

**9TH GRADE - Algebra**  
**MATH STANDARDS GUIDANCE**  
*WI Math Standards*

Domain: Seeing Structure in Expressions (A-SSE)		
CLUSTER	STANDARD	EXAMPLES
A. Interpret the structure of expressions. (M)	M.A.SSE.A.1 (F2Y) Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. For example, in the expression representing height of a projectile, $-16t^2+vt+c$ recognizing there are three terms in the expression, factors within some of the terms, and coefficients. Interpret within the context the meaning of the coefficient $-16$ as related to gravity, the factor of $v$ as the initial velocity, and the $c$ -term as initial height. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret the expression representing population growth $P(1+r)^n$ as the product of $P$ and a factor not depending on $P$ . Interpret the meaning of the $P$ -factor as initial population and the other factor as being related to growth rate and a period of time.	
	M.A.SSE.A.2 (F2Y) 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 $(x^2-y^2)(x^2+y^2)$
B. Write expressions in equivalent forms to solve problems. (M)	M.A.SSE.B.3 (F2Y) 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. b. 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, if the expression $1.15^t$ represents growth in an investment account at time $t$ (measured in years), it can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly rate of return is 1.2% based on an annual growth rate of 15%.	

Domain: Creating Equations (A-CED)		
CLUSTER	STANDARD	EXAMPLES
A. Create equations that describe numbers or relationships. (M)	M.A.CED.A.1 (F2Y) 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.	
	M.A.CED.A.2(F2Y) Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	
	M.A.CED.A.3(F2Y) Represent constraints by equations or inequalities and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.	For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
	M.A.CED.A.4(F2Y) Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	For example, rearrange the formula $C = 5/9 (F-32)$ so you solve for $F$

Domain: Reasoning with Equations and Inequalities (A-REI)		
CLUSTER	STANDARD	EXAMPLES

A. Understand solving equations as a process of reasoning and explain the reasoning	M.A.REI.A.1 (F2Y) 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.	
B. Solve equations and inequalities in one variable.	M.A.REI.B.3 (F2Y) Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. M.A.REI.B.4 (F2Y) Solve quadratic equations by inspection (e.g., for $x^2 = 49$ ), taking square roots, completing the square, the quadratic formula, factoring, and graphing 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 $b$ .	
C. Solve systems of equations.	M.A.REI.C.5 (F2Y) Justify 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. M.A.REI.C.6 (F2Y) Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. M.A.REI.C.7 (F2Y) 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 $x^2 + y^2 = 3$ . M.A.REI.C.8 (+) Represent a system of linear equations as a single matrix equation in a vector variable. M.A.REI.C.9 (+) 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).	
D. Represent and solve equations and inequalities graphically.	M.A.REI.D.10 (F2Y) 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). M.A.REI.D.11 (F2Y) 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. M.A.REI.D.12 (F2Y) 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.	e.g., using technology to graph the functions, make tables of values, or find successive approximations.

**Domain: Interpreting Functions (F-IF)**

CLUSTER	STANDARD	EXAMPLES
A. Understand the concept of a function and use function notation.	M.F.IF.A.1 (F2Y) Understand that a function from one set, discrete or continuous, (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. M.F.IF.A.2 (F2Y) Use function notation, evaluate functions, and interpret statements that use function notation in terms of a context. M.F.IF.A.3 (F2Y) Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.	For example, in an arithmetic sequence, $f(x) = f(x-1) + C$ or in a geometric sequence, $f(x) = f(x-1) \cdot C$ , where $C$ is a constant.
B. Interpret functions that arise in applications in terms of context. (M)	M.F.IF.B.4 (F2Y) 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. M.F.IF.B.5 Relate the domain of a function to its graph and find an appropriate domain (discrete or continuous) in the context of the given problem. M.F.IF.B.6 Calculate and interpret the average rate of change of a linear or nonlinear function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.	

<p>C. Analyze functions using different representations. (M)</p>	<p>M.F.IF.C.7 M.F.IF.C.7a (F2Y)            Graph functions expressed symbolically and show key features of the graph using an efficient method.            a. Graph linear and quadratic functions and show intercepts, maxima, and minima, and exponential functions, showing intercepts and end behavior.            b. 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 logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.</p>	
	<p>M.F.IF.C.8 (F2Y)            Write a function defined by an expression in equivalent forms to reveal and explain different properties of the function.            a. Use an efficient process to rewrite <math>f(x) = ax^2+bx+c</math> as <math>f(x) = a(x-h)^2 +k</math> or <math>f(x)=a(x-p)(x-q)</math> to determine the characteristics of the function and interpret these in terms of a context.            b. Use the properties of exponents to interpret expressions for exponential functions.            For example, identify percent rate of change in functions, where <math>t</math> is in years, such as <math>y = (1.01)^{12t}</math> is approximately <math>y = (1.127)^t</math> where <math>t</math> is in years, meaning it is a 1% growth rate each.</p>	
	<p>M.F.IF.C.9 (F2Y) Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).</p>	<p>For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</p>

**Domain: Building Functions (F-BF)**

CLUSTER	STANDARD	EXAMPLES
<p>A. Build a function that models a relationship between two quantities. (M)</p>	<p>M.F.BF.A1 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.            b. Combine standard function types using arithmetic operations. For example: The temperature of a cup of coffee can be modeled by combining together a function representing difference in temperature and the actual room temperature, which results in an exponential model. An average cost function can be created by dividing the cost of purchasing <math>n</math> items by the number of <math>n</math> items purchased, which results in a rational function.            c. Work with composition of functions using tables, graphs, and symbols. For example, if <math>T(y)</math> is the temperature in the atmosphere as a function of height, and <math>h(t)</math> is the height of a weather balloon as a function of time, then <math>T(h(t))</math> is the temperature at the location of the weather balloon as a function of time.</p>	
	<p>M.F.BF.B.3 Identify the effect on the graph of replacing <math>f(x)</math> by <math>f(x) + k</math>, <math>k f(x)</math>, <math>f(kx)</math>, and <math>f(x + k)</math> using transformations for specific values of <math>k</math> (both positive and negative); find the value of <math>k</math> 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.</p> <p>M.F.BF.B.4 Identify and create inverse functions, using tables, graphs, and symbolic methods to solve for the other variable. For example: Each car in a state is assigned a unique license plate number, and each license plate number is assigned to a unique car; thus there is an inverse relationship. Rearrange the formula <math>C=59(F-32)</math> so you solve for <math>F</math>. You examine a table of values and realize the inputs and outputs are invertible. Two graphs are symmetrical about the line <math>y = x</math>.</p>	

**Domain: Interpreting Categorical and Quantitative Data (S-ID)**

CLUSTER	STANDARD	EXAMPLES
<p>A. Summarize, represent, and interpret data on a single count or measurement variable. (M)</p>	<p>M.SP.ID.A.1 (F2Y) Represent data with plots on the real number line (dot plots, histograms, and box plots)</p>	
	<p>M.SP.ID.A.2 (F2Y) 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.</p>	
	<p>M.SP.ID.A.3 (F2Y) Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p>	
	<p>M.SP.ID.A.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 statistical packages calculators, spreadsheets, and tables to estimate areas under the normal curve.</p>	

B. Summarize, represent, and interpret data on two categorical and quantitative variables. (M)	M.SP.ID.B.5 (F2Y) 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 as examples of proportionality and disproportionality). Recognize possible associations and trends in the data.	
	M.SP.ID.B.6 (F2Y) 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 appropriate families of functions to model. b. 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.	
C. Interpret linear models (M)	M.SP.ID.C.7 (F2Y) Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	
	M.SP.ID.C.8 (F2Y) Use technology to create a correlation coefficient for a linear fit and then interpret its meaning for the model.	
	M.SP.ID.C.9 (F2Y) Distinguish between correlation and causation. For example, cities with a higher number of fast food restaurants tend to have more hospitals. While there is a clear correlation (likely driven by population), we cannot conclude that fast food restaurants are causing more hospitals to open. There is a relationship between height and reading level in elementary school children. This is not because changes in height cause better reading ability. Rather as children get older, they get both taller and improve in their reading skills	
<b>Domain: Linear, Quadratic, and Exponential Models (F-LE)</b>		
<b>CLUSTER</b>	<b>STANDARD</b>	<b>EXAMPLES</b>
A. Construct and compare linear, quadratic, and exponential models and solve problems. (M)	M.F.LE.A.1 (F2Y) 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. b. 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.	
	M.F.LE.A.2 (F2Y) 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). M.F.LE.A.3 (F2Y) Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. M.F.LE.A.4 For exponential models, express as a logarithm the solution to $abct^d = d$ where $a$ , $c$ , and $d$ are numbers and the base $b$ is 2, 10, or $e$ ; evaluate the logarithm using technology.	
	M.F.LE.B.5 (F2Y) Interpret the parameters in a linear or exponential function in terms of a context.	
B. Interpret expressions for functions in terms of the situation they model.		
<b>Domain: Quantities (N-Q)</b>		
<b>CLUSTER</b>	<b>STANDARD</b>	<b>EXAMPLES</b>
Reason qualitatively and quantitatively to solve problems. (M)	M.N.Q.A.1 (F2Y) 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.	
	M.N.Q.A.2 (F2Y) Define appropriate quantities for the purpose of descriptive modeling.	

A. Use appropriate units, label quantities, and use units in problem situations.	M.N.Q.A.3 (F2Y) Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	
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Domain: The Real Number System (N-RN)

CLUSTER	STANDARD	EXAMPLES
A. Extend the properties of exponents to rational exponents.	M.N.RN.A.1 (F2Y) Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents.	
	M.N.RN.A.2 (F2Y) Rewrite expressions involving radicals and rational exponents using the properties of exponents.	
B. Use properties of rational and irrational numbers.	M.N.RN.B.3 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.	

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