Mathematics- Algebra 1

Units of Instruction

2021-2022

Revised Curriculum

Mathematics- Algebra 1

UNIT 1: Solve Linear Equations & Inequalities in One Variable	UNIT 2: Graphing Linear Equations & Inequalities in Two Variables	UNIT 3: Solving Systems of Linear Equations & Inequalities	UNIT 4: Exponential Relationships	UNIT 5: Quadratic Relationships	UNIT 6: Statistical Questions
KY.HS.A.18 KY.HS.A.1 KY.HS.A.12 KY.HS.A.15 KY.HS.A.16 KY.HS.N.4 KY.HS.N.5 KY.HS.N.6 **7 weeks** **3.5 weeks**	**KY.HS.A.25** **KY.HS.F.3** **KY.HS.F.4** **KY.HS.SP.7** KY.HS.A.13 KY.HS.A.23 KY.HS.F.2 KY.HS.F.6 KY.HS.F.7 KY.HS.F.11 KY.HS.F.14 KY.HS.F.1 KY.HS.N.4 KY.HS.N.5 KY.HS.N.6 **7 weeks** **3.5 weeks**	**KY.HS.A.20** **KY.HS.A.25** KY.HS.A.2 KY.HS.A.14 KY.HS.A.24 KY.HS.N.4 KY.HS.N.5 KY.HS.N.6 KY.HS.F.1 **6 weeks** **3 weeks**	**KY.HS.F.12** KY.HS.N.1 KY.HS.N.2 KY.HS.A.3c KY.HS.F.2 KY.HS.F.5b KY.HS.F.7 KY.HS.F.11 KY.HS.F.14 KY.HS.N.4 KY.HS.N.5 KY.HS.N.6 KY.HS.F.1 **4 weeks** **2 weeks**	**KY.HS.A.5** **KY.HS.A.19a** **KY.HS.F.4a** KY.HS.A.1 KY.HS.A.3 KY.HS.A.7 KY.HS.F.5a KY.HS.F.13 KY.HS.N.4 KY.HS.N.5 KY.HS.N.6 KY.HS.F.1 **9 weeks** **4.5 weeks**	**KY.HS.SP.6a** KY.HS.SP.6b KY.HS.SP.8 KY.HS.N.4 KY.HS.N.5 KY.HS.N.6 KY.HS.F.1 **2 weeks** **1 week**

Mathematics- Algebra 1

BOONE COUNTY SCHOOLS

ACHIEVING EXCELLENCE TOGETHER

Unit 1: Solving Linear Equations and Inequalities in One Variable

Mathematics - Algebra 1

Unit 1: Solving Linear Equations and Inequalities in One Variable

Duration: 7 Weeks/ 3.5 Weeks

Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Priority Standards	
Standards	**Clarifications**
Cluster: Solve equations and inequalities in one variable. **KY.HS.A.18 Solve linear equations and inequalities in one variable, including literal equations with coefficients represented by letters.** MP.2, MP.7	Students use all properties of both equations and inequalities to solve for one variable.
Supporting Standards	
Standards	**Clarifications**
Cluster: Interpret the structure of expressions. **KY.HS.A.1 Interpret expressions that represent a**	Students encounter simpler scenarios where they interpret $r \cdot t$ as the product of a given rate and time or interpret the perimeter expression (2l+2w) contextually

quantity in terms of its context. ★ **a. Interpret parts of an expression, such as terms, factors and coefficients.** **b. Interpret complicated expressions, given a context, by viewing one or more of their parts as a single entity.** MP.2, MP.6	as the sum of twice the length and twice the width of a rectangle. Students encounter more complicated scenarios where they interpret P(1+r)n contextually as the product of a principal investment, P and (1+r)n which represents an investment rate, compounding factor and time.
Cluster: Create equations that describe numbers or relationships. **KY.HS.A.12 Create equations and inequalities in one variable and use them to solve problems.** MP.1, MP.4	Students use the addition, subtraction, multiplication and division properties for both equations and inequalities to solve problems. These equations may arise from linear and quadratic functions and simple rational and exponential functions
Cluster: Create equations that describe numbers or relationships. **KY.HS.A.15 Rearrange formulas to solve a literal equation, highlighting a quantity of interest, using the same reasoning as in solving equations.** MP.2, MP.7	Students encounter scenarios where they rewrite formulas/equations for variables different from the commonly used formulas. An example may include, but not being limited to, students rearranging Ohm's law (V = IR) to highlight resistance R, rather than the variable for voltage V.
Cluster: Understand solving equations as a process of reasoning and explain the reasoning. **KY.HS.A.16 Understand each step in solving a**	Students reason with and about collections of equivalent expressions to see how all the expressions in the collection are linked together through the properties of operations. They discern patterns in sequences of solving equation problems that reveal

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. MP.1, MP.3	structures in the equations themselves: 2x+ 4 = 10, 2(x− 3) + 4 = 10, 2(3x − 4) + 4 = 10, etc. After solving many linear equations in one variable, students look for general methods for solving a generic linear equation in one variable by replacing the numbers with letters: ax + b= cx + d. They have opportunities to pay close attention to calculations involving the properties of operations, properties of equality and properties of inequality as they find equivalent expressions and solve equations, noting common ways to solve different types of equations.
KY.HS.N.4 KY.HS.N.5 KY.HS.N.6	
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.4 Use units in context as a way to understand problems and to guide the solution of multi-step problems; ★** **a. Choose and interpret units consistently in formulas;** **b. Choose and interpret the scale and the origin in graphs and data displays.** MP.5, MP.6	Graphical representations and data displays include but are not limited to: line graphs, circle graphs, histograms, multi-line graphs, scatterplots and multi-bar graphs.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.5 Define appropriate units in context for the purpose of descriptive modeling. ★** MP.1, MP.6	In real-world situations, answers are usually represented by numbers with units. Units involve measurement, which requires precision and accuracy. For example, students should recognize that units measuring speed would not be appropriate for situations involving volume. Additionally students should understand when one dimensional, two

	dimensional, or three dimensional units are most applicable.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.6 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. ★** MP.2, MP.6	While KY.HS.N.6 does not require a formal discussion or use of significant digits in the scientific sense, students understand a level of precision. For example, when using the Pythagorean Theorem with measurements given in tenths of an inch, it is appropriate for students to express answers to the nearest tenth, but not to the nearest hundredth because that level of precision was not used in the original measures.

Mathematics - Algebra 1

Unit 2: Graphing Linear Equations & Inequalities in Two Variables

Mathematics- Algebra 1
Unit 2: Graphing Linear Equations and Inequalities in Two Variables

Duration: 7 Weeks/ 3.5 Weeks

Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Priority Standards	
Standards	**Clarifications**
Cluster: Represent and solve equations and inequalities graphically. **KY.HS.A.25 Graph linear inequalities in two variables.** **a. Graph the solutions to a linear inequality as a half-plane (excluding the boundary in the case of a strict inequality).** **b. Graph the solution set to a system of linear inequalities as the intersection of the corresponding half-planes.** MP.5, MP.6	Students recall skills regarding graphing the solutions of a linear inequality in the coordinate plane in order to graph the solution set for a system of linear inequalities. Students utilize these skills in other standards via linear programming.

Cluster: Interpret functions that arise in applications in terms of the context. **Standards** **KY.HS.F.3 Understand average rate of change of a function over an interval.** **a. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.** **b. Estimate the rate of change from a graph. ★** MP.2, MP.4	The rate of change over an interval is equivalent to the slope between the endpoints of the interval. For linear functions, the rate of change is constant, over all intervals. However, for nonlinear functions, the average rate of change may vary depending on the interval.
Cluster: Analyze functions using different representations. **KY.HS.F.4 Graph functions expressed symbolically and show key features of the graph, with and without using technology (computer, graphing calculator). ★** **a. Graph linear and quadratic functions and show intercepts, maxima and minima.** **b. Graph square root, cube root and absolute value functions.** **c. Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior.** **d. Graph exponential and logarithmic functions, showing intercepts and end behavior.** MP.4, MP.5	Within a family, the functions often have commonalities in the shapes of their graphs and in the kinds of features important for identifying and describing functions. This standard indicates the function families in students' repertoires, detailing which features are required for several key families. Students demonstrate fluency with linear, quadratic and exponential functions, including the ability to graph without using technology. In other function families, students graph simple cases without technology and more complex ones with technology.
Cluster: Interpret linear models.	Students demonstrate interpreting slope in the context

KY.HS.SP.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. MP.1, MP.2	of a given situation when examining two variable statistics as being "for each additional known unit increase in an explanatory variable, we expect or predict a known unit increase (or decrease) in the response variable." Students demonstrate interpreting intercept in the context of a given situation when examining two variable statistics as being "the predicted known unit of a response variable when the explanatory variable is zero known units."
Supporting Standards	
Standards	**Clarifications**
Cluster: Create equations that describe numbers or relationships. **KY.HS.A.13 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.** MP.2, MP.5	Students solve systems of equations with two or more variables to solve problems in the real world setting.
Cluster: Represent and solve equations and inequalities graphically. **KY.HS.A.23 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.** MP.1, MP.4	Students make connections between algebra and geometry within this standard. Students acquire the basic understanding that the coordinates of the points of intersection of the graphs are the pairs of values of the variables that solve the system.

Cluster: Understand the concept of a function and use function notation. **KY.HS.F.2 Recognize that arithmetic and geometric sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.** MP.7, MP.8	Sequences are functions with a domain consisting of whole numbers.
Cluster: Build a function that models a relationship between two quantities. **KY.HS.F.6 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.** MP.4, MP.7	b. Use real-world examples when appropriate. .
Cluster: Build a function that models a relationship between two quantities. **KY.HS.F.7 Use arithmetic and geometric sequences to model situations and scenarios.** **a. Use formulas (explicit and recursive) to generate terms for arithmetic and geometric sequences.** **b. Write formulas to model arithmetic and geometric sequences and apply those formulas in realistic situations. ★** MP.4, MP.8	Examples include, but are not limited to: • calculating mortgages • drug dosages • simple interest
Cluster: Construct and compare linear, quadratic and exponential models and solve problems.	Linear functions have the same average rate of change over same-sized intervals; the same value is added to

KY.HS.F.11 Distinguish between situations that can be modeled with linear functions and with exponential functions. **a. Recognize and justify 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.** MP.3, MP.8	the output over each interval. In contrast, the outputs of exponential functions grow or decay by the same percent over same-sized intervals; the same value is multiplied by the output over each interval.
Cluster: Interpret expressions for functions in terms of the situation they model. **KY.HS.F.14 Interpret the parameters in a linear or exponential function in terms of a context.** MP.1, MP.2	More than just substituting values into a given formula, this requires students to understand how changing specific parameters will change the function output. An example of this with an exponential function (f(x) = a • bx) might be changing the "b" from a number greater than 1 to a number between 0 and 1. Students should recognize this creates a decay problem instead of a growth problem. Similarly, changing the "a" parameter creates corresponding changes to the graph and has different implications within the realistic context.
Cluster: Understand the concept of a function and use function notation. **KY.HS.F.1 Understand properties and key features of functions and the different ways functions can be represented.** **a. Understand that a function from one set (called the**	a. When describing relationships between quantities, the defining characteristic of a function is the input value determines the output value or, equivalently, the output value depends upon the input value. In some situations where two quantities are related, each can be viewed as a function of the other. c. A function is often described and understood in

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. **b. Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.** **c. 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.** **d. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.** **e. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).** MP.2, MP.4, MP.7	terms of the output behavior, or over what input values is it increasing, decreasing, or constant. Important questions include, "For what input values is the output value positive, negative, or 0? What happens to the output when the input value gets very large in magnitude?" Graphs become useful representations for understanding and comparing functions because these behaviors are often easy to see in the graphs of functions. Key features include, but are not limited to: intercepts; intervals where the function is increasing, decreasing, or remaining constant; relative maxima and minima; symmetries; end behavior; periodicity. e. Students compare characteristics from various representations for one type of family of function at a time. For quadratics, students might determine which function has the larger maximum when given two different representations of quadratic functions.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.4 Use units in context as a way to understand problems and to guide the solution of multi-step problems; ★** **a. Choose and interpret units consistently in formulas;** **b. Choose and interpret the scale and the origin in graphs and data displays.** MP.5, MP.6	Graphical representations and data displays include but are not limited to: line graphs, circle graphs, histograms, multi-line graphs, scatterplots and multi-bar graphs.

Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.5 Define appropriate units in context for the purpose of descriptive modeling. ★** MP.1, MP.6	In real-world situations, answers are usually represented by numbers with units. Units involve measurement, which requires precision and accuracy. For example, students should recognize that units measuring speed would not be appropriate for situations involving volume. Additionally students should understand when one dimensional, two dimensional, or three dimensional units are most applicable.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.6 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. ★** MP.2, MP.6	While KY.HS.N.6 does not require a formal discussion or use of significant digits in the scientific sense, students understand a level of precision. For example, when using the Pythagorean Theorem with measurements given in tenths of an inch, it is appropriate for students to express answers to the nearest tenth, but not to the nearest hundredth because that level of precision was not used in the original measures.

Mathematics- Algebra 1

Unit 3: Solving Systems of Linear Equations & Inequalities

Mathematics - Algebra 1
Unit 3: Solving Systems of Linear Equations and Inequalities

Duration: 6 Weeks/ 3 Weeks

Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Priority Standards	
Standards	**Clarifications**
Cluster: Solve systems of equations. **KY.HS.A.20 Solve systems of linear equations in two variables.** **a. Understand a system of two equations in two variables has the same solution as a new system formed by replacing one of the original equations with an equivalent equation.** **B. Solve systems Of linear equations with graphs, substitution and elimination, focusing on pairs of linear equations in two variables.** MP.3, MP.6	a. This part of the standard is not focused on the actual process of solving a system of equations, but rather the proof of the method (specifically the elimination method). b. Students utilize a variety of methods to solve system of equations including graphing the system, solving using the substitution method, solving the system with elimination both with and without involving multiplication. Students recognize the conclusion of these processes may result in obtaining one solution (expressed as an ordered pair), no solution or infinitely many solutions.
Cluster: Represent and solve equations and	Students recall skills regarding graphing the solutions of

inequalities graphically. **KY.HS.A.25 Graph linear inequalities in two variables.** **a. Graph the solutions to a linear inequality as a half-plane (excluding the boundary in the case of a strict inequality).** **b. Graph the solution set to a system of linear inequalities as the intersection of the corresponding half-planes.** MP.5, MP.6	a linear inequality in the coordinate plane in order to graph the solution set for a system of linear inequalities. Students utilize these skills in other standards via linear programming.

Supporting Standards	
Standards	**Clarifications**
Cluster: Interpret the structure of expressions. **KY.HS.A.2 Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.** MP.7, MP.8	Students see x^4 – y^4 as (x^2)^2 – (y^2)^2, thus recognizing it as a difference of squares factored as (x^2 – y^2)(x^2 + y^2). Additionally, students see there are three commonly used forms for a quadratic expression: • Standard form • Factored form • Vertex form and can identify when one form might be more useful than another.

Cluster: Create equations that describe numbers or relationships. **KY.HS.A.14 Create a system of equations or inequalities to represent constraints within a modeling context. Interpret the solution(s) to the corresponding system as viable or nonviable options within the context.** MP.4, MP.5	Students may be asked to find an optimal solution and the conditions under which the optimal solution would occur for a given real world situation.
Cluster: Represent and solve equations and inequalities graphically. **KY.HS.A.24 Justify that the solutions of the equations f(x) = g(x) are the x-coordinates of the points where the graphs of y = f(x) and y = g(x) intersect. Find the approximate solutions graphically, using technology or tables. ★** MP.3, MP.5	Students justify solutions for equations which Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential and logarithmic functions. ★
Cluster: Understand the concept of a function and use function notation. **KY.HS.F.1 Understand properties and key features of functions and the different ways functions can be represented.** **a. 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**	a. When describing relationships between quantities, the defining characteristic of a function is the input value determines the output value or, equivalently, the output value depends upon the input value. In some situations where two quantities are related, each can be viewed as a function of the other. c. A function is often described and understood in terms of the output behavior, or over what input values is it increasing, decreasing, or constant. Important questions include, “For what input values is the output value positive, negative, or 0? What happens to the

corresponding to the input x. **b. Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.** **c. 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.** **d. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.** **e. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).** MP.2, MP.4, MP.7	output when the input value gets very large in magnitude?" Graphs become useful representations for understanding and comparing functions because these behaviors are often easy to see in the graphs of functions. Key features include, but are not limited to: intercepts; intervals where the function is increasing, decreasing, or remaining constant; relative maxima and minima; symmetries; end behavior; periodicity. e. Students compare characteristics from various representations for one type of family of function at a time. For quadratics, students might determine which function has the larger maximum when given two different representations of quadratic functions.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.4 Use units in context as a way to understand problems and to guide the solution of multi-step problems; ★** **a. Choose and interpret units consistently in formulas;** **b. Choose and interpret the scale and the origin in graphs and data displays.** MP.5, MP.6	Graphical representations and data displays include but are not limited to: line graphs, circle graphs, histograms, multi-line graphs, scatterplots and multi-bar graphs.

Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.5 Define appropriate units in context for the purpose of descriptive modeling. ★** MP.1, MP.6	In real-world situations, answers are usually represented by numbers with units. Units involve measurement, which requires precision and accuracy. For example, students should recognize that units measuring speed would not be appropriate for situations involving volume. Additionally students should understand when one dimensional, two dimensional, or three dimensional units are most applicable.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.6 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. ★** MP.2, MP.6	While KY.HS.N.6 does not require a formal discussion or use of significant digits in the scientific sense, students understand a level of precision. For example, when using the Pythagorean Theorem with measurements given in tenths of an inch, it is appropriate for students to express answers to the nearest tenth, but not to the nearest hundredth because that level of precision was not used in the original measures.

Mathematics - Algebra 1

Unit 4: Exponential Relationships

Mathematics - Algebra 1

Unit 4: Exponential Relationships

Duration: 4 Weeks/ 2 Weeks

Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Priority Standards	
Standards	**Clarifications**
Cluster: Construct and compare linear, quadratic and exponential models and solve problems. **KY.HS.F.12 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).** MP.7, MP.8	Students construct functions with and without technology.
Supporting Standards	
Standards	**Clarifications**

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Cluster: Extend the properties of exponents to rational exponents.

KY.HS.N.1 Extend the properties of integer exponents to rational exponents, allowing for the expression of radicals in terms of rational exponents.

MP.2, MP.7

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Students understand that a single root can be expressed as a rational exponent with a numerator of one and a base that is equal to the root index. Students understand that powers and roots can be concisely expressed as a single rational exponent where the numerator is the power and the denominator is the root index. For example, students understand that defining 4^ 1/3 is the same as the cube root of 4 because
4^(⅓)3 = (4 ^⅓)^ 3 so4^ (⅓)3 must equal 4.

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Cluster: Extend the properties of exponents to rational exponents.

KY.HS.N.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

MP.7

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Standards KY.HS.N.2 builds on standard KY.HS.N.1 by extending student understanding to situations where the numerator is not one. For example, students understand that defining 4 ^(m/n) is the same as
n (√4)^m and n√4^ m . Include contextual examples, such as rewriting the volume of a sphere to identify the radius as a function of volume.

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Cluster: Write expressions in equivalent forms to solve problems.

KY.HS.A.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★
a. Write the standard form of a given polynomial and identify the terms, coefficients, degree, leading coefficient and constant term.
b. Factor a quadratic expression to reveal the zeros of the function it defines.

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KY.HS.A.3b Students recognize the connection between the zero product property and solving a quadratic in one variable by setting factored expressions equal to zero.
KY.HS.A.3c

<table>
<tr><th>Name</th><th>Product of Powers</th><th>Quotient of Powers</th><th>Power of a Product</th><th>Power of a Quotient</th><th>Power of a Power</th><th>Negative Exponent</th></tr>
<tr><td>Property</td><td>$a^m \cdot a^n = a^{m+n}$</td><td>$\frac{a^m}{a^n} = a^{m-n}$</td><td>$(a \cdot b)^n = a^n \cdot b^n$</td><td>$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$</td><td>$(a^m)^n = a^{mn}$</td><td>$a^{-n} = \frac{1}{a^n}$</td></tr>
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c. Use the properties of exponents to rewrite exponential expressions. MP.5, MP.7	
Cluster: Understand the concept of a function and use function notation. **KY.HS.F.2 Recognize that arithmetic and geometric sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.** MP.7, MP.8	Sequences are functions with a domain consisting of whole numbers.
Cluster: Analyze functions using different representations. **KY.HS.F.5 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 and classify the exponential function as representing growth or decay.** MP.3, MP.6	b. Students examine real-world situations with constant multiplicative change, represented as expressions, such as growth or decay.
Cluster: Build a function that models a relationship between two quantities.	Examples include, but are not limited to: • calculating mortgages • drug dosages

KY.HS.F.7 Use arithmetic and geometric sequences to model situations and scenarios. **a. Use formulas (explicit and recursive) to generate terms for arithmetic and geometric sequences.** **b. Write formulas to model arithmetic and geometric sequences and apply those formulas in realistic situations. ★** MP.4, MP.8	· simple interest
Cluster: Construct and compare linear, quadratic and exponential models and solve problems. **KY.HS.F.11 Distinguish between situations that can be modeled with linear functions and with exponential functions.** **a. Recognize and justify 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.** MP.3, MP.8	Linear functions have the same average rate of change over same-sized intervals; the same value is added to the output over each interval. In contrast, the outputs of exponential functions grow or decay by the same percent over same-sized intervals; the same value is multiplied by the output over each interval.
Cluster: Interpret expressions for functions in terms of the situation they model.	More than just substituting values into a given formula, this requires students to understand how changing

KY.HS.F.14 Interpret the parameters in a linear or exponential function in terms of a context. MP.1, MP.2	specific parameters will change the function output. An example of this with an exponential function (f(x) = a · bx) might be changing the "b" from a number greater than 1 to a number between 0 and 1. Students should recognize this creates a decay problem instead of a growth problem. Similarly, changing the "a" parameter creates corresponding changes to the graph and has different implications within the realistic context.
Cluster: Understand the concept of a function and use function notation. **KY.HS.F.1 Understand properties and key features of functions and the different ways functions can be represented.** **a. 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.** **b. Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.** **c. 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.** **d. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.** **e. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal**	a. When describing relationships between quantities, the defining characteristic of a function is the input value determines the output value or, equivalently, the output value depends upon the input value. In some situations where two quantities are related, each can be viewed as a function of the other. c. A function is often described and understood in terms of the output behavior, or over what input values is it increasing, decreasing, or constant. Important questions include, "For what input values is the output value positive, negative, or 0? What happens to the output when the input value gets very large in magnitude?" Graphs become useful representations for understanding and comparing functions because these behaviors are often easy to see in the graphs of functions. Key features include, but are not limited to: intercepts; intervals where the function is increasing, decreasing, or remaining constant; relative maxima and minima; symmetries; end behavior; periodicity. e. Students compare characteristics from various representations for one type of family of function at a time. For quadratics, students might determine which function has the larger maximum when given two different representations of quadratic functions.

descriptions). MP.2, MP.4, MP.7	
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.4 Use units in context as a way to understand problems and to guide the solution of multi-step problems; ★** **a. Choose and interpret units consistently in formulas;** **b. Choose and interpret the scale and the origin in graphs and data displays.** MP.5, MP.6	Graphical representations and data displays include but are not limited to: line graphs, circle graphs, histograms, multi-line graphs, scatterplots and multi-bar graphs.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.5 Define appropriate units in context for the purpose of descriptive modeling. ★** MP.1, MP.6	In real-world situations, answers are usually represented by numbers with units. Units involve measurement, which requires precision and accuracy. For example, students should recognize that units measuring speed would not be appropriate for situations involving volume. Additionally students should understand when one dimensional, two dimensional, or three dimensional units are most applicable.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.6 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. ★** MP.2, MP.6	While KY.HS.N.6 does not require a formal discussion or use of significant digits in the scientific sense, students understand a level of precision. For example, when using the Pythagorean Theorem with measurements given in tenths of an inch, it is appropriate for students to express answers to the nearest tenth, but not to the nearest hundredth because that level of precision was not used in the original measures.

Mathematics - Algebra 1

BOONE COUNTY SCHOOLS

ACHIEVING EXCELLENCE TOGETHER

Unit 5: Quadratic Relationships

Mathematics - Algebra 1
Unit 5: Quadratic Relationships

Duration: 9 Weeks/4.5 Weeks

Standards for Mathematical Practice	
MP.1. Make sense of problems and persevere in solving them. MP.2. Reason abstractly and quantitatively. MP.3. Construct viable arguments and critique the reasoning of others. MP.4. Model with mathematics.	MP.5. Use appropriate tools strategically. MP.6. Attend to precision. MP.7. Look for and make use of structure. MP.8. Look for and express regularity in repeated reasoning.
Priority Standards	
Standards	**Clarifications**
Cluster: Perform arithmetic operations on polynomials. **KY.HS.A.5 Add, subtract and multiply polynomials.** MP.7, MP.8	Students combine like terms and make use of the distributive property when adding, subtracting and multiplying polynomials.
Cluster: Solve equations and inequalities in one variable. **KY.HS.A.19 Solve quadratic equations in one**	Students observe that methods for solving quadratic equations are interrelated and certain situations may more appropriately call upon one method as opposed to

variable. **a. Solve quadratic equations by taking square roots, 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.** MP.1, MP.8	the other methods.
Cluster: Analyze functions using different representations. **KY.HS.F.4 Graph functions expressed symbolically and show key features of the graph, with and without using technology (computer, graphing calculator). ★** **a. Graph linear and quadratic functions and show intercepts, maxima and minima.** MP.4, MP.5	Within a family, the functions often have commonalities in the shapes of their graphs and in the kinds of features important for identifying and describing functions. This standard indicates the function families in students' repertoires, detailing which features are required for several key families. Students demonstrate fluency with linear, quadratic and exponential functions, including the ability to graph without using technology. In other function families, students graph simple cases without technology and more complex ones with technology.
Supporting Standards	
Standards	**Clarifications**
Cluster: Interpret the structure of expressions. **KY.HS.A.1 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, given a context, by viewing one or more of their parts as a single entity.**	Students encounter simpler scenarios where they interpret r · t as the product of a given rate and time or interpret the perimeter expression (2l+2w) contextually as the sum of twice the length and twice the width of a rectangle. Students encounter more complicated scenarios where they interpret P(1+r)n contextually as the product of a principal investment, P and (1+r)n which represents an investment rate, compounding factor and time.

<table>
<tr>
<td>MP.2, MP.6</td>
<td></td>
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<tr>
<td>Cluster: Write expressions in equivalent forms to solve problems.

KY.HS.A.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★
a. Write the standard form of a given polynomial and identify the terms, coefficients, degree, leading coefficient and constant term.
b. Factor a quadratic expression to reveal the zeros of the function it defines.
c. Use the properties of exponents to rewrite exponential expressions.

MP.5, MP.7</td>
<td>KY.HS.A.3b Students recognize the connection between the zero product property and solving a quadratic in one variable by setting factored expressions equal to zero.
KY.HS.A.3c
<table>
<tr><td>Name</td><td>Product of Powers</td><td>Quotient of Powers</td><td>Power of a Product</td><td>Power of a Quotient</td><td>Power of a Power</td><td>Negative Exponent</td></tr>
<tr><td>Property</td><td>$a^m \cdot a^n = a^{m+n}$</td><td>$\frac{a^m}{a^n} = a^{m-n}$</td><td>$(a \cdot b)^n = a^n \cdot b^n$</td><td>$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$</td><td>$(a^m)^n = a^{mn}$</td><td>$a^{-n} = \frac{1}{a^n}$</td></tr>
</table></td>
</tr>
<tr>
<td>Cluster: Understand the relationship between zeros and factors of polynomials.

KY.HS.A.7 Identify roots of polynomials when suitable factorizations are available. Know these roots become the zeros (x-intercepts) for the corresponding polynomial function.

MP.2, MP.5, MP.7</td>
<td>Methods of finding roots could include, but are not limited to:
• factoring
• synthetic division
• long division
• an analysis of the graph (created by hand or through use of technology).</td>
</tr>
<tr>
<td>Cluster: Analyze functions using different representations.</td>
<td>a. Quadratic functions provide a rich playground for developing this ability, since the three principal forms for a quadratic expression (expanded, factored and</td>
</tr>
</table>

KY.HS.F.5 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **a. Identify zeros, extreme values and symmetry of the graph within the context of a quadratic function.** MP.3, MP.6	completed square) each give insight into different aspects of the function.
Cluster: Construct and compare linear, quadratic and exponential models and solve problems. **KY.HS.F.13 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.** MP.7, MP.8	Students compare functions by focusing on how the output values change over intervals of equal length. Even though a linear function may initially be increasing faster than an exponential function, an increasing exponential function always eventually exceeds an increasing linear function.
Cluster: Understand the concept of a function and use function notation. **KY.HS.F.1 Understand properties and key features of functions and the different ways functions can be represented.** **a. 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.**	a. When describing relationships between quantities, the defining characteristic of a function is the input value determines the output value or, equivalently, the output value depends upon the input value. In some situations where two quantities are related, each can be viewed as a function of the other. c. A function is often described and understood in terms of the output behavior, or over what input values is it increasing, decreasing, or constant. Important questions include, “For what input values is the output value positive, negative, or 0? What happens to the output when the input value gets very large in

b. Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context. **c. 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.** **d. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.** **e. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).** MP.2, MP.4, MP.7	magnitude?" Graphs become useful representations for understanding and comparing functions because these behaviors are often easy to see in the graphs of functions. Key features include, but are not limited to: intercepts; intervals where the function is increasing, decreasing, or remaining constant; relative maxima and minima; symmetries; end behavior; periodicity. e. Students compare characteristics from various representations for one type of family of function at a time. For quadratics, students might determine which function has the larger maximum when given two different representations of quadratic functions.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.4 Use units in context as a way to understand problems and to guide the solution of multi-step problems; ★** **a. Choose and interpret units consistently in formulas;** **b. Choose and interpret the scale and the origin in graphs and data displays.** MP.5, MP.6	Graphical representations and data displays include but are not limited to: line graphs, circle graphs, histograms, multi-line graphs, scatterplots and multi-bar graphs.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.5 Define appropriate units in context for the**	In real-world situations, answers are usually represented by numbers with units. Units involve measurement, which requires precision and accuracy. For example, students should recognize that units

purpose of descriptive modeling. ★ MP.1, MP.6	measuring speed would not be appropriate for situations involving volume. Additionally students should understand when one dimensional, two dimensional, or three dimensional units are most applicable.
Cluster: Reason quantitatively and use units to solve problems. **KY.HS.N.6 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. ★** MP.2, MP.6	While KY.HS.N.6 does not require a formal discussion or use of significant digits in the scientific sense, students understand a level of precision. For example, when using the Pythagorean Theorem with measurements given in tenths of an inch, it is appropriate for students to express answers to the nearest tenth, but not to the nearest hundredth because that level of precision was not used in the original measures.

Mathematics - Algebra 1

Unit 6: Statistical Questions

Mathematics - Algebra 1
Unit 6: Statistical Questions

Duration: 2 Weeks/ 1 Week

<table>
<tr><th colspan="2">Standards for Mathematical Practice</th></tr>
<tr><td>MP.1. Make sense of problems and persevere in solving them.
MP.2. Reason abstractly and quantitatively.
MP.3. Construct viable arguments and critique the reasoning of others.
MP.4. Model with mathematics.</td><td>MP.5. Use appropriate tools strategically.
MP.6. Attend to precision.
MP.7. Look for and make use of structure.
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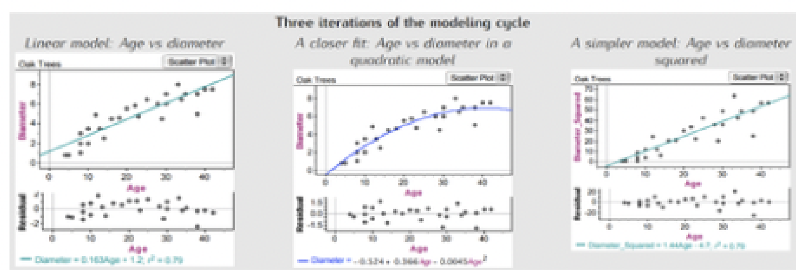
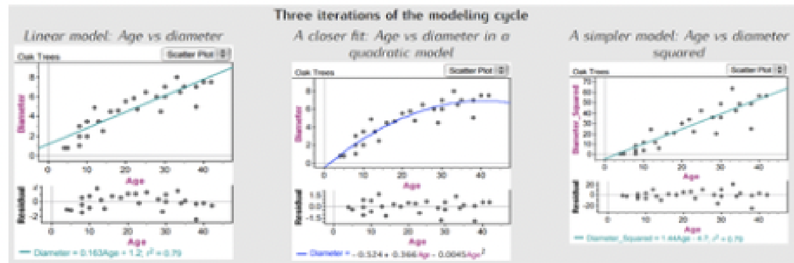
<tr><th colspan="2">Priority Standards</th></tr>
<tr><th>Standards</th><th>Clarifications</th></tr>
<tr><td>Cluster: Summarize, represent and interpret data on two categorical and quantitative variables.

KY.HS.SP.6 Represent data on two quantitative variables on a scatter plot and describe how the explanatory and response variables are related.
a. Calculate an appropriate mathematical model, or use a given mathematical model, for data to solve problems in context.

MP.3, MP.4, MP.5</td><td>Emphasize linear, quadratic and exponential models as illustrated below.

</td></tr>
</table>

<table>
<tr><th colspan="2">Supporting Standards</th></tr>
<tr><th>Standards</th><th>Clarifications</th></tr>
<tr><td>Cluster: Summarize, represent and interpret data on two categorical and quantitative variables.

KY.HS.SP.6 Represent data on two quantitative variables on a scatter plot and describe how the explanatory and response variables are related.
b. Informally assess the fit of a model (through calculating correlation for linear data, plotting, calculating and/or analyzing residuals).

MP.3, MP.4, MP.5</td><td>Emphasize linear, quadratic and exponential models as illustrated below.

</td></tr>
<tr><td>Cluster: Interpret linear models.

KY.HS.SP.8 Understand the role and purpose of correlation in linear regression.
a. Use technology to compute correlation coefficient of a linear fit.
b. Interpret the meaning of the correlation within the context of the data.
c. Describe the limitations of correlation when establishing causation.

MP.5, MP.6</td><td>a. Students use technology to perform the calculation of:
$$r = \frac{\Sigma(x-\overline{x})}{\sqrt{\Sigma(x-\overline{x})^2}\sqrt{\Sigma(y-\overline{y})^2}}$$
b. Students understand correlation measures linear associations between two quantitative variables addressing the direction (positive or negative) and the relative strength of the given association.
c. Students understand one of the most common misinterpretations of correlation is to think of it as a synonym for causation. A high correlation between two variables (suggesting a statistical association between the two) does not imply one causes the other.</td></tr>
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KY.HS.F.1 Understand properties and key features of</td><td>a. When describing relationships between quantities, the defining characteristic of a function is the input value determines the output value or, equivalently, the output value depends upon the input value. In some</td></tr>
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functions and the different ways functions can be represented. **a. 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.** **b. Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.** **c. 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.** **d. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.** **e. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).** MP.2, MP.4, MP.7	situations where two quantities are related, each can be viewed as a function of the other. c. A function is often described and understood in terms of the output behavior, or over what input values is it increasing, decreasing, or constant. Important questions include, “For what input values is the output value positive, negative, or 0? What happens to the output when the input value gets very large in magnitude?” Graphs become useful representations for understanding and comparing functions because these behaviors are often easy to see in the graphs of functions. Key features include, but are not limited to: intercepts; intervals where the function is increasing, decreasing, or remaining constant; relative maxima and minima; symmetries; end behavior; periodicity. e. Students compare characteristics from various representations for one type of family of function at a time. For quadratics, students might determine which function has the larger maximum when given two different representations of quadratic functions.
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