MATH III CCR MATH STANDARDS

Mathematical Habits of Mind	
1. Make sense of problems and persevere in solving them.	5. Use appropriate tools strategically.
2. Reason abstractly and quantitatively.	6. Attend to precision
3. Construct viable arguments and critique the reasoning of others.	7. Look for and make use of structure.
4. Model with mathematics.	8. Look for and express regularity in repeated reasoning.

INFERENCES AND CONCLUSIONS FROM DATA

Cluster	Summarize, represent, and interpret data on single count or measurement variable.				
M.3HS.1 (*)	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. Instructional Note: While students may have heard of the normal distribution, it is unlikely that they will have prior experience using it to make specific estimates. Build on students' understanding of data distributions to help them see how the normal distribution uses area to make estimates of frequencies (which can be expressed as probabilities). Emphasize that only some data are well described by a normal distribution.				
Cluster	**Understand and evaluate random processes underlying statistical experiments.**				
M.3HS.2 (*)	Understand that statistics allows inferences to be made about population parameters based on a random sample from that population.				
M.3HS.3 (*)	Decide if a specified model is consistent with results from a given data-generating process, for example, using simulation. (e.g., 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?) Instructional Note: Include comparing theoretical and empirical results to evaluate the effectiveness of a treatment.				
Cluster	**Make inferences and justify conclusions from sample surveys, experiments, and observational studies.**				
M.3HS.4 (*,^)	Recognize the purposes of and differences among sample surveys, experiments and observational studies; explain how randomization relates to each. Instructional Note: In earlier grades, students are introduced to different ways of collecting data and use graphical displays and summary statistics to make comparisons. These ideas are revisited with a focus on how the way in which data is collected determines the scope and nature of the conclusions that can be drawn from that data. The concept of statistical significance is developed informally through simulation as meaning a result that is unlikely to have occurred solely as a result of random selection in sampling or random assignment in an experiment.				
M.3HS.5 (*,^)	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. Instructional Note: Focus on the variability of results from experiments—that is, focus on statistics as a way of dealing with, not eliminating, inherent randomness.				
M.3HS.6 (*,^)	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. Instructional Note: Focus on the variability of results from experiments—that is, focus on statistics as a way of dealing with, not eliminating, inherent randomness.				
M.3HS.7 (*,^)	Evaluate reports based on data. Instructional Note: In earlier grades, students are introduced to different ways of collecting data and use graphical displays and summary statistics to make comparisons. These ideas are revisited with a focus on how the way in which data is collected determines the scope and nature of the conclusions that can be drawn from that data. The concept of statistical significance is developed informally through simulation as meaning a result that is unlikely to have occurred solely as a result of random selection in sampling or random assignment in an experiment.				
Cluster	**Use probability to evaluate outcomes of decisions.**				
M.3HS.8 (+, ^)	Use probabilities to make fair decisions (e.g., drawing by lots or using a random number generator).				
M.3HS.9 (+, ^)	Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, and/or pulling a hockey goalie at the end of a game). Instructional Note: Extend to more complex probability models. Include situations such as those involving quality control or diagnostic tests that yields both false positive and false negative results.				

POLYNOMIALS, RATIONAL, AND RADICAL RELATIONSHIPS

Cluster	Use complex numbers in polynomial identities and equations.				
M.3HS.10 (+)	Extend polynomial identities to the complex numbers. For example, rewrite $x^2 + 4$ as $(x + 2i)(x − 2i)$. Instructional Note: Build on work with quadratics equations in Mathematics II. Limit to polynomials with real coefficients.				
M.3HS.11 (+)	Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.				
Cluster	**Interpret the structure of expressions.**				
M.3HS.12 (*)	Interpret expressions that represent a quantity in terms of its context.				
	a. Interpret parts of an expression, such as terms, factors, and coefficients.				
	b. Interpret complicated expressions by viewing one or more of their parts as a single entity. (e.g., Interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.)				
	Instructional Note: Extend to polynomial and rational expressions.				
M.3HS.13 (*)	Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 − y^4$ as $(x^2)^2 − (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 − y^2)(x^2 + y^2)$. Instructional Note: Extend to polynomial and rational expressions.				
Cluster	**Write expressions in equivalent forms to solve problems.**				
M.3HS.14 (^)	Derive the formula for the sum of a geometric series (when the common ratio is not 1), and use the formula to solve problems. (e.g., Calculate mortgage payments.) Instructional Note: Consider extending to infinite geometric series in curricular implementations of this course description.				
Cluster	**Perform arithmetic operations on polynomials.**				
M.3HS.15 (*)	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. Instructional Note: Extend beyond the quadratic polynomials found in Mathematics II.				
Cluster	**Understand the relationship between zeros and factors of polynomials.**				
M.3HS.16 (*)	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).				
M.3HS.17 (*)	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.				
Cluster	**Use polynomial identities to solve problems.**				
M.3HS.18 (^)	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. Instructional Note: This cluster has many possibilities for optional enrichment, such as relating the example in M.A2HS.10 to the solution of the system $u^2 + v^2 = 1$, v = t(u+1), relating the Pascal triangle property of binomial coefficients to $(x + y)^{n+1} = (x + y)(x + y)^n$, deriving explicit formulas for the coefficients, or proving the binomial theorem by induction.				
M.3HS.19 (+,^)	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. Instructional Note: This cluster has many possibilities for optional enrichment, such as relating the example in M.A2HS.10 to the solution of the system $u^2 + v^2 = 1$, v = t(u+1), relating the Pascal triangle property of binomial coefficients to $(x + y)^{n+1} = (x + y)(x + y)^n$, deriving explicit formulas for the coefficients, or proving the binomial theorem by induction.				
Cluster	**Rewrite rational expressions**				
M.3HS.20 (*)	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. Instructional Note: The limitations on rational functions apply to the rational expressions.				

M.3HS.21 (+)	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. Instructional Note: Requires the general division algorithm for polynomials.				
Cluster	**Understand solving equations as a process of reasoning and explain the reasoning.**				
M.3HS.22 (*)	Solve simple rational and radical equations in one variable and give examples showing how extraneous solutions may arise. Instructional Note: Extend to simple rational and radical equations.				
Cluster	**Represent and solve equations and inequalities graphically.**				
M.3HS.23 (*,^)	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. Instructional Note: Include combinations of linear, polynomial, rational, radical, absolute value, and exponential functions.				
Cluster	**Analyze functions using different representations.**				
M.3HS.24 (*,^)	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior. Instructional Note: Relate to the relationship between zeros of quadratic functions and their factored forms.				

TRIGONOMETRY OF GENERAL TRIANGLES AND TRIGONOMETRIC FUNCTIONS

Cluster	**Apply trigonometry to general triangles.**				
M.3HS.25 (+,^)	Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.				
M.3HS.26 (+, ^)	Prove the Laws of Sines and Cosines and use them to solve problems. Instructional Note: With respect to the general case of the Laws of Sines and Cosines, the definitions of sine and cosine must be extended to obtuse angles.				
M.3HS.27 (+,^)	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 and/or resultant forces).				
Cluster	**Extend the domain of trigonometric functions using the unit circle.**				
M.3HS.28 (*)	Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.				
M.3HS.29 (*)	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.				
Cluster	**Model periodic phenomena with trigonometric functions.**				
M.3HS.30 (*)	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.				

MATHEMATICAL MODELING

Cluster	**Create equations that describe numbers or relationships.**				
M.3HS.31 (*,^)	Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. Instructional Note: Use all available types of functions to create such equations, including root functions, but constrain to simple cases.				
M.3HS.32 (*,^)	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. Instructional Note: While functions will often be linear, exponential or quadratic the types of problems should draw from more complex situations than those addressed in Mathematics I. For example, finding the equation of a line through a given point perpendicular to another line allows one to find the distance from a point to a line.				
M.3HS.33 (*,^)	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. (e.g., Represent inequalities describing nutritional and cost constraints on combinations of different foods.)				

M.3HS.34 (*,^)	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (e.g., Rearrange Ohm's law V = IR to highlight resistance R.) Instructional Note: The example given applies to earlier instances of this standard, not to the current course.				
Cluster	**Interpret functions that arise in applications in terms of a context.**				
M.3HS.35 (*)	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. Instructional Note: Emphasize the selection of a model function based on behavior of data and context.				
M.3HS.36 (*)	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. (e.g., If the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.) Instructional Note: Emphasize the selection of a model function based on behavior of data and context.				
M.3HS.37 (*)	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. Instructional Note: Emphasize the selection of a model function based on behavior of data and context.				
Cluster	**Analyze functions using different representations.**				
M.3HS.38 (*,^)	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 square root, cube root and piecewise-defined functions, including step functions and absolute value functions. b. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline and amplitude. Instructional Note: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.				
M.3HS.39 (*,^)	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. Instructional Note: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.				
M.3HS.40 (*,^)	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). (e.g., Given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.) Instructional Note: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.				
Cluster	**Build a function that models a relationship between two quantities.**				
M.3HS.41 (*)	Write a function that describes a relationship between two quantities. Combine standard function types using arithmetic operations. (e.g., Build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.) Instructional Note: Develop models for more complex or sophisticated situations than in previous courses.				
Cluster	**Build new functions from existing functions.**				
M.3HS.42 (*)	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. Instructional Note: Use transformations of functions to find more optimum models as students consider increasingly more complex situations. Note the effect of multiple transformations on a single function and the common effect of each transformation across function types. Include functions defined only by graph.				
M.3HS.43 (*)	Find inverse functions. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. (e.g., $f(x) = 2 x^3$ or f(x) = (x+1)/(x-1) for x ≠ 1.) Instructional Note: Extend this standard to simple rational, simple radical, and simple exponential functions.				
Cluster	**Construct and compare linear, quadratic, and exponential models and solve problems.**				

M.3HS.44 (*)	For exponential models, express as a logarithm the solution to a $a\,b^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology. Instructional Note: Consider extending this unit to include the relationship between properties of logarithms and properties of exponents, such as the connection between the properties of exponents and the basic logarithm property that log xy = log x + log y.				
Cluster	**Visualize relationships between two dimensional and three-dimensional objects.**				
M.3HS.45 (*,^)	Identify the shapes of two-dimensional cross-sections of three dimensional objects and identify three-dimensional objects generated by rotations of two-dimensional objects.				
Cluster	**Apply geometric concepts in modeling situations.**				
M.3HS.46 (*,^)	Use geometric shapes, their measures and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).				
M.3HS.47 (*,^)	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile or BTUs per cubic foot).				
M.3HS.48 (*,^)	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost and/or working with typographic grid systems based on ratios).				

Math III LA course does not include the (+) standards.

Math III STEM course includes standards identified by (+) sign

Math III TR course (Technical Readiness) includes standards identified by (*)

Math IV TR course (Technical Readiness) includes standards identified by (^)