

Diocese of Venice  
Curricular Standards:  
**Mathematics**

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*Middle School and High School  
Grades 6-12*



# *Basic Principles underlying All Standards to be used for the Planning of Curriculum for the Diocese of Venice*

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Basic principles which inform all Catholic education in the Schools of the Diocese of Venice are:

- All knowledge, in some way, reflects God's Truth, Beauty and Goodness.
- Curriculum and instruction enable deeper incorporation of the children into the Church, the formation of community within the school; and respect for the uniqueness and dignity of each person as created in the image of God.
- Education fosters growth in Christian virtue and contributes to development and formation of the whole person in light of his/her ultimate end and the good of the society of which he/she is a member.
- Each subject is to be examined in the context of the Catholic faith and is to be illuminated by Gospel values.
- Learning and formation occur in the Catholic school without separation as does the development of each student on both the natural and supernatural levels.
- Curriculum and instruction seeks to promote a synthesis of faith, life and culture and to form students as disciples of Jesus.



# *Diocese Of Venice Catholic School Standards For Mathematics*



Mathematics is the study of quantity, structure, space, and change. Attention should be paid to the needs of today's society in teaching mathematics by fostering real world application, enabling students to undertake responsibilities in society both locally and globally while witnessing to the faith.

Individual subjects must be taught according to their own particular methods. It would be wrong to consider subjects as mere adjuncts to faith or as a useful means of teaching apologetics. They enable the pupil to assimilate skills, knowledge, intellectual methods and moral and social attitudes, all of which help to develop his personality and lead him to take his place as an active member of the community of man. Their aim is not merely the attainment of knowledge but the acquisition of values and the discovery of truth. *The Catholic School*, 39

### **In a Catholic school, curricular formation...**

1. Involves the integral formation of the whole person, body, mind, and spirit, in light of his or her ultimate end and the good of society.<sup>i</sup>
2. Promotes human virtues and the dignity of the human person, as created in the image and likeness of God and modeled on the person of Jesus Christ.<sup>ii</sup>
3. Seeks to know and understand objective reality which includes transcendent Truth, is knowable by reason and faith, and finds its origin, unity, and end in God.
4. Develops a Catholic worldview and enables a deeper incorporation of the student into the heart of the Catholic Church.<sup>iii</sup>
5. Encourages a synthesis of faith, life, and culture.<sup>iv</sup>

**Mathematics 6<sup>th</sup> Grade Catholic Integrated Faith Standards**

MA.6.IF	Catholic Curricular Standards and Dispositions in Mathematics			
	MA.6.IF	6th Grade Math Integration of Faith		
			MA.6.IF.1	Recognize the power of the human mind as both a gift from God and a reflection of Him in whose image and likeness we are made.
			MA.6.IF.2	Demonstrate the mental habits of precise, determined, careful, and accurate questioning, inquiry, and reasoning.
			MA.6.IF.3	Develop lines of inquiry (as developmentally appropriate) to understand why things are true and why they are false.
			MA.6.IF.4	Display a sense of wonder about mathematical relationships as well as confidence in mathematical certitude.
			MA.6.IF.5	Survey the truths about mathematical objects that are interesting in their own right and independent of human opinions.

**6<sup>th</sup> Grade Mathematics**

MA.6.EE	Grade 6 Expressions & Equations			
		MA.6.EE.1	Apply and extend previous understandings of arithmetic to algebraic expressions.	
				MA.6.EE.1.1 Write and evaluate numerical expressions involving whole-number exponents.
				MA.6.EE.1.2 Write, read, and evaluate expressions in which letters stand for numbers; a. Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation ,Subtract y from 5, as 5-y; 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. For example, 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; c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used 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). For example, use the formulas $V = s^3$ and $A = 6s^2$ to find the volume and surface area of a cube with sides of length $s = 1/2$ .
				MAFS.6.EE.1.3 Apply the properties of operations to generate equivalent expressions. For example, 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 $3y$ .
				MAFS.6.EE.1.4	Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). For example, the expressions $y + y + y$ and $3y$ are equivalent because they name the same number regardless of which number $y$ stands for.
		MA.6.EE.2	Reason about and solve one-variable equations and inequalities.		
				MA.6.EE.2.1	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.
				MA.6.EE.2.2	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.
				MA.6.EE.2.3	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 non-negative rational numbers.
				MA.6.EE.2.4	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.
		MA.6.EE.3	Represent and analyze quantitative relationships between dependent and independent variables.		
				MA.6.EE.3.1	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 relate these to the equation. For example, 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.
MA.6.G	Grade 6 Geometry				
		MA.6.G.1	Solve real-world and mathematical problems involving area, surface area, and volume.		
				MA.6.G.1.1	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.
				MA.6.G.1.2	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 $V = l w h$ and $V = B h$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.
				MA.6.G.1.3	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.
				MA.6.G.1.4	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.
MA.6.RP	Grade 6 Ratios & Proportional Relationships				
		MA.6.RP.1	Understand ratio concepts and use ratio reasoning to solve problems.		
				MA.6.RP.1.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, 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
				MA.6.RP.1.2	Understand the concept of a unit rate $a/b$ associated with a ratio $a:b$ with $b \neq 0$ , and use rate language in the context of a ratio relationship. For example, 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.

					<p>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; a. 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; Solve unit rate problems including those involving unit pricing and constant speed. For example, 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?; c. 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; d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities; e. Understand the concept of Pi as the ratio of the circumference of a circle to its diameter.</p>
MA.6.SP	Grade 6 Statistics & Probability				
		MA.6.SP.1	Develop understanding of statistical variability.		
				MA.6.SP.1.1	<p>Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, “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 student ages.</p>

				MA.6.SP.1.2	Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
				MA.6.SP.1.3	Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
		MA.6.SP.2	Summarize and describe distributions.		
				MA.6.SP.2.1	Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
				MA.6.SP.2.2	Summarize numerical data sets in relation to their context, such as by; a. Reporting the number of observations; Describing the nature of the attribute under investigation, including how it was measured and its units of measurement; c. 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 were gathered; d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.
MA.6.NS	Grade 6 The Number System				
		MA.6.NS.1	Apply and extend previous understandings of multiplication and division to divide fractions by fractions.		
				MA.6.NS.1.1	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. For example, create a story context for $(2/3) \div (3/4)$

					and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that $(2/3) \div (3/4) = 8/9$ because $3/4$ of $8/9$ is $2/3$ . (In general, $(a/b) \div (c/d) = ad/bc$ .) 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?
		MA.6.NS.2	Compute fluently with multi-digit numbers and find common factors and multiples.		
				MA.6.NS.2.1	Fluently divide multi-digit numbers using the standard algorithm.
				MA.6.NS.2.2	Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
				MA.6.NS.2.3	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. For example, express $36 + 8$ as $4(9 + 2)$ .
		MA.6.NS.3	Apply and extend previous understandings of numbers to the system of rational numbers.		
				MA.6.NS.3.1	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,

					credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.
				MA.6.NS.3.2	Understand a rational number as 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; a. 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; 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; c. 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.
				MA.6.NS.3.3	Understand ordering and absolute value of rational numbers; a. Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. For example, interpret $-3 > -7$ as a statement that -3 is located to the right of -7 on a number line oriented from left to right; Write, interpret, and explain statements of order for rational numbers in real-world contexts. For example, write $-3^{\circ}\text{C} > -7^{\circ}\text{C}$ to express the fact that $-3^{\circ}\text{C}$ is warmer than $-7^{\circ}\text{C}$ ; c. Understand

					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. For example, for an account balance of -30 dollars, write $ -30  = 30$ to describe the size of the debt in dollars; d. Distinguish comparisons of absolute value from statements about order. For example, recognize that an account balance less than -30 dollars represents a debt greater than 30 dollars.
				MA.6.NS.3.4	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.

**Mathematics 7<sup>th</sup> Grade Catholic Integrated Faith Standards**

MA.7.IF	Catholic Curricular Standards and Dispositions in Mathematics			
	MA.7.IF	7th Grade Math Integration of Faith		
			MA.7.IF.1	Recognize the power of the human mind as both a gift from God and a reflection of Him in whose image and likeness we are made.
			MA.7.IF.2	Demonstrate the mental habits of precise, determined, careful, and accurate questioning, inquiry, and reasoning.
			MA.7.IF.3	Develop lines of inquiry (as developmentally appropriate) to understand why things are true and why they are false.
			MA.7.IF.4	Display a sense of wonder about mathematical relationships as well as confidence in mathematical certitude.
			MA.7.IF.5	Survey the truths about mathematical objects that are interesting in their own right and independent of human opinions.

**7<sup>th</sup> Grade Mathematics**

MA.7.EE	Grade 7 Expressions & Equations				
		MA.7.EE.1	Use properties of operations to generate equivalent expressions.		
				MA.7.EE.1.1	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
				MA.7.EE.1.2	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. For example, $a + 0.05a = 1.05a$ means that increase by 5%, is the same as “multiply by 1.05.”
		MA.7.EE.2	Solve real-life and mathematical problems using numerical and algebraic expressions and equations.		
				MA.7.EE.2.1	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 to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional $\frac{1}{10}$ of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar $9\frac{3}{4}$ inches long in the center of a door that is $27\frac{1}{2}$ 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.
				MA.7.EE.2.2	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; a. 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. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?; b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$ , where $p$ , $q$ , and $r$ are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. For example: 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.
MA.7.G	Grade 7 Geometry				
		MA.7.G.1	Draw, construct, and describe geometrical figures and describe the relationships between them.		
				MA.7.G.1.1	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.

				MA.7.G.1.2	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.
				MA.7.G.1.3	Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.
		MA.7.G.2	Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.		
				MA.7.G.2.1	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.
				MA.7.G.2.2	Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.
				MA.7.G.2.3	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.
MAFS.7.RP	Grade 7 Ratios & Proportional Relationships				
		MAFS.7.RP.1	Analyze proportional relationships and use them to solve real-world and mathematical problems.		
				MAFS.7.RP.1.1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.

					For example, if a person walks $\frac{1}{2}$ mile in each $\frac{1}{4}$ hour, compute the unit rate as the complex fraction $\frac{1/2}{1/4}$ miles per hour, equivalently 2 miles per hour.
				MAFS.7.RP.1.2	Recognize and represent proportional relationships between quantities; a. Decide 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; Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships; c. Represent proportional relationships by equations. For example, 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 $t = pn$ ; d. 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.
				MAFS.7.RP.1.3	Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.
MA.7.SP	Grade 7 Statistics & Probability				
		MA.7.SP.1	Use random sampling to draw inferences about a population.		
				MA.7.SP.1.1	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.
				MA.7.SP.1.2	Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example, 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.
		MA.7.SP.2	Draw informal comparative inferences about two populations.		
				MA.7.SP.2.1	Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. For example, 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.
				MA.7.SP.2.2	Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. For example, 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.
		MA.7.SP.3	Investigate chance processes and develop, use, and evaluate probability models.		
				MA.7.SP.3.1	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 $\frac{1}{2}$ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.
				MA.7.SP.3.2	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. For example, 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.
				MA.7.SP.3.3	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; a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. For example, 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; Develop a

					probability model (which may not be uniform) by observing frequencies in data generated from a chance process. For example, 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?
					Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation; a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs; Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., rolling double sixes) identify the outcomes in the sample space which compose the event; c. Design and use a simulation to generate frequencies for compound events. For example, 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?
MA.7.SP.3.4					
MA.7.NS	Grade 7 The Number System				
		MA.7.NS.1	Apply and extend previous understandings of operations with fractions to add, subtract, , multiply, and divide rational numbers.		
				MA.7.NS.1.1	Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and

					<p>subtraction on a horizontal or vertical number line diagram; a. Describe situations in which opposite quantities combine to make 0. For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged; Understand <math>p + q</math> as the number located a distance <math> q </math> from <math>p</math>, in the positive or negative direction depending on whether <math>q</math> 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; c. Understand subtraction of rational numbers as adding the additive inverse, <math>p - q = p + (-q)</math> 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; d. Apply properties of operations as strategies to add and subtract rational numbers.</p>
				MA.7.NS.1.2	<p>Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers; a. Understand 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 <math>(-1)(-1) = 1</math> and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts; Understand 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. Interpret quotients of rational numbers by describing real-world contexts; c.</p>

					Apply properties of operations as strategies to multiply and divide rational numbers; d. 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.
				MA.7.NS.1.3	Solve real-world and mathematical problems involving the four operations with rational numbers.

**Mathematics 8<sup>th</sup> Grade Catholic Integrated Faith Standards**

MA.8.IF	Catholic Curricular Standards and Dispositions in Mathematics			
	MA.8.IF	3rd Grade Math Integration of Faith		
			MA.8.IF.1	Recognize the power of the human mind as both a gift from God and a reflection of Him in whose image and likeness we are made.
			MA.8.IF.2	Demonstrate the mental habits of precise, determined, careful, and accurate questioning, inquiry, and reasoning.
			MA.8.IF.3	Connecting the discipline within mathematics to the development of natural virtues
			MA.8.IF.4	Develop lines of inquiry (as developmentally appropriate) to understand why things are true and why they are false.
			MA.8.IF.6	Survey the truths about mathematical objects that are interesting in their own right and independent of human opinions.
			MA.8.IF.5	Display a sense of wonder about mathematical relationships as well as confidence in mathematical certitude.

**8<sup>th</sup> Grade Mathematics**

MA.8.EE	Grade 8 Expressions & Equations			
		MA.8.EE.1	Work with radicals and integer exponents.	
				MA.8.EE.1.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$ .
				MA.8.EE.1.2 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.
				MA.8.EE.1.3 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. For example, estimate the population of the United States as $3 \times 10^8$ and the population of the world as $7 \times 10^9$ , and determine that the world population is more than 20 times larger.
				MA.8.EE.1.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. 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.

		MA.8.EE.2	Understand the connections between proportional relationships, lines, and linear equations.		
				MA.8.EE.2.1	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
				MA.8.EE.2.2	Use similar 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 the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$ .
		MA.8.EE.3	Analyze and solve linear equations and pairs of simultaneous linear equations.		
				MA.8.EE.3.1	Solve linear equations in one variable; a. 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); Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
				MA.8.EE.3.2	Analyze and solve pairs of simultaneous linear equations; a. 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; Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6; c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.
MA.8.F	Grade 8 Functions				
		MA.8.F.1	Define, evaluate, and compare functions.		
				MA.8.F.1.1	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.
				MA.8.F.1.2	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, 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.
				MA.8.F.1.3	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. For example, 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.
		MA.8.F.2	Use functions to model relationships between quantities.		
				MA.8.F.2.1	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.
				MA.8.F.2.2	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.
MA.8.G	Grade 8 Geometry				
		MA.8.G.1	Understand congruence and similarity using physical models, transparencies, or geometry software.		
				MA.8.G.1.1	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; Angles are taken to angles of the same measure; c. Parallel lines are taken to parallel lines.
				MA.8.G.1.2	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.
				MA.8.G.1.3	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
				MA.8.G.1.4	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.
				MA.8.G.1.5	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 sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.
		MA.8.G.2	Understand and apply the Pythagorean Theorem.		
				MA.8.G.2.1	Explain a proof of the Pythagorean Theorem and its converse.
				MA.8.G.2.2	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
				MA.8.G.2.3	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

		MA.8.G.3	Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.		
				MA.8.G.3.1	Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.
MA.8.SP	Grade 8 Statistics & Probability				
		MA.8.SP.1	Investigate patterns of association in bivariate data.		
				MA.8.SP.1.1	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.
				MA.8.SP.1.2	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.
				MA.8.SP.1.3	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, 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.
				MA.8.SP.1.4	Understand that patterns of association can also 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. For example, 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?
MA.8.NS	Grade 8 The Number System				
		MA.8.NS.1	Know that there are numbers that are not rational, and approximate them by rational numbers.		
				MA.8.NS.1.1	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.
				MA.8.NS.1.2	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., $\sqrt{2}$ ). For example, by truncating the decimal expansion of $\sqrt{2}$ , 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.

**Mathematics 9<sup>th</sup>-12<sup>th</sup> Grade Catholic Integrated Faith Standards**

MA.912.IF	Catholic Curricular Standards and Dispositions in Mathematics		
	MA.912.IF	High School Math Integration of Faith	
			MA.912.IF.1 Demonstrate the mental habits of precise, determined, careful, and accurate questioning, inquiry, and reasoning in the pursuit of transcendent truths.
			MA.912.IF.2 Develop lines of inquiry to understand why things are true and why they are false.
			MA.912.IF.3 Have faith in the glory and dignity of human reason as both a gift from God and a reflection of Him in whose image and likeness we are made.
			MA.912.IF.4 Explain how mathematics in its reflection of the good, true, and beautiful reveals qualities of being and the presence of God.
			MA.912.IF.5 Display a sense of wonder about mathematical relationships, especially mathematical certitude which is independent of human opinion.
			MA.912.IF.6 Share with others the beauty, harmony, proportion, radiance, and wholeness present in mathematics.
			MA.912.IF.7 Advocate for the pursuit of understanding for its own sake and the intrinsic value or discovery of the true and the beautiful often at the requirement of great sacrifice, discipline, and effort.
			MA.912.IF.8 Exhibit appreciation for the ongoing nature of mathematical inquiry.
			MA.912.IF.9 Exhibit habits of thinking quantitatively and in an orderly manner, especially through immersion in mathematical observations found within creation.

			MA.912.IF.10	Propose how mathematical objects or proofs (such as the golden mean, the Fibonacci numbers, the musical scale, and geometric proofs) suggest divine origin.
			MA.912.IF.11	Exhibit appreciation for the process of discovering meanings and truths existing within the solution of the problem and not just arriving at an answer.
			MA.912.IF.12	Exhibit humility at knowing that as a human being man can only grasp a portion of the truths of the universe.
			MA.912.IF.13	Advance an understanding of the ability of the human intellect to know and the desire of the will to want to know more.
			MA.912.IF.14	Explain the nature of rational discourse and argument and the desirability of precision and deductive certainty which mathematics makes possible and is not possible to the same degree in other disciplines.
			MA.912.IF.15	Demonstrate how sound logical arguments and other processes of mathematics are foundational to its discipline.
			MA.912.IF.16	Recognize how mathematical arguments and processes can be extrapolated to other areas of study, including theology and philosophy.
			MA.912.IF.17	Explain how it is possible to mentally abstract and construct mathematical objects from direct observations of reality and how one's perception of that reality is important to what one is doing (see Appendix F).
			MA.912.IF.18	Recognize personal bias in inquiry and articulate why inquiry should be undertaken in a fair and independent manner.
			MA.912.IF.19	Evaluate the ongoing nature of mathematical inquiry, its inexhaustibility, and its openness to the infinite.
			MA.912.IF.20	Explain man's limitations of understanding and uncovering all mathematical knowledge.

			MA.912.IF.21	Explain how fundamental questions of values, common sense, and religious and human truths and experiences are beyond the scope of mathematical inquiry and its syllogisms.
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**Algebra High School**

MA.912.A-APR	Grades 9-12 Algebra: Arithmetic with Polynomials Rational Expressions				
		MA.912.A-APR.1	Perform arithmetic operations on polynomials		
				MA.912.A-APR.1.1	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.
		MA.912.A-APR.2	Understand the relationship between zeros and factors of polynomials		
				MA.912.A-APR.2.1	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 $p(x)$ .
				MA.912.A-APR.2.2	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.
		MA.912.A-APR.3	Use polynomial identities to solve problems		
				MA.912.A-APR.3.1	Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.
				MA.912.A-APR.3.2	Know and apply the Binomial Theorem for 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.
		MA.912.A-APR.4	Rewrite rational expressions		
				MA.912.A-APR.4.1	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.
				MA.912.A-APR.4.2	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.
MA.912.A-CED	Grades 9-12 Algebra: Creating Equations				
		MA.912.A-CED.1	Create equations that describe numbers or relationships		
				MA.912.A-CED.1.1	Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational, absolute, and exponential functions.
				MA.912.A-CED.1.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
				MA.912.A-CED.1.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example,

					represent inequalities describing nutritional and cost constraints on combinations of different foods.
				MA.912.A-CED.1.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance $R$ .
MA.912.A-REI	Grades 9-12 Algebra: Reasoning with Equations and Inequalities				
		MA.912.A-REI.1	Understand solving equations as a process of reasoning and explain the reasoning		
				MA.912.A-REI.1.1	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.
				MA.912.A-REI.1.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
		MA.912.A-REI.2	Solve equations and inequalities in one variable		
				MA.912.A-REI.2.1	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
				MA.912.A-REI.2.2	Solve quadratic equations in one variable; a. 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; 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 $b$ .
		MA.912.A-REI.3	Solve systems of equations		
				MA.912.A-REI.3.1	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.
				MA.912.A-REI.3.2	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
				MA.912.A-REI.3.3	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = 3x$ and the circle $x^2 + y^2 = 3$ .
				MA.912.A-REI.3.4	Represent a system of linear equations as a single matrix equation in a vector variable.
				MA.912.A-REI.3.5	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).
		MA.912.A-REI.4	Represent and solve equations and inequalities graphically		
				MA.912.A-REI.4.1	Understand 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).
				MA.912.A-REI.4.2	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.
				MA.912.A-REI.4.3	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.
MA.912.A-SSE	Grades 9-12 Algebra: Seeing Structure in Expressions				
		MA.912.A-SSE.1	Interpret the structure of expressions		
				MA.912.A-SSE.1.1	Interpret expressions that represent a quantity in terms of its context; a. Interpret parts of an expression, such as terms, factors, and coefficients; Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret as the product of $P$ and a factor not depending on $P$ .
				MA.912.A-SSE.1.2	Use the structure of an expression to identify ways to rewrite it. For example, see $x^2 - y^2$ as $(x - y)(x + y)$ , thus recognizing it as a difference of squares that can be factored as $(x - y)(x + y)$ .
		MA.912.A-SSE.2	Write expressions in equivalent forms to solve problems		
				MA.912.A-SSE.2.1	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression; a. Factor a quadratic expression to reveal the zeros of the function it defines; Complete the square in a

					quadratic expression to reveal the maximum or minimum value of the function it defines; c. Use the properties of exponents to transform expressions for exponential functions. For example the expression can be rewritten as $a^x = b^y$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.
				MA.912.A-SSE.2.2	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. For example, calculate mortgage payments.
<b>Calculus High School</b>					
MA.912.C	Grades 9-12 Calculus				
		MA.912.C.1	Limits and Continuity		
				MA.912.C.1.1	Understand the concept of limit and estimate limits from graphs and tables of values.
				MA.912.C.1.2	Find limits by substitution.
				MA.912.C.1.3	Find limits of sums, differences, products, and quotients.
				MA.912.C.1.4	Find limits of rational functions that are undefined at a point.
				MA.912.C.1.5	Find one-sided limits.
				MA.912.C.1.6	Find limits at infinity.
				MA.912.C.1.7	Decide when a limit is infinite and use limits involving infinity to describe asymptotic behavior.
				MA.912.C.1.8	Find special limits such as
				MA.912.C.1.9	Understand continuity in terms of limits.
				MA.912.C.1.10	Decide if a function is continuous at a point.
				MA.912.C.1.11	Find the types of discontinuities of a function.

				MA.912.C.1.12	Understand and use the Intermediate Value Theorem on a function over a closed interval.
				MA.912.C.1.13	Understand and apply the Extreme Value Theorem: If $f(x)$ is continuous over a closed interval, then $f$ has a maximum and a minimum on the interval.
		MA.912.C.2	Differential Calculus		
				MA.912.C.2.1	Understand the concept of derivative geometrically, numerically, and analytically, and interpret the derivative as an instantaneous rate of change or as the slope of the tangent line.
				MA.912.C.2.2	State, understand, and apply the definition of derivative.
				MA.912.C.2.3	Find the derivatives of functions, including algebraic, trigonometric, logarithmic, and exponential functions.
				MA.912.C.2.4	Find the derivatives of sums, products, and quotients.
				MA.912.C.2.5	Find the derivatives of composite functions using the Chain Rule.
				MA.912.C.2.6	Find the derivatives of implicitly-defined functions.
				MA.912.C.2.7	Find derivatives of inverse functions.
				MA.912.C.2.8	Find second derivatives and derivatives of higher order.
				MA.912.C.2.9	Find derivatives using logarithmic differentiation.
				MA.912.C.2.10	Understand and use the relationship between differentiability and continuity.
				MA.912.C.2.11	Understand and apply the Mean Value Theorem.
		MA.912.C.3	Applications of Derivatives		

				MA.912.C.3.1	Find the slope of a curve at a point, including points at which there are vertical tangent lines and no tangent lines.
				MA.912.C.3.2	Find an equation for the tangent line to a curve at a point and a local linear approximation.
				MA.912.C.3.3	Decide where functions are decreasing and increasing. Understand the relationship between the increasing and decreasing behavior of $f$ and the sign of $f'$ .
				MA.912.C.3.4	Find local and absolute maximum and minimum points.
				MA.912.C.3.5	Find points of inflection of functions. Understand the relationship between the concavity of $f$ and the sign of $f''$ . Understand points of inflection as places where concavity changes.
				MA.912.C.3.6	Use first and second derivatives to help sketch graphs. Compare the corresponding characteristics of the graphs of $f$ , $f'$ , and $f''$ .
				MA.912.C.3.7	Use implicit differentiation to find the derivative of an inverse function.
				MA.912.C.3.8	Solve optimization problems.
				MA.912.C.3.9	Find average and instantaneous rates of change. Understand the instantaneous rate of change as the limit of the average rate of change. Interpret a derivative as a rate of change in applications, including velocity, speed, and acceleration.
				MA.912.C.3.10	Find the velocity and acceleration of a particle moving in a straight line.
				MA.912.C.3.11	Model rates of change, including related rates problems.
				MA.912.C.3.12	Solve problems using the Newton-Raphson method.
		MA.912.C.4	Integral Calculus		

				MA.912.C.4.1	Use rectangle approximations to find approximate values of integrals.
				MA.912.C.4.2	Calculate the values of Riemann Sums over equal subdivisions using left, right, and midpoint evaluation points.
				MA.912.C.4.3	Interpret a definite integral as a limit of Riemann sums.
				MA.912.C.4.4	Interpret a definite integral of the rate of change of a quantity over an interval as the change of the quantity over the interval. That is, $\int_a^b f(x)dx = f(b) - f(a)$ (Fundamental Theorem of Calculus).
				MA.912.C.4.5	Use the Fundamental Theorem of Calculus to evaluate definite and indefinite integrals and to represent particular antiderivatives. Perform analytical and graphical analysis of functions so defined.
				MA.912.C.4.6	Use these properties of definite integrals: $[f(x) + g(x)]dx = f(x)dx + g(x)dx$ , $k \int f(x)dx = k \int f(x)dx$ , $\int f(x)dx = 0$ , $\int f(x)dx = - \int f(x)dx$ , $\int f(x)dx + \int f(x)dx = \int f(x)dx$ . If $f(x) \geq g(x)$ on $[a, b]$ , then $\int_a^b f(x)dx \geq \int_a^b g(x)dx$ .
				MA.912.C.4.7	Use integration by substitution (or change of variable) to find values of integrals.
				MA.912.C.4.8	Use Riemann Sums, the Trapezoidal Rule, and technology to approximate definite integrals of functions represented algebraically, geometrically, and by tables of values.
		MA.912.C.5	Applications of Integration		
				MA.912.C.5.1	Find specific antiderivatives using initial conditions, including finding velocity functions from acceleration functions, finding position

					functions from velocity functions, and solving applications related to motion along a line.
				MA.912.C.5.2	Solve separable differential equations, and use them in modeling.
				MA.912.C.5.3	Solve differential equations of the form $dy/dt=ky$ as applied to growth and decay problems.
				MA.912.C.5.4	Use slope fields to display a graphic representation of the solution to a differential equation, and locate particular solutions to the equation.
				MA.912.C.5.5	Use definite integrals to find the area between a curve and the x-axis or between two curves.
				MA.912.C.5.6	Use definite integrals to find the average value of a function over a closed interval.
				MA.912.C.5.7	Use definite integrals to find the volume of a solid with known cross-sectional area, including solids of revolution.
				MA.912.C.5.8	Apply integration to model, and solve problems in physical, biological, and social sciences.
MA.912.F-BF	Grades 9-12 Functions: Building Functions				
		MA.912.F-BF.1	Build a function that models a relationship between two quantities.		
				MA.912.F-BF.1.1	Write a function that describes a relationship between two quantities; a. Determine an explicit expression, a recursive process, or steps for calculation from a context; Combine standard function types using arithmetic operations. For example, 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; c. Compose functions. For example, 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.
				MA.912.F-BF.1.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
		MA.912.F-BF.2	Build new functions from existing functions		
				MA.912.F-BF.2.1	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.
				MA.912.F-BF.2.2	Find inverse functions; a. 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. For example, $f(x) = 2x - 3$ or $f(x) = (x + 1)/(x - 1)$ for $x \neq 1$ ; Verify by composition that one function is the inverse of another; c. Read values of an inverse function from a graph or a table, given that the function has an inverse; d. Produce an invertible function from a non-invertible function by restricting the domain.
				MA.912.F-BF.2.3	Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
				MA.912.F-BF.2.4	Use the change of base formula.

MA.912.F-IF	Grades 9-12 Functions: interpreting Functions				
		MA.912.F-IF.1	Understand the concept of a function and use function notation.		
				MA.912.F-IF.1.1	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. 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 $y = f(x)$ .
				MA.912.F-IF.1.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
				MA.912.F-IF.1.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$ , $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$ .
		MA.912.F-IF.2	Interpret functions that arise in applications in terms of the context		
				MA.912.F-IF.2.1	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.

				MA.912.F-IF.2.2	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function $h(n)$ gives the number of person-hours it takes to assemble engines in a factory, then the positive integers would be an appropriate domain for the function.
				MA.912.F-IF.2.3	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.
		MA.912.F-IF.3	Analyze functions using different representations		
				MA.912.F-IF.3.1	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases; a. Graph linear and quadratic functions and show intercepts, maxima, and minima; Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions; c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior; d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior; e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude, and using phase shift.
				MA.912.F-IF.3.2	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function; a. 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; Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y =$ , $y =$ , $y =$ , $y =$ , and classify them as representing exponential growth or decay.
				MA.912.F-IF.3.3	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
MA.912.F-LE	Grades 9-12 Functions: Linear, Quadratic, & Exponential Models				
		MA.912.F-LE.1	Construct and compare linear, quadratic, and exponential models and solve problems		
				MA.912.F-LE.1.1	Distinguish between situations that can be modeled with linear functions and with exponential functions; a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals; Recognize situations in which one quantity changes at a constant rate per unit interval relative to another; c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
				MAFS.912.F-LE.1.2	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).

				MAFS.912.F-LE.1.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
				MAFS.912.F-LE.1.4	For exponential models, express as a logarithm the solution to $ab^t = d$ where $a$ , $c$ , and $d$ are numbers and the base $b$ is 2, 10, or $e$ ; evaluate the logarithm using technology.
		MAFS.912.F-LE.2	Interpret expressions for functions in terms of the situation they model		
				MAFS.912.F-LE.2.1	Interpret the parameters in a linear or exponential function in terms of a context.
MA.912.F-TF	Grades 9-12 Functions: Trigonometric Functions				
		MA.912.TF.1	Extend the domain of trigonometric functions using the unit circle		
				MA.912.TF.1.1	Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle; Convert between degrees and radians.
				MA.912.TF.1.2	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.
				MA.912.TF.1.3	Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$ , $\pi/4$ and $\pi/6$ , and use the unit circle to express the values of sine, cosine, and tangent for $\pi/3$ , $\pi/4$ , $\pi/6$ , $\pi/3 + x$ , and $2\pi/3$ , $\pi/4 + x$ , $\pi/6 + x$ in terms of their values for $x$ , where $x$ is any real number.

				MA.912.TF.1.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
		MA.912.TF.2	Model periodic phenomena with trigonometric functions		
				MA.912.TF.2.1	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
				MA.912.TF.2.2	Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
				MA.912.TF.2.3	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.
		MA.912.TF.3	Prove and apply trigonometric identities		
				MA.912.TF.3.1	Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to calculate trigonometric ratios.
				MA.912.TF.3.2	Prove the addition and subtraction, half-angle, and double-angle formulas for sine, cosine, and tangent and use these formulas to solve problems.
<b>Geometry High School</b>					
MA.912.G-C	Grades 9-12 Geometry: Circles				
		MA.912.G-C.1	Understand and apply theorems about circles		
				MA.912.G-C.1.1	Prove that all circles are similar.
				MA.912.G-C.1.2	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.
				MA.912.G-C.1.3	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
				MA.912.G-C.1.4	Construct a tangent line from a point outside a given circle to the circle.
		MA.912.G-C.2	Find arc lengths and areas of sectors of circles		
				MA.912.G-C.2.1	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.
MA.912.G-CO	Grades 9-12 Geometry: Congruence				
		MA.912.G-CO.1	Experiment with transformations in the plane		
				MA.912.G-CO.1.1	Know 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.
				MA.912.G-CO.1.2	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).

				MA.912.G-CO.1.3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
				MA.912.G-CO.1.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
				MA.912.G-CO.1.5	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.
		MA.912.G-CO.2	Understand congruence in terms of rigid motions.		
				MA.912.G-CO.2.1	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.
				MA.912.G-CO.2.2	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.
				MA.912.G-CO.2.3	Explain how the criteria for triangle congruence (ASA, SAS, SSS, and Hypotenuse-Leg) follow from the definition of congruence in terms of rigid motions.
		MA.912.G-CO.3	Prove geometric theorems		
				MA.912.G-CO.3.1	Prove theorems about lines and angles; use theorems about lines and angles to solve problems. 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.
				MA.912.G-CO.3.2	Prove theorems about triangles; use theorems about triangles to solve problems. Theorems include: measures of interior angles of a triangle sum to $180^\circ$ ; triangle inequality theorem; 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.
				MA.912.G-CO.3.3	Prove theorems about parallelograms; use theorems about parallelograms to solve problems. 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.
		MA.912.G-CO.4	Make geometric constructions		
				MA.912.G-CO.4.1	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.
				MA.912.G-CO.4.2	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

MA.912.G-GPE	Grades 9-12 Geometry: Expressing Geometric properties with Equations				
		MA.912.G-GPE.1	Translate between the geometric description and the equation for a conic section		
				MA.912.G-GPE.1.1	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.
				MA.912.G-GPE.1.2	Derive the equation of a parabola given a focus and directrix.
				MA.912.G-GPE.1.3	Derive the equations of ellipses and hyperbolas given the foci and directrices.
		MA.912.G-GPE.2	Use coordinates to prove simple geometric theorems algebraically		
				MA.912.G-GPE.2.1	Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point $(1, \sqrt{3})$ lies on the circle centered at the origin and containing the point $(0, 2)$ .
				MA.912.G-GPE.2.2	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).
				MA.912.G-GPE.2.3	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

				MA.912.G-GPE.2.4	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
MA.912.G-GMD	Grades 9-12 Geometry: Geometric Measurement & Dimension				
		MA.912.G-GMD.1	Explain volume formulas and use them to solve problems		
				MA.912.G-GMD.1.1	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.
				MA.912.G-GMD.1.2	Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.
				MA.912.G-GMD.1.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
		MAFS.912.G-GMD.2	Visualize relationships between two-dimensional and three-dimensional objects		
				MAFS.912.G-GMD.2.1	Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
MA.912.G-MG	Grades 9-12 Geometry: Modeling with Geometry				
		MA.912.G-MG.1	Apply geometric concepts in modeling situations		
				MA.912.G-MG.1.1	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

				MA.912.G-MG.1.2	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
				MA.912.G-MG.1.3	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).
MA.912.G-SRT	Grades 9-12 Geometry: Similarity, right Triangles, & Trigonometry				
		MA.912.G-SRT.1	Understand similarity in terms of similarity transformations		
				MA.912.G-SRT.1.1	Verify experimentally the properties of dilations given by a center and a scale factor: • 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; • The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
				MA.912.G-SRT.1.2	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.
				MA.912.G-SRT.1.3	Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
		MA.912.G-SRT.2	Prove theorems involving similarity		
				MA.912.G-SRT.2.1	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.
				MA.912.G-SRT.2.2	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
		MA.912.G-SRT.3	Define trigonometric ratios and solve problems involving right triangles		
				MA.912.G-SRT.3.1	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.
				MA.912.G-SRT.3.2	Explain and use the relationship between the sine and cosine of complementary angles.
				MA.912.G-SRT.3.3	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
		MAFS.912.G-SRT.4	Apply trigonometry to general triangles		
				MAFS.912.G-SRT.4.1	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.
				MAFS.912.G-SRT.4.2	Prove the Laws of Sines and Cosines and use them to solve problems.
				MAFS.912.G-SRT.4.3	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).
MA.912.N-Q	Grades 9-12 Number & Number Quantities				
		MA.912.N-Q.1	Reason quantitatively and use units to solve problems.		

				MA.912.N-Q.1.1	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.
				MA.912.N-Q.1.2	Define appropriate quantities for the purpose of descriptive modeling.
				MA.912.N-Q.1.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
MA.912.N-CN	Grades 9-12 Number Quantity: The Complex Number System				
		MA.912.N-CN.1	Perform arithmetic operations with complex numbers.		
				MA.912.N-CN.1.1	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.
				MA.912.N-CN.1.2	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
				MA.912.N-CN.1.3	Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.
		MA.912.N-CN.2	Represent complex numbers and their operations on the complex plane.		
				MA.912.N-CN.2.1	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.
				MA.912.N-CN.2.2	Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on

					the complex plane; use properties of this representation for computation. For example, $(-1 + \sqrt{3}i)^3 = 8$ because $(-1 + \sqrt{3}i)$ has modulus 2 and argument $120^\circ$ .
				MA.912.N-CN.2.3	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.
		MA.912.N-CN.3	Use complex numbers in polynomial identities and equations.		
				MA.912.N-CN.3.1	Solve quadratic equations with real coefficients that have complex solutions.
				MA.912.N-CN.3.2	Extend polynomial identities to the complex numbers. For example, rewrite $x + 4$ as $(x + 2i)(x - 2i)$ .
				MA.912.N-CN.3.3	Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
MA.912.N-RN	Grades 9-12 Number Quantity: The Real Number System				
		MA.912.N-RN.1	Extend the properties of exponents to rational exponents.		
				MA.912.N-RN.1.1	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. For example, we define to be the cube root of 5 because we want $=$ to hold, so must equal 5.
				MA.912.N-RN.1.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.

		MA.912.N-RN.2	Use properties of rational and irrational numbers.		
				MA.912.N-RN.2.1	Explain why the sum or product of two 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.
MA.912.N-VM	Grades 9-12 Number & Quantity: Vector & Matrix Quantities				
		MA.912.N-VM.1	Represent and model with vector quantities.		
				MA.912.N-VM.1.1	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\ $ , $v$ ).
				MA.912.N-VM.1.2	Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
				MA.912.N-VM.1.3	Solve problems involving velocity and other quantities that can be represented by vectors.
		MA.912.N-VM.2	Perform operations on vectors.		
				MA.912.N-VM.2.1	<p>Add and subtract vectors.</p> <ul style="list-style-type: none"> <li>•a. 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.</li> <li>•b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.</li> <li>•c. Understand vector subtraction <math>v - w</math> as <math>v + (-w)</math>, where <math>-w</math> is the additive inverse of <math>w</math>, with the</li> </ul>

					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..
				MA.912.N-VM.2.2	Multiply a vector by a scalar; a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c =$ ; Compute the magnitude of a scalar multiple $cv$ using $\ cv\  =  c v$ . Compute the direction of $cv$ knowing that when $ c v \neq 0$ , the direction of $cv$ is either along $v$ (for $c > 0$ ) or against $v$ (for $c < 0$ ).
		MA.912.N-VM.3	Perform operations on matrices and use matrices in applications.		
				MA.912.N-VM.3.1	Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
				MA.912.N-VM.3.2	Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.
				MA.912.N-VM.3.3	Add, subtract, and multiply matrices of appropriate dimensions.
				MA.912.N-VM.3.4	Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
				MA.912.N-VM.3.5	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.

				MA.912.N-VM.3.6	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.
				MA.912.N-VM.3.7	Work with 2 x2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.
MA.912.S-CP	Grades 9-12 Statistics & Probability: Conditional Probability & the Rules of Probability				
		MA.912.S-CP.1	Understand independence and conditional probability and use them to interpret data		
				MA.912.S-CP.1.1	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”).
				MA.912.S-CP.1.2	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.
				MA.912.S-CP.1.3	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.
				MA.912.S-CP.1.4	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. For example, 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.
				MA.912.S-CP.1.5	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.
		MA.912.S-CP.2	Use the rules of probability to compute probabilities of compound events in a uniform probability model		
				MA.912.S-CP.2.1	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 the model.
				MA.912.S-CP.2.2	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.
				MA.912.S-CP.2.3	Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B A) = P(B)P(A B)$ , and interpret the answer in terms of the model.
				MA.912.S-CP.2.4	Use permutations and combinations to compute probabilities of compound events and solve problems.
MA.912.S-ID	Grades 9-12 Statistics & Probability: Interpreting Categorical & Quantitative Data				

		MA.912.S-ID.1	Summarize represent, and interpret data on a single count or measurement variable		
				MA.912.S-ID.1.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
				MA.912.S-ID.1.2	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.
				MA.912.S-ID.1.3	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
				MA.912.S-ID.1.4	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.
		MA.912.S-ID.2	Summarize, represent, and interpret data on two categorical and quantitative variables		
				MA.912.S-ID.2.1	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.
				MA.912.S-ID.2.2	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related; a. 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; Informally assess the fit of a function by plotting and analyzing residuals; c. Fit a linear function for a scatter plot that suggests a linear association.
		MA.912.S-ID.3	Interpret linear models		
				MA.912.S-ID.3.1	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
				MA.912.S-ID.3.2	Compute (using technology) and interpret the correlation coefficient of a linear fit.
				MA.912.S-ID.3.3	Distinguish between correlation and causation.
MA.912.S-IC	Grades 9-12 Statistics & Probability: Making Inferences & Justifying Conclusions				
		MA.912.S-IC.1	Understand and evaluate random processes underlying statistical experiments		
				MA.912.S-IC.1.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
				MAFS.912.S-IC.1.2	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?
		MA.912.S-IC.2	Make inferences and justify conclusions from sample surveys, experiments, and observational studies		
				MA.912.S-IC.2.1	Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

				MA.912.S-IC.2.2	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.
				MA.912.S-IC.2.3	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
				MA.912.S-IC.2.4	Evaluate reports based on data.
MA.912.S-MD	Grades 9-12 Statistics & Probability: Using Probability to Make Decisions				
		MA.912.S-MD.1	Calculate expected values and use them to solve problems		
				MA.912.S-MD.1.1	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.
				MA.912.S-MD.1.2	Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
				MA.912.S-MD.1.3	Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. For example, 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.
				MA.912.S-MD.1.4	Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example, 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?
		MA.912.S-MD.2	Use probability to evaluate outcomes of decisions		
				MA.912.S-MD.2.1	Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values; a. Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant; Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.
				MA.912.S-MD.2.2	Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
				MA.912.S-MD.2.3	Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

<sup>i</sup> *The Catholic School, 1977, #36, 47, 49. Gravissimum Educationis, 1965, #1, par. 1; USCCB. Seven themes of Catholic social teaching.*

<sup>ii</sup> *The Religious Dimension of Education in a Catholic School, 1988, #52, 56; The Catholic School, 1977, #55.*

<sup>iii</sup> *The Religious Dimension of Education in a Catholic School, 1988, #71, 74-77; The Catholic School, 1977, #50*

<sup>iv</sup> *The Religious Dimension of Education in a Catholic School, 1988, #52; The Catholic School, #37.*