013-26/MCC9-12.A.REI.11)

B - Statistics and Probability

- use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets (CCGPS) (MAGC_B2013-27/MCC9-12.S.ID.2)
- use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve (CCGPS) (MAGC_B2013-28/MCC9-12.S.ID.4)
- represent data on two quantitative variables on a scatter plot, and describe how the variables are related (CCGPS) (MAGC_B2013-29/MCC9-12.S.ID.6)
- fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize quadratic models (CCGPS) (MAGC_B2013-30/MCC9-12.S.ID.6a)
- understand statistics as a process for making inferences about population parameters based on a random sample from that population (CCGPS) (MAGC_B2013-31/MCC9-12.S.IC.1)
B - Statistics and Probability (continued)

- decide if a specified model is consistent with results from a given data-generating process, (e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?) (CCGPS) (MAGC_B2013-32/MCC9-12.S.IC.2)
- recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each (CCGPS) (MAGC_B2013-33/MCC9-12.S.IC.3)
- use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling (CCGPS) (MAGC_B2013-34/MCC9-12.S.IC.4)
- use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant (CCGPS) (MAGC_B2013-35/MCC9-12.S.IC.5)
- evaluate reports based on data (CCGPS) (MAGC_B2013-36/MCC9-12.S.IC.6)

C - Geometry

- derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation (CCGPS) (MAGC_C2013-37/MCC9-12.G.GPE.1)
- derive the equation of a parabola given a focus and directrix (CCGPS) (MAGC_C2013-38/MCC9-12.G.GPE.2)
- use coordinates to prove simple geometric theorems algebraically. (CCGPS) (MAGC_C2013-39/MCC9-12.G.GPE.4)
- identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects (CCGPS) (MAGC_C2013-40/MCC9-12.G.GMD.4)
- use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder) (CCGPS) (MAGC_C2013-41/MCC9-12.G.MG.1)
- apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot) (CCGPS) (MAGC_C2013-42/MCC9-12.G.MG.2)
- apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios) (CCGPS) (MAGC_C2013-43/MCC9-12.G.MG.3)

D - Function

- for a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity (CCGPS) (MAGC_D2013-44/MCC9-12.F.IF.4)
- relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. e.g., if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function (CCGPS) (MAGC_D2013-45/MCC9-12.F.IF.5)
- calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph (CCGPS) (MAGC_D2013-46/MCC9-12.F.IF.6)
- graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases (CCGPS) (MAGC_D2013-47/MCC9-12.F.IF.7)
- graph linear and quadratic functions and show intercepts, maxima, and minima (CCGPS) (MAGC_D2013-48/MCC9-12.F.IF.7a)
- graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions (CCGPS) (MAGC_D2013-49/MCC9-12.F.IF.7b)
- graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior (CCGPS) (MAGC_D2013-50/MCC9-12.F.IF.7c)
- graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior (CCGPS) (MAGC_D2013-51/MCC9-12.F.IF.7d)
D – Function (continued)

- graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude (CCGPS) (MAGC_D2013-52/MCC9-12.F.IF.7e)
- write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function (CCGPS) (MAGC_D2013-53/MCC9-12.F.IF.8)
- use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context (CCGPS) (MAGC_D2013-54/MCC9-12.F.IF.8a)
- use the properties of exponents to interpret expressions for exponential functions (CCGPS) (MAGC_D2013-55/MCC9-12.F.IF.8b)
- compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). e.g., given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum (CCGPS) (MAGC_D2013-56/MCC9-12.F.IF.9)
- write a function that describes a relationship between two quantities (CCGPS) (MAGC_D2013-57/MCC9-12.F.BF.1)
- determine an explicit expression, a recursive process, or steps for calculation from a context (CCGPS) (MAGC_D2013-58/MCC9-12.F.BF.1a)
- combine standard function types using arithmetic operations (e.g., build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model) (CCGPS) (MAGC_D2013-59/MCC9-12.F.BF.1b)
- compose functions (e.g., if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time) (CCGPS) (MAGC_D2013-60/MCC9-12.F.BF.1c)
- identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them (CCGPS) (MAGC_D2013-61/MCC9-12.F.BF.3)
- solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse (CCGPS) (MAGC_D2013-63/MCC9-12.F.BF.4a)
- verify by composition that one function is the inverse of another (CCGPS) (MAGC_D2013-64/MCC9-12.F.BF.4b)
- read values of an inverse function from a graph or a table, given that the function has an inverse (CCGPS) (MAGC_D2013-65/MCC9-12.F.BF.4c)
- understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents (CCGPS) (MAGC_D2013-66/MCC9-12.F.BF.5)
- observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function (CCGPS) (MAGC_D2013-67/MCC9-12.F.LE.3)
- for exponential models, express as a logarithm the solution to ab(ct) = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology (CCGPS) (MAGC_D2013-68/MCC9-12.F.LE.4)
- understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle (CCGPS) (MAGC_D2013-69/MCC9-12.F.TF.1)
- explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle (CCGPS) (MAGC_D2013-70/MCC9-12.F.TF.2)
- choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline (CCGPS) (MAGC_D2013-71/MCC9-12.F.TF.5)
- prove the Pythagorean identity (sin A)² + (cos A)² = 1 and use it to find sin A, cos A, or tan A, given sin A, cos A, or tan A, and the quadrant of the angle (CCGPS) (MAGC_D2013-72/MCC9-12.F.TF.8)
E - Numbers

- explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents (CCGPS) (MAGC_E2013-73/MCC9-12.N.RN.1)
- rewrite expressions involving radicals and rational exponents using the properties of exponents (CCGPS) (MAGC_E2013-74/MCC9-12.N.RN.2)
- explain why the sum or product of rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational (CCGPS) (MAGC_E2013-75/MCC9-12.N.RN.3)
- know there is a complex number i such that \( i^2 = -1 \), and every complex number has the form \( a + bi \) with \( a \) and \( b \) real (CCGPS) (MAGC_E2013-76/MCC9-12.N.CN.1)
- use the relation \( i^2 = -1 \) and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers (CCGPS) (MAGC_E2013-77/MCC9-12.N.CN.2)
- find the conjugate of a complex number; use conjugates to find quotients of complex numbers (CCGPS) (MAGC_E2013-78/MCC9-12.N.CN.3)
- solve quadratic equations with real coefficients that have complex solutions (CCGPS) (MAGC_E2013-79/MCC9-12.N.CN.7)
- extend polynomial identities to the complex numbers (e.g., rewrite \( x^2 + 4 \) as \((x + 2i)(x - 2i)\)) (CCGPS) (MAGC_E2013-80/MCC9-12.N.CN.8)
- know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials (CCGPS) (MAGC_E2013-81/MCC9-12.N.CN.9)

PreCalculus CC

A - Algebra

- represent a system of linear equations as a single matrix equation in a vector variable (CCGPS) (MAPR_A2013-1/MCC9-12.A.REI.8)
- find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 \( \times \) 3 or greater) (CCGPS) (MAPR_A2013-2/MCC9-12.A.REI.9)

B - Statistics and Probability

- apply the general Multiplication Rule in a uniform probability model, \( P(A \text{ and } B) = [P(A)]x[P(B|A)] = [P(B)]x[P(A|B)] \), and interpret the answer in terms of the model (CCGPS) (MAPR_B2013-3/MCC9-12.S.CP.8)
- use permutations and combinations to compute probabilities of compound events and solve problems (CCGPS) (MAPR_B2013-4/MCC9-12.S.CP.9)
- define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions (CCGPS) (MAPR_B2013-5/MCC9-12.S.MD.1)
- calculate the expected value of a random variable; interpret it as the mean of the probability distribution (CCGPS) (MAPR_B2013-6/MCC9-12.S.MD.2)
- develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value (e.g., find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes) (CCGPS) (MAPR_B2013-7/MCC9-12.S.MD.3)
B - Statistics and Probability (continued)

- develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value (e.g., find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?) (CCGPS) (MAPR_B2013-8/MCC9-12.S.MD.4)
- weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values (CCGPS) (MAPR_B2013-9/MCC9-12.S.MD.5)
- find the expected payoff for a game of chance (e.g., find the expected winnings from a state lottery ticket or a game at a fast-food restaurant) (CCGPS) (MAPR_B2013-10/MCC9-12.S.MD.5a)
- evaluate and compare strategies on the basis of expected values (e.g., compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident) (CCGPS) (MAPR_B2013-11/MCC9-12.S.MD.5b)
- use probabilities to make fair (equally likely) decisions (e.g., drawing by lots, using a random number generator) (CCGPS) (MAPR_B2013-12/MCC9-12.S.MD.6)
- analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game) (CCGPS) (MAPR_B2013-13/MCC9-12.S.MD.7)

C - Geometry

- derive the formula \( A = \frac{1}{2}ab \sin(C) \) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side (CCGPS) (MAPR_C2013-14/MCC9-12.G.SRT.9)
- prove the Laws of Sines and Cosines and use them to solve problems (CCGPS) (MAPR_C2013-15/MCC9-12.G.SRT.10)
- understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces) (CCGPS) (MAPR_C2013-16/MCC9-12.G.SRT.11)
- derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant (CCGPS) (MAPR_C2013-17/MCC9-12.G.GPE.3)

D - Functions

- find inverse functions (CCGPS) (MAPR_D2013-18/MCC9-12.F.BF.4)
- produce an invertible function from a non-invertible function by restricting the domain (CCGPS) (MAPR_D2013-19/MCC9-12.F.BF.4d)
- use special triangles to determine geometrically the values of sine, cosine, tangent for \( \frac{\pi}{3}, \frac{\pi}{4} \) and \( \frac{\pi}{6} \), and use the unit circle to express the values of sine, cosine, and tangent for \( \frac{\pi}{2} + \theta \), \( -\theta \), and \( 2\pi - \theta \) in terms of their values for \( \theta \), where \( \theta \) is any real number (CCGPS) (MAPR_D2013-20/MCC9-12.F.TF.3)
- use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions (CCGPS) (MAPR_D2013-21/MCC9-12.F.TF.4)
- understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed (CCGPS) (MAPR_D2013-22/MCC9-12.F.TF.6)
- use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context (CCGPS) (MAPR_D2013-23/MCC9-12.F.TF.7)
- prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems (CCGPS) (MAPR_D2013-24/MCC9-12.F.TF.9)
E - Numbers

- find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers (CCGPS) (MAPR_E2013-25/MCC9-12.N.CN.3)
- represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number (CCGPS) (MAPR_E2013-26/MCC9-12.N.CN.4)
- represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation (e.g., \((?1+ ?3i)^3 = 8\) because \((?1+ ?3i)\) has modulus 2 and argument 120°) (CCGPS) (MAPR_E2013-27/MCC9-12.N.CN.5)
- calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints (CCGPS) (MAPR_E2013-28/MCC9-12.N.CN.6)
- recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., \(v, |v|, ||v||, \gamma\)) (CCGPS) (MAPR_E2013-29/MCC9-12.N.VM.1)
- find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point (CCGPS) (MAPR_E2013-30/MCC9-12.N.VM.2)
- solve problems involving velocity and other quantities that can be represented by vectors (CCGPS) (MAPR_E2013-31/MCC9-12.N.VM.3)
- add and subtract vectors (CCGPS) (MAPR_E2013-32/MCC9-12.N.VM.4)
- add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes (CCGPS) (MAPR_E2013-33/MCC9-12.N.VM.4a)
- given two vectors in magnitude and direction form, determine the magnitude and direction of their sum (CCGPS) (MAPR_E2013-34/MCC9-12.N.VM.4b)
- understand vector subtraction \(v - w\) as \(v + (-w)\), where \((-w)\) is the additive inverse of \(w\), with the same magnitude as \(w\) and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise (CCGPS) (MAPR_E2013-35/MCC9-12.N.VM.4c)
- multiply a vector by a scalar (CCGPS) (MAPR_E2013-36/MCC9-12.N.VM.5)
- represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, (e.g., as \(c(vx, vy) = (cvx, cvy)\)) (CCGPS) (MAPR_E2013-37/MCC9-12.N.VM.5a)
- compute the magnitude of a scalar multiple \(cv\) using \(||cv|| = |c|v||. Compute the direction of \(cv\) knowing that when \(|c|v = 0\), the direction of \(cv\) is either along \(v\) (for \(c > 0\)) or against \(v\) (for \(c < 0\)) (CCGPS) (MAPR_E2013-38/MCC9-12.N.VM.5b)
- use matrices to represent and manipulate data, (e.g., to represent payoffs or incidence relationships in a network) (CCGPS) (MAPR_E2013-39/MCC9-12.N.VM.6)
- multiply matrices by scalars to produce new matrices, (e.g., as when all of the payoffs in a game are doubled) (CCGPS) (MAPR_E2013-40/MCC9-12.N.VM.7)
- add, subtract, and multiply matrices of appropriate dimensions (CCGPS) (MAPR_E2013-41/MCC9-12.N.VM.8)
- understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties (CCGPS) (MAPR_E2013-42/MCC9-12.N.VM.9)
- understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse (CCGPS) (MAPR_E2013-43/MCC9-12.N.VM.10)
- multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors (CCGPS) (MAPR_E2013-44/MCC9-12.N.VM.11)
- work with 2 X 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area (CCGPS) (MAPR_E2013-45/MCC9-12.N.VM.12)
**Accelerated PreCalculus CC**

**A - Algebra**
- represent a system of linear equations as a single matrix equation in a vector variable (CCGPS) (MAPA_A2013-1/MCC9-12.A.REI.8)
- find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension \(3 \times 3\) or greater) (CCGPS) (MAPA_A2013-2/MCC9-12.A.REI.9)

**B - Statistics and Probability**
- apply the general Multiplication Rule in a uniform probability model, \(P(A \text{ and } B) = [P(A)]x[P(B|A)] = [P(B)]x[P(A|B)]\), and interpret the answer in terms of the model (CCGPS) (MAPA_B2013-4/MCC9-12.S.CP.8)
- use permutations and combinations to compute probabilities of compound events and solve problems (CCGPS) (MAPA_B2013-5/MCC9-12.S.CP.9)
- define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions (CCGPS) (MAPA_B2013-6/MCC9-12.S.MD.1)

**B - Statistics and Probability (continued)**
- calculate the expected value of a random variable; interpret it as the mean of the probability distribution (CCGPS) (MAPA_B2013-7/MCC9-12.S.MD.2)
- develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value (e.g., find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes) (CCGPS) (MAPA_B2013-8/MCC9-12.S.MD.3)
- develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value (e.g., find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?) (CCGPS) (MAPA_B2013-9/MCC9-12.S.MD.4)
- weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values (CCGPS) (MAPA_B2013-10/MCC9-12.S.MD.5)
- find the expected payoff for a game of chance (e.g., find the expected winnings from a state lottery ticket or a game at a fast-food restaurant) (CCGPS) (MAPA_B2013-11/MCC9-12.S.MD.5a)
- evaluate and compare strategies on the basis of expected values (e.g., compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident) (CCGPS) (MAPA_B2013-12/MCC9-12.S.MD.5b)
- use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator) (CCGPS) (MAPA_B2013-13/MCC9-12.S.MD.6)
- analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game) (CCGPS) (MAPA_B2013-14/MCC9-12.S.MD.7)
C - Geometry

- derive the formula $A = \frac{1}{2}ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side (CCGPS) (MAPA_C2013-15/MCC9-12.G.SRT.9)
- prove the Laws of Sines and Cosines and use them to solve problems (CCGPS) (MAPA_C2013-16/MCC9-12.G.SRT.10)
- understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces) (CCGPS) (MAPA_C2013-17/MCC9-12.G.SRT.11)
- derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant (CCGPS) (MAPA_C2013-18/MCC9-12.G.GPE.3)

D - Functions

- find inverse functions (CCGPS) (MAPA_D2013-19/MCC9-12.F.BF.4)
- produce an invertible function from a non-invertible function by restricting the domain (CCGPS) (MAPA_D2013-20/MCC9-12.F.BF.4d)
- use special triangles to determine geometrically the values of sine, cosine, tangent, cosecant, secant, cotangent for $\frac{\pi}{3}, \frac{\pi}{4}$ and $\frac{\pi}{6}$, and use the unit circle to express the values of sine, cosine, tangent, cosecant, secant, and cotangent for $\pi + x$, $\pi - x$, and $2\pi - x$ in terms of their values for $x$, where $x$ is any real number (CCGPS) (MAPA_D2013-21/MCC9-12.F.TF.3)
- use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions (CCGPS) (MAPA_D2013-22/MCC9-12.F.TF.4)
- understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed (CCGPS) (MAPA_D2013-23/MCC9-12.F.TF.6)
- use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context (CCGPS) (MAPA_D2013-24/MCC9-12.F.TF.7)
- prove the addition, subtraction, and double angle formulas for sine, cosine, and tangent and use them to solve problems (CCGPS) (MAPA_D2013-25/MCC9-12.F.TF.9)
- compare and contrast properties of functions within and across the following types: Linear, quadratic, polynomial, power, rational, exponential, logarithmic, trigonometric and piecewise (CCGPS) (MAPA_D2013-26/MCC9-12.F.BF)
- students will explore the continuity of functions of two independent variables in terms of the limits of such functions as $(x,y)$ approaches a given point in the plane (CCGPS) (MAPA_D2013-27/MCC9-12.F.BF)

E - Numbers

- find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers (CCGPS) (MAPA_E2013-28/MCC9-12.N.CN.3)
- represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number (CCGPS) (MAPA_E2013-29/MCC9-12.N.CN.4)
- represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation (e.g., $(-1 + \sqrt{3}i)^3 = 8$ because $(-1 + \sqrt{3}i)$ has modulus 2 and argument $120^\circ$) (CCGPS) (MAPA_E2013-30/MCC9-12.N.CN.5)
- calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints (CCGPS) (MAPA_E2013-31/MCC9-12.N.CN.6)
- recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $v$, $|v|$, $||v||$, $\vec{v}$) (CCGPS) (MAPA_E2013-32/MCC9-12.N.VM.1)
- find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point (CCGPS) (MAPA_E2013-33/MCC9-12.N.VM.2)
- solve problems involving velocity and other quantities that can be represented by vectors (CCGPS) (MAPA_E2013-34/MCC9-12.N.VM.3)
- add and subtract vectors (CCGPS) (MAPA_E2013-35/MCC9-12.N.VM.4)
E – Numbers (continued)

- add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes (CCGPS) (MAPA_E2013-36/MCC9-12.N.VM.4a)

- given two vectors in magnitude and direction form, determine the magnitude and direction of their sum (CCGPS) (MAPA_E2013-37/MCC9-12.N.VM.4b)

- understand vector subtraction $v - w$ as $v + (-w)$, where $(-w)$ is the additive inverse of $w$, with the same magnitude as $w$ and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise (CCGPS) (MAPA_E2013-38/MCC9-12.N.VM.4c)

- multiply a vector by a scalar (CCGPS) (MAPA_E2013-39/MCC9-12.N.VM.5)

- represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, (e.g., as $c(vx, vy) = (cvx, cvy)$) (CCGPS) (MAPA_E2013-40/MCC9-12.N.VM.5a)

- compute the magnitude of a scalar multiple $cv$ using $||cv|| = |c|v$. Compute the direction of $cv$ knowing that when $|c|v = 0$, the direction of $cv$ is either along $v$ (for $c > 0$) or against $v$ (for $c < 0$) (CCGPS) (MAPA_E2013-41/MCC9-12.N.VM.5b)

- use matrices to represent and manipulate data, (e.g., to represent payoffs or incidence relationships in a network) (CCGPS) (MAPA_E2013-42/MCC9-12.N.VM.6)

- multiply matrices by scalars to produce new matrices, (e.g., as when all of the payoffs in a game are doubled) (CCGPS) (MAPA_E2013-43/MCC9-12.N.VM.7)

- add, subtract, and multiply matrices of appropriate dimensions (CCGPS) (MAPA_E2013-44/MCC9-12.N.VM.8)

- understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties (CCGPS) (MAPA_E2013-45/MCC9-12.N.VM.9)

- understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse (CCGPS) (MAPA_E2013-46/MCC9-12.N.VM.10)

- multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors (CCGPS) (MAPA_E2013-47/MCC9-12.N.VM.11)

- work with $2 \times 2$ matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area (CCGPS) (MAPA_E2013-48/MCC9-12.N.VM.12)

Integrated Algebra I

A - Process Skills

- use appropriate technology to solve mathematical problems (GPS) (MAM1_A2009-1)

- build new mathematical knowledge through problem-solving (GPS) (MAM1_A2009-2)

- solve problems that arise in mathematics and in other areas (GPS) (MAM1_A2009-3)

- apply and adapt a variety of appropriate strategies to solve problems (GPS) (MAM1_A2009-4)

- monitor and reflect on the process of mathematical problem-solving (GPS) (MAM1_A2009-5)

- recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MAM1_A2009-6)

- make and investigate mathematical conjectures (GPS) (MAM1_A2009-7)

- investigate, develop, and evaluate mathematical arguments and proofs (GPS) (MAM1_A2009-8)

- select and use various types of reasoning and methods of proof (GPS) (MAM1_A2009-9)

- organize and consolidate mathematics thinking (GPS) (MAM1_A2009-10)

- communicate mathematical thinking coherently to peers, teachers, and others (GPS) (MAM1_A2009-11)

- analyze and evaluate the mathematical thinking and strategies of others (GPS) (MAM1_A2009-12)

- use the terminology and language of mathematics to express mathematical ideas precisely (GPS) (MAM1_A2009-13)
A - Process Skills (continued)
- recognize and use connections among mathematical ideas (GPS) (MAM1_A2009-14)
- explain how mathematical ideas interconnect and build on one another to produce a coherent whole (GPS) (MAM1_A2009-15)
- recognize and apply mathematics in contexts outside of mathematics (GPS) (MAM1_A2009-16)
- create and use pictures, manipulatives, models, and symbols to organize, record, and communicate mathematical ideas (GPS) (MAM1_A2009-17)
- select, apply, and translate among mathematical representations to solve problems (GPS) (MAM1_A2009-18)
- use representations to model and interpret physical, social, and mathematical phenomena (GPS) (MAM1_A2009-19)

C - Geometry
- determine the distance between two points (GPS) (MAM1_C2009-20)
- determine the distance between a point and a line (GPS) (MAM1_C2009-21)
- determine the midpoint of a segment (GPS) (MAM1_C2009-22)
- explain the distance formula as an application of the Pythagorean theorem (GPS) (MAM1_C2009-23)
- use the coordinate plane to investigate properties of and verify conjectures related to triangles and quadrilaterals (GPS) (MAM1_C2009-24)
- use conjecture, inductive reasoning, deductive reasoning, counterexamples, and indirect proof as appropriate (GPS) (MAM1_C2009-25)
- explain and use the relationships among a statement and its converse, inverse, and contrapositive (GPS) (MAM1_C2009-26)
- determine the sum of interior and exterior angles in a polygon (GPS) (MAM1_C2009-27)
- use and explain triangle inequality, side-angle inequality, and exterior-angle inequality (GPS) (MAM1_C2009-28)
- use and explain congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL) (GPS) (MAM1_C2009-29)
- use and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite (GPS) (MAM1_C2009-30)
- find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid (GPS) (MAM1_C2009-31)

E - Algebra
- represent functions using function notation (GPS) (MAM1_E2009-32)
- graph the basic functions f(x)=xn, where n=1 to 3, f(x)=√x, f(x)=|x|, and f(x)=1/x (GPS) (MAM1_E2009-33)
- graph transformations of basic functions including vertical shifts, horizontal shifts, stretches, and shrinks, as well as reflections across the x- and y-axes (GPS) (MAM1_E2009-34)
- investigate and explain the characteristics of a function: domain, range, zeros, intercepts, intervals of increase and decrease, maximum and minimum values, and end behavior (GPS) (MAM1_E2009-35)
- relate to a given context the characteristics of a function and use graphs and tables to investigate its behavior (GPS) (MAM1_E2009-36)
- recognize sequences as functions with domains that are whole numbers (GPS) (MAM1_E2009-37)
- explore rates of change, comparing constant rates of change (e.g., slope) versus variable rates of change and compare rates of change of linear, quadratic, square root, and other function families (GPS) (MAM1_E2009-38)
- determine graphically and algebraically whether a function has symmetry and whether it is even, odd, or neither (GPS) (MAM1_E2009-39)
- explain how any equation in x can be interpreted as the equation f(x) = g(x), and interpret the solutions of the equation as the x-value(s) of the intersection point(s) of the graphs of y = f(x) and y = g(x) (GPS) (MAM1_E2009-40)
- simplify algebraic and numeric expressions involving square root (GPS) (MAM1_E2009-41)
- perform operations with square roots (GPS) (MAM1_E2009-42)
- add, subtract, multiply, and divide polynomials (GPS) (MAM1_E2009-43)
- expand binomials using the Binomial Theorem (GPS) (MAM1_E2009-44)
E – Algebra (continued)

- add, subtract, multiply, and divide rational expressions (GPS) (MAM1_E2009-45)
- factor expressions by greatest common factor, grouping, trial and error, and special products limited to the following formulas:
  \[(x + y)^2 = x^2 + 2xy + y^2; \quad (x - y)^2 = x^2 - 2xy + y^2; \quad (x + y)(x - y) = x^2 - y^2; \quad (x + a)(x + b) = x^2 + (a + b)x + ab; \quad (x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3; \quad (x - y)^3 = x^3 - 3x^2y + 3xy^2 - y^3 (GPS) (MAM1_E2009-46)\]
- factor expressions by greatest common factor, grouping, trial and error, and special products limited to the following formulas:
  \[(x + y)^2 = x^2 + 2xy + y^2; \quad (x - y)^2 = x^2 - 2xy + y^2; \quad (x + y)(x - y) = x^2 - y^2; \quad (x + a)(x + b) = x^2 + (a + b)x + ab; \quad (x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3; \quad (x - y)^3 = x^3 - 3x^2y + 3xy^2 - y^3 (GPS) (MAM1_E2009-46)\]
- use area and volume models for polynomial arithmetic (GPS) (MAM1_E2009-47)
- solve quadratic equations in the form \(ax^2 + bx + c = 0\), where \(a = 1\), by using factorization and finding square roots where applicable (GPS) (MAM1_E2009-48)
- solve equations involving radicals such as \(\sqrt{x} + b = c\), using algebraic techniques (GPS) (MAM1_E2009-49)
- use a variety of techniques, including technology, tables and graphs, to solve equations resulting from the investigation of \(x^2 + bx + c = 0\) (GPS) (MAM1_E2009-50)
- solve simple rational equations that result in linear equations or quadratic equations with leading coefficient of 1 (GPS) (MAM1_E2009-51)

F - Data Analysis and Probability

- organize, represent, investigate, interpret, and make inferences from data (GPS) (MAM1_F2009-52)
- apply the addition and multiplication principles of counting (GPS) (MAM1_F2009-53)
- calculate and use simple permutations and combinations (GPS) (MAM1_F2009-54)
- find the probabilities of mutually exclusive events (GPS) (MAM1_F2009-55)
- find the probabilities of dependent events (GPS) (MAM1_F2009-56)
- calculate conditional probabilities (GPS) (MAM1_F2009-57)
- use expected value to predict outcomes (GPS) (MAM1_F2009-58)
- compare summary statistics (mean, median, quartiles and interquartile range) from one sample data distribution to another sample data distribution in describing center and variability of data distributions (GPS) (MAM1_F2009-59)
- compare averages of summary statistics from a large number of samples to the corresponding population parameters (GPS) (MAM1_F2009-60)
- explain how a random sample is used to improve the chance of selecting a representative sample (GPS) (MAM1_F2009-61)
- explore variability of data by determining the mean absolute deviation (the average of the absolute values of the deviations) (GPS) (MAM1_F2009-62)

G - Reading Across the Curriculum

- read and discuss mathematical material to establish context for subject matter, develop mathematical vocabulary, and to be aware of current research (GPS) (MAM1_G2009-63)
Integrated Geometry

A - Process Skills
- use appropriate technology to solve mathematical problems (GPS) (MAM2_A2009-1)
- build new mathematical knowledge through problem-solving (GPS) (MAM2_A2009-2)
- solve problems that arise in mathematics and in other areas (GPS) (MAM2_A2009-3)
- apply and adapt a variety of appropriate strategies to solve problems (GPS) (MAM2_A2009-4)
- monitor and reflect on the process of mathematical problem-solving (GPS) (MAM2_A2009-5)
- recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MAM2_A2009-6)
- make and investigate mathematical conjectures (GPS) (MAM2_A2009-7)
- investigate, develop, and evaluate mathematical arguments and proofs (GPS) (MAM2_A2009-8)
- select and use various types of reasoning and methods of proof (GPS) (MAM2_A2009-9)
- organize and consolidate mathematics thinking (GPS) (MAM2_A2009-10)
- communicate mathematical thinking coherently to peers, teachers, and others (GPS) (MAM2_A2009-11)
- analyze and evaluate the mathematical thinking and strategies of others (GPS) (MAM2_A2009-12)
- use the terminology and language of mathematics to express mathematical ideas precisely (GPS) (MAM2_A2009-13)
- recognize and use connections among mathematical ideas (GPS) (MAM2_A2009-14)
- explain how mathematical ideas interconnect and build on one another to produce a coherent whole (GPS) (MAM2_A2009-15)
- recognize and apply mathematics in contexts outside of mathematics (GPS) (MAM2_A2009-16)
- create and use pictures, manipulatives, models, and symbols to organize, record, and communicate mathematical ideas (GPS) (MAM2_A2009-17)
- select, apply, and translate among mathematical representations to solve problems (GPS) (MAM2_A2009-18)
- use representations to model and interpret physical, social, and mathematical phenomena (GPS) (MAM2_A2009-19)

B - Numbers and Operations
- write square roots of negative numbers in imaginary form (GPS) (MAM2_B2009-20)
- write complex numbers in the form a + bi (GPS) (MAM2_B2009-21)
- add, subtract, multiply, and divide complex numbers (GPS) (MAM2_B2009-22)
- simplify expressions involving complex numbers (GPS) (MAM2_B2009-23)

C - Geometry
- identify and use special right triangles (GPS) (MAM2_C2009-24)
- determine the lengths of sides of 30° - 60° - 90° triangles (GPS) (MAM2_C2009-25)
- determine the lengths of sides of 45° - 45° - 90° triangles (GPS) (MAM2_C2009-26)
- define and apply sine, cosine, and tangent ratios to right triangles (GPS) (MAM2_C2009-27)
- explain the relationship of the trigonometric ratios for similar triangles (GPS) (MAM2_C2009-28)
- explain the relationship between the trigonometric ratios of complementary angles (GPS) (MAM2_C2009-29)
- solve application problems using the trigonometric ratios (GPS) (MAM2_C2009-30)
- apply properties of chords, tangents, and secants as an application of triangle similarity (GPS) (MAM2_C2009-31)
- apply properties of central, inscribed, and related angles (GPS) (MAM2_C2009-32)
- use the properties of circles to solve problems involving the length of an arc and the area of a sector (GPS) (MAM2_C2009-33)
- justify measurements and relationships in circles using geometric and algebraic properties (GPS) (MAM2_C2009-34)
- use and apply surface area and volume of a sphere (GPS) (MAM2_C2009-35)
- determine the effect on surface area and volume of changing the radius or diameter of a sphere (GPS) (MAM2_C2009-36)
E - Algebra

- investigate and explain characteristics of the greatest integer function (GPS) (MAM2_E2009-37)
- write absolute value functions as piecewise functions (GPS) (MAM2_E2009-38)
- investigate and explain characteristics of a variety of piecewise functions including domain, range, vertex, axis of symmetry, zeros, intercepts, extrema, points of discontinuity, intervals over which the function is constant, intervals of increase and decrease, and rates of change (GPS) (MAM2_E2009-39)
- solve absolute value equations and inequalities analytically, graphically, and by using appropriate technology (GPS) (MAM2_E2009-40)
- generalize properties of exponents to include all integer exponents (GPS) (MAM2_E2009-41)
- investigate and explain characteristics of exponential functions, including domain and range, asymptotes, zeros, intercepts, intervals of increase and decrease, rates of change, and end behavior (GPS) (MAM2_E2009-42)
- graph functions as transformations of \( f(x) = ax \) (GPS) (MAM2_E2009-43)
- solve simple exponential equations and inequalities analytically, graphically, and by using appropriate technology (GPS) (MAM2_E2009-44)
- use and explain basic exponential functions as models of real phenomena (GPS) (MAM2_E2009-45)
- represent geometric sequences as exponential functions with domains that are whole numbers (GPS) (MAM2_E2009-46)
- interpret the constant ratio in a geometric sequence as the base of the associated exponential function (GPS) (MAM2_E2009-47)
- analyze quadratic functions in the forms \( f(x) = ax^2 + bx + c \) and \( f(x) = a(x-h)^2 + k \) (GPS) (MAM2_E2009-48)
- convert between standard and vertex form (GPS) (MAM2_E2009-49)
- graph quadratic functions as transformations of the function \( f(x) = x^2 \) (GPS) (MAM2_E2009-50)
- investigate and explain characteristics of quadratic functions, including domain, range, vertex, axis of symmetry, zeros, intercepts, extrema, intervals of increase and decrease, and rates of change (GPS) (MAM2_E2009-51)
- investigate arithmetic series and explain various ways of computing their sums (GPS) (MAM2_E2009-52)
- interpret sequences of partial sums of arithmetic series as examples of quadratic functions (GPS) (MAM2_E2009-53)
- solve equations graphically using appropriate technology (GPS) (MAM2_E2009-54)
- find real and complex solutions of equations by factoring, taking square roots, and applying the quadratic formula (GPS) (MAM2_E2009-55)
- analyze the nature of roots using technology and the discriminant (GPS) (MAM2_E2009-56)
- solve quadratic inequalities both graphically and algebraically and describe the solutions using linear inequalities (GPS) (MAM2_E2009-57)
- explain the characteristics of functions and their inverses, including one-to-oneness, domain, and range (GPS) (MAM2_E2009-58)
- determine inverses of linear, quadratic, and power functions and functions of the form \( f(x) = a/x \), including the use of restricted domains (GPS) (MAM2_E2009-59)
- compare and contrast the graphs of functions and their inverses (GPS) (MAM2_E2009-60)
- use composition to verify that functions are inverses of each other (GPS) (MAM2_E2009-61)
High School Mathematics

F - Data Analysis and Probability
• pose a question and collect sample data from two or more different populations (GPS) (MAM2_F2009-62)
• calculate the means and standard deviations of sets of data (GPS) (MAM2_F2009-63)
• use means and standard deviations to compare data sets (GPS) (MAM2_F2009-64)
• compare the means and standard deviations of random samples with the corresponding population parameters, including those population parameters for normal distributions (GPS) (MAM2_F2009-65)
• explain why sample means vary from one sample to the next (GPS) (MAM2_F2009-66)
• explain why the distribution of the sample means has less variability than the population distribution (GPS) (MAM2_F2009-67)
• use population means and standard deviations to make informal inferences (GPS) (MAM2_F2009-68)
• gather and plot data that can be modeled with linear and quadratic functions (GPS) (MAM2_F2009-69)
• find good linear fits to data using simple methods such as the median-median line and "eyeballing" (GPS) (MAM2_F2009-70)
• apply the processes of linear and quadratic regression for curve fitting using appropriate technology (GPS) (MAM2_F2009-71)
• investigate issues that arise when using data to explore the relationship between two variables, including confusion between correlation and causation (GPS) (MAM2_F2009-72)

G - Reading Across the Curriculum
• read and discuss mathematical material to establish context for subject matter, develop mathematical vocabulary, and to be aware of current research (GPS) (MAM2_G2009-73)

Integrated Algebra II

A - Process Skills
• use appropriate technology to solve mathematical problems (GPS) (MAM3_A2010-1)
• build new mathematical knowledge through problem solving (GPS) (MAM3_A2010-2)
• solve problems that arise in mathematics and in other contexts (GPS) (MAM3_A2010-3)
• apply and adapt a variety of appropriate strategies to solve problems (GPS) (MAM3_A2010-4)
• monitor and reflect on the process of mathematical problem solving (GPS) (MAM3_A2010-5)
• recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MAM3_A2010-6)
• make and investigate mathematical conjectures (GPS) (MAM3_A2010-7)
• investigate, develop and evaluate mathematical arguments and proofs (GPS) (MAM3_A2010-8)
• select and use various types of reasoning and methods of proof (GPS) (MAM3_A2010-9)
• organize and consolidate mathematics thinking (GPS) (MAM3_A2010-10)
• communicate mathematical thinking coherently to peers, teachers and others (GPS) (MAM3_A2010-11)
• analyze and evaluate the mathematical thinking and strategies of others (GPS) (MAM3_A2010-12)
• use the terminology and language of mathematics to express mathematical ideas precisely (GPS) (MAM3_A2010-13)
• recognize and use connections among mathematical ideas (GPS) (MAM3_A2010-14)
• explain how mathematical ideas interconnect and build on one another to produce a coherent whole (GPS) (MAM3_A2010-15)
• recognize and apply mathematics in contexts outside of mathematics (GPS) (MAM3_A2010-16)
• create and use pictures, manipulatives, models and symbols to organize, record and communicate mathematical ideas (GPS) (MAM3_A2010-17)
• select, apply and translate among mathematical representations to solve problems (GPS) (MAM3_A2010-18)
• use representations to model and interpret physical, social and mathematical phenomena (GPS) (MAM3_A2010-19)
C - Geometry

- find equations of circles (GPS) (MAM3_C2010-20)
- graph a circle given an equation in general form (GPS) (MAM3_C2010-21)
- find the equation of a tangent line to a circle at a given point (GPS) (MAM3_C2010-22)
- solve a system of equations involving a circle and a line (GPS) (MAM3_C2010-23)
- solve a system of equations involving two circles (GPS) (MAM3_C2010-24)
- convert equations of conics by completing the square (GPS) (MAM3_C2010-25)
- graph conic sections, identifying fundamental characteristics (GPS) (MAM3_C2010-26)
- write equations of conic sections (including parabolas, circles, ellipses and hyperbolas) given appropriate information (GPS) (MAM3_C2010-27)
- plot the point \((x, y, z)\) and identify it as a vertex of a rectangular prism (GPS) (MAM3_C2010-28)
- apply the distance formula in 3-space (GPS) (MAM3_C2010-29)
- recognize and use equations of planes and spheres (GPS) (MAM3_C2010-30)

E - Algebra

- graph simple polynomial functions as translations of the function \(f(x) = ax^n\) (GPS) (MAM3_E2010-31)
- analyze the effects of the following on the graph of a polynomial function: degree, lead coefficient and multiplicity of real zeros (GPS) (MAM3_E2010-32)
- determine whether a polynomial function has symmetry and whether it is even, odd or neither (GPS) (MAM3_E2010-33)
- investigate and explain characteristics of polynomial functions, including domain and range, intercepts, zeros, relative and absolute extrema, intervals of increase and decrease, and end behavior (GPS) (MAM3_E2010-34)
- define and understand the properties of \(n\)th roots (GPS) (MAM3_E2010-35)
- extend properties of exponents to include rational exponents (GPS) (MAM3_E2010-36)
- define logarithmic functions as inverses of exponential functions (GPS) (MAM3_E2010-37)
- use and explain properties of logarithms by extending laws of exponents (GPS) (MAM3_E2010-38)
- investigate and explain characteristics of exponential and logarithmic functions including domain and range, asymptotes, zeros, intercepts, intervals of increase and decrease, and rate of change (GPS) (MAM3_E2010-39)
- graph functions as transformations of \(f(x) = ax, f(x) = \log ax, f(x) = ex\) and \(f(x) = \ln x\) (GPS) (MAM3_E2010-40)
- explore real phenomena related to exponential and logarithmic functions including half-life and doubling time (GPS) (MAM3_E2010-41)
- find real and complex roots of higher degree polynomial equations using the factor theorem, remainder theorem, rational root theorem and fundamental theorem of algebra, incorporating complex and radical conjugates (GPS) (MAM3_E2010-42)
- solve polynomial, exponential and logarithmic equations analytically, graphically and using appropriate technology (GPS) (MAM3_E2010-43)
- solve polynomial, exponential and logarithmic inequalities analytically, graphically and using appropriate technology and represent solution sets of inequalities using interval notation (GPS) (MAM3_E2010-44)
- solve a variety of types of equations by appropriate means choosing among mental calculation, pencil and paper, or appropriate technology (GPS) (MAM3_E2010-45)
- add, subtract, multiply and invert matrices choosing appropriate methods including technology (GPS) (MAM3_E2010-46)
- find the determinants and inverses of two-by-two matrices using pencil and paper, and find inverses of larger matrices using technology (GPS) (MAM3_E2010-47)
- examine the properties of matrices, contrasting them with properties of real numbers (GPS) (MAM3_E2010-48)
- represent a system of linear equations as a matrix equation (GPS) (MAM3_E2010-49)
- solve matrix equations using inverse matrices (GPS) (MAM3_E2010-50)
- represent and solve realistic problems using systems of linear equations (GPS) (MAM3_E2010-51)
- solve systems of inequalities in two variables, showing the solutions graphically (GPS) (MAM3_E2010-52)
E – Algebra (continued)
- represent and solve realistic problems using linear programming (GPS) (MAM3_E2010-53)
- apply matrix representations of vertex-edge graphs to represent realistic situations (GPS) (MAM3_E2010-54)
- use matrices to solve problems that can be represented by vertex-edge graphs (GPS) (MAM3_E2010-55)

F - Data Analysis and Probability
- create probability histograms of discrete random variables, using both experimental and theoretical probabilities (GPS) (MAM3_F2010-56)
- solve problems involving probabilities by interpreting a normal distribution as a probability histogram for a continuous random variable (z-scores are used for a general normal distribution) (GPS) (MAM3_F2010-57)
- determine intervals about the mean that include a given percent of data (GPS) (MAM3_F2010-58)
- determine the probability that a given value falls within a specified interval (GPS) (MAM3_F2010-59)
- estimate how many items in a population fall within a specified interval (GPS) (MAM3_F2010-60)
- compare experimental and observational studies by posing questions and collecting, analyzing and interpreting data (GPS) (MAM3_F2010-61)

G - Reading Across the Curriculum
- read and discuss mathematical material to establish context for subject matter, develop mathematical vocabulary and to be aware of current research (GPS) (MAM3_G2010-62)

Integrated Trigonometry

A - Process Skills
- use appropriate technology to solve mathematical problems (GPS) (MAM4_A2011-1)
- build new mathematical knowledge through problem solving (GPS) (MAM4_A2011-2)
- solve problems that arise in mathematics and in other areas (GPS) (MAM4_A2011-3)
- apply and adapt a variety of appropriate strategies to solve problems (GPS) (MAM4_A2011-4)
- monitor and reflect on the process of mathematical problem solving (GPS) (MAM4_A2011-5)
- recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MAM4_A2011-6)
- make and investigate mathematical conjectures (GPS) (MAM4_A2011-7)
- investigate, develop and evaluate mathematical arguments and proofs (GPS) (MAM4_A2011-8)
- select and use various types of reasoning and methods of proof (GPS) (MAM4_A2011-9)
- organize and consolidate mathematical thinking (GPS) (MAM4_A2011-10)
- analyze and evaluate the mathematical thinking and strategies of others (GPS) (MAM4_A2011-11)
- use the terminology and language of mathematics to express mathematical ideas precisely (GPS) (MAM4_A2011-12)
- recognize and use connections among mathematical ideas (GPS) (MAM4_A2011-13)
- explain how mathematical ideas interconnect and build on one another to produce a coherent whole (GPS) (MAM4_A2011-14)
- recognize and apply mathematics in contexts outside of mathematics (GPS) (MAM4_A2011-15)
- create and use pictures, manipulatives, models and symbols to organize, record and communicate mathematical ideas (GPS) (MAM4_A2011-16)
- select, apply and translate among mathematical representations to solve problems (GPS) (MAM4_A2011-17)
- use representations to model and interpret physical, social and mathematical phenomena (GPS) (MAM4_A2011-18)
- communicate mathematical thinking coherently to peers, teachers and others (GPS) (MAM4_A2011-19)
E - Algebra
• investigate and explain characteristics of rational functions, including domain, range, zeros, points of discontinuity, intervals of increase and decrease, rates of change, local and absolute extrema, symmetry, asymptotes, and end behavior (GPS) (MAM4_E2011-20)
• find inverses of rational functions, discussing domain and range, symmetry, and function composition (GPS) (MAM4_E2011-21)
• solve rational equations and inequalities analytically, graphically and by using appropriate technology (GPS) (MAM4_E2011-22)
• convert between angles measured in degrees and radians, including but not limited to 0°, 30°, 45°, 60°, 90° their multiples and equivalences (GPS) (MAM4_E2011-23)
• apply the six trigonometric functions as functions of general angles in standard position (GPS) (MAM4_E2011-24)
• find values of trigonometric functions using points on the terminal sides of angles in the standard position (GPS) (MAM4_E2011-25)
• apply the six trigonometric functions as functions of arc length on the unit circle (GPS) (MAM4_E2011-26)
• find values of trigonometric functions using the unit circle (GPS) (MAM4_E2011-27)
• apply the six basic trigonometric functions as functions of real numbers (GPS) (MAM4_E2011-28)
• determine the characteristics of the graphs of the six basic trigonometric functions (GPS) (MAM4_E2011-29)
• graph transformations of trigonometric functions including changing period, amplitude, phase shift and vertical shift (GPS) (MAM4_E2011-30)
• apply graphs of trigonometric functions in realistic contexts involving periodic phenomena (GPS) (MAM4_E2011-31)
• compare and contrast properties of functions within and across the following types: linear, quadratic, polynomial, power, rational, exponential, logarithmic, trigonometric and piecewise (GPS) (MAM4_E2011-32)
• investigate transformations of functions (GPS) (MAM4_E2011-33)
• investigate characteristics of functions built through sum, difference, product, quotient and composition (GPS) (MAM4_E2011-34)
• establish and utilize trigonometric identities to simplify expressions and verify equivalence statements (GPS) (MAM4_E2011-35)
• solve trigonometric equations both graphically and algebraically over a variety of domains, using technology as appropriate (GPS) (MAM4_E2011-36)
• use the coordinates of a point on the terminal side of an angle to express x as r cos θ and y as r sin θ (GPS) (MAM4_E2011-37)
• apply the law of sines and the law of cosines (GPS) (MAM4_E2011-38)
• verify and apply the trigonometric formula to find the area of a triangle (GPS) (MAM4_E2011-39)
• find values of the inverse sine, inverse cosine and inverse tangent functions using technology as appropriate (GPS) (MAM4_E2011-40)
• determine characteristics of the inverse sine, inverse cosine and inverse tangent functions and their graphs (GPS) (MAM4_E2011-41)
• find and use recursive and explicit formulae for the terms of sequences (GPS) (MAM4_E2011-42)
• analyze and use simple arithmetic and geometric sequences (GPS) (MAM4_E2011-43)
• find and apply the sums of finite and, where appropriate, infinite arithmetic and geometric series (GPS) (MAM4_E2011-44)
• use summation notation to express finite series (GPS) (MAM4_E2011-45)
• represent vectors algebraically and geometrically (GPS) (MAM4_E2011-46)
• convert between vectors expressed using rectangular coordinates and expressed using magnitude and direction (GPS) (MAM4_E2011-47)
• add, subtract and compute scalar multiples of vectors (GPS) (MAM4_E2011-48)
• use vectors to solve realistic problems (GPS) (MAM4_E2011-49)
**High School Mathematics**

**F - Data Analysis and Probability**
- use simulation to develop the idea of the central limit theorem (GPS) (MAM4_F2011-50)
- use student-generated data from random samples of 30 or more members to determine the margin of error and confidence interval for a specified level of confidence (GPS) (MAM4_F2011-51)
- use confidence intervals and margins of error to make inferences from data about a population (GPS) (MAM4_F2011-52)

**G - Reading Across the Curriculum**
- read and discuss mathematical material to establish context for subject matter, develop mathematical vocabulary and to be aware of current research (GPS) (MAM4_G2011-53)

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**Accelerated Integrated Algebra I**

**A - Process Skills**
- use appropriate technology to solve mathematical problems (GPS) (MAA1_A2009-1)
- build new mathematical knowledge through problem-solving (GPS) (MAA1_A2009-2)
- solve problems that arise in mathematics and in other areas (GPS) (MAA1_A2009-3)
- apply and adapt a variety of appropriate strategies to solve problems (GPS) (MAA1_A2009-4)
- monitor and reflect on the process of mathematical problem-solving (GPS) (MAA1_A2009-5)
- recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MAA1_A2009-6)
- make and investigate mathematical conjectures (GPS) (MAA1_A2009-7)
- investigate, develop, and evaluate mathematical arguments and proofs (GPS) (MAA1_A2009-8)
- select and use various types of reasoning and methods of proof (GPS) (MAA1_A2009-9)
- organize and consolidate mathematics thinking (GPS) (MAA1_A2009-10)
- communicate mathematical thinking coherently to peers, teachers, and others (GPS) (MAA1_A2009-11)
- analyze and evaluate the mathematical thinking and strategies of others (GPS) (MAA1_A2009-12)
- use the terminology and language of mathematics to express mathematical ideas precisely (GPS) (MAA1_A2009-13)
- recognize and use connections among mathematical ideas (GPS) (MAA1_A2009-14)
- explain how mathematical ideas interconnect and build on one another to produce a coherent whole (GPS) (MAA1_A2009-15)
- recognize and apply mathematics in contexts outside of mathematics (GPS) (MAA1_A2009-16)
- create and use pictures, manipulatives, models, and symbols to organize, record, and communicate mathematical ideas (GPS) (MAA1_A2009-17)
- select, apply, and translate among mathematical representations to solve problems (GPS) (MAA1_A2009-18)
- use representations to model and interpret physical, social, and mathematical phenomena (GPS) (MAA1_A2009-19)

**B - Numbers and Operations**
- write square roots of negative numbers in imaginary form (GPS) (MAA1_B2009-20)
- write complex numbers in the form a + bi (GPS) (MAA1_B2009-21)
- add, subtract, multiply, and divide complex numbers (GPS) (MAA1_B2009-22)
- simplify expressions involving complex numbers (GPS) (MAA1_B2009-23)
High School Mathematics

C - Geometry

- investigate properties of geometric figures in the coordinate plane (GPS) (MAA1_C2009-24)
- determine the distance between two points (GPS) (MAA1_C2009-25)
- determine the distance between a point and a line (GPS) (MAA1_C2009-26)
- determine the midpoint of a segment (GPS) (MAA1_C2009-27)
- show the distance formula as an application of the Pythagorean theorem (GPS) (MAA1_C2009-28)
- use the coordinate plane to investigate properties of and verify conjectures related to triangles and quadrilaterals (GPS) (MAA1_C2009-29)
- use conjecture, inductive reasoning, deductive reasoning, counterexamples, and indirect proof as appropriate (GPS) (MAA1_C2009-30)
- apply and use the relationships among a statement and its converse, inverse, and contrapositive (GPS) (MAA1_C2009-31)
- discover, prove, and apply properties of triangles, quadrilaterals, and other polygons (GPS) (MAA1_C2009-32)
- determine the sum of interior and exterior angles in a polygon (GPS) (MAA1_C2009-33)
- use and explain triangle inequality, side-angle inequality, and exterior-angle inequality (GPS) (MAA1_C2009-34)
- use congruence postulates and theorems for triangles (GPS) (MAA1_C2009-35)
- find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid (GPS) (MAA1_C2009-37)
- apply properties of chords, tangents, and secants as an application of triangle similarity (GPS) (MAA1_C2009-38)
- apply properties of central, inscribed, and related angles (GPS) (MAA1_C2009-39)
- use the properties of circles to solve problems involving the length of an arc and the area of a sector (GPS) (MAA1_C2009-40)
- justify measurements and relationships in circles using geometric and algebraic properties (GPS) (MAA1_C2009-41)
- use and apply surface area and volume of a sphere (GPS) (MAA1_C2009-42)
- determine the effect on surface area and volume of changing the radius or diameter of a sphere (GPS) (MAA1_C2009-43)

E - Algebra

- explore functions, solve equations, and operate with radical, polynomial, and rational expressions (GPS) (MAA1_E2009-44)
- represent functions using function notation (GPS) (MAA1_E2009-45)
- graph the basic functions f(x)=xn, where n=1 to 3, f(x)=√x, f(x)=|x|, and f(x)=1/x (GPS) (MAA1_E2009-46)
- graph transformations of basic functions including vertical shifts, horizontal shifts, stretches, and shrinks, as well as reflections across the x- and y-axes (GPS) (MAA1_E2009-47)
- investigate and explain the characteristics of a function: domain, range, zeros, intercepts, intervals of increase and decrease, maximum and minimum values, and end behavior (GPS) (MAA1_E2009-48)
- analyze the characteristics of a function in a given context, and use graphs and tables to investigate its behavior (GPS) (MAA1_E2009-49)
- recognize sequences as functions with domains that are sets of whole numbers (GPS) (MAA1_E2009-50)
- explore rates of change, comparing constant rates of change (e.g., slope) versus variable rates of change and compare rates of change of linear, quadratic, square root, and other function families (GPS) (MAA1_E2009-51)
- determine graphically and algebraically whether a function has symmetry and whether it is even, odd, or neither (GPS) (MAA1_E2009-52)
- analyze any equation in x that can be interpreted as the equation f(x)=g(x), and then interpret the solutions of the equation as the x-value(s) of the intersection point(s) of the graphs of y = f(x) and y = g(x) (GPS) (MAA1_E2009-53)
- simplify algebraic and numeric expressions involving square root (GPS) (MAA1_E2009-54)
- perform operations with square roots (GPS) (MAA1_E2009-55)
- add, subtract, multiply, and divide polynomials (GPS) (MAA1_E2009-56)
- add, subtract, multiply, and divide rational expressions (GPS) (MAA1_E2009-57)
E – Algebra (continued)

- factor expressions by greatest common factor, grouping, trial and error, and special products limited to the following formulas:
  \[(x + y)^2 = x^2 + 2xy + y^2; (x - y)^2 = x^2 - 2xy + y^2; (x + y)(x - y) = x^2 - y^2; (x + a)(x + b) = x^2 + (a + b)x + ab; (x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3; (x - y)^3 = x^3 - 3x^2y + 3xy^2 - y^3\] (MAA1_E2009-58)
- use area and volume models for polynomial arithmetic (GPS) (MAA1_E2009-59)
- solve equations involving radicals such as \(\sqrt{x + b} = c\) (MAA1_E2009-60)
- solve simple rational equations that result in linear equations or quadratic equations with leading coefficient of 1 (MAA1_E2009-61)
- analyze quadratic functions in the forms \(f(x) = ax^2 + bx + c\) and \(f(x) = a(x-h)^2 + k\) (GPS) (MAA1_E2009-62)
- convert between standard and vertex form of quadratic functions (GPS) (MAA1_E2009-63)
- graph quadratic functions as transformations of the function \(f(x) = x^2\) (GPS) (MAA1_E2009-64)
- investigate and explain characteristics of quadratic functions, including domain, range, vertex, axis of symmetry, zeros, intercepts, extrema, intervals of increase and decrease, and rates of change (GPS) (MAA1_E2009-65)
- investigate arithmetic series and various ways of computing their sums (GPS) (MAA1_E2009-66)
- explore sequences of partial sums of arithmetic series as examples of quadratic functions (GPS) (MAA1_E2009-67)
- solve quadratic equations and inequalities in one variable (GPS) (MAA1_E2009-68)
- solve quadratic equations and inequalities graphically using appropriate technology (GPS) (MAA1_E2009-69)
- find real and complex solutions of quadratic equations by factoring, taking square roots, and applying the quadratic formula (GPS) (MAA1_E2009-70)
- analyze the nature of roots using technology and the discriminant (GPS) (MAA1_E2009-71)
- solve quadratic inequalities both graphically and algebraically and describe the solutions using linear inequalities (GPS) (MAA1_E2009-72)
- investigate step and piecewise functions, including greatest integer and absolute value functions (GPS) (MAA1_E2009-73)
- write absolute value functions as piecewise functions (GPS) (MAA1_E2009-74)
- investigate and explain characteristics of a variety of piecewise functions including domain, range, vertex, axis of symmetry, zeros, intercepts, extrema, points of discontinuity, intervals over which the function is constant, intervals of increase and decrease, and rates of change (GPS) (MAA1_E2009-75)
- solve absolute value equations and inequalities analytically, graphically, and by using appropriate technology (GPS) (MAA1_E2009-76)

F - Data Analysis and Probability

- apply the addition and multiplication principles of counting (GPS) (MAA1_F2009-77)
- calculate and use simple permutations and combinations (GPS) (MAA1_F2009-78)
- find the probabilities of mutually exclusive events (GPS) (MAA1_F2009-79)
- find the probabilities of dependent and independent events (GPS) (MAA1_F2009-80)
- calculate conditional probabilities (GPS) (MAA1_F2009-81)
- use expected value to predict outcomes (GPS) (MAA1_F2009-82)
- compare summary statistics (mean, median, quartiles, and interquartile range) from one sample data distribution to another sample data distribution in describing center and variability of the data distributions (GPS) (MAA1_F2009-83)
- compare the averages of the summary statistics from a large number of samples to the corresponding population parameters (GPS) (MAA1_F2009-84)
- explain how a random sample is used to improve the chance of selecting a representative sample (GPS) (MAA1_F2009-85)
- explore variability of data by determining the mean absolute deviation (the average of the absolute values of the deviations) (GPS) (MAA1_F2009-86)
- determine an algebraic model to quantify the association between two quantitative variables (GPS) (MAA1_F2009-87)
- gather and plot data that can be modeled with linear and quadratic functions (GPS) (MAA1_F2009-88)
High School Mathematics

F - Data Analysis and Probability (continued)
• examine the issues of curve fitting by finding good linear fits to data using simple methods such as the median-median line and "eyeballing" (GPS) (MAA1_F2009-89)
• apply the processes of linear and quadratic regression for curve fitting using appropriate technology (GPS) (MAA1_F2009-90)

G - Reading Across the Curriculum
• read and discuss mathematical material to establish context for subject matter, develop mathematical vocabulary, and to be aware of current research (GPS) (MAA1_G2009-91)

Accelerated Integrated Geometry

A - Process Skills
• use appropriate technology to solve mathematical problems (GPS) (MAA2_A2009-1)
• build new mathematical knowledge through problem-solving (GPS) (MAA2_A2009-2)
• solve problems that arise in mathematics and in other areas (GPS) (MAA2_A2009-3)
• apply and adapt a variety of appropriate strategies to solve problems (GPS) (MAA2_A2009-4)
• monitor and reflect on the process of mathematical problem-solving (GPS) (MAA2_A2009-5)
• recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MAA2_A2009-6)
• make and investigate mathematical conjectures (GPS) (MAA2_A2009-7)
• investigate, develop, and evaluate mathematical arguments and proofs (GPS) (MAA2_A2009-8)
• select and use various types of reasoning and methods of proof (GPS) (MAA2_A2009-9)
• organize and consolidate mathematics thinking (GPS) (MAA2_A2009-10)
• communicate mathematical thinking coherently to peers, teachers, and others (GPS) (MAA2_A2009-11)
• analyze and evaluate the mathematical thinking and strategies of others (GPS) (MAA2_A2009-12)
• use the terminology and language of mathematics to express mathematical ideas precisely (GPS) (MAA2_A2009-13)
• recognize and use connections among mathematical ideas (GPS) (MAA2_A2009-14)
• explain how mathematical ideas interconnect and build on one another to produce a coherent whole (GPS) (MAA2_A2009-15)
• recognize and apply mathematics in contexts outside of mathematics (GPS) (MAA2_A2009-16)
• create and use pictures, manipulatives, models, and symbols to organize, record, and communicate mathematical ideas (GPS) (MAA2_A2009-17)
• select, apply, and translate among mathematical representations to solve problems (GPS) (MAA2_A2009-18)
• use representations to model and interpret physical, social, and mathematical phenomena (GPS) (MAA2_A2009-19)

C - Geometry
• identify and use special right triangles (GPS) (MAA2_C2009-20)
• determine the lengths of sides of 30° - 60° - 90° triangles (GPS) (MAA2_C2009-21)
• determine the lengths of sides of 45° - 45° - 90° triangles (GPS) (MAA2_C2009-22)
• use and apply the relationship of the trigonometric ratios for similar triangles (GPS) (MAA2_C2009-23)
• explain the relationship between the trigonometric ratios of complementary angles (GPS) (MAA2_C2009-24)
• solve application problems using the trigonometric ratios (GPS) (MAA2_C2009-25)
• find equations of circles (GPS) (MAA2_C2009-26)
• graph a circle given an equation in general form (GPS) (MAA2_C2009-27)
• find the equation of a tangent line to a circle at a given point (GPS) (MAA2_C2009-28)
• solve a system of equations involving a circle and a line (GPS) (MAA2_C2009-29)
C – Geometry (continued)

- solve a system of equations involving two circles (GPS) (MAA2_C2009-30)
- recognize, analyze, and graph the equations of the conic sections (parabolas, circles, ellipses, and hyperbolas) (GPS) (MAA2_C2009-31)
- convert equations of conics by completing the square (GPS) (MAA2_C2009-32)
- graph conic sections, identifying fundamental characteristics (GPS) (MAA2_C2009-33)
- write equations of conic sections given appropriate information (GPS) (MAA2_C2009-34)
- plot the point \((x, y, z)\) and understand it as a vertex of a rectangular prism (GPS) (MAA2_C2009-35)
- apply the distance formula in 3-space (GPS) (MAA2_C2009-36)
- recognize and understand equations of planes and spheres (GPS) (MAA2_C2009-37)

E – Algebra

- extend properties of exponents to include all integer exponents (GPS) (MAA2_E2009-38)
- investigate and explain characteristics of exponential functions, including domain and range, asymptotes, zeros, intercepts, intervals of increase and decrease, rates of change, and end behavior (GPS) (MAA2_E2009-39)
- graph functions as transformations of \(f(x) = ax\) (GPS) (MAA2_E2009-40)
- solve simple exponential equations and inequalities analytically, graphically, and by using appropriate technology (GPS) (MAA2_E2009-41)
- use basic exponential functions as models of real phenomena (GPS) (MAA2_E2009-42)
  - explain that geometric sequences are exponential functions with domains that are sets of whole numbers (GPS) (MAA2_E2009-43)
- interpret the constant ratio in a geometric sequence as the base of the associated exponential function (GPS) (MAA2_E2009-44)
  - analyze the characteristics of functions and their inverses, including one-to-oneness, domain, and range (GPS) (MAA2_E2009-45)
- determine inverses of linear, quadratic, and power functions and functions of the form \(f(x) = a/x\), including the use of restricted domains (GPS) (MAA2_E2009-46)
- analyze the graphs of functions and their inverses (GPS) (MAA2_E2009-47)
- use composition to verify that functions are inverses of each other (GPS) (MAA2_E2009-48)
- graph simple polynomial functions as translations of the function \(f(x) = ax^n\) (GPS) (MAA2_E2009-49)
- describe the effects of the following on the graph of a polynomial function: degree, lead coefficient, and multiplicity of real zeros (GPS) (MAA2_E2009-50)
- determine whether a polynomial function has symmetry and whether it is even, odd, or neither (GPS) (MAA2_E2009-51)
- investigate and explain characteristics of polynomial functions, including domain and range, intercepts, zeros, relative and absolute extreme, intervals of increase and decrease, and end behavior (GPS) (MAA2_E2009-52)
- define and understand the properties of nth roots (GPS) (MAA2_E2009-53)
- extend properties of exponents to include rational exponents (GPS) (MAA2_E2009-54)
- define logarithmic functions as inverses of exponential functions (GPS) (MAA2_E2009-55)
- apply properties of logarithms by extending laws of exponents (GPS) (MAA2_E2009-56)
- investigate and explain characteristics of exponential and logarithmic functions including domain and range, asymptotes, zeros, intercepts, intervals of increase and decrease, and rate of change (GPS) (MAA2_E2009-57)
- graph functions as transformations of \(f(x) = ax, f(x) = \log ax, f(x) = ex, f(x) = \ln x\) (GPS) (MAA2_E2009-58)
- explore real phenomena related to exponential and logarithmic functions including half-life and doubling time (GPS) (MAA2_E2009-59)
- find real and complex roots of higher degree polynomial equations using the factor theorem, remainder theorem, rational root theorem, and fundamental theorem of algebra, incorporating complex and radical conjugates (GPS) (MAA2_E2009-60)
E – Algebra (continued)

- solve polynomial, exponential, and logarithmic equations analytically, graphically, and using appropriate technology (GPS) (MAA2_E2009-61)
- solve polynomial, exponential, and logarithmic inequalities analytically, graphically, and using appropriate technology and represent solution sets of inequalities using interval notation (GPS) (MAA2_E2009-62)
- solve a variety of types of equations by appropriate means choosing among mental calculation, pencil and paper, or appropriate technology (GPS) (MAA2_E2009-63)
- add, subtract, multiply, and invert matrices choosing appropriate methods, including technology (GPS) (MAA2_E2009-64)
- find the determinants and inverses of two-by-two and three-by-three matrices using pencil and paper, and find inverses of larger matrices using technology (GPS) (MAA2_E2009-65)
- examine the properties of matrices, contrasting them with properties of real numbers (GPS) (MAA2_E2009-66)
- represent a system of linear equations as a matrix equation (GPS) (MAA2_E2009-67)
- solve matrix equations using inverse matrices (GPS) (MAA2_E2009-68)
- represent and solve realistic problems using systems of linear equations (GPS) (MAA2_E2009-69)
- solve systems of inequalities in two variables, showing the solutions graphically (GPS) (MAA2_E2009-70)
- represent and solve realistic problems using linear programming (GPS) (MAA2_E2009-71)
- apply matrix representations of vertex-edge graphs (GPS) (MAA2_E2009-72)
- use graphs to represent realistic situations (GPS) (MAA2_E2009-73)
- use matrices to represent graphs, and solve problems that can be represented by graphs (GPS) (MAA2_E2009-74)

F - Data Analysis and Probability

- pose a question and collect sample data from two or more different populations (GPS) (MAA2_F2009-75)
- calculate and understand the means and standard deviations of sets of data (GPS) (MAA2_F2009-76)
- use means and standard deviations to compare data sets (GPS) (MAA2_F2009-77)
- compare the means and standard deviations of random samples with the corresponding population parameters to conclude that the different sample means vary from one sample to the next and that the distribution of the sample means has less variability than t (GPS) (MAA2_F2009-78)
- create probability histograms of discrete random variables, using both experimental and theoretical probabilities (GPS) (MAA2_F2009-79)
- solve problems involving probabilities by interpreting a normal distribution as a probability histogram for a continuous random variable (z-scores are used for a general normal distribution) (GPS) (MAA2_F2009-80)
- determine intervals about the mean that include a given percent of data (GPS) (MAA2_F2009-81)
- determine the probability that a given value fall within a specified interval (GPS) (MAA2_F2009-82)
- estimate how many items in a population fall within a specified interval (GPS) (MAA2_F2009-83)
- compare experimental and observational studies by posing questions and collecting, analyzing, and interpreting data (GPS) (MAA2_F2009-84)

G - Reading Across the Curriculum

- read and discuss mathematical material to establish context for subject matter, develop mathematical vocabulary, and to be aware of current research (GPS) (MAA2_G2009-85)
Accelerated Integrated Precalculus

A - Process Skills

- use appropriate technology to solve mathematical problems (GPS) (MAA3_A2009-1)
- build new mathematical knowledge through problem-solving (GPS) (MAA3_A2009-2)
- solve problems that arise in mathematics and in other areas (GPS) (MAA3_A2009-3)
- apply and adapt a variety of appropriate strategies to solve problems (GPS) (MAA3_A2009-4)
- monitor and reflect on the process of mathematical problem-solving (GPS) (MAA3_A2009-5)
- recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MAA3_A2009-6)
- make and investigate mathematical conjectures (GPS) (MAA3_A2009-7)
- investigate, develop, and evaluate mathematical arguments and proofs (GPS) (MAA3_A2009-8)
- select and use various types of reasoning and methods of proof (GPS) (MAA3_A2009-9)
- organize and consolidate mathematics thinking (GPS) (MAA3_A2009-10)
- communicate mathematical thinking coherently to peers, teachers, and others (GPS) (MAA3_A2009-11)
- analyze and evaluate the mathematical thinking and strategies of others (GPS) (MAA3_A2009-12)
- use the terminology and language of mathematics to express mathematical ideas precisely (GPS) (MAA3_A2009-13)
- recognize and use connections among mathematical ideas (GPS) (MAA3_A2009-14)
- explain how mathematical ideas interconnect and build on one another to produce a coherent whole (GPS) (MAA3_A2009-15)
- recognize and apply mathematics in contexts outside of mathematics (GPS) (MAA3_A2009-16)
- create and use pictures, manipulatives, models, and symbols to organize, record, and communicate mathematical ideas (GPS) (MAA3_A2009-17)
- select, apply, and translate among mathematical representations to solve problems (GPS) (MAA3_A2009-18)
- use representations to model and interpret physical, social, and mathematical phenomena (GPS) (MAA3_A2009-19)

E - Algebra

- investigate and explain characteristics of rational functions, including domain, range, zeros, points of discontinuity, intervals of increase and decrease, rates of change, local and absolute extrema, symmetry, asymptotes, and end behavior (GPS) (MAA3_E2009-20)
- find inverses of rational functions, discussing domain, range, symmetry and function composition (GPS) (MAA3_E2009-21)
- solve rational equations and inequalities analytically, graphically and by using appropriate technology (GPS) (MAA3_E2009-22)
- convert between angles measured in degrees and radians, including but not limited to 0°, 30°, 45°, 60°, 90° their multiples and equivalences (GPS) (MAA3_E2009-23)
- apply the six trigonometric functions as functions of general angles in standard position (GPS) (MAA3_E2009-24)
- find values of trigonometric functions using points on the terminal sides of angles in the standard position (GPS) (MAA3_E2009-25)
- apply the six trigonometric functions as functions of arc length on the unit circle (GPS) (MAA3_E2009-26)
- find values of trigonometric functions using the unit circle (GPS) (MAA3_E2009-27)
- apply the six basic trigonometric functions as functions of real numbers (GPS) (MAA3_E2009-28)
- determine characteristics of the graphs of the six basic trigonometric functions (GPS) (MAA3_E2009-29)
- graph transformations of trigonometric functions including changing period, amplitude, phase shift and vertical shift (GPS) (MAA3_E2009-30)
- apply graphs of trigonometric functions in realistic contexts involving periodic phenomena (GPS) (MAA3_E2009-31)
- compare and contrast properties of functions within and across the following types: linear, quadratic, polynomial, power, rational, exponential, logarithmic, trigonometric and piecewise (GPS) (MAA3_E2009-32)
- investigate transformations of functions (GPS) (MAA3_E2009-33)
E – Algebra (continued)

• investigate characteristics of functions built through sum, difference, product, quotient and composition (GPS) (MAA3_E2009-34)
• establish and utilize trigonometric identities to simplify expressions and verify equivalence statements (GPS) (MAA3_E2009-35)
• solve trigonometric equations both graphically and algebraically over a variety of domains, using technology as appropriate (GPS) (MAA3_E2009-36)
• use the coordinates of a point on the terminal side of an angle to express x as r cos θ and y as r sin θ (GPS) (MAA3_E2009-37)
• apply the law of sines and the law of cosines (GPS) (MAA3_E2009-38)
• verify and apply the trigonometric formula to find the area of a triangle (GPS) (MAA3_E2009-39)
• find values of the inverse sine, inverse cosine and inverse tangent functions using technology as appropriate (GPS) (MAA3_E2009-40)
• determine characteristics of the inverse sine, inverse cosine and inverse tangent functions and their graphs (GPS) (MAA3_E2009-41)
• find and use recursive and explicit formulae for the terms of sequences (GPS) (MAA3_E2009-42)
• analyze and use simple arithmetic and geometric sequences (GPS) (MAA3_E2009-43)
• investigate and analyze limits of sequences (GPS) (MAA3_E2009-44)
• use mathematical induction to find and prove formulae for sums of finite series (GPS) (MAA3_E2009-45)
• find and apply the sums of finite and, where appropriate, infinite arithmetic and geometric series (GPS) (MAA3_E2009-46)
• use summation notation to express series (GPS) (MAA3_E2009-47)
• determine geometric series and their limits (GPS) (MAA3_E2009-48)
• represent vectors algebraically and geometrically (GPS) (MAA3_E2009-49)
• convert between vectors expressed using rectangular coordinates and vectors expressed using magnitude and direction (GPS) (MAA3_E2009-50)
• add and subtract vectors and compute scalar multiples of vectors (GPS) (MAA3_E2009-51)
• use vectors to solve realistic problems (GPS) (MAA3_E2009-52)
• represent complex numbers in rectangular and trigonometric form (GPS) (MAA3_E2009-53)
• find products, quotients, powers and roots of complex numbers in rectangular and trigonometric form (GPS) (MAA3_E2009-54)
• describe parametric representations of plane curves (GPS) (MAA3_E2009-55)
• convert between Cartesian and parametric form (GPS) (MAA3_E2009-56)
• graph equations in parametric form showing direction and endpoints where appropriate (GPS) (MAA3_E2009-57)
• express coordinates of points in rectangular and polar form (GPS) (MAA3_E2009-58)
• graph and identify characteristics of simple polar equations including lines, circles, cardioids, limaçons and roses (GPS) (MAA3_E2009-59)

F - Data Analysis and Probability

• organize, represent, investigate, interpret, and make inferences from data, using the central limit theorem and the standard normal distribution (GPS) (MAA3_F2009-60)
• apply the central limit theorem to calculate confidence intervals for a population mean using data from large samples (GPS) (MAA3_F2009-61)
• use sample data and confidence intervals to draw conclusions about populations (GPS) (MAA3_F2009-62)
• use simulation to develop the idea of the central limit theorem (GPS) (MAA3_F2009-63)
• use student-generated data from random samples of 30 or more members to determine the margin of error and confidence interval for a specified level of confidence (GPS) (MAA3_F2009-64)
• use confidence intervals and margins of error to make inferences from data about a population (GPS) (MAA3_F2009-65)
G - Reading Across the Curriculum

- read and discuss mathematical material to establish context for subject matter, develop mathematical vocabulary, and to be aware of current research (GPS) (MAA3_G2009-66)

Calculus

A - Process Skills

- use appropriate technology to solve mathematical problems (GPS) (MACA_A2009-1)
- build new mathematical knowledge through problem-solving (GPS) (MACA_A2009-2)
- solve problems that arise in mathematics and in other areas (GPS) (MACA_A2009-3)
- apply and adapt a variety of appropriate strategies to solve problems (GPS) (MACA_A2009-4)
- monitor and reflect on the process of mathematical problem-solving (GPS) (MACA_A2009-5)
- recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MACA_A2009-6)

A - Process Skills (continued)

- make and investigate mathematical conjectures (GPS) (MACA_A2009-7)
- investigate, develop, and evaluate mathematical arguments and proofs (GPS) (MACA_A2009-8)
- select and use various types of reasoning and methods of proof (GPS) (MACA_A2009-9)
- organize and consolidate mathematics thinking (GPS) (MACA_A2009-10)
- communicate mathematical thinking coherently to peers, teachers, and others (GPS) (MACA_A2009-11)
- analyze and evaluate the mathematical thinking and strategies of others (GPS) (MACA_A2009-12)
- use the terminology and language of mathematics to express mathematical ideas precisely (GPS) (MACA_A2009-13)
- recognize and use connections among mathematical ideas (GPS) (MACA_A2009-14)
- explain how mathematical ideas interconnect and build on one another to produce a coherent whole (GPS) (MACA_A2009-15)
- recognize and apply mathematics in contexts outside of mathematics (GPS) (MACA_A2009-16)
- communicate mathematical thinking coherently to peers, teachers, and others (GPS) (MACA_A2009-17)
- select, apply, and translate among mathematical representations to solve problems (GPS) (MACA_A2009-18)
- use representations to model and interpret physical, social, and mathematical phenomena (GPS) (MACA_A2009-19)

B - Functions

- apply concepts of functions including domain, range, intercepts, symmetry, asymptotes, zeros, odd, even, and inverse (MACA_B2009-20)
- apply the algebra of functions by finding sum, product, quotient, composition, and inverse, where they exist (MACA_B2009-21)
- identify and apply properties of algebraic, trigonometric, piecewise, absolute value, exponential, and logarithmic functions (MACA_B2009-22)

C - Limits and Continuity

- calculate limits using algebra (MACA_C2009-23)
- evaluate limits of functions and apply properties of limits, including one-sided limits (MACA_C2009-24)
- estimate limits from graphs or tables of data (MACA_C2009-25)
- describe asymptotic behavior in terms of limits involving infinity (MACA_C2009-26)
- indicate where a function is continuous and where it is discontinuous (MACA_C2009-27)
- identify types of discontinuities graphically and analytically (MACA_C2009-28)
- apply the definition of continuity to a function at a point (MACA_C2009-29)
D - Derivatives
- define the derivative of a function in various ways: the limit of the difference quotient, the slope of the tangent line at a point, instantaneous rate of change, and the limit of the average rate of change (MACA_D2009-30)
- determine if a function is differentiable over an interval (MACA_D2009-31)
- determine where a function fails to be differentiable (MACA_D2009-32)
- apply the rules of differentiation, such as product and quotient rules, to algebraic functions, including successive derivatives (MACA_D2009-33)
- interpret derivative as a rate of change in the context of speed, velocity, and acceleration (MACA_D2009-34)
- apply the chain rule to composite functions, implicitly defined relations, and related rates of change (MACA_D2009-35)
- apply the rules of differentiation to trigonometric functions, such as product, quotient, and chain rules, including successive derivatives (MACA_D2009-36)

E - Applications of Derivatives
- apply the derivative to determine: the slope of a curve at a point, the equation of the tangent line to a curve at a point, and the equation of the normal line to a curve at a point (MACA_E2009-37)
- apply Rolle’s Theorem and the Mean Value Theorem (MACA_E2009-38)
- use the relationships between f(x), f'(x), and f''(x) to determine the increasing/decreasing behavior of f(x); determine the critical point(s) of f(x); determine the concavity of f(x) over an interval; and determine the point(s) of inflection of f(x) (MACA_E2009-39)
- given various pieces of information, sketch of graph(s) of f(x), f'(x), and f''(x) (MACA_E2009-40)
- find absolute (global) and relative (local) extrema (MACA_E2009-41)
- solve optimization problems (MACA_E2009-42)
- apply the extreme value theorem to problem situations (MACA_E2009-43)
- model rates of change involved with related rates problems (MACA_E2009-44)

F - Integrals
- define the antiderivative and apply its properties to problems such as distance and velocity from acceleration with initial condition, growth, and decay (MACA_F2009-45)
- compute Riemann sums using left, right, and midpoint evaluations and trapezoids (MACA_F2009-46)
- calculate area by a definite integral of Riemann sums over equal subdivisions (MACA_F2009-47)
- calculate areas by evaluation sums using sigma notation (MACA_F2009-48)
- relate the definite integral to the concept of the area under a curve; define and apply the properties of the definite integral (MACA_F2009-49)
- identify and use the Fundamental Theorem of Calculus in evaluation of definite integrals (MACA_F2009-50)
- evaluate integrals following directly from derivatives of basic functions (MACA_F2009-51)
- evaluate integrals by substitution of variables (including change of limits for definite integrals) (MACA_F2009-52)

G - Applications of the Integral
- apply the integral to the average or mean value of a function on an interval (MACA_G2009-53)
- evaluate the area between curves using integration formulas (MACA_G2009-54)
- evaluate the volume of a solid using known cross-sections (MACA_G2009-55)
- evaluate the volume of a solid of revolutions using the disk or washer method (MACA_G2009-56)

H - Reading Across the Curriculum
- read and discuss mathematical material to establish context for subject matter, develop mathematical vocabulary, and develop an awareness of current research (MACA_H2009-57)
Mathematics of Finance

A - Process Skills
- use appropriate technology to solve mathematical problems (GPS) (MAMF_A2011-1)
- build new mathematical knowledge through problem-solving (GPS) (MAMF_A2011-2)
- solve problems that arise in mathematics and in other areas (GPS) (MAMF_A2011-3)
- apply and adapt a variety of appropriate strategies to solve problems (GPS) (MAMF_A2011-4)
- monitor and reflect on the process of mathematical problem-solving (GPS) (MAMF_A2011-5)
- recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MAMF_A2011-6)
- make and investigate mathematical conjectures (GPS) (MAMF_A2011-7)
- solve problems that arise in mathematics and in other areas (GPS) (MAMF_A2011-8)
- apply and adapt a variety of appropriate strategies to solve problems (GPS) (MAMF_A2011-9)
- recognize reasoning and proof (evidence) as fundamental aspects of mathematics (GPS) (MAMF_A2011-10)
- communicate mathematical thinking coherently to peers, teachers, and others (GPS) (MAMF_A2011-11)
- analyze and evaluate the mathematical thinking and strategies of others (GPS) (MAMF_A2011-12)
- use the terminology and language of mathematics to express mathematical ideas precisely (GPS) (MAMF_A2011-13)
- recognize and use connections among mathematical ideas (GPS) (MAMF_A2011-14)
- explain how mathematical ideas interconnect and build on one another to produce a coherent whole (GPS) (MAMF_A2011-15)
- recognize and apply mathematics in contexts outside of mathematics (GPS) (MAMF_A2011-16)
- create and use pictures, manipulatives, models, and symbols to organize, record, and communicate mathematical ideas (GPS) (MAMF_A2011-17)
- select, apply, and translate among mathematical representations to solve problems (GPS) (MAMF_A2011-18)
- use representations to model and interpret physical, social, and mathematical phenomena (GPS) (MAMF_A2011-19)

B - Numbers and Operations
- use fractions, percents, and ratios to solve problems related to stock transactions, credit cards, taxes, budgets, automobile purchases, fuel economy, Social Security, Medicare, retirement planning, checking and saving accounts and other related finance applications (GPS) (MAMF_B2011-20)
- apply percent increase and decrease, ratios, and proportions (GPS) (MAMF_B2011-21)

C - Geometry
- apply the concepts of area, volume, scale factors, and scale drawings to planning for housing (GPS) (MAMF_C2011-22)
- apply the distance formula to trip planning (GPS) (MAMF_C2011-23)
- apply the properties of angles and segments in circles to accident investigation data (GPS) (MAMF_C2011-24)

E - Algebra
- use basic functions to solve and model problems related to stock transactions, banking and credit, employment and taxes, rent and mortgages, retirement planning, and other related finance applications (GPS) (MAMF_E2011-25)
- apply linear, quadratic, and cubic functions (GPS) (MAMF_E2011-26)
- apply rational and square root functions (GPS) (MAMF_E2011-27)
- apply greatest integer and piecewise functions (GPS) (MAMF_E2011-28)
- apply exponential and logarithmic functions (GPS) (MAMF_E2011-29)
- understand domain and range when limited to a financial problem situation (GPS) (MAMF_E2011-30)
- apply limits as end behavior of modeling functions (GPS) (MAMF_E2011-31)
- evaluate investments in banking and retirement planning using simple and compound interest, and future and present value formulas (GPS) (MAMF_E2011-32)
High School Mathematics

E – Algebra (continued)
• represent data and solve banking and retirement planning problems using matrices (GPS) (MAMF_E2011-33)

F - Data Analysis and Probability
• investigate data found in the stock market, retirement planning, transportation, budgeting, and home rental or ownership using measures of central tendency (GPS) (MAMF_F2011-34)
• recognize and interpret trends related to the stock market, retirement planning, insurance, car purchasing, and home rental or ownership using data displays including bar graphs, line graphs, stock bar charts, candlestick charts, box and whisker plots, stem and leaf plots, circle graphs, and scatter plots (GPS) (MAMF_F2011-35)
• use linear, quadratic, and cubic regressions as well as the correlation coefficient to evaluate supply and demand, revenue, profit, and other financial problem situations (GPS) (MAMF_F2011-36)
• use probability, the Monte Carlo method, and expected value model and predict outcomes related to the stock market, retirement planning, insurance, and investing (GPS) (MAMF_F2011-37)
• draw conclusions about applied problems using decision theory (MAMF_F2011-38)

Euclidean Geometry

A - Geometry from a Synthetic Perspective
• identify, prove, and apply theorems and properties related to congruent triangles, right triangles, and polygons (QCC, SAT I, ACT) (MAGA_A2001-1)
• apply properties and analyze relationships associated with points, segments, rays, lines, angles, planes, and polygons (QCC, SAT I, ACT) (MAGA_A2001-2)
• apply properties and analyze relationships with respect to circles and segments, lines, arcs, and angles associated with circles (QCC, SAT I, ACT) (MAGA_A2001-3)
• explore and interpret both two- and three-dimensional geometric figures using such topics as projections, cross sections, and locus problems (QCC, SAT I, ACT) (MAGA_A2001-4)
• apply inductive and deductive reasoning processes to form conjectures and then form conjectures using valid reasoning and laws of logic (QCC, ACT) (MAGA_A2001-5)
• write proofs including paragraph, two column, flow-chart, and indirect (QCC, ACT) (MAGA_A2001-6)
• examine and apply properties of rotations, reflections, translations, dilations, and symmetry of geometric figures (QCC, ACT) (MAGA_A2001-7)
• apply transformations vectors and scale changes to find the image of figures on the coordinate plane (QCC, ACT) (MAGA_A2001-8)
• determine composites of transformations (QCC) (MAGA_A2001-9)
• identify isometries of geometric figures (QCC) (MAGA_A2001-10)
• analyze parallel and perpendicular line relationships (QCC, SAT I, ACT) (MAGA_A2001-11)
• apply the properties of triangle inequalities (QCC, SAT I) (MAGA_A2001-12)
• apply properties of polygons and polyhedrons (QCC, SAT I) (MAGA_A2001-13)
• determine similar figures and apply the properties (QCC, SAT I, ACT) (MAGA_A2001-14)
• create constructions associated with segments, angles, polygons, and circles using compass and straightedge, paper folding, mira, and/or computer graphing software (QCC) (MAGA_A2003-1)
• prove and apply theorems associated with polygons with respect to angles, sides, segments, and angle sums (QCC) (MAGA_A2003-2)
High School Mathematics

B - Geometry from an Algebraic Perspective
- apply formulas for distances, midpoints, slopes, and circles (QCC, SAT I, ACT) (MAGA_B2001-15)
- determine perimeter, area, circumference, arc length, area of sectors, volume, and surface area of geometric figures using appropriate units (QCC, SAT I, ACT) (MAGA_B2001-16)
- draw and interpret three-dimensional graphs (QCC) (MAGA_B2001-17)
- apply the quadratic formula (QCC, SAT I) (MAGA_B2001-18)
- write coordinate proofs (QCC, ACT) (MAGA_B2001-19)
- find the coordinates of the point of intersection of two lines (QCC) (MAGA_B2001-20)
- write and graph equations of parallel, perpendicular, and intersecting lines satisfying given conditions (QCC, SAT I) (MAGA_B2001-21)
- compare and apply properties associated with similar figures using scale factors (QCC, HSGT, ACT) (MAGA_B2001-22)
- apply congruence and similarity properties of parallel lines, polygons, and solids (QCC) (MAGA_B2003-3)
- investigate and apply the Pythagorean Theorem and its converse (QCC) (MAGA_B2003-4)

C - Algebra
- write equations satisfying given conditions (QCC, ACT) (MAGA_C2001-23)

D - Probability
- apply geometric probability (SAT I, ACT) (MAGA_D2001-24)

E - Trigonometry
- apply special right triangle relationships (QCC, SAT I, ACT) (MAGA_E2001-25)
- explore sine, cosine, and tangent functions in right triangles (QCC, ACT) (MAGA_E2001-26)

F - Discrete Mathematics
- develop and apply algorithms (QCC, ACT) (MAGA_F2001-27)
- optimize perimeters, areas, and volumes and solve related problems (QCC, ACT) (MAGA_F2001-28)

Honors / Gifted Euclidean Geometry

A - Geometry from a Synthetic Perspective
- identify, prove, and apply theorems and properties related to congruent triangles, right triangles and polygons (QCC, SAT I) (MAHG_A2001-1)
- apply properties and analyze relationships associated with points, segments, rays, lines, angles, planes, and polygons (QCC, SAT I) (MAHG_A2001-2)
- explore and interpret both two and three dimensional geometric figures using such topics as projections, cross sections, and locus problems (QCC) (MAHG_A2001-3)
- create constructions associated with segments, angles, polygons, and circles using compass and straightedge, paper folding, mira, and/or computer graphing software (QCC) (MAHG_A2001-4)
- apply inductive and deductive reasoning process to form conjectures and then prove conjectures using valid reasoning and laws of logic (QCC) (MAHG_A2001-6)
- prove and apply theorems associated with polygons with respect to angles, sides, segments, and angle sum (QCC) (MAHG_A2001-7)
- apply properties and analyze relationships with respect to circles and segments, lines, and arcs, and angles associated with circles (QCC) (MAHG_A2001-8)
A - Geometry from a Synthetic Perspective

- construct direct and indirect proofs in written form such as paragraph, two-column, or flow-chart formats (QCC) (MAHG_A2001-10)
- apply and prove congruence and similarity properties of polygons and solids (QCC, SAT I) (MAHG_A2001-11)
- compare and apply properties associated with similar figures (QCC) (MAHG_A2002-1)
- recognize parallel lines and planes, skew lines, and pairs of angles formed when two lines are cut by a transversal (alternate and same side, interior and exterior, corresponding) (QCC, SAT I) (MAHG_A2003-1)
- use properties of quadrilaterals to establish and test relationships involving diagonals, angles, and lines of symmetry (QCC) (MAHG_A2003-2)
- determine the equivalence and validity of truth tables including sentences involving conditional statements, conjunctions, disjunctions, and negations (QCC) (MAHG_A2003-3)
- determine truth tables for sentences and use Venn Diagrams to illustrate the relationship represented by truth tables (QCC) (MAHG_A2003-4)
- recognize and apply similar polygons using ratio and proportion (QCC) (MAHG_A2003-5)

B - Geometry from an Algebraic Perspective

- write and graph equations of parallel, perpendicular, and intersecting lines satisfying given conditions (QCC, SAT I, ACT) (MAHG_B2001-12)
- develop and apply formulas for distance, midpoint, slope, and circles (QCC, SAT I, ACT) (MAHG_B2001-13)
- determine perimeter, area, circumference, arc length, area of sectors, and surface area of geometric figures using appropriate units (QCC, SAT I, ACT) (MAHG_B2001-14)
- write coordinate proofs (QCC) (MAHG_B2001-15)
- analyze effects of reflections, rotations, translations, dilations, and symmetry of geometric figures in the coordinate plane (QCC, HSGT) (MAHG_B2001-16)
- investigate and apply transformation vectors and scale changes to find the image of figures on the coordinate plane (QCC) (MAHG_B2001-17)
- create composites of transformations (QCC) (MAHG_B2001-19)
- apply indirect measurement and similarity theorems to solve problems involving similar polygons (QCC, ACT) (MAHG_B2002-2)
- develop and apply formulas to find lateral area, volume, and surface area of solids (QCC, ACT) (MAHG_B2002-3)
- find the exact or approximate volume and surface area of solids composed of prisms, pyramids, cylinders, cones, and/or spheres (QCC, ACT) (MAHG_B2002-4)
- determine the image, pre image, or inverse of a given mapping, and the composite of two mappings (QCC) (MAHG_B2003-6)
- investigate, apply, and examine proofs of the Pythagorean Theorem and its converse (QCC) (MAHG_B2003-7)
- compare the areas of similar polygons and the volume of similar solids to solve problems and justify the reasonableness of results (QCC) (MAHG_B2003-8)
- find the coordinates of the point of intersection of two lines (QCC) (MAHG_B2003-9)

C - Trigonometry

- apply special right triangle relationships (QCC, SAT I, ACT) (MAHG_C2001-25)
- explore and apply sine, cosine, and tangent ratios in right triangles (QCC, SAT I, ACT) (MAHG_C2001-26)
- use tangent, sine, and cosine ratios to solve application problems (QCC) (MAHG_C2003-10)
- apply the properties of triangle inequalities (QCC) (MAHG_C2003-11)
- apply geometric probability (QCC, PSAT, SAT I, ACT) (MAHG_C2003-12)
- optimize perimeter, area, and volumes of geometric figures and solids (QCC) (MAHG_C2003-13)
Algebra II

A - Algebra

- use graphs to solve linear and quadratic equations and inequalities (QCC, SAT I, ACT) (MAAA_A2001-1)
- describe functional relationships (QCC, ACT) (MAAA_A2001-2)
- solve, graph, apply, and interpret systems of linear and non-linear equations and inequalities in two and three variables using a variety of methods (QCC, SAT I, ACT) (MAAA_A2001-3)
- identify, write, solve, and graph absolute value, step, and constant functions (QCC, SAT I, ACT) (MAAA_A2001-4)
- solve and graph linear and quadratic equations and inequalities in one and two variables (QCC, SAT I, ACT) (MAAA_A2001-5)
- investigate, solve, and graph direct, joint, inverse, and combined variation problems (QCC, ACT) (MAAA_A2001-6)
- solve formulas for one variable (QCC) (MAAA_A2001-7)
- evaluate the results of matrix operations, such as addition, multiplication, and scalar operations, when defined (MAAA_A2003-2)
- simplify and evaluate expressions containing integer and rational exponents (QCC) (MAAA_A2003-3)
- identify and graph linear equation in one and two variables including vertical and horizontal lines, and write equations for lines using various combinations of given information (QCC) (MAAA_A2003-5)
- fit and model linear and nonlinear curves to data (QCC, SAT I) (MAAA_A2003-7)
- identify the inverse of relations algebraically and graphically, and determine if the inverse relation is a function (QCC) (MAAA_A2003-8)
- solve and graph linear inequalities in one variable, including compound inequalities and absolute value equations and inequalities (QCC) (MAAA_A2003-9)
- determine the number of solutions for a system of linear equations, and recognize the system as consistent (dependent or independent) or inconsistent (QCC) (MAAA_A2003-10)

B - Geometry from an Algebraic Perspective

- apply the Pythagorean Theorem, distance, and midpoint formulas as they pertain to conics (QCC, SAT I, ACT) (MAAA_B2001-7)
- identify, compare, graph, and solve problems involving conic sections (QCC, ACT) (MAAA_B2001-8)
- analyze transformations of functions and relations, and determine the effects on graphs and equations (QCC, ACT) (MAAA_B2001-9)

C - Statistics

- transform data to make interpretations and predictions (QCC, ACT) (MAAA_C2001-11)
- analyze the effects of data transformation on measures of central tendency and variability (MAAA_C2001-12)
- design, conduct, and interpret a statistical experiment (QCC) (MAAA_C2001-13)
- analyze data using measures of central tendency and standard deviations (MAAA_C2003-14)

D - Probability

- discriminate between and determine the number of permutations and combinations on n things taken r at a time (QCC, SAT I, ACT) (MAAA_D2001-14)
- solve numeration and finite probability problems, including finding the probability of mutually-exclusive events occurring (QCC, ACT) (MAAA_D2001-15)
- apply theoretical and conditional probabilities to find the probability of an event by determining the sample space of all possible outcomes and the number of successful outcomes (QCC, ACT) (MAAA_D2001-16)
- conduct binomial experiments (QCC) (MAAA_D2001-17)
- distinguish among odds, probabilities, and change and find the odds associated with given events (QCC, HSGT, SAT I) (MAAA_D2001-18)
- find theoretical and conditional probability, and determine probability of independent, dependent, and conditional events (QCC, SAT I) (MAAA_D2001-19)
High School Mathematics

D - Probability (continued)
• define probability in terms of sample spaces, outcomes and events (MAAA_D2003-15)
• apply the Binomial Theorem and relate it to Pascal’s Triangle (MAAA_D2003-16)
• expand and simplify binomial expressions (QCC) (MAAA_D2003-17)
• explore normal distributions (QCC) (MAAA_D2003-18)

E - Functions and Relations
• perform operations with complex numbers, including adding, subtracting, multiplying, dividing, and find additive inverses, conjugates, and absolute values (QCC, ACT) (MAAA_E2001-20)
• develop algorithms and analyze functions using the Fundamental Theorem of Algebra (QCC) (MAAA_E2001-23)
• determine and graph compositions and inverses of functions, using multiple notation formats, such as f [g(x)] and (f o g)(x) (QCC, ACT) (MAAA_E2001-24)
• recognize and apply the inverse relationship of exponential and logarithmic functions and graph and model each function (QCC, ACT) (MAAA_E2001-25)
• identify domain and range for algebraic and transcendental functions (QCC) (MAAA_E2001-26)
• compare and contrast linear, quadratic, exponential, logarithmic, and power functions (ACT) (MAAA_E2001-27)
• solve radical equations with one or two radical terms (QCC) (MAAA_E2003-19)
• determine quotients of polynomials using appropriate techniques (monomial divisor, long, or synthetic division) or graphing tools (QCC) (MAAA_E2003-20)
• apply theorems, including Remainder, Factor, Rational Root, and the Fundamental Theorem of Algebra, to polynomial equations (QCC) (MAAA_E2003-21)
• determine if a relation is linear based on an equation, data table, or graph (QCC) (MAAA_E2003-22)
• approximate real roots of polynomial equations using calculators or computers (QCC) (MAAA_E2003-23)
• identify, define, and graph relations that are functions, and evaluate functions for given input values (QCC) (MAAA_E2003-24)
• determine real or imaginary nth roots of real numbers (QCC) (MAAA_E2003-26)
• simplify radical expressions and their products, quotients, sums, and differences, including rationalizing denominators by using properties of radicals (QCC) (MAAA_E2003-27)
• solve quadratic equations and inequalities using various methods including factoring, completing the square, the quadratic formula, and graphing tools and methods (QCC) (MAAA_E2003-29)
• graph quadratic functions and determine their maximum or minimum values, the number of zeros, and whether the zeros are real or imaginary (QCC) (MAAA_E2003-30)
• solve problems using quadratics, such as problems involving motion and minimum/maximum values, and make predictions using data and regression techniques (QCC) (MAAA_E2003-31)
• analyze the nature of the roots of quadratic equations by using the discriminant and the relationship between roots and coefficients (QCC) (MAAA_E2003-32)
• model and solve exponential and logarithmic problems involving growth, decay, and compound interest, and make predictions from collected data using regression techniques (QCC) (MAAA_E2003-33)
• apply the definition and properties of logarithms and exponents to evaluate logarithms and solve exponential and logarithmic equations (QCC) (MAAA_E2003-35)
• solve rational equations and simplify rational expressions and their products, quotients, sums, and differences (QCC, SAT I, ACT) (MAAA_E2004-1)
High School Mathematics

F - Discrete Mathematics
- develop and investigate axiomatic systems (MAAA_F2001-28)
- apply basic counting principles and solve basic and compound counting problems (QCC) (MAAA_F2001-29)
- find sums and products of matrices (QCC) (MAAA_F2003-36)
- find determinants of $2 \times 2$ and $3 \times 3$ matrices (QCC) (MAAA_F2003-37)
- find and apply inverses of $2 \times 2$ and $3 \times 3$ matrices (QCC) (MAAA_F2003-38)
- apply matrices to practical situations (QCC) (MAAA_F2003-39)
- interpret arithmetic and geometric sequences and series (QCC, SAT I, ACT) (MAAA_F2004-2)

Honors / Gifted Algebra II

A - Geometry from an Algebraic Perspective
- analyze translations, rotations, and reflections of functions and relations and determine the effects on graphs and equations (QCC) (MAHA_A2001-1)
- investigate families of lines with different sloped and y-intercepts (QCC, ACT) (MAHA_A2001-2)
- analyze scale changes of functions and relations and determine the effects on graphs and equations (QCC) (MAHA_A2001-3)
- apply the Pythagorean Theorem, distance, and midpoint formulas (QCC) (MAHA_A2001-4)
- represent coordinates in trigonometric and polar form (QCC) (MAHA_A2003-1)

B - Statistics
- fit linear and nonlinear curves to data (QCC, SAT I) (MAHA_B2001-5)
- model exponential and logarithmic situations (QCC) (MAHA_B2001-6)
- analyze the effects of data transformations on measures of central tendency and variability (SAT I) (MAHA_B2001-7)
- transform data to make interpretations and predictions (SAT I) (MAHA_B2001-8)
- analyze data using measures of central tendency and standard deviations (QCC) (MAHA_B2003-2)
- apply the definitions and properties of logarithms (QCC) (MAHA_B2003-3)
- recognize the inverse relationship of logarithms and exponential functions and graph each function (QCC) (MAHA_B2003-4)
- determine values of common and natural logarithms and antilogarithms and apply the change of base rule (QCC) (MAHA_B2003-5)
- solve exponential and logarithmic equations (QCC) (MAHA_B2003-6)
- fit polynomials to data (MAHA_B2003-7)

C - Probability
- apply theoretical and conditional probabilities (QCC, ACT) (MAHA_C2001-9)
- conduct and analyze binomial experiments (QCC, ACT) (MAHA_C2001-10)
- apply Pascal’s triangle and its properties to binomial experiments (QCC, ACT) (MAHA_C2001-11)
- use permutations and combinations (QCC, SAT I) (MAHA_C2001-12)
- solve numeration and finite probability problems (QCC, SAT I, ACT) (MAHA_C2001-13)
- explore normal distributions (MAHA_C2003-8)
- determine probability of independent, dependent, and conditional probabilities (MAHA_C2003-9)
- use the Binomial Theorem to expand and simplify expressions (MAHA_C2003-10)

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D - Functions and Relations

- translate among tabular, symbolic, and graphical representations of functions (QCC, ACT) (MAHA_D2001-14)
- apply linear programming models (MAHA_D2001-15)
- compare and contrast linear, quadratic, exponential, logarithmic, and power functions (ACT) (MAHA_D2001-16)
- describe and analyze functional relationships (QCC, ACT) (MAHA_D2001-17)
- graph and model piecewise functions (QCC) (MAHA_D2001-18)
- apply absolute value, step, and constant functions (QCC) (MAHA_D2001-19)
- apply patterns of functional models (QCC) (MAHA_D2001-20)
- find and graph compositions and inverses of functions (QCC, ACT) (MAHA_D2001-21)
- investigate direct, inverse, joint, and quadratic variation (QCC, SAT I, ACT) (MAHA_D2001-22)
- formulate, solve, and graph equations for variation (QCC, ACT) (MAHA_D2001-23)
- formulate linear and quadratic equations and inequalities for given conditions (QCC, SAT I, ACT) (MAHA_D2001-24)
- find roots and intercepts of quadratic functions algebraically (QCC, SAT I, ACT) (MAHA_D2001-25)
- make connections among different representations of linear and quadratic functions (QCC, SAT I, ACT) (MAHA_D2001-26)
- explore polynomial functions including finding roots and intercepts (QCC, SAT I, ACT) (MAHA_D2001-28)
- determine maximum and minimum points of a graph and interpret the results in problem situations (QCC, SAT I) (MAHA_D2001-29)
- graph and solve problems involving circles, ellipses, hyperbolas, and parabolas (MAHA_D2001-30)
- identify domain and range for algebraic functions (QCC) (MAHA_D2003-11)
- determine quotients of polynomials using appropriate techniques (QCC) (MAHA_D2003-12)
- evaluate and simplify expressions with fractional exponents (QCC) (MAHA_D2003-13)
- solve equations with one or more radical terms (QCC) (MAHA_D2003-14)
- apply and graph absolute value functions (QCC) (MAHA_D2003-15)
- investigate parallel and perpendicular liners (QCC) (MAHA_D2003-16)
- analyze the nature of the roots of quadratic equations by using the discriminant and the relationship between roots and coefficients (QCC) (MAHA_D2003-17)

E - Discrete Mathematics

- use matrices to solve systems of equations and inequalities (QCC) (MAHA_E2001-31)
- analyze arithmetic and geometric sequences and series (QCC) (MAHA_E2001-34)
- find sums and products of matrices (MAHA_E2003-18)
- find determinants of 2 x 2 and 3 x 3 matrices (QCC) (MAHA_E2003-19)
- find and apply inverses of 2 x 2 and 3 x 3 matrices (QCC) (MAHA_E2003-20)

F - Trigonometry

- develop, graph, and apply the six trigonometric functions (QCC, ACT) (MAHA_F2001-35)
- solve problems using trigonometric ratios (QCC, ACT) (MAHA_F2001-36)
- identify and compare conic sections and sketch their graphs (MAHA_F2003-21)
- convert measures of angles between radians and degrees (MAHA_F2003-22)
- apply laws of sines and cosines (MAHA_F2003-23)

G - Algebra

- simplify expressions containing integral exponents (QCC) (MAHA_G2001-37)
- simplify rational and irrational expressions (QCC) (MAHA_G2001-38)
- solve problems involving rational and irrational equations (QCC) (MAHA_G2001-39)
G – Algebra (continued)

- factor polynomials (QCC, SAT I, ACT) (MAHA_G2001-40)
- investigate complex numbers (QCC, SAT I, ACT) (MAHA_G2001-41)
- perform operations with complex numbers (QCC, ACT) (MAHA_G2001-42)
- use graphs to solve linear and quadratic equations and inequalities (QCC, SAT I, ACT) (MAHA_G2001-43)
- solve and graph linear and quadratic equations and inequalities in two variables (QCC, SAT I, ACT) (MAHA_G2001-44)
- solve polynomial equations using the following theorems: Remainder, Factor, Rational Root Theorems, and Fundamental Theorem of Algebra (QCC) (MAHA_G2001-45)

Advanced Algebra and Trigonometry

A - Algebra

- make connections among different representations of linear and quadratic functions (QCC, ACT) (MAAT_A2001-1)

B - Geometry from an Algebraic Perspective

- graph and perform two- and three-dimensional vector computations (QCC, ACT) (MAAT_B2001-2)
- apply vector operations (QCC) (MAAT_B2001-3)
- model with vectors (QCC) (MAAT_B2001-4)
- verify geometric properties using vectors (QCC) (MAAT_B2001-5)

C - Functions

- investigate systems of three equations in three unknowns (QCC) (MAAT_C2001-6)
- draw and interpret three-dimensional graphs (QCC) (MAAT_C2001-7)
- apply piecewise and parametric functions and equations (MAAT_C2001-8)
- model and solve with polynomial, rational, radical, and transcendental functions and their compositions (QCC, ACT) (MAAT_C2001-9)
- analyze functions and their inverses (QCC, ACT) (MAAT_C2001-10)
- graph and analyze both linear and non-linear systems (QCC) (MAAT_C2001-11)
- apply linear programming models (MAAT_C2001-12)

D - Discrete Mathematics

- interpret arithmetic and geometric sequences and series (QCC, SAT I, ACT) (MAAT_D2001-13)
- write and interpret information matrices (QCC) (MAAT_D2001-14)
- apply sums and products of matrices (QCC) (MAAT_D2001-15)
- apply determinants of matrices (QCC) (MAAT_D2001-16)
- use matrices to solve systems of equations (QCC) (MAAT_D2001-17)
- use matrices to determine transformations (QCC) (MAAT_D2001-18)
- find the inverse of a square matrix, if it exists, for 2 x 2 and 3 x 3 matrices (QCC) (MAAT_D2001-19)
- use the Binomial theorem to expand and simplify binomial expressions (QCC) (MAAT_D2001-20)

E - Trigonometry

- solve trigonometric equations and verify trigonometric identities (QCC, ACT) (MAAT_E2001-19)
- graph and model circular functions (QCC, ACT) (MAAT_E2001-20)
- apply transformations to graphs of circular functions (QCC) (MAAT_E2001-21)
**High School Mathematics**

**E – Trigonometry (continued)**
- graph and evaluate trigonometric inverses (QCC) (MAAT_E2001-22)
- apply laws of sines and cosines including finding area of triangles (QCC) (MAAT_E2001-23)
- graph and apply trigonometric and circular functions (QCC, ACT) (MAAT_E2001-24)
- model with trigonometric and circular functions (QCC) (MAAT_E2001-25)
- solve trigonometric and circular equations (QCC) (MAAT_E2001-26)
- investigate trigonometric functions using polar coordinates and find powers and roots of complex numbers (QCC) (MAAT_E2001-27)
- represent complex numbers in trigonometric form (QCC) (MAAT_E2001-28)
- represent coordinates in trigonometric and polar form (QCC) (MAAT_E2001-29)
- sketch an angle in standard position and determine the reference and coterminal angles (QCC) (MAAT_E2003-3)
- determine the area of any triangle using an appropriate formula (QCC) (MAAT_E2003-4)
- convert measures of angles between radians and degrees (QCC) (MAAT_E2003-5)
- define and apply the basic operations and properties of complex numbers (QCC) (MAAT_E2003-6)

**F - Underpinnings of Calculus**
- explore slopes of secants approaching slopes of tangents (MAAT_F2001-30)
- determine maximum and minimum points of a graph and interpret the results in problem situations (QCC) (MAAT_F2001-31)
- analyze curves with respect to intervals of increase/decrease, end behavior, and horizontal, vertical, and oblique asymptotes (QCC) (MAAT_F2001-32)
- investigate Pascal’s triangle and its properties (QCC) (MAAT_F2001-33)

**Precalculus / Gifted Precalculus**

**A - Trigonometry**
- apply circle and angle relationships (QCC, SAT I, ACT) (MAPC_A2001-1)
- apply special right triangle relationships (QCC, SAT I, ACT) (MAPC_A2001-2)
- develop, graph, and apply the six trigonometric functions (QCC, ACT) (MAPC_A2001-3)
- apply laws of sines and cosines and determine area of any triangle (QCC) (MAPC_A2001-4)
- apply properties of circular functions (QCC) (MAPC_A2001-5)
- represent complex numbers in trigonometric form (MAPC_A2001-6)
- solve trigonometric equations and verify trigonometric identities (QCC, ACT) (MAPC_A2001-7)
- graph and model circular functions (QCC) (MAPC_A2001-8)
- apply transformations to graphs of circular functions (MAPC_A2001-9)
- solve, graph and evaluate trigonometric inverses (QCC) (MAPC_A2001-10)
- solve and graph polar equations (QCC) (MAPC_A2001-11)

**B - Statistics**
- fit and model linear and nonlinear curves to data (QCC) (MAPC_B2001-12)
C - Functions and Relations
- translate among tabular, symbolic, and graphical representation of functions (MAPC_C2001-13)
- solve polynomials equations over the field of complex numbers using the following theorems: Remainder, Factor, Rational Root, and Fundamental Theorem of Algebra (QCC) (MAPC_C2001-14)
- find and graph compositions of functions (QCC) (MAPC_C2001-15)
- find and graph inverses of functions (QCC) (MAPC_C2001-16)
- solve, graph, and model exponential and logarithmic equations and functions (QCC) (MAPC_C2001-17)
- graph and model piecewise functions (QCC) (MAPC_C2001-18)
- graph and analyze algebraic and transcendental functions (QCC) (MAPC_C2001-19)
- graph and analyze both linear and non-linear systems (QCC) (MAPC_C2001-20)
- graph and perform operations with complex numbers (QCC) (MAPC_C2001-21)

D - Discrete Mathematics
- use mathematical induction (QCC) (MAPC_D2001-23)
- analyze arithmetic and geometric sequences and series and apply the Binomial Theorem (QCC) (MAPC_D2003-1)

E - Underpinnings of Calculus
- analyze curves with respect to intervals of increase/decrease, end behavior, and horizontal, vertical, and oblique asymptotes (QCC) (MAPC_E2001-27)

F - Geometry from an Algebraic Perspective
- identify and compare conic sections and sketch their graphs (MAPC_F2001-28)
- perform vector operations algebraically and geometrically (QCC) (MAPC_F2001-29)
- graph and apply two- and three-dimensional vector problems (QCC) (MAPC_F2001-30)

G - Patterns and Functions
- apply sums, products, determinants, and inverses of matrices (QCC) (MAPC_G2001-31)

Discrete Mathematics

A - Analysis
- apply fair-division algorithms (QCC, SAT I) (MADM_A2002-1)
- determine election results using various procedures (QCC) (MADM_A2002-2)
- identify paradoxes (QCC) (MADM_A2002-3)
- use weighted voting, power indexes, and Arrow’s fairness criteria (QCC) (MADM_A2002-4)
- interpret Arrow’s Impossibility Theorem (QCC) (MADM_A2002-5)
- identify methods of apportionment and apportionment paradoxes (QCC) (MADM_A2003-1)

B - Graph Theory
- examine the structure of a graph (QCC) (MADM_B2002-6)
- construct different representations of graphs (QCC) (MADM_B2002-7)
- apply shortest path algorithms (QCC) (MADM_B2002-8)
- analyze networks using graphs as models (QCC) (MADM_B2002-9)
B - Graph Theory (continued)
• solve problems involving the notions of connectedness, completeness, bipartiteness, planarity, and graph coloring (QCC) (MADM_B2002-10)
• identify properties of graphs having circuits and/or paths (QCC) (MADM_B2002-11)
• apply definitions of a tree (QCC) (MADM_B2002-12)
• find minimal spanning tree for a given graph (QCC) (MADM_B2002-13)

C - Recurrence Relations
• iterate first-order recurrence relations (QCC, SAT I) (MADM_C2002-21)
• develop the closed form of a first-order linear recurrence relation (QCC, SAT I) (MADM_C2002-22)
• apply process of iteration in different situations (QCC) (MADM_C2002-23)
• analyze searching and sorting algorithms (QCC, SAT I) (MADM_C2002-24)

D - Matrix Algebra
• use powers of adjacency matrices to study connectivity properties of graphs and digraphs (QCC) (MADM_D2002-29)
• solve probability problems using tree analysis by applying Markov’s algorithm (QCC, SAT I) (MADM_D2002-30)
• solve population growth and control problems using the Leslie model (QCC) (MADM_D2002-31)
• use the Leontief input-output model of an economy (QCC) (MADM_D2002-32)

E - Sets
• describe sets using appropriate notation and terminology (QCC) (MADM_E2002-33)
• identify simple relations between sets (QCC) (MADM_E2002-34)
• perform operations on sets (QCC) (MADM_E2002-35)
• illustrate, and apply commutative laws, associative laws, distributive laws, and DeMorgan’s law (QCC) (MADM_E2002-36)
• construct simple proofs using Venn Diagrams (QCC) (MADM_E2002-37)
• determine power sets and Cartesian products of sets (QCC) (MADM_E2002-38)
• determine sets are closed with respect to a given operation (QCC) (MADM_E2002-39)
• investigate a variety of operations on various sets (QCC) (MADM_E2002-40)
• identify group properties for given sets and operations (QCC) (MADM_E2002-41)

F - The Real Number System
• examine the real number system (QCC) (MADM_F2002-42)
• construct simple proofs about even and odd numbers (QCC, SAT I) (MADM_F2002-43)
• write an integer given in base 10 as a numeral in any base with emphasis on base 2 (QCC) (MADM_F2002-44)

STATISTICS

A - Exploring One-Variable Data
• analyze and interpret data from tables, graphs, and charts including frequency, distributions, histograms, line plots, stem-and-leaf plots, and box plots (QCC, HSGT, SAT I, ACT) (MAST_A2002-1)
• summarize data using measures of central tendency (QCC, HSGT, SAT I, ACT) (MAST_A2002-2)
• summarize data using measures of spread such as range, interquartile range, variance, and standard deviation (QCC, SAT I, ACT) (MAST_A2002-3)
• identify trends in data represented graphically, including patterns, clusters, and outliers (QCC, HSGT, SAT I, ACT) (MAST_A2002-4)
B - Exploring Two-Variable Data

- analyze and interpret data from scatter plots (QCC, HSGT, SAT I, ACT) (MAST_B2002-5)
- analyze bivariate data represented graphically and predict results by fitting a line to the data using methods such as median fit and least squares and tools such as computers and calculators (QCC, SAT I, ACT) (MAST_B2002-6)
- characterize the correlation, calculate the correlation coefficient, and determine if a linear relationship exists (QCC) (MAST_B2002-7)
- investigate nonlinear relationships and use a grapher to determine the correlation coefficient (QCC, SAT I, ACT) (MAST_B2002-8)
- determine the effect that linear transformations have on the data (QCC, SAT I, ACT) (MAST_B2002-9)

C - Sampling

- distinguish between samples and populations (QCC) (MAST_C2002-10)
- identify characteristics of representative samples to minimize bias and error (QCC) (MAST_C2002-11)
- recognize the variability among repeated samples drawn from the same population (QCC) (MAST_C2002-12)
- apply the concept of randomness to sample selection (QCC) (MAST_C2002-13)
- identify appropriate sampling techniques appropriate to a given situation (QCC, HSGT, ACT) (MAST_C2002-14)
- choose an appropriate method of data collection such as surveys or opinion polls to solve problems (QCC, HSGT, ACT) (MAST_C2002-15)
- collect and analyze data, using experimental models, random number tables, and generators (QCC, HSGT, ACT) (MAST_C2002-16)

D - Probability and Simulation

- use the empirical approach to estimate probability based upon student-generated data sets, games of chance, manipulatives, and historic data (QCC, HSGT, ACT) (MAST_D2002-17)
- apply the Law of Large Numbers to develop the concept of theoretical probability (QCC, ACT) (MAST_D2002-18)
- use the eight-step process to build a model for simulating a given problem situation (QCC, ACT) (MAST_D2002-19)
- use manipulative materials, random number generators, calculators, and computers to perform a simulation to approximate the solution of a problem (QCC, HSGT, ACT) (MAST_D2002-20)
- perform simulations for problems where the probability of success is known or unknown (QCC, ACT) (MAST_D2002-21)
- perform simulations for situations with several key components (QCC, ACT) (MAST_D2002-22)
- apply counting techniques and calculate the probability of the union and the intersection of two events (QCC, SAT I, ACT) (MAST_D2002-23)
- determine the probability of a complement (QCC, HSGT, ACT) (MAST_D2002-24)
- calculate conditional probability (QCC, ACT) (MAST_D2002-25)
- distinguish between odds and probabilities (QCC, HSGT, ACT) (MAST_D2002-26)
- find the odds associated with given events (QCC, HSGT, ACT) (MAST_D2002-27)
- assign probabilities to the outcomes of a random variable and calculate expected value (QCC, ACT) (MAST_D2002-28)
- distinguish between discrete and continuous distributions (QCC) (MAST_D2002-29)
- solve problems using probability distributions (QCC, HSGT, ACT) (MAST_D2002-30)
E - Inference
• construct sampling distributions from binomial populations by using student experiments, random number tables, and computer simulations (QCC, SAT I, ACT) (MAST_E2002-31)
• construct and interpret 90% and 95% box plots for various size samples (QCC, SAT I, ACT) (MAST_E2002-32)
• develop the concept of estimating population parameters using confidence intervals produced from comparisons of box plots (QCC, SAT I, ACT) (MAST_E2002-33)
• apply the capture-recapture model to generate a confidence interval for a population (QCC) (MAST_E2002-34)
• use the Central Limit Theorem to understand the impact on the distribution of the sample mean, including the effect of sample size (QCC) (MAST_E2002-35)
• develop point and interval estimates for parameters such as mean, standard deviation, and proportion of successes (QCC) (MAST_E2002-36)

F - Analysis
• identify sound examples of applying statistics in decision-making and correct misuses of statistics (QCC) (MAST_F2003-1)
• interpret the outcomes of data analysis and communicate results (MAST_F2003-2)

Concepts of Problem Solving

A - Number and Number Relationships
• compute with integers, rational numbers, irrational numbers and exponential expressions (QCC, HSGT, SAT I) (MAT1_A2001-1)
• apply ratios, proportions, and percents (QCC, HSGT, SAT I) (MAT1_A2001-2)
• use estimation to determine the reasonableness of results (QCC, HSGT, SAT I) (MAT1_A2001-3)
• convert numbers from standard form to scientific notation and vice-versa (MAT1_A2001-4)
• identify and apply the properties of real numbers (QCC, HSGT, SAT I) (MAT1_A2003-1)
• order real numbers including fractions and decimals (QCC, HSGT) (MAT1_A2003-2)

B - Algebra
• write equations for relations and linear functions given tables and graphs (QCC) (MAT1_B2001-5)

B – Algebra (continued)
• write, evaluate, and perform operations with algebraic expressions (QCC, HSGT, SAT I) (MAT1_B2001-6)
• use rules to produce linear graphs (QCC, SAT I) (MAT1_B2001-7)
• apply direct and inverse relationships (QCC, HSGT, SAT I) (MAT1_B2001-8)
• solve and graph linear equations and inequalities (QCC, SAT I) (MAT1_B2001-9)
• solve problems that involve systems of two linear equations in two variables (QCC, SAT I) (MAT1_B2003-3)

C - Geometry from an Algebraic Perspective
• determine perimeter and area of polygons and irregular figures (QCC, HSGT, SAT I) (MAT1_C2001-10)
• graph figures in coordinate plane (QCC, HSGT, SAT I) (MAT1_C2001-11)
• investigate scale changes on coordinate graphs (QCC, HSGT, SAT I) (MAT1_C2001-12)
• investigate and apply the Pythagorean Theorem (QCC, HSGT, SAT I) (MAT1_C2001-13)
• estimate measurements and solve problems in both customary and metric systems (QCC) (MAT1_C2001-14)
• determine volume and surface area of solids (QCC) (MAT1_C2001-15)
D - Geometry from a Synthetic Perspective
- investigate parallel and perpendicular lines (QCC, SAT I) (MAT1_D2001-16)
- investigate properties of polygons (QCC, HSGT, SAT I) (MAT1_D2001-17)
- identify and differentiate between similar and congruent figures (QCC) (MAT1_D2001-18)
- identify figures that have been transformed by rotation, reflection, and translation (QCC) (MAT1_D2001-19)
- solve for missing sides and angles of a triangle (QCC, SAT I) (MAT1_D2003-4)

E - Statistics
- graph ordered pairs (QCC, HSGT) (MAT1_E2001-20)
- fit lines to data and interpret linear graphs (QCC, SAT I) (MAT1_E2001-21)
- use the mean, median, and mode to describe central tendencies and range to describe variability of a data set (QCC, HSGT, SAT I) (MAT1_E2001-22)
- judge the validity of arguments (QCC) (MAT1_E2001-23)
- interpret and make predictions from graphical representations of data (QCC) (MAT1_E2003-5)

F - Discrete Mathematics
- develop and present examples of simple algorithms (MAT1_F2001-24)

G - Probability
- identify possible outcomes of simple experiments and predict or describe the probability of a given event expressed as a rational from zero through one (QCC) (MAT1_G2003-6)

Concepts of Algebra

A - Number and Number Relationships
- use estimation to determine the reasonableness of results (QCC, HSGT) (MAT2_A2001-1)
- compute with integers, rational numbers, irrational numbers, and exponential expressions (QCC, HSGT, SAT I) (MAT2_A2001-2)
- apply and solve ratios, proportions, and percents (QCC, HSGT, SAT I) (MAT2_A2001-4)
- use estimation, conversion, and exact calculations in solving measurement problems using appropriate technology/instruments (MAT2_A2001-5)

B - Algebra
- write, evaluate, and perform operations with algebraic expressions and formulas (QCC, SAT I) (MAT2_B2001-6)
- sketch a graph of linear equations and inequalities in two variables given information such as slope, x-intercept, y-intercept, two points, or a linear equation; include special cases as vertical, horizontal, parallel, and perpendicular lines (QCC) (MAT2_B2001-7)
- solve simple rational equations (QCC) (MAT2_B2001-8)
- analyze graphical representations of systems of linear equations in two variables (QCC) (MAT2_B2001-9)
- solve quadratic equations using graphing factoring and the quadratic formula (QCC) (MAT2_B2001-10)
- factor polynomials (QCC) (MAT2_B2001-11)
- explore quadratic, exponential, and rational equations by analyzing graphical representations (QCC) (MAT2_B2001-12)
- define slope as rate of change and calculate slope given a change in two variables (QCC) (MAT2_B2003-1)
- solve and apply linear equations and inequalities using various methods (QCC, SAT I) (MAT2_B2003-2)
- solve simple radical equations and problems (QCC, SAT I) (MAT2_B2003-3)
High School Mathematics

B – Algebra (continued)
- simplify and identify characteristics of polynomials (QCC) (MAT2_B2003-4)
- recognize and write linear equations in two variables and identify graphs of lines, including special cases such as vertical, horizontal, parallel, and perpendicular lines (QCC) (MAT2_B2003-5)

C - Statistics
- graph ordered pairs and paired data (QCC, HSGT) (MAT2_C2001-13)
- analyze and represent data using tables, charts, and graphs (QCC, SAT I) (MAT2_C2001-14)
- collect, organize, and record data obtained through investigation and experimentation (QCC) (MAT2_C2001-15)
- judge the validity of arguments (QCC) (MAT2_C2001-16)
- interpret and make predictions from graphical representations of data (QCC) (MAT2_C2003-6)
- conduct and interpret a compound probability experiment (QCC) (MAT2_C2003-7)
- fit lines to data and interpret linear graphs (QCC, SAT I) (MAT2_C2003-8)

D - Functions and Relations
- investigate the concept of limit (MAT2_D2001-18)
- distinguish between relations and functions and identify domain and range (QCC) (MAT2_D2003-9)

E - Discrete Mathematics
- represent problem situations using discrete structures such as finite graphs and matrices (QCC) (MAT2_E2001-19)
- solve systems of equations using matrices (QCC) (MAT2_E2001-20)

F - Geometry from an Algebraic Perspective
- investigate and apply Pythagorean Theorem and its converse (QCC) (MAT2_F2003-10)

Informal Geometry

A - Geometry from an Algebraic Perspective
- use graphs to determine sum and difference of vectors (QCC) (MAIG_A2003-1)
- analyze translations, rotations, and reflections of functions and relations and determine the effects on graphs and equations (QCC) (MAIG_A2003-2)
- determine volume and surface area using formulas (QCC) (MAIG_A2003-3)
- apply the Pythagorean Theorem (QCC, HSGT, SAT I) (MAIG_A2003-4)
- determine perimeter and area of polygons and irregular figures (QCC, HSGT, SAT I) (MAIG_A2003-5)
- compare similar figures using scale factors (QCC, HSGT) (MAIG_A2003-6)
- apply size transformations and two-way stretches (QCC) (MAIG_A2003-7)
- identify, describe, and contract points, lines, planes, segments, and rays (QCC) (MAIG_A2003-8)
- identify and graph ordered pairs of numbers in the coordinate plane (QCC) (MAIG_A2003-9)
- apply the distance and midpoint formulas (QCC) (MAIG_A2003-10)
- find the slope of a line, write an equation of a line, and graph equations of lines (QCC) (MAIG_A2003-11)
- find the coordinates of the point of intersection of two lines, using algebra, graphing, and appropriate technology (QCC) (MAIG_A2003-12)
- use coordinate methods to explore, make conjectures, or prove properties of geometric figures, using tools such as algebra, graphing, and appropriate technology (QCC) (MAIG_A2003-13)
High School Mathematics

B - Geometry from a Synthetic Perspective
• write indirect proofs (QCC) (MAIG_B2003-14)
• apply rotations, reflections, and symmetry (QCC) (MAIG_B2003-15)
• apply transformation vectors (MAIG_B2003-16)
• determine the composites of transformations (QCC) (MAIG_B2003-17)
• identify isometries of geometric figures (QCC) (MAIG_B2003-18)
• interpret and draw three-dimensional objects (QCC) (MAIG_B2003-19)
• use transformational geometry to show congruency and similarity (QCC, HSGT, SAT I) (MAIG_B2003-20)
• apply line and angle relationships (QCC, SAT I) (MAIG_B2003-21)
• apply circle and angle relationships (QCC, SAT I) (MAIG_B2003-22)
• investigate parallel and perpendicular lines (QCC, SAT I) (MAIG_B2003-23)
• classify triangles and polygons (QCC) (MAIG_B2003-24)

C - Statistics
• judge the validity of arguments (QCC) (MAIG_C2003-25)

D - Probability
• explore and use theoretical probabilities (QCC) (MAIG_D2002-26)

E - Discrete Mathematics
• apply properties of logic (QCC) (MAIG_E2003-27)

F - Trigonometry
• solve problems using trigonometric ratios (QCC) (MAIG_F2003-28)
• find trigonometric ratios using right triangles (QCC) (MAIG_F2003-29)
• apply properties of special right triangles (QCC) (MAIG_F2003-30)

Applied Algebra

A - Number and Number Relationships
• use estimation, conversion, and exact calculations in solving measurement problems using appropriate technology/instruments (QCC) (MAAP_A2003-1)
• compute with integers and rational numbers (QCC, HSGT, SAT I) (MAAP_A2003-2)
• compute with exponential expressions (QCC, SAT I) (MAAP_A2003-3)
• apply and calculate area, volume, and surface area of objects (QCC) (MAAP_A2003-4)

B - Algebra
• write, evaluate, and perform operations with algebraic expressions and formulas (QCC, SAT I) (MAAP_B2003-5)
• solve and graph linear equations and inequalities in one and two variables and interpret the results in problem situations (QCC, SAT I) (MAAP_B2003-6)
• use tables and graphs as tools to interpret expressions and equations (QCC, SAT I) (MAAP_B2003-7)
• formulate linear equations and inequalities for given conditions (QCC, SAT I) (MAAP_B2003-8)
• factor simple monomials and polynomials to solve problems (QCC) (MAAP_B2003-9)
• identify the characteristics of and perform operations with polynomials (QCC) (MAAP_B2003-10)
• simplify simple radical expressions and solve radical equations (QCC) (MAAP_B2003-11)
High School Mathematics

C - Geometry from an Algebraic Perspective
- analyze translations, rotations, and reflections of functions and relations and determine the effects on graphs and equations (QCC) (MAAP_C2003-12)

D - Statistics
- investigate normal distributions (QCC, SAT I) (MAAP_D2003-13)
- investigate data transformations on graphs, measures of central tendency, and dispersion (SAT I) (MAAP_D2003-14)
- judge the validity of arguments (QCC) (MAAP_D2003-15)
- graph ordered pairs (QCC, HSGT) (MAAP_D2003-16)
- use the mean, median, and mode to describe central tendencies and range to describe variability of a data set (QCC, HSGT, SAT I) (MAAP_D2003-17)
- analyze and represent data using tables, charts, and graphs (MAAP_D2003-18)

E - Probability
- investigate the uses of probability (QCC, HSGT, SAT I) (MAAP_E2003-19)
- use simple computer simulations to estimate probabilities and to introduce the concept of a random variable (QCC, SAT I) (MAAP_E2003-20)
- use probability to determine odds and make predictions (QCC, HSGT, SAT I) (MAAP_E2003-21)
- find and use theoretical and conditional probability (QCC) (MAAP_E2003-22)
- determine probabilities from area models (QCC, HSGT, SAT I) (MAAP_E2003-23)
- count the number of ways an event can happen (QCC) (MAAP_E2003-24)

F - Functions and Relations
- solve, graph, and interpret both linear and non-linear systems (QCC, SAT I) (MAAP_F2003-25)
- formulate, solve, and graph equations for variation (QCC) (MAAP_F2003-26)
- use graphs to write and solve linear equations (QCC, SAT I) (MAAP_F2003-27)
- solve quadratic equations by graphing, factoring, using the quadratic formula, and interpret the results in problem situations (QCC) (MAAP_F2003-28)
- solve and graph simple nonlinear functions (QCC, SAT I) (MAAP_F2003-29)
- define relations and linear functional relationships (QCC, SAT I) (MAAP_F2003-30)
- identify patterns of functional models (QCC) (MAAP_F2003-31)
- identify functional relationships (QCC) (MAAP_F2003-32)
- determine maximum and minimum points of a graph (QCC, SAT I) (MAAP_F2003-33)
- solve rational equations (QCC) (MAAP_F2003-34)

G - Discrete Mathematics
- represent problem situations using discrete structures such as finite graphs and matrices (QCC) (MAAP_G2003-35)
- solve systems of equations using matrices (QCC) (MAAP_G2003-36)

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Mathematical Money Management

A - Net and Gross Income
- calculate total time worked from a timecard (QCC, HSGT, SAT I, ACT) (MAMM_A2002-1)
- calculate gross pay using various methods (QCC, HSGT, SAT I, ACT) (MAMM_A2002-2)
- compute net pay (QCC, HSGT, SAT I, ACT) (MAMM_A2002-3)
- compute various taxes such as income taxes, property taxes, Social Security taxes, estate, and inheritance taxes (QCC, HSGT, SAT I, ACT) (MAMM_A2002-4)
- discuss different types of taxes and how the funds are used (QCC) (MAMM_A2002-5)
- complete federal and state income tax forms for given data (QCC, SAT I, ACT) (MAMM_A2002-6)

B - Budgeting
- prepare a budget for a given income on a weekly, monthly, and annual basis (QCC) (MAMM_B2002-7)
- identify and compare various pay periods (QCC) (MAMM_B2002-8)
- explore and compare various methods of personal record keeping (QCC) (MAMM_B2002-9)
- investigate how income and personal goals affect financial planning and decisions (QCC) (MAMM_B2002-10)
- compare costs of various forms of transportation and lodging (QCC, HSGT) (MAMM_B2002-11)
- select a leisure-time activity and investigate related expenses (QCC, HSGT) (MAMM_B2002-12)
- plan a vacation using a given amount of money (QCC, HSGT) (MAMM_B2002-13)

C - Banking and Investing
- compare various banking institutions and services provided by each (QCC) (MAMM_C2002-14)
- model transactions associated with checking and savings accounts (QCC, HSGT) (MAMM_C2002-15)
- reconcile a checking account (QCC, SAT I, ACT) (MAMM_C2002-16)
- compare and contrast various methods of saving and investing money (QCC, HSGT) (MAMM_C2002-17)
- identify sources of retirement income and model a sample plan for retirement income (QCC) (MAMM_C2002-18)
- solve problems related to saving and investing money (QCC, HSGT, SAT I, ACT) (MAMM_C2002-19)
- calculate simple and compound interest (QCC, HSGT, SAT I, ACT) (MAMM_C2002-20)
- compare different lending institutions with respect to services, costs, and types of loans (QCC) (MAMM_C2002-21)
- compute interest and service charges for various types of loans (QCC, HSGT, SAT I, ACT) (MAMM_C2002-22)
- explain how a credit rating is established and how it affects the ability to obtain loans (QCC) (MAMM_C2002-23)

D - Housing
- determine the percentage of income available for monthly rent or mortgage payment (QCC) (MAMM_D2002-24)
- investigate costs associated with renting (QCC) (MAMM_D2002-25)
- compute the amount of down payment required to purchase a house/condominium (QCC, SAT I, ACT) (MAMM_D2002-26)
- calculate monthly mortgage payment and monthly escrow amount (QCC, SAT I, ACT) (MAMM_D2002-27)
- calculate total interest paid on the loan (QCC, HSGT, SAT I, ACT) (MAMM_D2002-28)
- estimate the closing costs associated with buying a house (QCC, HSGT, SAT I, ACT) (MAMM_D2002-29)
- compare and contrast cost of service providers (QCC) (MAMM_D2002-30)
- compare and contrast efficiency ratings for large and small appliances (QCC) (MAMM_D2002-31)
- identify advantages and disadvantages of property ownership (QCC) (MAMM_D2002-32)
E - Purchasing

- identify various means used to sell products and services (QCC, HSGT) (MAMM_E2002-33)
- explore instances of deceptive advertising, deceptive packaging, hard-sell tactics, and masked credit practices (QCC, HSGT) (MAMM_E2002-34)
  - compute sales tax, total purchase price, and change received in a cash purchase (QCC, HSGT, SAT I, ACT) (MAMM_E2002-35)
- examine advantages and disadvantages of extended warranties (QCC) (MAMM_E2002-36)
- calculate discount, successive discounts, and sale price of an item (QCC, HSGT, SAT I, ACT) (MAMM_E2002-37)
- compare unit-price to do comparison-shopping and determine the better buy (QCC, HSGT) (MAMM_E2002-38)
- complete a catalog order form and calculate the total cost (QCC, HSGT) (MAMM_E2002-39)
- compare various credit plans to determine best choice for the specific need (QCC) (MAMM_E2002-40)
- compute the finance charge for a charge account by unpaid balance method and average daily balance method (QCC, HSGT, SAT I, ACT) (MAMM_E2002-41)
- calculate the finance charge and monthly payment on an installment plan (QCC, HSGT, SAT I, ACT) (MAMM_E2002-42)
- explain advantages and disadvantages of using a credit card (QCC) (MAMM_E2002-43)
- calculate cost related to buying and owning a car (QCC, HSGT, SAT I, ACT) (MAMM_E2002-44)
- explain advantages and disadvantages of owning or leasing a vehicle (QCC) (MAMM_E2002-45)
- identify resources and procedures in the event of financial difficulty (QCC) (MAMM_E2002-46)
- interpret rights and responsibilities involved with leases, warranties, guarantees, and sales contracts (QCC) (MAMM_E2002-47)
- identify agencies that deal with consumer problems (QCC) (MAMM_E2002-48)

F - Insurance

- compare different kinds of life insurance and calculate premiums (QCC) (MAMM_F2002-49)
- compute health insurance premiums and expenses incurred when a claim is filed (QCC, SAT I, ACT) (MAMM_F2002-50)
- investigate forms of insurance, such as dental, disability, automobile, and accidental death (QCC) (MAMM_F2002-51)