

NOTE: This document contains only the list of numbered standards for the Mathematics curriculum Framework, as posted in the curriculum database on the NHEON website at www.nheon.org.

Mathematics Curriculum Framework

[How this framework is organized \(click here\)](#)

[Rationale \(click here\)](#)

[Societal Goals \(click here\)](#)

[How students learn mathematics \(click here\)](#)

[References \(click here\)](#)

NOTE TO THE VIEWER: The NH Mathematics Curriculum Framework has been renumbered to be consistent with the other NH frameworks. Thus, "broad goals" are now numbered as curriculum standards in the 2nd placeholder, the 3rd placeholder represents the end-of-grade designation, and the 4th placeholder represents proficiency standards. These proficiency standards are actually a combination of what were previously termed curriculum standards **and** proficiency standards.

Strand (click on strand title to view purpose statement and curriculum standards for each strand)	Curriculum Standard (click on number to view curriculum standard)	End-of-Grade 3 (primary) (click on number to view proficiency standards for this grade range)	End-of-Grade 6 (intermediate) (click on number to view proficiency standards for this grade range)	End-of-Grade 10 (secondary) (click on number to view proficiency standards for this grade range)
1. Problem Solving and Reasoning	1.1	1.1.3	1.1.6	1.1.10
	1.2	1.2.3	1.2.6	1.2.10
2. Communication and Connections	2.1	2.1.3	2.1.6	2.1.10
	2.2	2.2.3	2.2.6	2.2.10
3. Numbers, Numeration, Operations, and Number Theory	3.1	3.1.3	3.1.6	3.1.10
	3.2	3.2.3	3.2.6	3.2.10
	3.3	3.3.3	3.3.6	3.3.10
	3.4	3.4.3	3.4.6	3.4.10
4. Geometry, Measurement, and Trigonometry	4.1	4.1.3	4.1.6	4.1.10
	4.2	4.2.3	4.2.6	4.2.10
	4.3	4.3.3	4.3.6	4.3.10
	4.4	4.4.3	4.4.6	4.4.10
5. Data Analysis, Statistics, and Probability	5.1	5.1.3	5.1.6	5.1.10
6. Functions, Relations, and Algebra	6.1	6.1.3	6.1.6	6.1.10
	6.2	6.2.3	6.2.6	6.2.10
7. Mathematics of Change	7.1	7.1.3	7.1.6	7.1.10

8. Discrete Mathematics	8.1	8.1.3	8.1.6	8.1.10
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FRAMEWORK: MATHEMATICS

STRAND: PROBLEM SOLVING and REASONING

1. Problem Solving and Reasoning

1.1 Students will use problem-solving strategies to investigate and understand increasingly complex mathematical content. (Formerly identified as 1a. K-12 Broad Goal.)

PURPOSE of MA1.1: Problem solving should serve as the organizing feature of the mathematics curriculum as well as other areas of study and be applied to everyday activities. Problem-solving must not be seen as a separate topic, but rather the centerpiece of the mathematics curriculum. Students should have many experiences in posing and solving problems from their world, from data that are meaningful to them, and from mathematical investigations.

Mathematics - Problem Solving & Reasoning -- Curriculum Standard 1 -- End-of-Grade 3 (MA1.1.3)

- 1.1.3.1 Make up problems based on everyday experiences.
- 1.1.3.2 Solve problems using a variety of strategies (for example: make a list, draw a picture, or guess and check).
- 1.1.3.3 Formulate and solve real-world problems.
- 1.1.3.4 Verify and interpret results with respect to the original problem.
- 1.1.3.5 Generalize solutions and apply strategies to new problem situations.
- 1.1.3.6 Solve multi-step problems.
- 1.1.3.7 Use problem solving approaches to investigate and understand new mathematical content, both independently and in groups.
- 1.1.3.8 Demonstrate that a problem may be solved in more than one way.
- 1.1.3.9 Exhibit confidence in their ability to solve problems independently and in groups.
- 1.1.3.10 Display increasing perseverance, and persistence in problem solving.
- 1.1.3.11 Write about problem solutions and solution processes.

(Items above were originally termed curriculum standards. Items below were originally termed proficiency standards.)

- 1.1.3.12 Formulate problems from everyday and mathematical situations.
- 1.1.3.13 Solve problems that require the use of strategies (for example: making a list, drawing a picture, looking for a pattern, or acting out).
- 1.1.3.14 Solve problems with and without using manipulatives and calculators.

Mathematics - Problem Solving & Reasoning -- Curriculum Standard 1 -- End-of-Grade 6 (MA1.1.6)

- 1.1.6.1 Solve problems using a variety of strategies (for example: look for a simpler problem, or working backwards).
 - 1.1.6.2 Formulate and solve real-world problems.
 - 1.1.6.3 Solve multi-step problems and problems with multiple solutions or no solution; and recognize problems where more information is needed.
 - 1.1.6.4 Use problem-solving approaches to investigate and understand mathematical content.
 - 1.1.6.5 Verify and interpret results with respect to the original problem.
 - 1.1.6.6 Demonstrate that a problem may be solved in more than one way.
 - 1.1.6.7 Develop confidence, perseverance, and persistence in problem solving both independently and in groups.
 - 1.1.6.8 Generalize solutions and apply strategies to new problem situations.
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- 1.1.6.9 Solve problems that require the use of strategies (for example: working backwards; looking for patterns and relationships; guess and check; making tables, charts, and graphs; solving a simpler version of a problem; looking for similar problems; drawing a diagram; or creating a model).
 - 1.1.6.10 Formulate, solve, and verify problems from every-day and mathematical situations and interpret the results.
 - 1.1.6.11 Solve multi-step problems, solve problems with multiple solutions, recognize when a problem has no solution, and recognize problems where more information is needed.
 - 1.1.6.12 Solve problems using manipulatives, graphs, charts, diagrams, and calculators.

Mathematics - Problem Solving & Reasoning -- Curriculum Standard 1 -- End-of-Grade 10 (MA1.1.10)

- 1.1.10.1 Determine, collect and organize the relevant data needed to solve real-world problems.
 - 1.1.10.2 Determine the reasonableness of solutions to real-world problems.
 - 1.1.10.3 Use technology whenever appropriate to solve real-world problems which require strategies previously learned.
 - 1.1.10.4 Use technology whenever appropriate to solve problems related to basic living skills including, but not limited to, personal finance, wages, banking and credit, home improvement problems, measurement, taxes, business situations, purchasing, and transportation.
 - 1.1.10.5 Apply problem solving strategies to solve problems in the natural and social sciences and in pure mathematics.
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- 1.1.10.6 Determine, collect, and organize the relevant data needed to solve real-world problems.
 - 1.1.10.7 Choose the appropriate technology needed to solve a real-world problem.
 - 1.1.10.8 Translate results of a computation into solutions that fit the real-world problem (for example, when a computation shows that one needs 3.2 gallons of paint to paint a room, how much paint do you buy?).

- 1.1.10.9 Determine if the solution of a real-world problem is reasonable.
- 1.1.10.10 Use technology to solve a problem from science, social science, or mathematics.

1.2 Students will use mathematical reasoning. (Formerly identified as 1b. K-12 Broad Goal.)

PURPOSE of MA1.2: Students need to recognize that memorized facts, rules, and procedures are only a part of mathematics. They need opportunities to use these facts, rules, and procedures to make conjectures, develop and refine their reasoning abilities, gather evidence, and produce valid rules and generalizations. Students need to be able to justify their thinking through examples and explanations and appreciate that how a problem is solved is as important as the answer.

Mathematics - Problem Solving & Reasoning -- Curriculum Standard 2 -- End-of-Grade 3 (MA1.2.3)

- 1.2.3.1 Draw conclusions using inductive reasoning.
 - 1.2.3.2 Use models, known facts, properties, and relationships to explain their thinking.
 - 1.2.3.3 Explain conjectures, solution processes, and answers.
 - 1.2.3.4 Demonstrate belief that mathematics makes sense.
 - 1.2.3.5 Demonstrate conservation of number and length by using reversibility of thought.
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- 1.2.3.6 Continue a number pattern.
 - 1.2.3.7 Identify the missing information needed to find a solution to a given story problem.
 - 1.2.3.8 Compare and contrast geometric figures.
 - 1.2.3.9 Verify an answer to a problem.
 - 1.2.3.10 Continue a geometric pattern.
 - 1.2.3.11 Defend a conjecture with an appropriate argument.
 - 1.2.3.12 Discuss the use of a problem solving strategy. Example: "I chose this method to solve the problem because ..."

Mathematics - Problem Solving & Reasoning -- Curriculum Standard 2 -- End-of-Grade 6 (MA1.2.6)

- 1.2.6.1 Draw conclusions using inductive reasoning, elementary deductive reasoning, and reasoning by analogy.
 - 1.2.6.2 Use models, known facts, properties, and relationships to explain their thinking.
 - 1.2.6.3 Explain conjectures, solutions processes, and answers.
 - 1.2.6.4 Appreciate the pervasive use and power of reasoning as a part of mathematics.
 - 1.2.6.5 Show increasing ability to understand and apply reasoning processes and spatial reasoning (symmetry, reflections, motions in the plane, and identifying three-dimensional objects from two-dimensional drawings).
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- 1.2.6.6 Continue a pattern involving integers and positive rational numbers.

- 1.2.6.7 Solve problems involving two-and three-dimensional geometric shapes and explain one's reasoning.
- 1.2.6.8 Use elementary deductive reasoning to solve word problems.
- 1.2.6.9 Use models, known facts, properties, and relationships to explain thinking and to justify answers and solution processes.

Mathematics - Problem Solving & Reasoning -- Curriculum Standard 2 -- End-of-Grade 10 (MA1.2.10)

- 1.2.10.1 Draw logical conclusions and make generalizations using deductive and inductive reasoning.
 - 1.2.10.2 Formulate and test mathematical conjectures and arguments.
 - 1.2.10.3 Determine the validity of an argument and/or a solution.
 - 1.2.10.4 Apply mathematical reasoning skills, when appropriate, in other disciplines.
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- 1.2.10.5 Use inductive reasoning to make generalizations from an observed pattern.
 - 1.2.10.6 Use logical reasoning, as well as estimation and mental computations, to determine the validity of a solution.
 - 1.2.10.7 Justify conjectures, defend generalizations, and write logical arguments.

FRAMEWORK: MATHEMATICS

STRAND: COMMUNICATION and CONNECTIONS

2. Communication and Connections

2.1 Students will communicate their understanding of mathematics. (Formerly 2a. K-12 Broad Goal.)

PURPOSE of MA2.1: Reading, writing, talking, listening, and modeling, provide students with the opportunity to integrate the language of mathematics into their world, and help them to develop understanding. Actively exploring, investigating, describing, and explaining mathematical ideas promote communication which leads to a greater comprehension of mathematical concepts.

Mathematics – Communication and Connections -- Curriculum Standard 1 -- End-of-Grade 3 (MA2.1.3)

- 2.1.3.1 Relate everyday language to mathematical language and symbols.
 - 2.1.3.2 Discuss, illustrate, and write about mathematical concepts and relationships.
 - 2.1.3.3 Use language to reflect on, clarify, and articulate thinking about mathematical ideas and situations.
 - 2.1.3.4 Demonstrate mathematical communication through discussion, reading, writing, listening, and responding, individually and in groups.
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- 2.1.3.5 Discuss (in writing) mathematical concepts and relationships.
- 2.1.3.6 Draw pictures and use objects to illustrate mathematical concepts.
- 2.1.3.7 Write about the mathematical topics presented.
- 2.1.3.8 Defend conjectures and tentative generalizations.

Mathematics – Communication and Connections -- Curriculum Standard 1 -- End-of-Grade 6 (MA2.1.6)

- 2.1.6.1 Relate everyday language to mathematical language and symbols.
 - 2.1.6.2 Discuss, illustrate, and write about mathematical concepts and relationships.
 - 2.1.6.3 Use language to reflect on, clarify, and articulate thinking about mathematical ideas and situations.
 - 2.1.6.4 Demonstrate mathematical communication through discussion, representation, reading, writing, listening, and responding, individually and in groups.
 - 2.1.6.5 Use a variety of technologies (for example: computers, calculators, video, CD-ROM, or laser disc, to represent and communicate mathematical ideas).
 - 2.1.6.6 Understand and appreciate the economy and power of mathematical symbolism and its role in the development of mathematics.
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- 2.1.6.7 Demonstrate an understanding of mathematical concepts and relationships through a variety of methods (for example: writing, graphing, charts, diagrams, number sentences, or symbols).
- 2.1.6.8 Explain, analyze, and evaluate mathematical arguments and conclusions presented by others.
- 2.1.6.9 Explain conclusions, thought processes, and strategies in problem-solving situations.
- 2.1.6.10 Make conjectures and defend generalizations.
- 2.1.6.11 Evaluate the validity of a mathematical statement.

Mathematics – Communication and Connections -- Curriculum Standard 1 -- End-of-Grade 10 (MA2.1.10)

- 2.1.3.1 Formulate questions, conjectures, definitions, and generalizations about, data, information, and problem situations.
 - 2.1.3.2 Use a variety of technologies to represent and communicate mathematical ideas and determine the appropriateness of their use.
 - 2.1.3.3 Understand, explain, analyze, and evaluate mathematical arguments and conclusions made by others.
 - 2.1.3.4 Understand the efficiency and power of mathematical notation.
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- 2.1.3.5 Evaluate given information and determine appropriate questions suggested by the situation.
 - 2.1.3.6 Evaluate given information and determine appropriate generalizations suggested by the situation.
 - 2.1.3.7 Describe orally and/or in writing how various technologies can be used to communicate about a specific situation.
 - 2.1.3.8 Use mathematical symbols and notation to communicate mathematically.
 - 2.1.3.9 Justify conjectures, defend generalizations and write logical arguments.

2.2 Students will recognize, develop, and explore mathematical connections. (Formerly 2b. K-12 Broad Goal.)

PURPOSE of MA2.2: Mathematical topics, ideas, and procedures must be connected to each other and to the students' everyday experiences, both in and out of school. In particular, mathematics must be connected to all other curriculum areas. Mathematical connections will help students become aware of the usefulness of mathematics, serve to bridge the concrete and the abstract, and enable deeper understanding of important ideas.

Mathematics – Communication and Connections -- Curriculum Standard 2 -- End-of-Grade 3 (MA2.2.3)

- 2.2.3.1 Understand the mathematical processes of addition, subtraction, and multiplication and relate them to one another.

- 2.2.3.2 Recognize different representations of concepts and procedures (for example, students should recognize the relationship among seven counters, seven tally marks, and the symbol 7).
- 2.2.3.3 Translate among different representations as appropriate.
- 2.2.3.4 Recognize relationships among different topics in mathematics.
- 2.2.3.5 Recognize and use mathematics in other curriculum areas.
- 2.2.3.6 Recognize and use mathematics in their daily lives.
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- 2.2.3.7 Demonstrate the relationship between addition and multiplication and between addition and subtraction.
- 2.2.3.8 Demonstrate the relationship between fractions and decimals.
- 2.2.3.9 Identify mathematical situations occurring in children's literature.
- 2.2.3.10 Identify mathematical applications in social studies (for example: graphs, tables, or maps).
- 2.2.3.11 Identify the use of mathematical skills and concepts in science (for example: measurement, graphs, or data analysis).
- 2.2.3.12 Identify examples of geometry in nature, art, and architecture.
- 2.2.3.13 Use probability and statistics to describe and predict simple events.
- 2.2.3.14 Use money in real-world situations.
- 2.2.3.15 Use geometric representations for fractions and decimals and to explain arithmetic operations.

Mathematics – Communication and Connections -- Curriculum Standard 2 -- End-of-Grade 6 (MA2.2.6)

- 2.2.6.1 Understand the mathematical processes and procedures of addition, subtraction, multiplication, and division and relate them to one another.
- 2.2.6.2 Recognize equivalent representations of concepts and procedures and translate among them as appropriate (for example, understand how the addition of whole numbers, fractions, and decimals are related).
- 2.2.6.3 Recognize relationships among different topics in mathematics.
- 2.2.6.4 Recognize and use mathematics in other curriculum areas and in their daily lives.
- 2.2.6.5 Link concepts and procedures (for example, know why you "invert and multiply" when dividing two fractions).
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- 2.2.6.6 Identify the relationships among the four basic operations on rational numbers.
- 2.2.6.7 Identify the relationship among the basic operations as applied to whole numbers and to positive rational numbers.
- 2.2.6.8 Use mathematical skills, concepts, and applications in other disciplines (for example: graphs in social studies, patterns in art, or music and geometry in technology education).

Mathematics – Communication and Connections -- Curriculum Standard 2 -- End-of-Grade 10 (MA2.2.10)

- 2.2.10.1 View mathematics as an integrated whole. (Be able to synthesize the varied branches.)
- 2.2.10.2 Explain the relationship between a real-world problem and an appropriate mathematical model.
- 2.2.10.3 Explain in oral or written form how mathematics connects to other disciplines, to daily life, careers, and society.
- 2.2.10.4 Use models and calculators or other technologies to develop equivalent representations of the same mathematical concept.
- 2.2.10.5 Recognize the logical development of mathematics from basic assumptions and definitions, and understand that mathematics frequently arises out of real-world applications.
- 2.2.10.6 Recognize that many real world applications require an understanding of use of mathematical concepts (for example: personal finance, running a business, building a house, following a recipe, or sending a rocket to the moon).
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- 2.2.10.7 Explain in oral or written form the relationships among various mathematical concepts (for example, the relationship between exponentiation and multiplication).
- 2.2.10.8 Translate among equivalent representations of the same concept (for example, a table of values, an equation, and a graph may all be representations of the same function).
- 2.2.10.9 Explain in oral or written form the relationships between a real-world problem and an appropriate mathematical model.
- 2.2.10.10 Explain in oral or written form how mathematics connects to other areas (for example: geometry in art and architecture, data analysis in social studies and exponential growth in finance).

FRAMEWORK: MATHEMATICS

STRAND: NUMBERS, NUMERATION, OPERATIONS, & NUMBER THEORY

3. Numbers, Numeration, Operations, and Number Theory

3.1 Students will develop number sense and an understanding of our numeration system. (Formerly 3a. K-12 Broad Goal.)

PURPOSE of MA3.1: Students must understand numbers if they are to make sense of the ways numbers are used in their everyday world. Numbers are used to describe and interpret real-world phenomena. Students need to use numbers to quantify, to identify location, to identify a specific object in a collection, to name, to measure, and to model real-world situations. They need to understand relative magnitude in order to make sense of everyday situations.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 1 -- End-of-Grade 3 (MA3.1.3)

- 3.1.3.1 Order a set of numbers (0-99) from smallest to largest.
 - 3.1.3.2 Name the whole number immediately before or after any 2-digit number.
 - 3.1.3.3 Name the number that is ten units before or ten units after any 2-digit number.
 - 3.1.3.4 Compare any two 2-digit numbers to determine which is greater or less.
 - 3.1.3.5 Read and write whole numbers.
 - 3.1.3.6 Show understanding of place value concepts via the use of physical models.
 - 3.1.3.7 Recognize and demonstrate the difference in magnitude of whole numbers and fractions.
 - 3.1.3.8 Demonstrate knowledge of differences in the use of ordinal and cardinal numbers.
 - 3.1.3.9 Interpret the multiple uses of numbers encountered in the real-world.
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- 3.1.3.10 Identify and write a 3-digit number given a physical model or an illustration of a place-value model, and given a 3-digit number, create a model.
 - 3.1.3.11 Read and write three-digit whole numbers.
 - 3.1.3.12 Identify the number 1000 as a unit or in various combinations of hundreds, tens, and ones.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 1 -- End-of-Grade 6 (MA3.1.6)

- 3.1.6.1 Read and write integers and positive rational numbers.
- 3.1.6.2 Represent and identify whole numbers, fractions, and decimals using physical models.
- 3.1.6.3 Use physical models to represent integers and positive rational numbers.
- 3.1.6.4 Explore the relationship of simple decimals to fractions.

- 3.1.6.5 Explore the operations of addition, subtraction, multiplication, and division of integers using manipulatives or representational models.
- 3.1.6.6 Demonstrate an understanding of denominate numbers (numbers involving units of measure, such as 3 in.) through applications to real-life situations.
- 3.1.6.7 Explore the meaning of 10%, 25%, 50%, 75%, and 100% and their fraction and decimal equivalents.
- 3.1.6.8 Demonstrate an understanding of prime and composite numbers.
- 3.1.6.9 Identify multiples and factors of whole numbers.
- 3.1.6.10 Identify numbers divisible by 2, 3, 5, 9, and 10.
- 3.1.6.11 Demonstrate an understanding of the periodicity of numbers.
- 3.1.6.12 Explore ancient numeration systems and the use of different bases (such as base 2 and 5).
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- 3.1.6.13 Name and identify a fraction or decimal, given a physical representation.
- 3.1.6.14 Given a decimal representation in tenths or hundredths, write an equivalent fraction.
- 3.1.6.15 Given an integer or a positive rational number, represent the number with the use of physical models or diagrams.
- 3.1.6.16 Explain the use of numbers in various every-day contexts (for example: calendars, clocks, signs, or literature).
- 3.1.6.17 Given a set of fractional models, name and write those that represent equivalent fractions.
- 3.1.6.18 Given a pair of fractions, determine which is larger by using physical models or illustrations.
- 3.1.6.19 Develop and use order relations for integers and positive rational numbers.
- 3.1.6.20 Apply number theory to the factoring of whole numbers and the equivalency of positive rational numbers.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 1 -- End-of-Grade 10 (MA3.1.10)

- 3.1.10.1 Read and write rational numbers.
- 3.1.10.2 Use physical models to represent rational numbers.
- 3.1.10.3 Recognize and demonstrate the difference in magnitude of rational numbers.
- 3.1.10.4 Compare magnitudes of integers, rational, and irrational numbers.
- 3.1.10.5 Develop and use order relations for integers, rational and irrational numbers.
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- 3.1.10.6 Read and write rational numbers.
- 3.1.10.7 Use physical models to represent rational numbers.
- 3.1.10.8 Compare and order real numbers.

3.2 Students will understand the concepts of number operations. (Formerly 3b. K-12 Broad Goal.)

PURPOSE of MA 3.2: Students need to build an awareness of the properties of an operation, see relationships among operations, and acquire insight into the effects of

operations on real numbers. Students need to recognize conditions in real-world situations where the use of these operations is indicated and useful.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 2 -- End-of-Grade 3 (MA3.2.3)

- 3.2.3.1 Develop meaning for the operations of addition, subtraction, multiplication, and division by modeling and discussing a rich variety of problem situations.
 - 3.2.3.2 Demonstrate and explain the relationship between these operations.
 - 3.2.3.3 Relate the mathematical language and symbols to problem situations and informal language.
 - 3.2.3.4 Recognize that a wide range of problem situations can be represented by one expression.
 - 3.2.3.5 Recognize the effect of performing the operations of addition, subtraction, multiplication, and division with whole numbers.
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- 3.2.3.6 Count by ones, twos, fives, and tens.
 - 3.2.3.7 Identify even and odd numbers and explain the difference.
 - 3.2.3.8 Use manipulatives and pictures to represent multiplication as repeated addition or arrays.
 - 3.2.3.9 Use manipulatives and pictures to represent division as the sharing of objects and as the number of groups of shared objects.
 - 3.2.3.10 Given a word problem, choose the appropriate operation or operations to solve it.
 - 3.2.3.11 Explain the relationship among the four basic operations.
 - 3.2.3.12 Given an equation, such as " $3 + 5 = 8$," write a story problem that could be solved using the equation.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 2 -- End-of-Grade 6 (MA3.2.6)

- 3.2.6.1 Develop meaning for multiplication and division of whole numbers, fractions, and decimals by modeling and discussing a rich variety of problem situations.
 - 3.2.6.2 Demonstrate and explain the relationship among the four basic operations and, when appropriate, use the associative, commutative, and distributive properties to simplify computations.
 - 3.2.6.3 Explore and develop the concepts of addition and subtraction of fractions and decimals using manipulatives.
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- 3.2.6.4 Apply the associative, commutative, and distributive properties in a problem solving situation.
 - 3.2.6.5 Apply the multiplicative and additive properties of zero and the multiplicative property of one.
 - 3.2.6.6 Demonstrate an understanding of multiplication as repeated addition and of division as repeated subtraction.
 - 3.2.6.7 Demonstrate an understanding that the product of two whole numbers greater than 1 is greater than either of the factors.

- 3.2.6.8 Demonstrate an understanding that when dividing two whole numbers that are greater than one, the quotient will be smaller than the dividend.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 2 -- End-of-Grade 10 (MA3.2.10)

- 3.2.10.1 Demonstrate an understanding of the operations of addition, subtraction, multiplication, and division of rational numbers, and the effect of performing these operations. (For example, “what can one say about the quotient when dividing by a fraction between 0 and 1?”).
- 3.2.10.2 Understand the standard algebraic order of operations.
- 3.2.10.3 Understand the properties of exponents.
- 3.2.10.4 Recognize when to use and how to apply the field properties.
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- 3.2.10.5 Examine the four basic operations from a functional perspective; that is, as operations on ordered pairs.
- 3.2.10.6 Connect the properties of operations on real numbers to common uses (for example, the distributive property is used in each of the following cases: $2x + 3x = 5x$; $2/7 + 3/7 = 5/7$; and $2(3x + 4) = 6x + 8$).

3.3 Students will compute. (Formerly 3c. K-12 Broad Goal.)

PURPOSE: The purpose of computation is to solve problems. While computation remains important in mathematics and in everyday life, advances of technology require us to rethink how computation is done today. Students must recognize that estimation, mental computation, use of calculators, and paper and pencil calculation are all appropriate ways to compute solutions to problems. Basic fact memorization should be incorporated into a rich curriculum rather than be its primary focus.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 3 -- End-of-Grade 3 (MA3.3.3)

- 3.3.3.1 Model, explain, and develop proficiency with basic facts and algorithms.
- 3.3.3.2 Use a variety of mental computation and estimation techniques.
- 3.3.3.3 Use calculators in appropriate computational situations.
- 3.3.3.4 Given a problem, select appropriate computational techniques to solve the problem and determine the reasonableness of the result.
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- 3.3.3.5 Using physical models and illustrations, determine the sum or difference of fractions with like or unlike denominators.
- 3.3.3.6 Using physical models and illustrations, determine the sum or difference of decimals.
- 3.3.3.7 Develop and use algorithms to add and subtract decimals.
- 3.3.3.8 Subtract any two 2-digit numbers.
- 3.3.3.9 Use manipulatives to illustrate an algorithm for adding or subtracting whole numbers less than 1,000.
- 3.3.3.10 Add two or more whole numbers less than 1000.

- 3.3.3.11 Use a calculator to extend addition to include 4-digit numbers and subtraction to include 3-and 4-digit numbers.
- 3.3.3.12 Demonstrate mastery of the multiplication facts with factors less than or equal to 5.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 3 -- End-of-Grade 6 (MA3.3.6)

- 3.3.6.1 Multiply and divide whole numbers and decimals.
 - 3.3.6.2 Add integers and positive rational numbers using models or representations.
 - 3.3.6.3 Use a variety of mental computation techniques.
 - 3.3.6.4 Use calculators in appropriate computational situations. Given a problem, select an appropriate computational technique to solve the problem and determine the reasonableness of the result.
 - 3.3.6.5 Explore operations with fractions using manipulatives.
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- 3.3.6.6 Demonstrate mastery of the multiplication facts with factors less than or equal to 10.
 - 3.3.6.7 Select an appropriate computational technique in the solution of problems and check the reasonableness of results through mental computation and estimation strategies.
 - 3.3.6.8 Use calculators in appropriate problem solving situations.
 - 3.3.6.9 Add integers using models or representations.
 - 3.3.6.10 Multiply three digit whole numbers by two digit whole numbers.
 - 3.3.6.11 Divide three digit whole numbers by two digit whole numbers.
 - 3.3.6.12 Multiply and divide two and three digit decimals.
 - 3.3.6.13 Using physical models and illustrations, determine the sum or difference of fractions with like and unlike denominators (using only halves, fourths, and eighths).
 - 3.3.6.14 Using physical models, illustrations, and calculators, determine the sum or difference of decimals.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 3 -- End-of-Grade 10 (MA3.3.10)

- 3.3.10.1 Apply the standard algebraic order of operations with real numbers.
 - 3.3.10.2 Apply the properties of exponents with real numbers.
 - 3.3.10.3 Simplify expressions involving the use of grouping symbols such as parentheses.
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- 3.3.10.4 Perform the four basic operations with rational numbers.
 - 3.3.10.5 Simplify expressions containing rational numbers, integer exponents, and grouping symbols using conventional methods and technology.
 - 3.3.10.6 Evaluate numerical expressions containing scientific notation.
 - 3.3.10.7 Use the order of operations to evaluate expressions.
 - 3.3.10.8 Use the field properties to simplify expressions.

3.4 Students will use mental computation and estimation skills and strategies and know when it is appropriate to do so. (Formerly 3d. K-12 Broad Goal.)

PURPOSE: Students should know what is meant by estimation and mental computation, when they are appropriate, and how close an estimate is required in a given situation. Students should be encouraged to estimate the solution of problems before computation or measurement is done, and to use estimation to determine the reasonableness of answers, and to recognize when an estimate is sufficient as an answer.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 4 -- End-of-Grade 3 (MA3.4.3)

- 3.4.3.1 Use a variety of estimation strategies when solving problems.
 - 3.4.3.2 Determine the reasonableness of answers for problems involving arithmetic operations.
 - 3.4.3.3 Recognize and use estimation and mental computation to solve problems where exact answers are not required.
 - 3.4.3.4 Estimate appropriate units of measurement.
 - 3.4.3.5 Estimate or predict an approximate solution to a problem.
 - 3.4.3.6 Communicate the strategies used in estimation based upon previous experiences.
 - 3.4.3.7 Use estimation to determine the reasonableness of a calculation done by calculator or computer.
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- 3.4.3.8 Use estimation and mental computation to determine the reasonableness of answers for problems involving addition and subtraction.
- 3.4.3.9 Use estimation and mental computation to solve problems where exact answers are not required.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 4 -- End-of-Grade 6 (MA3.4.6)

- 3.4.6.1 Use a variety of mental computation techniques in appropriate situations.
 - 3.4.6.2 Demonstrate estimation skills through a variety of strategies.
 - 3.4.6.3 Determine the reasonableness of answers.
 - 3.4.6.4 Recognize and use estimation and mental computation to solve problems where exact answers are not required.
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- 3.4.6.5 Use estimation and mental computation to determine the reasonableness of answers obtained from the four basic operations on rational numbers.
- 3.4.6.6 Select and use appropriate mental computation and estimation strategies in problem situations when exact answers are not needed.

Mathematics – Number, Numeration, etc. -- Curriculum Standard 4 -- End-of-Grade 10 (MA3.4.10)

- 3.4.10.1 Determine the reasonableness of answers for problems involving arithmetic operations on real numbers.
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- 3.4.10.2 Use estimation and mental computation to determine the reasonableness of answers obtained from the four basic operations on real numbers.
- 3.4.10.3 Select and use appropriate mental computation and estimation strategies in problem situations when exact answers are not needed.
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FRAMEWORK: MATHEMATICS

STRAND: GEOMETRY, MEASUREMENT, & TRIGONOMETRY

4. Geometry, Measurement, and Trigonometry

4.1 Students will name, describe, model, classify, and compare geometric shapes and their properties with an emphasis on their wide applicability in human activity. (Formerly 4a. K-12 Broad Goal.)

PURPOSE of MA 4.1: Geometry helps students represent and describe the world in which they live. Students need to investigate, experiment, and explore geometric properties using both technology and hands on materials.

Mathematics – Geometry, etc. -- Curriculum Standard 1 -- End-of-Grade 3 (MA4.1.3)

- 4.1.3.1 Name, model, describe, and classify cubes, spheres, cones, cylinders, pyramids, and rectangular solids.
 - 4.1.3.2 Name, model, describe, and classify circles, rectangles, squares, triangles, trapezoids, parallelograms, kites, and rhombuses (diamonds).
 - 4.1.3.3 Name, model, describe, and classify right, acute, obtuse, and straight angles.
 - 4.1.3.4 Determine when pairs of figures are congruent.
 - 4.1.3.5 Determine the presence or absence of lines of symmetry for given figures.
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- 4.1.3.6 Use the terms points, lines, and line segments in describing two dimensional figures.
- 4.1.3.7 Draw line segments and lines.
- 4.1.3.8 Draw lines of symmetry.
- 4.1.3.9 Determine if two plane figures are congruent by matching.
- 4.1.3.10 Identify, describe, and draw a kite.
- 4.1.3.11 Identify and describe pyramids.

Mathematics – Geometry, etc. -- Curriculum Standard 1 -- End-of-Grade 6 (MA4.1.6)

- 4.1.6.1 Explore, discuss, and describe properties of common two and three dimensional figures.
 - 4.1.6.2 Explore congruence and similarity of two dimensional figures.
 - 4.1.6.3 Investigate rotational and reflective symmetry. (Point and line symmetry.)
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- 4.1.6.4 Identify, describe, and name properties of triangles, quadrilaterals, and other polygons.
- 4.1.6.5 Identify point and line symmetry in given polygons.
- 4.1.6.6 Measure and classify angles.
- 4.1.6.7 Identify and draw congruent and similar figures using graph paper.

Mathematics – Geometry, etc. -- Curriculum Standard 1 -- End-of-Grade 10 (MA4.1.10)

- 4.1.10.1 Explore the relationship among definitions, postulates, and theorems.
 - 4.1.10.2 Investigate the properties of two and three dimensional shapes.
 - 4.1.10.3 Deduce properties of and relationships among figures from given assumptions.
 - 4.1.10.4 Use compass and straightedge, manipulatives, and technology to explore geometric constructions.
 - 4.1.10.5 Deduce properties and relationships among congruent figures and similar figures.
 - 4.1.10.6 Explore basic transformations (for example: reflections, translations, rotations, or dilations).
 - 4.1.10.7 Use basic transformations to demonstrate similarity, symmetry, and congruence of figures.
 - 4.1.10.8 Explore relationships between synthetic and coordinate representations.
 - 4.1.10.9 Apply principles of coordinate geometry, i.e., graph lines and circles and determine the slope and intercept of a line, mid-point of a line segment, the center and radius of a circle.
 - 4.1.10.10 Understand the interrelationships between algebraic and geometric representations of the same mathematical concept.
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- 4.1.10.11 Represent and solve problems using the properties of two and three dimensional geometric figures.
- 4.1.10.12 Use technology, manipulatives, and/or coordinate geometry to deduce and explain the properties of and the relationships among geometric figures.
- 4.1.10.13 Translate between synthetic and coordinate representations.

4.2 Students will develop spatial sense. (Formerly 4b. K-12 Broad Goal.)

PURPOSE of MA 4.2: We live in a three dimensional world. To interpret, understand, and appreciate that world, students need to develop an understanding of space. Research suggests that there is a high correlation between spatial abilities and success in mathematics. Spatial skills include making and interpreting drawings, forming mental images, visualizing changes, and generalizing about perceptions in the environment.

Mathematics – Geometry, etc. -- Curriculum Standard 2 -- End-of-Grade 3 (MA4.2.3)

- 4.2.3.1 Use position terms (for example: inside, outside, above, top-to-bottom, over, or under).
 - 4.2.3.2 Copy and make shapes by drawing and using manipulatives (for example: pattern blocks, or tangrams).
 - 4.2.3.3 Draw, compare, and visualize shapes in various positions.
 - 4.2.3.4 Investigate and predict results of combining, subdividing, and changing shapes using manipulatives (for example: pattern blocks, or tangrams).
 - 4.2.3.5 Construct various three dimensional objects.
 - 4.2.3.6 Describe and/or draw three-dimensional objects from different perspectives.
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- 4.2.3.7 Divide and separate a shape into smaller shapes.

- 4.2.3.8 Recognize and make shapes that can be created from a set of three simple shapes.
- 4.2.3.9 Identify congruent figures.
- 4.2.3.10 Draw figures congruent to a given figure.
- 4.2.3.11 Construct three dimensional objects.

Mathematics – Geometry, etc. -- Curriculum Standard 2 -- End-of-Grade 6 (MA4.2.6)

- 4.2.6.1 Explore transformational geometry through the use of slides, flips, and turns and the relations to tessellation's.
 - 4.2.6.2 Explore classification of two and three dimensional figures based upon properties.
 - 4.2.6.3 Enhance spatial sense using manipulatives and computer graphics.
 - 4.2.6.4 Explore the relationships and properties of two dimensional and three dimensional figures using manipulatives and technology.
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- 4.2.6.5 Tessellate (tile) a plane with a given figure and create a figure that will tile the plane.
- 4.2.6.6 Describe the shadow of certain figures.

Mathematics – Geometry, etc. -- Curriculum Standard 2 -- End-of-Grade 10 (MA4.2.10)

- 4.2.10.1 Explore two dimensional and three dimensional geometry using shadows, perspectives, projections, and maps.
 - 4.2.10.2 Explore the effects of reflections, translations, rotations, and dilations in the study of congruent and similar geometric shapes and tessellation's.
 - 4.2.10.3 Understand, model, describe, analyze, and apply patterns produced by processes of geometric change, formally connecting iteration, approximations, limits, self similarity, and fractals.
 - 4.2.10.4 Use manipulatives and computer graphics to enhance spatial sense and to increase understanding of geometry and to explore its connections to other parts of mathematics, science, and art.
 - 4.2.10.5 Explore other geometries and their applications (for example, non Euclidean geometries have significant applications in science).
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- 4.2.10.6 Sketch specific two dimensional figures, given definitions and/or properties.
- 4.2.10.7 Demonstrate that the conditions necessary for congruence or the conditions necessary for similarity are met.
- 4.2.10.8 Use technology, manipulatives, and/or coordinate geometry to explain properties of transformations (for example: translations, line reflections, rotations, dilations, and the composition of these transformations).
- 4.2.10.9 Demonstrate an understanding of properties among two and three dimensional figures.

4.3 Students will develop an understanding of measurement and systems of measurement through experiences which enable them to use a variety of

techniques, tools, and units of measurement to describe and analyze quantifiable phenomena. (Formerly 4c. K-12 Broad Goal.)

PURPOSE of MA 4.3: Measurement is used in many ways throughout our lives. Students must be introduced to the standard units of measure used in both the metric and English Systems. Students should estimate and measure length, area, capacity, volume, weight, time and temperature, as well as discover practical uses of these skills. High school students must develop more mature insights into the essential role of measurement as a link between the abstractions of mathematics and the concreteness of the real-world. By using various techniques and tools, we describe and analyze quantifiable phenomena to understand and organize our world.

Mathematics – Geometry, etc. -- Curriculum Standard 3 -- End-of-Grade 3 (MA4.3.3)

- 4.3.3.1 Understand the need for a uniform unit of measure.
 - 4.3.3.2 Develop measuring skills.
 - 4.3.3.3 Investigate the attributes of length, area, capacity, volume, and weight using standard (metric and English) and nonstandard units of measure.
 - 4.3.3.4 Understand the attributes of time and temperature.
 - 4.3.3.5 Relate measurement ideas to geometric ideas.
 - 4.3.3.6 Develop the concepts of perimeter and area.
 - 4.3.3.7 Make and use estimates of measurements.
 - 4.3.3.8 Develop an understanding of money.
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- 4.3.3.9 Tell time to the nearest minute.
 - 4.3.3.10 Measure line segments to the nearest half inch and quarter inch and to the nearest centimeter.
 - 4.3.3.11 Investigate the measure of perimeters.
 - 4.3.3.12 Add units of length that may or may not require regrouping of inches to feet or centimeters to meters.
 - 4.3.3.13 Estimate weight using pounds or kilograms.
 - 4.3.3.14 Estimate capacity using quarts, gallons, or liters.
 - 4.3.3.15 Given a standard unit, estimate and measure the area of a rectangular region.
 - 4.3.3.16 Given a standard unit, estimate the area of any region.
 - 4.3.3.17 Investigate the addition of hour and half hour time intervals.
 - 4.3.3.18 Given an amount of money, determine if a purchase can be made.

Mathematics – Geometry, etc. -- Curriculum Standard 3 -- End-of-Grade 6 (MA4.3.6)

- 4.3.6.1 Investigate and compare standard and nonstandard units of measurement for length, area volume, capacity, weight, time, and temperature.
 - 4.3.6.2 Explore and discover formulas for area and volume.
 - 4.3.6.3 Explore estimation strategies for finding areas and volumes.
 - 4.3.6.4 Explore conversion of units within a measurement system and between systems.
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- 4.3.6.5 Find and/or estimate the perimeter and area of a given quadrilateral or triangle.
 - 4.3.6.6 Demonstrate an understanding of the use of maps, scale drawings, and timelines.

4.3.6.7 Compare the relationship between similar figures and their areas.

Mathematics – Geometry, etc. -- Curriculum Standard 3 -- End-of-Grade 10 (MA4.3.10)

- 4.3.10.1 Explore linear and area measures of two dimensional figures.
 - 4.3.10.2 Explore the volume, surface area and linear measures of three dimensional figures.
 - 4.3.10.3 Apply the Pythagorean Theorem to real-world situations.
 - 4.3.10.4 Enhance, extend, apply, and formalize understandings and applications of measurement including strategies for determining perimeters, areas, and volumes by using formulas, approximations, and computer geometry programs.
 - 4.3.10.5 Use ratio and proportions to explore the properties of similar figures and use these properties to solve problems.
 - 4.3.10.6 Choose appropriate techniques and tools to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurement.
 - 4.3.10.7 Choose an appropriate unit of measure and use appropriate formulas to find perimeter and circumference, area of polygons and circles, the volume and surface area of selected solids, and the measure of angles.
 - 4.3.10.8 Choose appropriate units for measuring size, rates, and energy.
 - 4.3.10.9 Select and use appropriate formulas and procedures to determine a measure when a direct measurement is not available.
 - 4.3.10.10 Understand and apply measurement in career based contexts and in interdisciplinary situations.
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- 4.3.10.11 Identify and use appropriate units of measurement.
 - 4.3.10.12 Approximate areas of irregular shapes drawn on a grid.
 - 4.3.10.13 Convert commonly used measurements to equivalent ones within a measurement system.
 - 4.3.10.14 Apply the formulas for and choose an appropriate unit of measurement to find the linear and area measures associated with two dimensional figures and the volume and surface area of three dimensional figures.
 - 4.3.10.15 Apply the Pythagorean theorem to problem solving situations.
 - 4.3.10.16 Select an appropriate procedure to determine a measure when a direct measurement cannot be made.
 - 4.3.10.17 Use ratio and proportion to find the measure of all sides of similar figures.

4.4 Students will know the basic concepts of trigonometry and apply these concepts to real-world problems. (Formerly 4d. K-12 Broad Goal.)

PURPOSE of MA4.4: All students should explore real-world phenomena which involve right triangle trigonometry. These experiences should include the use of the sine, cosine, and tangent ratios. Technology should be used to facilitate the learning of trigonometry, allowing students more time and power to explore realistic applications.

Mathematics – Geometry, etc. -- Curriculum Standard 4 -- End-of-Grade 3 (MA4.4.3)

None at this level.

Mathematics – Geometry, etc. -- Curriculum Standard 4 -- End-of-Grade 6 (MA4.4.6)

4.4.6.1 Explore similar figures and the ratios of corresponding lengths (sides) and areas.

4.4.6.2 Make scale drawings, keeping sides in proportion. (Scale factor to be kept to a small whole number or fraction with denominator less than 6.)

Mathematics – Geometry, etc. -- Curriculum Standard 4 -- End-of-Grade 10 (MA4.4.10)

4.4.10.1 Explore the sine, cosine, and tangent ratios in right triangles.

4.4.10.2 Use the sine, cosine, and tangent ratios to solve real-world problems.

4.4.10.3 Use technology or manipulatives to apply basic trigonometric ratios to solve practical real-world problem.

FRAMEWORK: MATHEMATICS

STRAND: DATA ANALYSIS, STATISTICS, & PROBABILITY

5. Data Analysis, Statistics, and Probability

5.1 Students will use data analysis, statistics and probability to analyze given situations and the outcomes of experiments. (Formerly 5a. K-12 Broad Goal.)

PURPOSE of MA5.1: Collecting, organizing, displaying, and interpreting data, as well as using the information to make decisions and predictions, have become very important in our society. Statistical instruction should be carried out in a spirit of investigation and exploration so students can answer questions about data. Probability must be studied in familiar contexts encouraging students to model situations. Students need to investigate fairness, chances of winning, and uncertainty. Technology should be used as a tool throughout the investigation process.

Mathematics – Data Analysis, etc. – Curriculum Standard 1 - End-of-Grade 3 (MA5.1.3)

- 5.1.3.1 Collect, organize, describe, and interpret data.
 - 5.1.3.2 Formulate and solve problems that involve collecting, organizing, and analyzing data.
 - 5.1.3.3 Predict outcomes and carry out simple activities involving probability.
 - 5.1.3.4 Determine which event is most likely or least likely to happen, given appropriate information.
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- 5.1.3.5 Collect data, construct, and interpret picture and bar graphs.
 - 5.1.3.6 Interpret circle graphs.
 - 5.1.3.7 Write a story problem using information from a graph.
 - 5.1.3.8 Given appropriate information, determine which is most likely to happen or whether one event is more likely than another.

Mathematics – Data Analysis, etc. -- Curr Standard 1 - End-of-Grade 6 (MA5.1.6)

- 5.1.6.1 Collect, organize, describe, represent, and interpret data in both simulations and real world situations.
 - 5.1.6.2 Simulate, display, graph, and analyze data using technology and other means.
 - 5.1.6.3 Investigate and explore mean, median, and mode.
 - 5.1.6.4 Investigate and explore the basic elements of sampling.
 - 5.1.6.5 Make predictions, inferences, and decisions based on interpretation of data.
 - 5.1.6.6 Demonstrate an ability to read and interpret statistical data presented in text.
 - 5.1.6.7 Explore situations involving probability.
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- 5.1.6.8 Construct and interpret line plots, stem and leaf plots, frequency distributions, and graphs.
- 5.1.6.9 Use multiple representations to display equivalent data.
- 5.1.6.10 Select appropriate data to solve simulations and real world problems.
- 5.1.6.11 Simulate, display, graph and analyze data in a variety of mediums.
- 5.1.6.12 Determine and explore various uses of mean, median, and mode.
- 5.1.6.13 Use sampling techniques to make predictions.
- 5.1.6.14 Given a sample space find probabilities of events.

Mathematics – Data Analysis, etc. -- Curriculum Standard 1 -- End-of-Grade 10 (MA5.1.10)

- 5.1.10.1 Collect, organize, describe and interpret data from familiar contexts.
 - 5.1.10.2 Use a variety of techniques which include but are not limited to spreadsheets, tables, stem and leaf plots, box and whisker plots, to analyze data and make predictions.
 - 5.1.10.3 Understand sampling and recognize its role in statistical claims.
 - 5.1.10.4 Understand and apply measures of central tendency, dispersion and correlation.
 - 5.1.10.5 Design a statistical experiment to study a problem, conduct the experiment, interpret, and communicate the outcomes.
 - 5.1.10.6 Use graphics technology to analyze real world data.
 - 5.1.10.7 Apply the normal curve and its properties to familiar contexts.
 - 5.1.10.8 Use relative frequency and probability, as appropriate, to represent and solve problems involving uncertainty.
 - 5.1.10.9 Use simulations to estimate probabilities.
 - 5.1.10.10 Create, interpret, and understand applications of discrete and continuous probability distributions.
 - 5.1.10.11 Make predictions based on interpolation and extrapolation from data.
 - 5.1.10.12 Make decisions based on interpretation of data.
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- 5.1.10.13 Given a bar, line, circle or picture graph, interpret and analyze the data.
 - 5.1.10.14 Choose an appropriate scale and construct a graph or diagram using a set of numerical data in a variety of mediums.
 - 5.1.10.15 Calculate the common measures of central tendency: mean, median and mode.
 - 5.1.10.16 Use appropriate measure of central tendency in problem situations.
 - 5.1.10.17 Given a set of numerical data, determine the ordered pairs and make a scatter plot.
 - 5.1.10.18 Use sample sets to make appropriate inferences and predictions.
 - 5.1.10.19 Predict and find the probability of outcomes of a simple probability experiment.
 - 5.1.10.20 Interpret probabilities in real world situations (for example: lotteries, or medical testing).

FRAMEWORK: MATHEMATICS

STRAND: FUNCTIONS, RELATIONS & ALGEBRA

6. Functions, Relations and Algebra

- 6.1. Students will recognize patterns and describe and represent relations and functions with tables, graphs, equations and rules, and analyze how a change in one element results in a change in another. (Formerly 6a. K-12 Broad Goal.)

PURPOSE of MA 6.1: One of the central themes of mathematics is the study of patterns, relations, and functions. This study requires students to recognize, describe, and generalize patterns and build mathematical models to predict the behavior of real-world phenomenon that exhibit the observed pattern. This study of patterns leads to an exploration of functions, a concept which is an important unifying idea in all aspects of mathematics.

Mathematics – Functions, etc. – Curriculum Standard 1 - End-of-Grade 3 (MA6.1.3)

- 6.1.3.1 Use concrete models to create a pattern, describe the pattern, and represent the pattern symbolically in a table.
- 6.1.3.2 Recognize, describe, extend, and create a wide variety of patterns.
- 6.1.3.3 Represent and describe mathematical relationships.
- 6.1.3.4 Explore the use of variables and open sentences to express relationships.
- 6.1.3.5 Discover patterns or relationships from graphical representations.
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- 6.1.3.6 Recognize and describe patterns that involve numbers and shapes.
- 6.1.3.7 Create patterns.
- 6.1.3.8 Write an open sentence (equation) to express a relationship.

Mathematics – Functions, etc. – Curriculum Standard 1 - End-of-Grade 6 (MA6.1.6)

- 6.1.6.1 Recognize, describe, analyze, extend, and create a wide variety of patterns using models, tables, graphs, simple rules, and manipulatives such as pattern blocks.
- 6.1.6.2 Explore functional relationships to describe how a change in one quantity results in a change in another.
- 6.1.6.3 Explore number patterns to discover properties and relationships.
- 6.1.6.4 Analyze properties and relationships related to prime numbers, composite numbers, rational numbers, multiples, factors, and exponents.
- 6.1.6.5 Investigate field properties: commutative, associative, distributive, inverse and identity elements.
- 6.1.6.6 Explore simple linear equations.
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- 6.1.6.7 Generalize simple patterns using words.
- 6.1.6.8 Extend a pattern using models.
- 6.1.6.9 Identify properties and relationships related to prime numbers, composite numbers, rational numbers, multiples, factors, and exponents.
- 6.1.6.10 Determine how a change in length or width affects perimeter, area, and volume of two and three dimensional figures.
- 6.1.6.11 Solve simple linear equations by using concrete materials, tables, or graphs.
- 6.1.6.12 Apply the following properties when appropriate: commutative, associative, distributive, inverse, and identity elements.

Mathematics – Functions, etc. – Curriculum Standard 1 - End-of-Grade 10 (MA6.1.10)

- 6.1.10.1 Analyze functions and relations to describe how a change in one quantity results in a change in another.
 - 6.1.10.2 Use polynomial, rational, trigonometric, and exponential functions to model real-world relationships.
 - 6.1.10.3 Use charts and tables to organize and represent data.
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- 6.1.10.4 Develop algebraic formulas to express relationships which occur in other disciplines (for example: science, or economics).
 - 6.1.10.5 Recognize and describe relationships within a set of data.

6.2. Students will use algebraic concepts and processes to represent situations that involve variable quantities with expressions, equations, inequalities, matrices and graphs. (Formerly 6b. K-12 Broad Goal.)

PURPOSE of MA 6.2: Algebra is the language through which much of mathematics is communicated. It provides a means of representing concepts at an abstract level and then applying those concepts. Students in grades K-6 should explore algebraic concepts in an informal way, emphasizing physical models, data, graphs and other mathematical representations. Formal algebraic manipulation may be deferred to later grades. The understanding of algebraic representation is a prerequisite to formal work in virtually all of mathematics. Algebraic processes are important tools in the study of natural sciences and social sciences.

Mathematics – Functions, etc. – Curriculum Standard 2 - End-of-Grade 3 (MA6.2.3)

- 6.2.3.1 Represent situations and number patterns with concrete materials, tables, graphs, verbal rules, and equations; and translate from one to another.
 - 6.2.3.2 Develop an understanding of commutative and associative properties.
 - 6.2.3.3 Write and solve open sentences that describe everyday situations.
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- 6.2.3.4 Use recall of number facts to solve simple equations (for example, $4 + _ = 9$ may be solved by remembering the fact that $4 + 5$ is 9).
 - 6.2.3.5 Write the number pattern described by a written or verbal rule.

- 6.2.3.6 Illustrate the commutative and associative laws of addition and the commutative law of multiplication with manipulatives.

Mathematics – Functions, etc. – Curriculum Standard 2 - End-of-Grade 6 (MA6.2.6)

- 6.2.6.1 Represent situations and number patterns with concrete materials, tables, graphs, verbal rules, and standard algebraic notation.
- 6.2.6.2 Understand the use of literal variables, expressions, equations, and inequalities.
- 6.2.6.3 Analyze tables and graphs to identify algebraic relationships.
- 6.2.6.4 Solve simple linear equations using informal, graphical, and concrete methods.
- 6.2.6.5 Plot points on a number line.
- 6.2.6.6 Plot points on a rectangular coordinate system.
- 6.2.6.7 Explore using equations to model word problems and how to solve the problems using the equations.
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- 6.2.6.8 Use calculators, computers, and other technology to explore linear relationships.
- 6.2.6.9 Plot points on a number line or in the plane.
- 6.2.6.10 Use trial and error to find a solution to an equation from among a given replacement set.
- 6.2.6.11 Solve simple linear equations using concrete, informal methods.
- 6.2.6.12 Given a table or graph, select a sentence describing the underlying relationship(s).

Mathematics – Functions, etc. – Curriculum Standard 2 - End-of-Grade 10 (MA6.2.10)

- 6.2.10.1 Simplify algebraic expressions using the standard order of operations.
- 6.2.10.2 Perform polynomial operations with manipulatives.
- 6.2.10.3 Model and solve problems that involve varying quantities with variables, expressions, equations, inequalities, absolute values, vectors, and matrices.
- 6.2.10.4 Evaluate algebraic expressions for given values of the variable.
- 6.2.10.5 Write an equation, using one or two variables, which represents a real-world problem.
- 6.2.10.6 Write an inequality, using one or two variables, which represents a real-world problem.
- 6.2.10.7 Solve equations and inequalities in one or two variables, by informal and formal algebraic methods.
- 6.2.10.8 Use tables and graphs as tools to interpret expressions, equations, and inequalities.
- 6.2.10.9 Develop, explain, use, and analyze, procedures for operating on algebraic expressions and matrices.
- 6.2.10.10 Solve equations and inequalities of varying degrees using graphing calculators and computers as well as appropriate paper and pencil techniques.
- 6.2.10.11 Model real-world problems with systems of equations or inequalities.
- 6.2.10.12 Solve systems of equations or inequalities using technology as well as pencil and paper techniques.
- 6.2.10.13 Use technology to explore the use of matrices in the solution of systems of equations.
- 6.2.10.14 Understand the logic and purposes of algebraic procedures.

- 6.2.10.15 Interpret algebraic equations and inequalities geometrically and describe geometric objects algebraically.
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- 6.2.10.16 Evaluate simple algebraic expressions for given values of the variable.
- 6.2.10.17 Perform simple operations on matrices.
- 6.2.10.18 Write an equation or inequality in one variable which represents a real-world problem.
- 6.2.10.19 Solve equations and inequalities in one variable.
- 6.2.10.20 Graph the solution set of equations and inequalities in one variable.
- 6.2.10.21 Use appropriate graphing technology (for example: a graphing calculator, or graphing software) to graph an equation or inequality in two variables.
- 6.2.10.22 Use appropriate graphing technology (such as a graphing calculator or graphing software) to solve systems of linear equations in two variables.
- 6.2.10.23 Solve and justify, orally or in writing, the algebraic solution to a real-world problem.

FRAMEWORK: MATHEMATICS

STRAND: MATHEMATICS of CHANGE

7. Mathematics of Change

7.1. Students will be able to use concepts about mathematical change in analyzing patterns, graphs, and applied situations. (Formerly 7a. K-12 Broad Goal.)

PURPOSE of MA 7.1: All natural phenomena are characterized by change. Mathematics is a tool for representing and describing this change, and a preliminary understanding of change is an important precursor to the more formal ideas of calculus. Through explorations of patterns, tables, graphs, functions, and situations which focus on the nature of change, representation, understanding, and recognition of types of change can be promoted. Real-world examples of change can be examined. Proportional reasoning and experience with rates should be part of this process.

Mathematics – Math of Change – Curriculum Standard 1 - End-of-Grade 3 (MA7.1.3)

- 7.1.3.1 Record data in situations where change is occurring.
 - 7.1.3.2 Notice similarities and differences between patterns, in numerical and geometric situations.
 - 7.1.3.3 Observe and describe term by term change in patterns.
 - 7.1.3.4 Compare growth patterns.
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- 7.1.3.5 Describe the term by term change in a pattern (for example, given a number pattern: describe the rule that was used, determine the next term and explain the reasoning used).
 - 7.1.3.6 Given two patterns, describe how they are similar.
 - 7.1.3.7 Given two patterns, describe how they are different.

Mathematics – Math of Change – Curriculum Standard 1 - End-of-Grade 6 (MA7.1.6)

- 7.1.6.1 Explore sequences involving number and geometric patterns.
 - 7.1.6.2 Explore rates of change from familiar contexts.
 - 7.1.6.3 Explore meaning of comparisons (for example: cost per unit, miles per hour, wage rates, or batting averages).
 - 7.1.6.4 Explore rates of change in discrete (cost per unit) and continuous (distance per unit of time) settings.
 - 7.1.6.5 Interpret and compare rates of change by looking at graphs.
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- 7.1.6.6 Recognize and extend sequences of number and geometric patterns.
 - 7.1.6.7 Describe and interpret change from graphs and/or tables of data.

- 7.1.6.8 Find averages (for example: batting averages, or grade point averages) and compute rates in familiar contexts (for example: soft drink consumption, distance per unit of time, hourly wages , or paint mixing).

Mathematics – Math of Change – Curriculum Standard 1 - End-of-Grade 10 (MA7.1.10)

- 7.1.10.1 Use proportional reasoning strategies to solve problems about rates.
- 7.1.10.2 Extend patterns and predict nth terms in number sequences.
- 7.1.10.3 Extend patterns and predict nth terms in sequences of geometric figures.
- 7.1.10.4 Examine tables of numbers from familiar contexts to determine if patterns exist.
- 7.1.10.5 Recognize and describe different types of change (for example: arithmetic, geometric, periodic, damped, or oscillating).
- 7.1.10.6 Calculate and describe change in continuous and discrete contexts which are familiar.
- 7.1.10.7 Interpret and analyze information about change in familiar situations (for example: percent change, average change, or rates such as distance per unit time).
- 7.1.10.8 Recognize and interpret information about change in graphs of functions.
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- 7.1.10.9 Solve rate problems that involve proportional reasoning.
- 7.1.10.10 Extend patterns and predict nth terms in number sequences, using words and/or symbols.
- 7.1.10.11 Extend patterns and predict nth terms in sequences of geometric figures, using words and/or symbols.
- 7.1.10.12 Examine tables of numbers from familiar contexts to determine if patterns exist.
- 7.1.10.13 Differentiate among different types of change (for example: arithmetic, geometric, or periodic).
- 7.1.10.14 Calculate and describe change in continuous and discrete contexts which are familiar.
- 7.1.10.15 Interpret and analyze information about change in familiar situations (for example: percent change, average change, or rates such as distance per unit time).

FRAMEWORK: MATHEMATICS

STRAND: DISCRETE MATHEMATICS

8. Discrete Mathematics

(Click here to read more about *Discrete Mathematics*.) Discrete mathematics is defined as the study of topics which involve items that can be counted, rather than continuous amounts which can only be measured. Discrete mathematics is actually an umbrella term which includes such topics as: counting techniques, sets, relations, functions, logic and reasoning, patterning (iteration and recursion), algorithms, and induction. Probability, networks, graph theory, social decision making, and matrices should also be included in a discrete mathematics curriculum. Embedded in these areas are the three main themes of discrete mathematics: existence (Is there a solution?), counting (How many solutions are there?), and efficiency (What is the best solution?).

8.1. Students will use a variety of tools from discrete mathematics to explore and model real-world situations. (Formerly 8a. K-12 Broad Goal.)

PURPOSE of MA8.1: Information and communication continue to impact the modern world and require the understanding of discrete mathematics. Decision making involving sets and systems having a countable number of elements needs to be integrated throughout the curriculum. Students should have experiences with finite graphs, matrices, sequences, recursion and the development and testing of algorithms.

Mathematics – Discrete Math – Curriculum Standard 1 - End-of-Grade 3 (MA8.1.3)

- 8.1.3.1 Solve simple counting problems by making lists (for example, handshakes among 3 people).
 - 8.1.3.2 Explore alternate routes on maps.
 - 8.1.3.3 Use strategies in game situations.
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- 8.1.3.4 For a given situation, list all possible combinations (for example: list all possible clothes ensembles with two shirts and three pairs of pants; or, given a map, list all possible paths from point A to point B).

Mathematics – Discrete Math – Curriculum Standard 1 - End-of-Grade 6 (MA8.1.6)

- 8.1.6.1 Represent data in an organized fashion so the number of items in a set can be determined.
 - 8.1.6.2 Recognize, describe, extend, and create a wide variety of sequences.
 - 8.1.6.3 Create simple algorithms as a more efficient way of solving problems.
 - 8.1.6.4 Investigate the benefits of various alternatives in simple networks.
 - 8.1.6.5 Use logic and inductive reasoning to make predictions related to a series of statements.
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- 8.1.6.6 Use counting techniques to determine the number of outcomes for situations (for example: handshake problems, menu ordering, or clothes matching).
- 8.1.6.7 Solve problems for finding efficient routes (for example: mail delivery, or snow plowing for two or three streets).
- 8.1.6.8 Given three statements organize their content into chart form to investigate their relationships.

Mathematics – Discrete Math – Curriculum Standard 1 - End-of-Grade 10 (MA8.1.10)

- 8.1.10.1 Represent data and solve problem situations using graphs, trees and matrices.
 - 8.1.10.2 Use algebraic and geometric iteration to explore patterns and solve problems.
 - 8.1.10.3 Use combinations and permutations to solve a variety of problems.
 - 8.1.10.4 Use algorithms for finding optimal paths and circuits in graphs.
 - 8.1.10.5 Solve optimization problems.
 - 8.1.10.6 Analyze different algorithms for efficiency.
 - 8.1.10.7 Create and interpret discrete probability distributions using technologies whenever appropriate.
 - 8.1.10.8 Use linear programming to solve problems.
 - 8.1.10.9 Use the counting principle to solve problems.
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- 8.1.10.10 Use combinations and permutations to solve a variety of problems.