

## 6-12 Mathematics Grade-Level Expectations

*Missouri Department of Elementary and Secondary Education*

*Spring 2016*

### Ratios and Proportional Relationships

RP	Grade 6	Grade 7	Grade 8
A	<b>Understand and use ratios to solve problems.</b>	<b>Analyze proportional relationships and use them to solve problems.</b>	
	Understand a ratio as a comparison of two quantities and represent these comparisons.	Compute unit rates, including those that involve complex fractions, with like or different units.	
	Understand the concept of a unit rate associated with a ratio, and describe the meaning of unit rate.	Recognize and represent proportional relationships between quantities. a. Determine when two quantities are in a proportional relationship. b. Identify and/or compute the constant of proportionality (unit rate). c. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation. d. Recognize that the graph of any proportional relationship will pass through the origin.	
	Solve problems involving ratios and rates. a. Create tables of equivalent ratios, find missing values in the tables and plot the pairs of values on the Cartesian coordinate plane. b. Solve unit rate problems. c. Solve percent problems. d. Convert measurement units within and between two systems of measurement.	Solve problems involving ratios, rates, percentages and proportional relationships.	

### Number Sense and Operations

NS	Grade 6	Grade 7	Grade 8
A	<b>Apply and extend previous understandings of multiplication and division to divide fractions by fractions.</b>	<b>Apply and extend previous understandings of operations to add, subtract, multiply and divide rational numbers.</b>	<b>Know that there are numbers that are not rational, and approximate them by rational numbers.</b>
	<p>Compute and interpret quotients of positive fractions.</p> <p>a. Solve problems involving division of fractions by fractions.</p>	<p>Apply and extend previous understandings of numbers to add and subtract rational numbers.</p> <p>a. Add and subtract rational numbers.</p> <p>b. Represent addition and subtraction on a horizontal or vertical number line.</p> <p>c. Describe situations and show that a number and its opposite have a sum of 0 (additive inverses).</p> <p>d. Understand subtraction of rational numbers as adding the additive inverse.</p> <p>e. Determine the distance between two rational numbers on the number line is the absolute value of their difference.</p> <p>f. Interpret sums and differences of rational numbers.</p>	<p>Explore the real number system.</p> <p>a. Know the differences between rational and irrational numbers.</p> <p>b. Understand that all rational numbers have a decimal expansion that terminates or repeats.</p> <p>c. Convert decimals which repeat into fractions and fractions into repeating decimals.</p> <p>d. Generate equivalent representations of rational numbers.</p>
		<p>Apply and extend previous understandings of numbers to multiply and divide rational numbers.</p> <p>a. Multiply and divide rational numbers.</p> <p>b. Determine that a number and its reciprocal have a product of 1 (multiplicative inverse).</p> <p>c. Understand that every quotient of integers (with non-zero divisor) is a rational number.</p> <p>d. Convert a rational number to a decimal.</p> <p>e. Understand that all rational numbers can be written as fractions or decimal numbers that terminate or repeat.</p> <p>f. Interpret products and quotients of rational numbers by describing real-world contexts.</p>	<p>Estimate the value and compare the size of irrational numbers and approximate their locations on a number line.</p>
		<p>Solve problems involving the four arithmetic operations with rational numbers.</p>	

### Number Sense and Operations

NS	Grade 6	Grade 7	Grade 8
<b>B</b>	<b>Compute with non-negative multi-digit numbers, and find common factors and multiples.</b>		
	Demonstrate fluency with division of multi-digit whole numbers.		
	Demonstrate fluency with addition, subtraction, multiplication and division of decimals.		
	Find common factors and multiples. a. Find the greatest common factor (GCF) and the least common multiple (LCM). b. Use the distributive property to express a sum of two whole numbers with a common factor as a multiple of a sum of two whole numbers.		
NS	Grade 6	Grade 7	Grade 8
<b>C</b>	<b>Apply and extend previous understandings of numbers to the system of rational numbers.</b>		
	Use positive and negative numbers to represent quantities.		
	Locate a rational number as a point on the number line. a. Locate rational numbers on a horizontal or vertical number line. b. Write, interpret and explain problems of ordering of rational numbers. c. Understand that a number and its opposite (additive inverse) are located on opposite sides of zero on the number line.		

### Number Sense and Operations

	Understand that the absolute value of a rational number is its distance from 0 on the number line.		
	Extend prior knowledge to generate equivalent representations of rational numbers between fractions, decimals and percentages (limited to terminating decimals and/or benchmark fractions of $\frac{1}{3}$ and $\frac{2}{3}$ ).		

### Expressions, Equations and Inequalities

EEI	Grade 6	Grade 7	Grade 8
<b>A</b>	<b>Apply and extend previous understandings of arithmetic to algebraic expressions.</b>	<b>Use properties of operations to generate equivalent expressions.</b>	<b>Work with radicals and integer exponents.</b>
	Describe the difference between an expression and an equation.	Apply properties of operations to simplify and to factor linear algebraic expressions with rational coefficients.	Know and apply the properties of integer exponents to generate equivalent expressions.
	<p>Create and evaluate expressions involving variables and whole number exponents.</p> <ol style="list-style-type: none"> <li>a. Identify parts of an expression using mathematical terminology.</li> <li>b. Evaluate expressions at specific values of the variables.</li> <li>c. Evaluate non-negative rational number expressions.</li> <li>d. Write and evaluate algebraic expressions.</li> <li>e. Understand the meaning of the variable in the context of the situation.</li> </ol>	Understand how to use equivalent expressions to clarify quantities in a problem.	<p>Investigate concepts of square and cube roots.</p> <ol style="list-style-type: none"> <li>a. Solve equations of the form <math>x^2 = p</math> and <math>x^3 = p</math>, where p is a positive rational number.</li> <li>b. Evaluate square roots of perfect squares less than or equal to 625 and cube roots of perfect cubes less than or equal to 1000.</li> <li>c. Recognize that square roots of non-perfect squares are irrational.</li> </ol>
	Identify and generate equivalent algebraic expressions using mathematical properties.		Express very large and very small quantities in scientific notation and approximate how many times larger one is than the other.
			<p>Use scientific notation to solve problems.</p> <ol style="list-style-type: none"> <li>a. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.</li> <li>b. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities.</li> </ol>

## Expressions, Equations and Inequalities

EEI	Grade 6	Grade 7	Grade 8
<b>B</b>	<b>Reason about and solve one-variable equations and inequalities.</b>	<b>Solve problems using numerical and algebraic expressions and equations.</b>	<b>Understand the connections between proportional relationships, lines and linear equations.</b>
	Use substitution to determine whether a given number in a specified set makes a one-variable equation or inequality true.	Solve multi-step problems posed with rational numbers. a. Convert between equivalent forms of the same number. b. Assess the reasonableness of answers using mental computation and estimation strategies.	Graph proportional relationships. a. Interpret the unit rate as the slope of the graph. b. Compare two different proportional relationships.
	Understand that if any solutions exist, the solution set for an equation or inequality consists of values that make the equation or inequality true.	Write and/or solve linear equations and inequalities in one variable. a. Write and/or solve equations of the form $x+p = q$ and $px = q$ in which $p$ and $q$ are rational numbers. b. Write and/or solve two-step equations of the form $px + q = r$ and $p(x + q) = r$ , where $p$ , $q$ and $r$ are rational numbers, and interpret the meaning of the solution in the context of the problem. c. Write, solve and/or graph inequalities of the form $px + q > r$ or $px + q < r$ , where $p$ , $q$ and $r$ are rational numbers.	Apply concepts of slope and y-intercept to graphs, equations and proportional relationships. a. Explain why the slope ( $m$ ) is the same between any two distinct points on a non-vertical line in the Cartesian coordinate plane. b. 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 $b$ .
	Write and solve equations using variables to represent quantities, and understand the meaning of the variable in the context of the situation.		
	Solve one-step linear equations in one variable involving non-negative rational numbers.		

**Expressions, Equations and Inequalities**

	Recognize that inequalities may have infinitely many solutions. a. Write an inequality of the form $x > c$ , $x < c$ , $x \geq c$ , or $x \leq c$ to represent a constraint or condition. b. Graph the solution set of an inequality.		
<b>EEI</b>	<b>Grade 6</b>	<b>Grade 7</b>	<b>Grade 8</b>
<b>C</b>	<b>Represent and analyze quantitative relationships between dependent and independent variables.</b>		<b>Analyze and solve linear equations and inequalities and pairs of simultaneous linear equations.</b>
	Identify and describe relationships between two variables that change in relationship to one another. a. Write an equation to express one quantity, the dependent variable, in terms of the other quantity, the independent variable. b. Analyze the relationship between the dependent and independent variables using graphs, tables and equations and relate these representations to each other.		Solve linear equations and inequalities in one variable. a. Create and identify linear equations with one solution, infinitely many solutions or no solutions. b. Solve linear equations and inequalities with rational number coefficients, including equations and inequalities whose solutions require expanding expressions using the distributive property and combining like terms.
			Analyze and solve systems of linear equations. a. Graph systems of linear equations and recognize the intersection as the solution to the system. b. Explain why solution(s) to a system of two linear equations in two variables correspond to point(s) of intersection of the graphs. c. Explain why systems of linear equations can have one solution, no solution or infinitely many solutions. d. Solve systems of two linear equations.

## Geometry and Measurement

GM	Grade 6	Grade 7	Grade 8
A	<b>Solve problems involving area, surface area and volume.</b>	<b>Draw and describe geometrical figures and describe the relationships between them.</b>	<b>Understand congruence and similarity using physical models, transparencies or geometry software.</b>
	Find the area of polygons by composing or decomposing the shapes into rectangles or triangles.	Solve problems involving scale drawings of real objects and geometric figures, including computing actual lengths and areas from a scale drawing and reproducing the drawing at a different scale.	Verify experimentally the congruence properties of rigid transformations. a. Verify that angle measure, betweenness, collinearity and distance are preserved under rigid transformations. b. Investigate if orientation is preserved under rigid transformations.
	Find the volume of right rectangular prisms. a. Understand that the volume of a right rectangular prism can be found by filling the prism with multiple layers of the base. b. Apply $V = l * w * h$ and $V = Bh$ to find the volume of right rectangular prisms.	Use a variety of tools to construct geometric shapes. a. Determine if provided constraints will create a unique triangle through construction. b. Construct special quadrilaterals given specific parameters.	Understand that two-dimensional figures are congruent if a series of rigid transformations can be performed to map the pre-image to the image. a. Describe a possible sequence of rigid transformations between two congruent figures.
	Solve problems by graphing points in all four quadrants of the Cartesian coordinate plane. a. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the Cartesian coordinate plane b. 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 distances between points with the same first coordinate or the same second coordinate. d. Construct polygons in the Cartesian coordinate plane.	Describe two-dimensional cross sections of pyramids, prisms, cones and cylinders.	Describe the effect of dilations, translations, rotations and reflections on two-dimensional figures using coordinates.

### Geometry and Measurement

	<p>Solve problems using nets.</p> <p>a. Represent three-dimensional figures using nets made up of rectangles and triangles.</p> <p>b. Use nets to find the surface area of three-dimensional figures whose sides are made up of rectangles and triangles.</p>	<p>Understand concepts of circles.</p> <p>a. Analyze the relationships among the circumference, the radius, the diameter, the area and Pi in a circle.</p> <p>b. Know and apply the formulas for circumference and area of circles to solve problems.</p>	<p>Understand that two-dimensional figures are similar if a series of transformations (rotations, reflections, translations and dilations) can be performed to map the pre-image to the image.</p> <p>a. Describe a possible sequence of transformations between two similar figures.</p>
			<p>Explore angle relationships and establish informal arguments.</p> <p>a. Derive the sum of the interior angles of a triangle.</p> <p>b. Explore the relationship between the interior and exterior angles of a triangle.</p> <p>c. Construct and explore the angles created when parallel lines are cut by a transversal.</p> <p>d. Use the properties of similar figures to solve problems.</p>
<b>GM</b>	<b>Grade 6</b>	<b>Grade 7</b>	<b>Grade 8</b>
<b>B</b>		<b>Apply and extend previous understanding of angle measure, area and volume.</b>	<b>Understand and apply the Pythagorean Theorem.</b>
		Use angle properties to write and solve equations for an unknown angle.	Use models to demonstrate a proof of the Pythagorean Theorem and its converse.
		<p>Understand the relationship between area, surface area and volume.</p> <p>a. Find the area of triangles, quadrilaterals and other polygons composed of triangles and rectangles.</p> <p>b. Find the volume and surface area of prisms, pyramids and cylinders.</p>	Use the Pythagorean Theorem to determine unknown side lengths in right triangles in problems in two- and three-dimensional contexts.
			Use the Pythagorean Theorem to find the distance between points in a Cartesian coordinate system.

**Geometry and Measurement**

GM	Grade 6	Grade 7	Grade 8
C			<b>Solve problems involving volume of cones, pyramids and spheres.</b>
			Solve problems involving surface area and volume. a. Understand the concept of surface area and find surface area of pyramids. b. Understand the concepts of volume and find the volume of pyramids, cones and spheres.

### Data Analysis, Statistics and Probability

DSP	Grade 6	Grade 7	Grade 8
<b>A</b>	<b>Develop understanding of statistical variability.</b>	<b>Use random sampling to draw inferences about a population.</b>	<b>Investigate patterns of association in bivariate data.</b>
	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.	Understand that statistics can be used to gain information about a population by examining a sample of the population. a. Understand that a sample is a subset of a population. b. Understand that generalizations from a sample are valid only if the sample is representative of the population. c. Understand that random sampling is used to produce representative samples and support valid inferences.	Construct and interpret scatter plots of bivariate measurement data to investigate patterns of association between two quantities.
	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.	Use data from multiple samples to draw inferences about a population and investigate variability in estimates of the characteristic of interest.	Generate and use a trend line for bivariate data, and informally assess the fit of the line.
	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 from a single number.		Interpret the parameters of a linear model of bivariate measurement data to solve problems.
			Understand the patterns of association in bivariate categorical data displayed in a two-way table. a. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. b. Use relative frequencies calculated for rows or columns to describe possible association between the two variables.

**Data Analysis, Statistics and Probability**

DSP	Grade 6	Grade 7	Grade 8
<b>B</b>	<b>Summarize and describe distributions.</b>	<b>Draw informal comparative inferences about two populations.</b>	
	Display and interpret data. a. Use dot plots, histograms and box plots to display and interpret numerical data. b. Create and interpret circle graphs.	Analyze different data distributions using statistical measures.	
	Summarize numerical data sets in relation to the context. a. Report the number of observations. b. Describe the nature of the attribute under investigation, including how it was measured and its units of measurement. c. Give 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 of the data. d. Analyze the choice of measures of center and variability based on the shape of the data distribution and/or the context of the data.	Compare the numerical measures of center, measures of frequency and measures of variability from two random samples to draw inferences about the population.	
DSP	Grade 6	Grade 7	Grade 8
<b>C</b>		<b>Develop, use and evaluate probability models.</b>	
		Investigate the probability of chance events. a. Determine probabilities of simple events. b. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.	
		Investigate the relationship between theoretical and experimental probabilities for simple events. a. Predict outcomes using theoretical probability. b. Perform experiments that model theoretical	

**Data Analysis, Statistics and Probability**

		probability. c. Compare theoretical and experimental probabilities.	
		Explain possible discrepancies between a developed probability model and observed frequencies. a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.	
		Find probabilities of compound events using organized lists, tables, tree diagrams and simulations. a. Represent the sample space of a compound event. b. Design and use a simulation to generate frequencies for compound events.	

## Functions

F	Grade 6	Grade 7	Grade 8
A			<b>Define, evaluate and compare functions.</b>
			Explore the concept of functions. (The use of function notation is not required.) a. Understand that a function assigns to each input exactly one output. b. Determine if a relation is a function. c. Graph a function.
			Compare characteristics of two functions each represented in a different way.
			Investigate the differences between linear and nonlinear functions. a. Interpret the equation $y = mx + b$ as defining a linear function, whose parameters are the slope ( $m$ ) and the $y$ -intercept ( $b$ ). b. Recognize that the graph of a linear function has a constant rate of change c. Give examples of nonlinear functions.
F	Grade 6	Grade 7	Grade 8
B			<b>Use functions to model relationships between quantities.</b>
			Use functions to model linear relationships between quantities. a. Explain the parameters of a linear function based on the context of a problem. b. Determine the parameters of a linear function. c. Determine the $x$ -intercept of a linear function.
			Describe the functional relationship between two quantities from a graph or a verbal description.

## Functions


### Number and Quantity

NQ	Algebra 1	Algebra 2
<b>A</b>	<b>Extend and use properties of rational exponents.</b>	<b>Extend and use the relationship between rational exponents and radicals.</b>
	Explain how the meaning of rational exponents extends from the properties of integer exponents.	Extend the system of powers and roots to include rational exponents.
	Rewrite expressions involving radicals and rational exponents using the properties of exponents. Limit to rational exponents with a numerator of 1.	Create and recognize equivalent expressions involving radical and exponential forms of expressions.
		Add, subtract, multiply and divide radical expressions.
		Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.
NQ	Algebra 1	Algebra 2
<b>B</b>	<b>Use units to solve problems.</b>	<b>Use complex numbers.</b>
	Use units of measure as a way to understand and solve problems involving quantities. a. Identify, label and use appropriate units of measure within a problem. b. Convert units and rates. c. Use units within problems. d. Choose and interpret the scale and the origin in graphs and data displays.	Represent complex numbers.
	Define and use appropriate quantities for representing a given context or problem.	Add, subtract, multiply and divide complex numbers.
	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	Know and apply the Fundamental Theorem of Algebra.

### Seeing Structure in Expressions

SSE	Algebra 1	Algebra 2
<b>A</b>	<b>Interpret and use structure.</b>	<b>Define and use logarithms.</b>
	Interpret the contextual meaning of individual terms or factors from a given problem that utilizes formulas or expressions.	Develop the definition of logarithms based on properties of exponents.
	Analyze the structure of polynomials to create equivalent expressions or equations.	Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations.
	Choose and produce equivalent forms of a quadratic expression or equations to reveal and explain properties. a. Find the zeros of a quadratic function by rewriting it in factored form. b. Find the maximum or minimum value of a quadratic function by completing the square.	Use properties of logarithms to solve equations or find equivalent expressions.
		Understand why logarithmic scales are used, and use them to solve problems.

### Creating Equations

CED	Algebra 1	Algebra 2
<b>A</b>	<b>Create equations that describe linear, quadratic and exponential relationships.</b>	
	Create equations and inequalities in one variable and use them to model and/or solve problems.	
	Create and graph linear, quadratic and exponential equations in two variables.	
	Represent constraints by equations or inequalities and by systems of equations or inequalities, and interpret the data points as a solution or non-solution in a modeling context.	
	Solve literal equations and formulas for a specified variable that highlights a quantity of interest.	

### Reasoning with Equations and Inequalities

REI	Algebra 1	Algebra 2
<b>A</b>	<b>Understand solving equations as a process, and solve equations and inequalities in one variable.</b>	<b>Solve equations and inequalities.</b>
	Explain how each step taken when solving an equation or inequality in one variable creates an equivalent equation or inequality that has the same solution(s) as the original.	Create and solve equations and inequalities, including those that involve absolute value.
	Solve problems involving quadratic equations. <ul style="list-style-type: none"> <li>a. Use the method of completing the square to create an equivalent quadratic equation.</li> <li>b. Derive the quadratic formula.</li> <li>c. Analyze different methods of solving quadratic equations.</li> </ul>	Solve rational equations where numerators and denominators are polynomials and where extraneous solutions may result.
REI	Algebra 1	Algebra 2
<b>B</b>	<b>Solve systems of equations.</b>	<b>Solve general systems of equations and inequalities.</b>
	Solve a system of linear equations algebraically and/or graphically.	Create and solve systems of equations that may include non-linear equations and inequalities.
	Solve a system consisting of a linear equation and a quadratic equation algebraically and/or graphically.	
	Justify that the technique of linear combination produces an equivalent system of equations.	
REI	Algebra 1	Algebra 2
<b>C</b>	<b>Represent and solve linear and exponential equations and inequalities graphically.</b>	
	Explain that the graph of an equation in two variables is the set of all its solutions plotted in the Cartesian coordinate plane.	

**Reasoning with Equations and Inequalities**

	Graph the solution to a linear inequality in two variables.	
	Solve problems involving a system of linear inequalities.	

### Arithmetic with Polynomials and Rational Expressions

APR	Algebra 1	Algebra 2
<b>A</b>	<b>Perform operations on polynomials.</b>	<b>Perform operations on polynomials and rational expressions.</b>
	Add, subtract and multiply polynomials, and understand that polynomials follow the same general rules of arithmetic and are closed under these operations.	Extend the knowledge of factoring to include factors with complex coefficients.
	Divide polynomials by monomials.	Understand the Remainder Theorem and use it to solve problems.
		Find the least common multiple of two or more polynomials.
		Add, subtract, multiply and divide rational expressions.
		Identify zeros of polynomials when suitable factorizations are available, and use the zeros to sketch the function defined by the polynomial.

### Interpreting Functions

IF	Algebra 1	Algebra 2
<b>A</b>	<b>Understand the concept of a function and use function notation.</b>	<b>Use and interpret functions.</b>
	Understand that a function from one set (domain) to another set (range) assigns to each element of the domain exactly one element of the range. a. Represent a function using function notation. b. Understand that the graph of a function labeled $f$ is the set of all ordered pairs $(x, y)$ that satisfy the equation $y=f(x)$ .	Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.
	Use function notation to evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.	Translate between equivalent forms of functions.
IF	Algebra 1	Algebra 2
<b>B</b>	<b>Interpret linear, quadratic and exponential functions in terms of the context.</b>	
	Using tables, graphs and verbal descriptions, interpret key characteristics of a function that models the relationship between two quantities.	
	Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.	
	Determine the average rate of change of a function over a specified interval and interpret the meaning.	
	Interpret the parameters of a linear or exponential function in terms of the context.	
IF	Algebra 1	Algebra 2
<b>C</b>	<b>Analyze linear, quadratic and exponential functions using different representations.</b>	
	Graph functions expressed symbolically and identify and interpret key features	

### Interpreting Functions

	of the graph.	
	Translate between different but equivalent forms of a function to reveal and explain properties of the function and interpret these in terms of a context.	
	Compare the properties of two functions given different representations.	

## Building Functions

BF	Algebra 1	Algebra 2
A	<b>Build new functions from existing functions (limited to linear, quadratic and exponential).</b>	<b>Create new functions from existing functions.</b>
	Analyze the effect of translations and scale changes on functions.	Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary).
		Derive inverses of functions, and compose the inverse with the original function to show that the functions are inverses.
		Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.

## Modeling

FM	Algebra 1	Algebra 2
A		<b>Use functions to model real-world problems.</b>
		Create functions and use them to solve applications of quadratic and exponential function model problems.

## Linear, Quadratic and Exponential Models

LQE	Algebra 1	Algebra 2
<b>A</b>	<b>Construct and compare linear, quadratic and exponential models and solve problems.</b>	
	Distinguish between situations that can be modeled with linear or exponential functions. a. Determine that linear functions change by equal differences over equal intervals. b. Recognize exponential situations in which a quantity grows or decays by a constant percent rate per unit interval.	
	Describe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically.	
	Construct linear, quadratic and exponential equations given graphs, verbal descriptions or tables.	
LQE	Algebra 1	Algebra 2
<b>B</b>	<b>Use arithmetic and geometric sequences.</b>	
	Write arithmetic and geometric sequences in recursive and explicit forms, and use them to model situations and translate between the two forms.	
	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the set of integers.	
	Find the terms of sequences given an explicit or recursive formula.	

## Data and Statistical Analysis

DS	Algebra 1	Algebra 2
<b>A</b>	<b>Summarize, represent and interpret data.</b>	<b>Make inferences and justify conclusions.</b>
	Analyze and interpret graphical displays of data.	Analyze how random sampling could be used to make inferences about population parameters.
	Use statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets.	Determine whether a specified model is consistent with a given data set.
	Interpret differences in shape, center and spreads in the context of the data sets, accounting for possible effects of outliers.	Describe and explain the purposes, relationship to randomization and differences among sample surveys, experiments and observational studies.
	Summarize data in two-way frequency tables. a. Interpret relative frequencies in the context of the data. b. Recognize possible associations and trends in the data.	Use data from a sample to estimate characteristics of the population and recognize the meaning of the margin of error in these estimates.
	Construct a scatter plot of bivariate quantitative data describing how the variables are related; determine and use a function that models the relationship. a. Construct a linear function to model bivariate data represented on a scatter plot that minimizes residuals. b. Construct an exponential function to model bivariate data represented on a scatter plot that minimizes residuals.	Describe and explain how the relative sizes of a sample and the population affect the margin of error of predictions.
	Interpret the slope (rate of change) and the y-intercept (constant term) of a linear model in the context of the data.	Analyze decisions and strategies using probability concepts.
	Determine and interpret the correlation coefficient for a linear association.	Evaluate reports based on data.
	Distinguish between correlation and causation.	

**Data and Statistical Analysis**

DS	Algebra 1	Algebra 2
B		<b>Fit a data set to a normal distribution.</b>
		Know and use the characteristics of normally distributed data sets; predict what percentage of the data will be above or below a given value that is a multiple of standard deviations above or below the mean.
		Fit a data set to a distribution using its mean and standard deviation to determine whether the data is approximately normally distributed.

## Congruence

CO	Geometry
A	Experiment with transformations in the plane.
	Define angle, circle, perpendicular line, parallel line, line segment and ray based on the undefined notions of point, line, distance along a line and distance around a circular arc.
	Represent transformations in the plane, and describe them as functions that take points in the plane as inputs and give other points as outputs.
	Describe the rotational symmetry and lines of symmetry of two-dimensional figures.
	Develop definitions of rotations, reflections and translations in terms of angles, circles, perpendicular lines, parallel lines and line segments.
	Demonstrate the ability to rotate, reflect or translate a figure, and determine a possible sequence of transformations between two congruent figures.
CO	Geometry
B	Understand congruence in terms of rigid motions.
	Develop the definition of congruence in terms of rigid motions.
	Develop the criteria for triangle congruence from the definition of congruence in terms of rigid motions.
CO	Geometry
C	Prove geometric theorems.
	Prove theorems about lines and angles.
	Prove theorems about triangles.
	Prove theorems about polygons.

## Congruence

<b>CO</b>	<b>Geometry</b>
<b>D</b>	<b>Make geometric constructions.</b>
	Construct geometric figures using various tools and methods.

### Similarity, Right Triangles, and Trigonometry

<b>SRT</b>	<b>Geometry</b>
<b>A</b>	<b>Understand similarity in terms of similarity transformations.</b>
	Construct and analyze scale changes of geometric figures.
	Use the definition of similarity to decide if figures are similar and to solve problems involving similar figures.
	Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
<b>SRT</b>	<b>Geometry</b>
<b>B</b>	<b>Prove theorems involving similarity.</b>
	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
<b>SRT</b>	<b>Geometry</b>
<b>C</b>	<b>Define trigonometric ratios, and solve problems involving right triangles.</b>
	Understand that side ratios in right triangles define the trigonometric ratios for acute angles.
	Explain and use the relationship between the sine and cosine of complementary angles.
	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles.
	Derive the formula $A = \frac{1}{2} ab \sin(C)$ for the area of a triangle.

## Circles

<b>C</b>	<b>Geometry</b>
<b>A</b>	<b>Understand and apply theorems about circles.</b>
	Prove that all circles are similar using similarity transformations.
	Identify and describe relationships among inscribed angles, radii and chords of circles.
	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
<b>C</b>	<b>Geometry</b>
<b>B</b>	<b>Find arc lengths and areas of sectors of circles.</b>
	Derive the formula for the length of an arc of a circle.
	Derive the formula for the area of a sector of a circle.

### Exploring Geometric Properties with Equations

GPE	Geometry
<b>A</b>	<b>Translate between the geometric description and the equation for a conic section.</b>
	Derive the equation of a circle.
	Derive the equation of a parabola given a focus and directrix.
<b>GPE</b>	<b>Geometry</b>
<b>B</b>	<b>Use coordinates to prove geometric theorems algebraically.</b>
	Use coordinates to prove geometric theorems algebraically.
	Prove the slope criteria for parallel and perpendicular lines and use them to solve problems.
	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.

## Geometric Measurement and Dimension

<b>GMD</b>	<b>Geometry</b>
<b>A</b>	<b>Explain volume formulas and use them to solve problems.</b>
	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 volume formulas for cylinders, pyramids, cones, spheres and composite figures to solve problems.
<b>GMD</b>	<b>Geometry</b>
<b>B</b>	<b>Visualize relationships between two-dimensional and three-dimensional objects.</b>
	Identify the shapes of two-dimensional cross-sections of three-dimensional objects.
	Identify three-dimensional objects generated by transformations of two-dimensional objects.

## Modeling with Geometry

MG	Geometry
A	<b>Apply geometric concepts in modeling situations.</b>
	Use geometric shapes, their measures and their properties to describe objects.
	Apply concepts of density based on area and volume in modeling situations.
	Apply geometric methods to solve design mathematical modeling problems.

## Conditional Probability and Rules of Probability

CP	Geometry
<b>A</b>	<b>Understand independence and conditional probability and use them to interpret data.</b>
	Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections or complements of other events.
	Understand the definition of independent events and use it to solve problems.
	Calculate conditional probabilities of events.
	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.
	Recognize and explain the concepts of conditional probability and independence in a context.
	Apply and interpret the Addition Rule for calculating probabilities.
	Apply and Interpret the general Multiplication Rule in a uniform probability model.
	Use permutations and combinations to solve problems.

### **An Important Note Regarding Post-Algebra 2 Mathematical Studies\***

It is strongly recommended by the Missouri Department of Higher Education, and by this standards-writing group that for students to be college-ready, students must take a mathematics course during their senior year in high school. Many Missouri high school students will be enrolled in Algebra 2 during the sophomore or junior year of high school and accordingly, should plan to take additional coursework in mathematics each year thereafter prior to graduation. Some of the additional topics listed below are specifically recommended by the Missouri Department of Higher Education's Curriculum Alignment Initiative; others are topics that have been traditionally covered in Honors Algebra 2 classes or fourth year mathematics classes. However, it is very important to note that there are many other topics that could be included in a pre-calculus course.

- Using a unit circle, create the functions  $f(t) = \sin(t)$  and  $g(t) = \cos(t)$  to define the position of a point on the circle, at time  $t$ . Graph these functions in the Cartesian coordinate plane, and define and explore amplitude, period and midline.
- Use parameter changes to amplitude, period, midline and phase shift to model real-world contexts. Use the form  $f(t) = A \sin(B(t+h)) + k$  and explain how to determine each of the parameters  $A$ ,  $B$ ,  $h$  and  $k$ .
- Solve equations involving trigonometric functions.
- Solve problems using trigonometric identities.
- Solve problems using Law of Sines and Law of Cosines.
- Graph using polar coordinates.
- Perform partial fraction decomposition of rational functions.
- Perform operations with matrices and vectors.
- Analyze and graph rational functions.

\*Excerpted from the secondary mathematics learning standards submitted by the 1490 workgroup to the Missouri State Board of Education on October 1, 2015.