High School - Algebra 2

North Boone CUSD 200

UNITS (8/8 SELECTED)	SUGGESTED DURATION
Unit 1: Functions	*25 lessons*
Unit 2: Quadratic Functions, Equations, & Relations	*20 lessons*
Unit 3: Polynomial Functions, Expressions, & Equations	*24 lessons*
Unit 4: Rational Functions, Expressions, & Equations	*24 lessons*
Unit 5: Radical Functions, Expressions, & Equations	*24 lessons*
Unit 6: Exponential & Logarithmic Functions & Equations	*24 lessons*
Unit 7: Trigonometric Functions	*10 lessons*
Unit 8: Probability & Statistics	*9 lessons*

Unit 1: Functions

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STANDARDS

IF.B.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

IF.B.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.

IF.C.7b: Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

CED.A.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.

BF.B.3: 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.

BF.B.4: Find inverse functions.

PRIORITY STANDARDS

CED.A.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.
IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
IF.B.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.
BF.B.3	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.

Unit 1: Functions

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DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Most relations that describe real-world situations are functions. The quantities or entities that comprise the relationships are known as variables; and, one of these entities (the dependent variable) depends on the other (the independent variable). Functions may be one-to-one or many-to-one, but, by definition, cannot be one-to many. Functions may be represented with an equation or formula, a graph, or a table. Understanding how functions behave and developing fluency in working with functions and function notation are useful in solving a variety of real-world problems. Understanding absolute value functions is useful for solving real-world comparison and distance problems.	How can you analyze functions to solve real-world problems? How can you use absolute value functions to solve real-world problems?

Students will know (Knowledge):	Students will be able to do (Skills):
• Key concepts and vocabulary associated with functions, including: coefficient, domain, function, interval, range, transformation, even function, inverse function, odd function, parameter, absolute value, absolute value equation, range, symmetry, vertex • Key attributes of a function, and how are they related to the function's graph • Ways you can transform the graph of a function • What an inverse function is and how to verify that it is an inverse function • Two ways to solve an absolute value inequality	• Correctly use key concepts and vocabulary associated with functions in discussion and explanations of problem solving • Determine the domain, range, and end behavior of a function • Identify the features of the graph of an absolute value function • Solve an absolute value equation

Unit 2: Quadratic Functions, Equations, & Relations

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STANDARDS

CN.A.1: Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real.

CN.A.2: Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

CN.C.7: Solve quadratic equations with real coefficients that have complex solutions.

REI.C.6: Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

REI.C.7: Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.

PRIORITY STANDARDS

Unit 2: Quadratic Functions, Equations, & Relations

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DESIRED RESULTS

Enduring Understandings	Essential Question(s)
The ability to solve problems is the heart of mathematics. Quadratic functions can help solve real-world problems in areas like business, science, and structural design. Real world situations can be represented symbolically and graphically. Systems or equations and inequalities are useful in solving real world problems such as maximizing profits in business. Algebraic expressions and equations generalize relationships from specific cases. A problem solver understands what has been done, knows why the process was appropriate, and can support it with reasons and evidence. There can be different strategies to solve a problem, but some are more effective and efficient than others are.	How can you use quadratic equations to solve real-world problems? How can you use systems of equations to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key vocabulary associated with quadratic functions, equations, and relations, including: complex number, imaginary number, imaginary unit, pure imaginary number, linear equation in three variables, matrix, ordered triple • How imaginary numbers are useful in solving quadratic equations	• Correctly use key vocabulary associated with quadratic functions, equations, and relations in discussions and explanations of problem solving • Add, subtract, and multiply complex numbers • Find the complex solutions of any quadratic equation • Solve a system composed of a linear equation in two variables and a quadratic equation in two variables

Students will know (Knowledge):	Students will be able to (Skills):
	• Find the solution(s) of a system of three linear equations in three variables • Use quadratic equations and systems of equations to solve real-world and mathematical problems

Unit 3: Polynomial Functions, Expressions, & Equations

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STANDARDS

APR.A.1: Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

APR.B.2: 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).

APR.C.5: (+) 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.

IF.C.7c: Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

BF.B.3: 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.

SSE.A.2: Use the structure of an expression to identify ways to rewrite it.

PRIORITY STANDARDS

SSE.A.2	Use the structure of an expression to identify ways to rewrite it.
IF.C.7c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
BF.B.3	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.

Unit 3: Polynomial Functions, Expressions, & Equations

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DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Polynomial functions can be used to analyze and predict real world phenomena such as weather patterns or financial trends. Polynomials and polynomial equations are used to model such things as 3-D surface area and volume for packaging, roller coasters, or firework displays. Polynomial functions have graphs that are smooth, continuous curves that never “levels off” or approach an asymptote. Polynomials are represented algebraically by expressions involving a sum of whole-number powers of one or more variables that are multiplied by coefficients. The Fundamental Theorem of Algebra ties everything together. It states that every polynomial function of degree n ≥ 1 has n zeros (counting multiplicities) in the field of complex numbers. Note that this theorem applies even in the case where the polynomial function has complex coefficients.	How can polynomial functions help to solve real-world problems? How can you use polynomials to solve real-world problems? How can you use polynomial equations to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key vocabulary associated with polynomial functions, expressions, and equations including: cubic function, polynomial function, binomial, monomial, polynomial, synthetic division, trinomial, root, multiplicity • How the graphs of $f(x) = a(x – h)^3 + k$ and $f(x) = [1/b (x – h))]^3 + k$ are related to the graph of $f(x) = x^3$ • The type of expression that results when two polynomials are added or subtracted • The type of expression that results when two polynomials are multiplied	• Correctly use key vocabulary associated with polynomial functions, expressions, and equations in discussions and explanations of problem solving • Sketch the graph of a polynomial function in intercept form • Add or subtract two polynomials • Multiply polynomials • Ways to factor a polynomial • Ways to divide polynomials

Unit 3: Polynomial Functions, Expressions, & Equations

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Students will know (Knowledge):	Students will be able to (Skills):
• How the Binomial Theorem is useful • How factoring polynomials is useful • What the Fundamental Theorem of Algebra and its corollary tell say about the roots of the polynomial equation p(x) = 0 where p(x) has degree n	• Given the quotient of two polynomials, determine if the divisor is a factor of the dividend • Find the rational roots of a polynomial equation

Unit 4: Rational Functions, Expressions, & Equations

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STANDARDS

IF.C.7d: (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

APR.D.7: (+) 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.

REI.A.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

PRIORITY STANDARDS

Unit 4: Rational Functions, Expressions, & Equations

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DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Many real-world situations that involve dividing one quantity by another (such as rates of speed or any per-capita measure) can be represented by rational functions. Rational expressions and equations can then be used to model these situations. A rational function has the form $f(x) = \frac{p(x)}{q(x)}$ where p(x) and q(x) are polynomials. A rational expression is a quotient of two polynomials. The arithmetic of rational expressions is governed by the same rules as the arithmetic of rational numbers. The simplest rational functions are given by inverse variations whose graphs are hyperbolas with the x- and y-axes as asymptotes.	How can you use rational functions to solve real-world problems? How can you use rational expressions and equations to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with rational functions, expressions, and equations, including: asymptote, parent function, rational function, closure, extraneous solution, rational expression, reciprocal • How the graphs $a\left(\frac{1}{x-h}\right)+k$ and $f(x)=\frac{1}{\frac{1}{b}(x-h)}+k$ are related to the graph of $f(x)=\frac{1}{x}$	• Correctly use key concepts and vocabulary associated with rational functions, expressions, and equations in discussions and explanations of problem solving • Identify the features of the graph of a rational function needed in order to sketch the graph • Add and subtract rational expressions • Multiply and divide rational expressions • Solve rational equations

Students will know (Knowledge):	Students will be able to (Skills):
• The features of the graph of a rational functions that should be identified in order to sketch the graph • The methods available for solving rational equations	

Unit 5: Radical Functions, Expressions, & Equations

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STANDARDS

RN.A.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.

RN.A.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents.

IF.C.7b: Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

BF.B.4a: 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.

REI.A.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

PRIORITY STANDARDS

Unit 5: Radical Functions, Expressions, & Equations

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DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Radical functions can often be used to describe relationships found in the natural world such as the relationship between the age and weight of animals. The inverse relation of a function may or may not itself be a function. A function is one-to-one if and only if its inverse relation is a function. Given a relation defined by a set of ordered pairs (x, y), the inverse relation is the set of ordered pairs (y , x). Thus, the graph of an inverse relation is the reflection of the graph of the original relation across the line y = x. Solving radical equations allows us to evaluate claims or make predictions in situations that involve radical relationships such as the stopping distance of a car. Rational exponents are defined to be consistent with definitions and properties for integer exponents. Exponents can be extended to irrational numbers.	How can you use radical functions to solve real-world problems? How can you use radical expressions and equations to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with radical functions, expressions, and equations, including: cube root function, index, inverse function, square root function, extraneous solution, radical expression, rational exponent • The functions that are the inverses of quadratic and cubic functions	• Correctly use key concepts and vocabulary associated with radical functions, expressions, and equations in discussions and explanations of problem solving • Find the functions that are the inverses of quadratic and cubic functions

Unit 5: Radical Functions, Expressions, & Equations

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Students will know (Knowledge):	Students will be able to (Skills):
• How rational exponents are related to radicals and roots	• Use transformations of a parent square root function to graph functions of the form $g(x)=a\sqrt{(x-h)}+k$ or $g(x)=\sqrt{\frac{1}{b}(x-h)}+k$ • Use transformations of parent cube root functions to graph functions of the form $f(x)=a\sqrt[3]{(x-h)}+k$ or $g(x)=\sqrt[3]{\frac{1}{b}(x-h)}+k$ • How to simplify expressions containing rational exponents or radicals involving nth roots • Solve equations involving square roots and cube roots

Unit 6: Exponential & Logarithmic Functions & Equations

High School - Algebra 2 - *Last Updated on March 21, 2019*

STANDARDS

BF.B.3: 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.

BF.B.5: (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

LE.A.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.

PRIORITY STANDARDS

BF.B.3	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.
LE.A.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.

Unit 6: Exponential & Logarithmic Functions & Equations

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DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Exponential functions can be used to compute such things as the age of a relic based on the half-lives of a carbon isotope and to predict such things as the size of a populations at some future time. An exponential function is a function of the form $f(x) = ab^x$, where $a \neq 0$, $b > 0$, and $b \neq 1$. Logarithmic functions are often found in relationships involving sensory data such as the relationship between the number of photons hitting a retina and the perceived brightness. A logarithm is an exponent. For $b^x = a$ for $b > 0$ and $b \neq 1$, the equivalent equation is $\log_b a = x$. Because logarithms are exponents, any property of logarithms may be proved by citing the corresponding property of exponents. Logarithms allow exponential operations to be 'undone'. When given the output of an exponential function, the input can be found using properties of logarithms.	How can you use exponential functions to solve real-world problems? How can you use logarithmic functions to solve real-world problems?

Students will know (Knowledge):	Students will be able to do (Skills):
• Key concepts and vocabulary associated with exponential and logarithmic functions and equations, such as: exponential decay, exponential functions, exponential growth, asymptote, common logarithm, logarithm, logarithmic function, natural logarithm, exponential equation	• Correctly use key concepts and vocabulary associated with exponential and logarithmic functions and equations in discussions and explanations of problem solving • Solve an equation of the form $ab^x = c$, where a and c are nonzero real numbers and b is greater than 0 and not equal to 1

Students will know (Knowledge):	Students will be able to do (Skills):
• How the graph of $g(x) = ab^{x-h} + k$ where $b > 1$ is related to the graph of $f(x) = b^x$ • How the graph of $g(x) = ab^{x-h} + k$ where $0 < b < 1$ related to the graph of $f(x) = b^x$ • The inverse of the exponential function $f(x) = b^x$ where $b > 0$ and $b \neq 1$, and the value of $f^{-1}(b^m)$ for any real number m • How the graph of $g(x) = a \log_b(x - h) + k$ where $b > 0$ and $b \neq 1$ is related to the graph of $f(x) = \log_b x$ • The properties of logarithms	• Ways to solve an equation of the form $ab^x = c$, where a and c are nonzero real numbers and b is greater than 0 and not equal to 1?

Unit 7: Trigonometric Functions

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STANDARDS

TF.A.1: Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

TF.A.2: Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

TF.C.8: Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.

PRIORITY STANDARDS

DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Unit circle definitions of trigonometric functions can be used to represent rotating figures on screens for such things as visual arts programming in video games and computer-generated drawings. A radian is a unit of angle measure that may be defined as follows: In a unit circle, a central angle that measures 1 radian intercepts an arc with a length of 1 unit. The circumference of the unit circle is 2π . Thus, 2π radians correspond to 360°.	How can the unit-circle definition of trigonometric functions help to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with trigonometric functions, including: angle of rotation, coterminal angles, radian measure, reference angle, amplitued, cosecant, cotangent, frequency, midline, period, periodic function, secant function • The relationship between the unit circle and radian measure • How the unit circle allows the trigonometric functions to be defined for all real numbers instead of just for acute angles	• Correctly use key concepts and vocabulary associated with trigonometric functions in discussions and explanations of problem solving • Use a given value of one of the trigonometric functions to calculate the values of the other functions

Unit 8: Probability & Statistics

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STANDARDS

CP.A.1: Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").

CP.A.2: Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

CP.A.4: Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.

CP.B.8: (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.

CP.B.9: (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

MD.B.6: (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

IC.B.3: Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

IC.B.4: 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.

IC.B.5: Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

PRIORITY STANDARDS

Unit 8: Probability & Statistics

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DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Probability is useful for analyzing the likelihood that a particular event will happen (such as, that a die will show 6 on a throw or that it will rain). A probability is a number between 0 and 1 inclusive that measures the likelihood of an event. A combination is a grouping of items in which the order does not matter. In a permutation, the order of the items does matter. Conditional probability and independence of events are useful for analyzing how the occurrence of one event affects the probability of another. Two events are independent if the occurrence of one does not affect the probability of the other. Understanding probability can be helpful in solving real-world problems, such as those concerning long-term risk. Making inferences from data can be helpful in solving real-world problems such as whether the positive effects of a new medicine outweigh its negative side effects.	How can you use probability to solve real-world problems? How can you use conditional probability and independence of events to solve real-world problems? How can you use probability to solve real-world problems? How can making inference from data help to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with probability and statistics, such as: set, element, empty set, universal set, subset, intersection, union, complement, theoretical probability, permutation, Fundamental Counting Principle, factorial,	• Correctly use key concepts and vocabulary associated with probability and statistics in discussions and explanations of problem solving • Use sets and their relationships to calculate probabilities

Students will know (Knowledge):	Students will be able to (Skills):
combination, conditional probability, independent events, dependent events, confidence interval, margin of error, survey, observational study, experiment, randomized comparative experiment, null hypothesis, statistically significant, resampling, permutation test • When the order of the objects maters in listing or choosing a set of objects • How probabilities are affected when events are mutually exclusive or overlapping • What it means for two events to be independent • The kinds of statistical research there are and which one can establish cause-effect relationships between variables	• Determine the number of ways a certain number of objects can be chosen from a larger group of objects • Calculate a conditional probability • Find the probability of dependent events • Use probability to help make fair decisions • Use conditional probability to help make real-world decisions • Calculate a confidence interval and a margin of error for a population proportion or population mean • Determine when an observed difference between the control group and treatment group in an experiment is likely to be caused by the treatment