ɜLUE VALLEY DISTRICT CURRICULUM

MATHEMATICS | Pre-Calculus

ORGANIZING THEME/TOPIC	CONTENT	FOCUS STANDARDS & SKILLS	ACTIVITES/TASKS
Unit 1: Functions & Graphs (Chapter 1)	1.1 Modeling & Equation Solving (Tables to Graphs to Equations) 1.2 & 1.3 (together by functions) Functions & Properties *Domain & Range *Discontinuity *Inc/Dec *End Behavior *Intercepts *Boundedness *Max/Min *Asymptotes *Symmetry *Piecewise 1.4 Combination & Composition of Functions *Operations on Functions *Composition & Decomposition of Functions * Domain	nterpreting Functions F-IF **Understand the concept of a function and use function notation.** 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*). 2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. **Interpret functions that arise in applications in terms of the context.** 3. 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.*★ 4. 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 n engines in a factory, then the positive integers would be an appropriate domain for the function.*★ **Analyze functions using different representations.** 5. 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. 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. *6.* 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 squadratic function and an algebraic expression* Building Functions F-BF **Build a function that models a relationship between two quantities.** 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.	

	*Modeling within the topic 1.5 Inverse Functions (skip parametric relations for regular) *Find inverses *Notation *Domain & Range 1.6 Graphical Transformations *Translations *Reflections *Stretches & Shrinks *Inverses *Use all representations (Graph, Algebraic, Table & Word) 1.7 Modeling with Functions *Calculator & Algebraic	b. 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.* **Build new functions from existing functions.** 2. 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.* 3. 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) =2 x3 or f(x) = (x+1)/(x-1) for x ≠ 1.* b. (+) 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.	

Unit 2: Chapter 4 Trigonometric Functions	4.1 Angles & Measures *Radians *Degrees (DMS) *Angular Speed *Compass Bearings 4.2 Right Triangle Trig *Finding 6 trig functions *Special Triangles *Application Problems *Calculator Modes 4.3 Circular Functions *Vocabulary *Unit Circle *Finding trig ratios given point on terminal side. 4.4 Graphs of Sines & Cosine Functions *Transformations *Characteristics *Frequency vs Period *Application *Write equation given graph 4.5 Graphs of Tangent, Cotangent, Secant, Cosecant *Transformations *Characteristics *Frequency vs Period *Application *Solving using calculator/unit circle	Trigonometric Functions F-TF: **Extend the domain of trigonometric functions using the unit circle.** 1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. 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 counter-clockwise around the unit circle. 3. Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ & $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi-x$, $\pi+x$, and $2\pi-x$ in terms of their values for x, where x is any real number. 4. Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. **Model periodic phenomena with trigonometric functions.** 5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. Similarity, Right Triangles, and Trigonometry G-SRT : **Define trigonometric ratios and solve problems involving right triangles.** 6. 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. 7. Explain and use the relationship between the sine and cosine of complementary angles. Interpreting Functions F-IF : **Analyze functions using different representations.** 8. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ (e.) Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. Interpreting Functions F-IF 7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. Trigonometric Functions F-TF 2. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems. Trigonometric Functions F-TF **Extend the domain of trigonometric functions using the unit circle.** **Model periodic phenomena with trigonometric functions.** 5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.★ 6. (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. 7. (+) 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.★	Temperature Project Wikki Stix for graphing Sine & Cosine

	(Skip 4.6 in Regular) 4.7 Inverse Trig Functions *Defining, Graphing & Evaluating *Domain & Range 4.8 Applications of Trigonometry *Complexity of Problem/method of solving at a "regular" level.		
Unit 3: Chapter 5: Analytic Trigonometry	5.1 Fundamental Identities *Simplify & Solving Using Identities *Memorize: Reciprocal, Quotient, Pythagorean 5.2 Proving Trig Identities *Complexity of Problem/method of solving at a "regular" level. 5.3 Sum & Difference Identities *Memorize: Sum/Difference for Sine & Cosine 5.4 Multiple-Angle Identities *Memorize: Double Angle	F-TF #1 – Prove the Pythagorean identity $\sin^2 x + \cos^2 x = 1$, and use it to find sin(x), cos(x) or tan(x) given sin(x), cos(x), or tan(x) and the quadrant. F-TF #2 – (+) Prove the addition and subtraction formula for sine, cosine, and tangent and use them to solve problems. G-SRT #10 – (+) Prove the Law of Sines and Law of Cosines and use them to solve problems. G-SRT #11 -- Understand and apply the laws of Sines and Cosines to find unknown measurements in right and non-right triangles. These are the only applicable CCSS for this unit, but other learning objectives include: 5.1 – Students will be able to use the trigonometric identities to simplify trigonometric expressions and solve trigonometric equations. 5.2 – Students will be able to prove trigonometric identities. 5.3 – Students will be able to apply the identities for the cosine, sine, and tangent of a difference or sum. 5.4 – Students will be able to apply the double-angle identities, power-reducing identities, and half-angle identities.	

	5.5 &5.6 Law of Sines and Cosines *Algebraic *Application		
Unit 4: Chapter 2	2.1 Linear & Quadratic Functions *Writing Equations *Completing the Square *Vertex / Axis of Symmetry *Modeling *Average Rate of Change *Free-Fall Motion 2.2 Power Functions *Direct & Inverse Variation *(Not graphing for regular) 2.3 High Degree Polynomials *End Behavior with limit notation *Finding Zeros *Multiplicity *Sketching Curves *Modeling 2.4 & 2.5 Finding Zeros *Use calculator & synthetic division *Write the polynomial function given the roots. (no using a given complex zero to write the linear factorization) *Factor & Remainder Theorem *(No Lower/Upper Bound Test or Descartes Rule of Signs for regular)	1) 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. Alg:D2:C4:(A-APR.6) 2) 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.Alg:D4:C2:(A-REI.4a) 3) 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. Alg:D4:C2:(A-REI.4b) 4) Solve quadratic equations in one variable. b. 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 +bi for real numbers a and b. 5) Fun:D1:C2:(F-IF.4) 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 maximum and minimums; symmetries; end behavior; and periodicity.** 6) Fun:D1:C3:(F-IF.7c) Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* (c.) Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. 7) Fun:D1:C3:(F-IF.8a) 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. 8) Num:D3:C1:(N-CN.1) Know there is a complex number i such that i^2=-1 and every complex number has the form a+bi and a and b are real. 9) Num:D3:C3:(N-CN.7) Solve quadratic equations with real coefficients that have complex solutions. 10) Num:D3:C3:(N-CN.8)(+) (+) Extend polynomial identities to the complex numbers. *For example, rewrite x^2+4 as (x+2i)(x-2i).* 11) Num:D3:C3:(N-CN.9)(+) (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. Section 2.1 includes the following non CCSS; however, learning objectives include: *Average Rate of Change	BVSW has a modeling project for polynomials This could be where we implement more PBL to maintain the rigor. BVN has some application projects/work to share.

	2.6 Graphs of Rational Functions *Limits & Asymptotes *End Behavior Asymptotes *Intercepts *Domain & Find the Hole *Sketch a graph 2.7 Rational Equations *Solving *Extraneous *Modeling 2.8 Solving Inequalities *Sign Chart (factored form or something they can factor) *Solve Graphically *Modeling		
Unit 5: Chapter 3 Exponential, Logistic, & Logarithmic Functions	3.1 Exponential Functions * Growth function * Decay Function * Definition of e * Logistic Functions	Alg:D4:C4:(A-REI.11) 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. Fun:D1:C3:(F-IF.7e) Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* (e.) Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. Fun:D2:C2:(F-BF.5)(+) (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. Alg:D1:C2:(A-SSE.3)	Detective/Murder/Mystery Activity (A.Wade) BVN has project stuff for lesson 3.6

	3.2 Exponential & Logistic Modeling *Writing Equations (exponential, logistic) 3.3 Logarithmic Functions *Converting Log/Exp *Basic Properties of Logarithms 3.4 Properties of Logarithms *Product, Quotient & Power Rule, Change of Base 3.5 Solving Exponential Equations *Basic Solving (including use of properties) *Newton's Law *Order of Magnitude 3.6 Mathematics of Finance	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.* a. Factor 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:* *1.15^t can be rewritten as (1.15^(1/12))^(12t) approx. 1.012^(12t) to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* Alg:D3:C1:(A-CED.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 and exponential functions.* Fun:D1:C3:(F-IF.7e) Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* (e.) Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. Fun:D1:C3:(F-IF.8b) Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02)^t, y=(0.97)^t, y=(1.01)^(12t), y=(1.2)^(t/10), and classify them as representing exponential growth or decay. Fun:D3:C1:(F-LE.4) For exponential models, express as a logarithm the solution to ab^(ct)=d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology. Fun:D2:C1:(F-BF.1b) Write a function that describes a relationship between two quantities.* (b.) 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 Fun:D2:C2:(F-BF.5)(+) (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. Fun:D3:C1:(F-LE.1a) 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. Fun:D3:C1:(F-LE.1b) Distinguish between situations that can be modeled with linear functions and with exponential functions. (b.) Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. Fun:D3:C1:(F-LE.1c) Distinguish between situations that can be modeled with linear functions and with exponential functions. (c.) Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. Fun:D3:C1:(F-LE.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). Fun:D3:C1:(F-LE.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 Fun:D3:C1:(F-LE.4) For exponential models, express as a logarithm the solution to ab^(ct)=d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology. Fun:D3:C2:(F-LE.5) Interpret the parameters in a linear, quadratic, or exponential function in terms of a context Num:D1:C1:(N-RN.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 5 1/3 to be the cube root of 5 because we want (5 1/3) 3 = 5 (1/3)3 to hold, so (5 1/3) 3 must equal 5.* Num:D1:C1:(N-RN.2) Rewrite expressions involving radicals and rational exponents using the properties of exponents.	
Unit 6:	9.2 Binomial Theorem 9.3 Sequences	9.2 – Students will be able to find expand a power of a binomial using the binomial theorem or Pascal's triangle. 9.2 – Students will be able to find the coefficient of a given term of a binomial expansion. F-IF #3 – Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. F-BF #2 – Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	

Misc Topics (Time allowing & teacher discretion)	9.4 Series 6.1 Vectors 6.3 Parametric	F-LQE #2 – Construct arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs A-SSE #4 – 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	