

Arkansas Tutorials are designed specifically for the Arkansas Standards found in the Curriculum Framework documents to prepare students for the ACT Aspire in English, reading, writing, math and science tests.

Math Tutorials offer targeted instruction, practice and review designed to develop computational fluency, deepen conceptual understanding, and apply mathematical practices. They automatically identify and address learning gaps down to elementary-level content, using adaptive remediation to bring students to grade-level no matter where they start. Students engage with the content in an interactive, feedback-rich environment as they progress through standards-aligned modules. By constantly honing the ability to apply their knowledge in abstract and real world scenarios, students build the depth of knowledge and higher order skills required to demonstrate their mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible to students through focused content, modeled logic and process, multi-modal representations, and personalized feedback as students reason through increasingly challenging problems. The Review It offers a high impact summary of key concepts and relates those concepts to students' lives. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers after each attempt. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are strong and where they're still learning.

Unit 1: Creating and Solving Equations and Inequalities

• FORMULATING AND SOLVING EQUATIONS FROM WORD PROBLEMS

- HSA.CED.A.1: Creating Equations Create equations that describe numbers or relationships Create equations and inequalities in one variable and use them to solve problems.
- HSF.IF.C.8: Interpreting Functions Analyze functions using different representations Write expressions for functions in different but equivalent forms to reveal key features of the function. Use the properties of exponents to interpret expressions for exponential functions.
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $(x) \neq 0$.) Compose functions.
- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $()$ 0.) Compose functions.
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $()$ 0.) Compose functions.
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $()$ 0.) Compose functions.
- HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.
- **FORMULATING AND SOLVING INEQUALITIES FROM WORD PROBLEMS**
 - HSA.CED.A.1: Creating Equations Create equations that describe numbers or relationships Create equations and inequalities in one variable and use them to solve problems.
 - HSA.CED.A.3: Creating Equations Create equations that describe numbers or relationships Represent and interpret constraints by equations or inequalities, and by systems of equations and/or inequalities. Interpret solutions as viable or nonviable options in a modeling and/or real-world context.

Unit 2: Working with Equations

• AXIOMS OF EQUALITY

- HSA.SSE.B.3: Seeing Structure in Expressions Write expressions in equivalent forms to solve problems Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. Factor a quadratic expression to reveal the zeros of the function it defines. Complete the square in a quadratic expression to

reveal the maximum or minimum value of the function it defines. Use the properties of exponents to transform expressions for exponential functions.

- HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
- HSA.REI.A.1: Reasoning with Equations and Inequalities Understand solving equations as a process of reasoning and explain the reasoning Assuming that equations have a solution, construct a solution and justify the reasoning used.

- **LITERAL EQUATIONS**

- HSA.CED.A.1: Creating Equations Create equations that describe numbers or relationships Create equations and inequalities in one variable and use them to solve problems.

Unit 3: Concepts with Functions

- **INVERSE FUNCTIONS**

- HSF.BF.B.4: Building Functions Build new functions from existing functions Find inverse functions. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2x + 1$ or $f(x) = (x + 1)/(x - 1)$ for $f(x) = 2$. Verify by composition that one function is the inverse of another. (Algebra II) Read values of an inverse function from a graph or a table, given that the function has an inverse. (Algebra II) Produce an invertible function from a non-invertible function by restricting the domain.

- **GRAPHING AND MANIPULATING $Y = MX + B$**

- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.IF.B.6: Interpreting Functions Interpret functions that arise in applications in terms of the context Calculate and interpret the average rate of change of a function (presented algebraically or as a table) over a specified interval. Estimate the rate of change from a graph.
- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.

Unit 4: Exponents and Exponential Functions

• LAWS OF EXPONENTS

- HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
- HSA.APR.D.6: Arithmetic with Polynomials and Rational Expressions Rewrite rational expressions Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, (where $a(x)$ is the dividend, $b(x)$ is the divisor, $q(x)$ is the quotient, and $r(x)$ is the remainder) 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.
- HSA.REI.A.1: Reasoning with Equations and Inequalities Understand solving equations as a process of reasoning and explain the reasoning Assuming that equations have a solution, construct a solution and justify the reasoning used.
- HSN.RN.A.1: The Real Number System Extend the properties of exponents to rational exponents Explain how extending the properties of integer exponents to rational exponents provides an alternative notation for radicals.
- HSN.RN.A.2: The Real Number System Extend the properties of exponents to rational exponents Rewrite expressions involving radicals and rational exponents using the properties of exponents.
- HSN.RN.B.4: The Real Number System Use properties of rational and irrational numbers Simplify radical expressions. Perform operations (add, subtract, multiply, and divide) with radical expressions. Rationalize denominators and/or numerators.

• EXPONENTIAL FUNCTIONS

- HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.IF.B.6: Interpreting Functions Interpret functions that arise in applications in terms of the context Calculate and interpret the average rate of change of a function (presented algebraically or as a table) over a specified interval. Estimate the rate of change from a graph.

- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- HSA.SSE.B.3: Seeing Structure in Expressions Write expressions in equivalent forms to solve problems Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. Factor a quadratic expression to reveal the zeros of the function it defines. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. Use the properties of exponents to transform expressions for exponential functions.
- HSF.IF.C.8: Interpreting Functions Analyze functions using different representations Write expressions for functions in different but equivalent forms to reveal key features of the function. Use the properties of exponents to interpret expressions for exponential functions.
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.
- HSF.IF.B.5: Building Functions Build new functions from existing functions Relate the domain of a function to its graph. Relate the domain of a function to the quantitative relationship it describes.
- HSA.CED.A.1: Creating Equations Create equations that describe numbers or relationships Create equations and inequalities in one variable and use them to solve problems.
- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $(x) \neq 0$.) Compose functions.
- **EXPONENTIAL GROWTH AND DECAY**
 - HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.
 - HSA.SSE.B.3: Seeing Structure in Expressions Write expressions in equivalent forms to solve problems Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. Factor a quadratic expression to

reveal the zeros of the function it defines. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. Use the properties of exponents to transform expressions for exponential functions.

- HSF.IF.C.8: Interpreting Functions Analyze functions using different representations Write expressions for functions in different but equivalent forms to reveal key features of the function. Use the properties of exponents to interpret expressions for exponential functions.
- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
- HSF.IF.B.6: Interpreting Functions Interpret functions that arise in applications in terms of the context Calculate and interpret the average rate of change of a function (presented algebraically or as a table) over a specified interval. Estimate the rate of change from a graph.

Unit 5: Logarithmic Expressions and Functions

• EVALUATING LOGARITHMIC EXPRESSIONS

- HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.
- HSF.LE.A.4: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Express exponential models as logarithms. Express logarithmic models as exponentials. Use properties of logarithms to simplify and evaluate logarithmic expressions (expanding and/or condensing logarithms as appropriate). Evaluate logarithms with or without technology.

• LOGARITHMIC FUNCTIONS

- HSF.BF.B.4: Building Functions Build new functions from existing functions Find inverse functions. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2x^3$ or $f(x) = (x + 1)/(x - 1)$ for $x \neq 1$. Verify by composition that one function is the inverse of another. (Algebra II) Read values of an inverse function from a graph or a table, given that the function has an inverse. (Algebra II) Produce an invertible function from a non-invertible function by restricting the domain.
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.

- HSF.LE.A.4: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Express exponential models as logarithms. Express logarithmic models as exponentials. Use properties of logarithms to simplify and evaluate logarithmic expressions (expanding and/or condensing logarithms as appropriate). Evaluate logarithms with or without technology.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.

Unit 6: Solving Exponential and Logarithmic Equations and Inequalities

• SOLVING EXPONENTIAL EQUATIONS

- HSF.BF.B.4: Building Functions Build new functions from existing functions Find inverse functions. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2x + 1$ or $f(x) = (x + 1)/(x - 1)$ for $x \neq 1$. Verify by composition that one function is the inverse of another. (Algebra II) Read values of an inverse function from a graph or a table, given that the function has an inverse. (Algebra II) Produce an invertible function from a non-invertible function by restricting the domain.
- HSA.SSE.B.3: Seeing Structure in Expressions Write expressions in equivalent forms to solve problems Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. Factor a quadratic expression to reveal the zeros of the function it defines. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. Use the properties of exponents to transform expressions for exponential functions.
- HSF.IF.C.8: Interpreting Functions Analyze functions using different representations Write expressions for functions in different but equivalent forms to reveal key features of the function. Use the properties of exponents to interpret expressions for exponential functions.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

- HSF.LE.A.4: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Express exponential models as logarithms. Express logarithmic models as exponentials. Use properties of logarithms to simplify and evaluate logarithmic expressions (expanding and/or condensing logarithms as appropriate). Evaluate logarithms with or without technology.

• SOLVING LOGARITHMIC EQUATIONS

- HSF.LE.A.4: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Express exponential models as logarithms. Express logarithmic models as exponentials. Use properties of logarithms to simplify and evaluate logarithmic expressions (expanding and/or condensing logarithms as appropriate). Evaluate logarithms with or without technology.
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.
- HSF.BF.B.4: Building Functions Build new functions from existing functions Find inverse functions. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2x + 1$ or $f(x) = (x + 1)/(x - 1)$ for $x \neq 1$. Verify by composition that one function is the inverse of another. (Algebra II) Read values of an inverse function from a graph or a table, given that the function has an inverse. (Algebra II) Produce an invertible function from a non-invertible function by restricting the domain.

• SOLVING EXPONENTIAL INEQUALITIES

- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
- HSA.CED.A.3: Creating Equations Create equations that describe numbers or relationships Represent and interpret constraints by equations or inequalities, and by systems of equations and/or inequalities. Interpret solutions as viable or nonviable options in a modeling and/or real-world context.
- HSA.CED.A.1: Creating Equations Create equations that describe numbers or relationships Create equations and inequalities in one variable and use them to solve problems.

Unit 7: Arithmetic with Polynomials

• ADDITION AND SUBTRACTION OF POLYNOMIALS

- HSA.APR.A.1: Arithmetic with Polynomials and Rational Expressions Perform arithmetic operations on polynomials Add, subtract, and multiply polynomials. Understand that

polynomials, like the integers, are closed under addition, subtraction, and multiplication.

- **MULTIPLICATION OF POLYNOMIALS**

- HSA.APR.A.1: Arithmetic with Polynomials and Rational Expressions Perform arithmetic operations on polynomials Add, subtract, and multiply polynomials. Understand that polynomials, like the integers, are closed under addition, subtraction, and multiplication.

- **DIVISION OF POLYNOMIALS**

- HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
- HSA.APR.D.6: Arithmetic with Polynomials and Rational Expressions Rewrite rational expressions Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, (where $a(x)$ is the dividend, $b(x)$ is the divisor, $q(x)$ is the quotient, and $r(x)$ is the remainder) 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.
- HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.

Unit 8: Graphs and Representations of Quadratic Functions

- **PARABOLAS**

- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.

- **ANALYZING GRAPHS OF QUADRATIC FUNCTIONS**

- HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
- HSF.IF.B.5: Building Functions Build new functions from existing functions Relate the domain of a function to its graph. Relate the domain of a function to the quantitative relationship it describes.
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph

exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.

- HSA.APR.B.3: Arithmetic with Polynomials and Rational Expressions Understand the relationship between zeros and factors of polynomials. Identify zeros of polynomials when suitable factorizations are available. Use the zeros to construct a rough graph of the function defined by the polynomial.
- HSF.IF.C.8: Interpreting Functions Analyze functions using different representations Write expressions for functions in different but equivalent forms to reveal key features of the function. Use the properties of exponents to interpret expressions for exponential functions.
- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
- **REPRESENTATIONS OF QUADRATIC FUNCTIONS**
 - HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
 - HSA.CED.A.3: Creating Equations Create equations that describe numbers or relationships Represent and interpret constraints by equations or inequalities, and by systems of equations and/or inequalities. Interpret solutions as viable or nonviable options in a modeling and/or real-world context.
 - HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.
 - HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
 - HSF.IF.C.8: Interpreting Functions Analyze functions using different representations Write expressions for functions in different but equivalent forms to reveal key features of the function. Use the properties of exponents to interpret expressions for exponential functions.
 - HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $(x) \neq 0$.) Compose functions.

- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships. Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable. Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSA.APR.B.3: Arithmetic with Polynomials and Rational Expressions Understand the relationship between zeros and factors of polynomials. Identify zeros of polynomials when suitable factorizations are available. Use the zeros to construct a rough graph of the function defined by the polynomial.

Unit 9: Solving Quadratic Equations 1

• SOLVING QUADRATIC EQUATIONS BY FACTORING

- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable. Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSA.SSE.B.3: Seeing Structure in Expressions Write expressions in equivalent forms to solve problems. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. Factor a quadratic expression to reveal the zeros of the function it defines. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. Use the properties of exponents to transform expressions for exponential functions.
- HSF.IF.C.8: Interpreting Functions Analyze functions using different representations. Write expressions for functions in different but equivalent forms to reveal key features of the function. Use the properties of exponents to interpret expressions for exponential functions.
- HSA.APR.C.4: Arithmetic with Polynomials and Rational Expressions Use polynomial identities to solve problems. Prove polynomial identities and use them to describe numerical relationships.
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable. Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic

formula, factoring. Recognize complex solutions and write them as $a \pm bi$ for real numbers a and b .

- HSA.APR.B.3: Arithmetic with Polynomials and Rational Expressions Understand the relationship between zeros and factors of polynomials. Identify zeros of polynomials when suitable factorizations are available. Use the zeros to construct a rough graph of the function defined by the polynomial.
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a \pm bi$ for real numbers a and b .
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a \pm bi$ for real numbers a and b .
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $(x) \neq 0$.) Compose functions.

• **QUADRATIC FORMULA**

- HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.
- HSA.SSE.B.3: Seeing Structure in Expressions Write expressions in equivalent forms to solve problems Choose and produce an equivalent form of an expression to reveal and explain

properties of the quantity represented by the expression. Factor a quadratic expression to reveal the zeros of the function it defines. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. Use the properties of exponents to transform expressions for exponential functions.

- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSN.CN.C.7: The Complex Number System Use complex numbers in polynomial identities and equations Solve quadratic equations with real coefficients that have real or complex solutions.
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation.

Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $f(0) \neq 0$.) Compose functions.

- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSA.CED.A.3: Creating Equations Create equations that describe numbers or relationships Represent and interpret constraints by equations or inequalities, and by systems of equations and/or inequalities. Interpret solutions as viable or nonviable options in a modeling and/or real-world context.

Unit 10: Solving Quadratic Equations 2

• COMPLETING THE SQUARE

- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSA.SSE.B.3: Seeing Structure in Expressions Write expressions in equivalent forms to solve problems Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. Factor a quadratic expression to reveal the zeros of the function it defines. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. Use the properties of exponents to transform expressions for exponential functions.
- HSF.IF.C.8: Interpreting Functions Analyze functions using different representations Write expressions for functions in different but equivalent forms to reveal key features of the function. Use the properties of exponents to interpret expressions for exponential functions.
- HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic

formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .

- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.

• **COMPLEX NUMBERS AND QUADRATIC FUNCTIONS**

- HSN.CN.C.7: The Complex Number System Use complex numbers in polynomial identities and equations Solve quadratic equations with real coefficients that have real or complex solutions.
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSN.CN.A.1: The Complex Number System Perform arithmetic operations with complex numbers 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.
- HSN.CN.A.2: The Complex Number System Perform arithmetic operations with complex numbers Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .

- HSN.CN.A.1: The Complex Number System Perform arithmetic operations with complex numbers 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.
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. 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. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- HSN.CN.A.3: The Complex Number System Perform arithmetic operations with complex numbers Find the conjugate of a complex number. Use conjugates to find quotients of complex numbers.

Unit 11: Factoring Polynomials

• FACTORING SPECIAL CASES

- HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
- HSA.APR.C.4: Arithmetic with Polynomials and Rational Expressions Use polynomial identities to solve problems Prove polynomial identities and use them to describe numerical relationships.
- HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.
- HSA.APR.B.3: Arithmetic with Polynomials and Rational Expressions Understand the relationship between zeros and factors of polynomials. Identify zeros of polynomials when suitable factorizations are available. Use the zeros to construct a rough graph of the function defined by the polynomial.

• FACTORING CUBIC POLYNOMIALS

- HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
- HSA.APR.C.4: Arithmetic with Polynomials and Rational Expressions Use polynomial identities to solve problems Prove polynomial identities and use them to describe numerical relationships.
- HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.

- HSA.APR.B.3: Arithmetic with Polynomials and Rational Expressions Understand the relationship between zeros and factors of polynomials. Identify zeros of polynomials when suitable factorizations are available. Use the zeros to construct a rough graph of the function defined by the polynomial.

Unit 12: Factoring Higher-Order Polynomials

• FACTORING HIGHER-ORDER POLYNOMIALS

- HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.
- HSA.APR.B.3: Arithmetic with Polynomials and Rational Expressions Understand the relationship between zeros and factors of polynomials. Identify zeros of polynomials when suitable factorizations are available. Use the zeros to construct a rough graph of the function defined by the polynomial.
- HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
- HSA.APR.C.4: Arithmetic with Polynomials and Rational Expressions Use polynomial identities to solve problems Prove polynomial identities and use them to describe numerical relationships.
- HSN.CN.C.9: The Complex Number System Use complex numbers in polynomial identities and equations Know the Fundamental Theorem of Algebra. Show that it is true for quadratic polynomials.

• FACTOR THEOREM AND REMAINDER THEOREM

- HSA.APR.D.6: Arithmetic with Polynomials and Rational Expressions Rewrite rational expressions Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, (where $a(x)$ is the dividend, $b(x)$ is the divisor, $q(x)$ is the quotient, and $r(x)$ is the remainder) 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.
- HSA.APR.B.2: Arithmetic with Polynomials and Rational Expressions Understand the relationship between zeros and factors of polynomials. Know and apply the Factor and Remainder Theorems: 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 $p(x)$.

Unit 13: Polynomial Functions and Complex Numbers

• GRAPHS OF POLYNOMIAL FUNCTIONS

- HSA.APR.B.3: Arithmetic with Polynomials and Rational Expressions Understand the relationship between zeros and factors of polynomials. Identify zeros of polynomials when suitable factorizations are available. Use the zeros to construct a rough graph of the function defined by the polynomial.

- **HSF.IF.B.4: Interpreting Functions** Interpret functions that arise in applications in terms of the context 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.
- **HSF.IF.C.7: Interpreting Functions** Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- **HSF.BF.B.3: Building Functions** Build new functions from existing functions 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 of the transformed functions. Experiment with multiple transformations and illustrate an explanation of the effects on the graph with or without technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

- **COMPLEX NUMBERS**

- **HSN.CN.A.1: The Complex Number System** Perform arithmetic operations with complex numbers 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.
- **HSN.CN.A.3: The Complex Number System** Perform arithmetic operations with complex numbers Find the conjugate of a complex number. Use conjugates to find quotients of complex numbers.
- **HSN.CN.A.2: The Complex Number System** Perform arithmetic operations with complex numbers Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

Unit 14: Polynomial Identities and Complex Numbers

- **POLYNOMIAL IDENTITIES**

- **HSA.APR.C.4: Arithmetic with Polynomials and Rational Expressions** Use polynomial identities to solve problems Prove polynomial identities and use them to describe numerical relationships.
- **HSA.REI.B.4: Reasoning with Equations and Inequalities** Solve equations and inequalities in one variable Solve quadratic equations in one variable. 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. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .

- HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
- HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
- **POLYNOMIAL IDENTITIES AND COMPLEX NUMBERS**
 - HSN.CN.C.8: The Complex Number System Use complex numbers in polynomial identities and equations Extend polynomial identities to the complex numbers.
 - HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
 - HSA.APR.C.4: Arithmetic with Polynomials and Rational Expressions Use polynomial identities to solve problems Prove polynomial identities and use them to describe numerical relationships.
 - HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.
 - HSN.CN.A.1: The Complex Number System Perform arithmetic operations with complex numbers 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.
 - HSN.CN.C.7: The Complex Number System Use complex numbers in polynomial identities and equations Solve quadratic equations with real coefficients that have real or complex solutions.
 - HSA.REI.B.4: Reasoning with Equations and Inequalities Solve equations and inequalities in one variable Solve quadratic equations in one variable. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p) = q$ that has the same solutions. Solve quadratic equations (as appropriate to the initial form of the equation) by: inspection of a graph, taking square roots, completing the square, using the quadratic formula, factoring. Recognize complex solutions and write them as $a + bi$ for real numbers a and b .
 - HSN.CN.A.3: The Complex Number System Perform arithmetic operations with complex numbers Find the conjugate of a complex number. Use conjugates to find quotients of complex numbers.
 - HSN.CN.C.9: The Complex Number System Use complex numbers in polynomial identities and equations Know the Fundamental Theorem of Algebra. Show that it is true for quadratic polynomials.

Unit 15: Radical Functions and Equations**• ANALYZING GRAPHS OF SQUARE ROOT FUNCTIONS**

- HSF.BF.B.3: Building Functions Build new functions from existing functions 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 given the graphs of the transformed functions. Experiment with multiple transformations and illustrate an explanation of the effects on the graph with or without technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.BF.B.4: Building Functions Build new functions from existing functions Find inverse functions. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2x + 1$ or $f(x) = (x + 1)/(x - 1)$ for $x \neq 1$. Verify by composition that one function is the inverse of another. (Algebra II) Read values of an inverse function from a graph or a table, given that the function has an inverse. (Algebra II) Produce an invertible function from a non-invertible function by restricting the domain.

• SOLVING SQUARE ROOT EQUATIONS

- HSA.REI.A.2: Reasoning with Equations and Inequalities Understand solving equations as a process of reasoning and explain the reasoning Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- HSA.REI.A.1: Reasoning with Equations and Inequalities Understand solving equations as a process of reasoning and explain the reasoning Assuming that equations have a solution, construct a solution and justify the reasoning used.
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $f(x) \neq 0$.) Compose functions.

Unit 16: Rational Expressions and Equations**• OPERATIONS WITH RATIONAL EXPRESSIONS**

- HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression

using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.

- HSA.APR.D.7: Arithmetic with Polynomials and Rational Expressions Rewrite rational expressions Add, subtract, multiply, and divide by nonzero rational expressions. Understand that rational expressions, like the integers, are closed under addition, subtraction, and multiplication.
 - HSA.SSE.A.2: Seeing Structure in Expressions Interpret the structure of expressions Use the structure of an expression to identify ways to rewrite it.
 - HSA.APR.D.6: Arithmetic with Polynomials and Rational Expressions Rewrite rational expressions Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, (where $a(x)$ is the dividend, $b(x)$ is the divisor, $q(x)$ is the quotient, and $r(x)$ is the remainder) 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.
 - HSA.SSE.B.3: Seeing Structure in Expressions Write expressions in equivalent forms to solve problems Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. Factor a quadratic expression to reveal the zeros of the function it defines. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. Use the properties of exponents to transform expressions for exponential functions.
- **SOLVING RATIONAL EQUATIONS**
 - HSA.REI.A.1: Reasoning with Equations and Inequalities Understand solving equations as a process of reasoning and explain the reasoning Assuming that equations have a solution, construct a solution and justify the reasoning used.
 - HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
 - HSA.CED.A.3: Creating Equations Create equations that describe numbers or relationships Represent and interpret constraints by equations or inequalities, and by systems of equations and/or inequalities. Interpret solutions as viable or nonviable options in a modeling and/or real-world context.
 - HSA.REI.A.2: Reasoning with Equations and Inequalities Understand solving equations as a process of reasoning and explain the reasoning Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Unit 17: Rational Functions

- **ANALYZING GRAPHS OF RATIONAL FUNCTIONS**

- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.BF.B.3: Building Functions Build new functions from existing functions 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 given the graphs of the transformed functions. Experiment with multiple transformations and illustrate an explanation of the effects on the graph with or without technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.
- HSF.IF.B.5: Building Functions Build new functions from existing functions Relate the domain of a function to its graph. Relate the domain of a function to the quantitative relationship it describes.
- **MODELING SITUATIONS WITH RATIONAL FUNCTIONS**
 - HSN.Q.A.2: Quantities Reason quantitatively and use units to solve problems Define appropriate quantities for the purpose of descriptive modeling. (I.E., Use units appropriate to the problem being solved.)
 - HSA.REI.A.2: Reasoning with Equations and Inequalities Understand solving equations as a process of reasoning and explain the reasoning Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
 - HSA.SSE.A.1: Seeing Structure in Expressions Interpret the structure of expressions Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. Interpret complicated expressions by viewing one or more of their parts as a single entity.
 - HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
 - HSA.CED.A.3: Creating Equations Create equations that describe numbers or relationships Represent and interpret constraints by equations or inequalities, and by systems of equations

and/or inequalities. Interpret solutions as viable or nonviable options in a modeling and/or real-world context.

- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $(x) \neq 0$.) Compose functions.

Unit 18: Sequences

• SEQUENCES

- HSF.IF.A.3: Interpreting Functions Understand the concept of a function and use function notation Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $(x) \neq 0$.) Compose functions.
- HSF.BF.A.2: Building Functions Build a function that models a relationship between two quantities Write arithmetic and geometric sequences both recursively and with an explicit formula, and translate between the two forms. Use arithmetic and geometric sequences to model situations.
- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

• ARITHMETIC AND GEOMETRIC SEQUENCES

- HSF.BF.A.2: Building Functions Build a function that models a relationship between two quantities Write arithmetic and geometric sequences both recursively and with an explicit formula, and translate between the two forms. Use arithmetic and geometric sequences to model situations.
- HSF.IF.A.3: Interpreting Functions Understand the concept of a function and use function notation Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$

are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given (f, g) .

- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$ are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given (f, g) .) Compose functions.

• SUMS OF GEOMETRIC SEQUENCES

Unit 19: Working with Functions

• LINEAR VERSUS NONLINEAR FUNCTIONS

- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.IF.B.6: Interpreting Functions Interpret functions that arise in applications in terms of the context Calculate and interpret the average rate of change of a function (presented algebraically or as a table) over a specified interval. Estimate the rate of change from a graph.
- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.

• ARITHMETIC OPERATIONS ON FUNCTIONS

- HSF.BF.A.1: Building Functions Build a function that models a relationship between two quantities Write a function that describes a relationship between two quantities. From a context, determine an explicit expression, a recursive process, or steps for calculation. Combine standard function types using arithmetic operations. (e.g., given that $f(x)$ and $g(x)$

are functions developed from a context, find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $(f/g)(x)$, and any combination thereof, given $(x) \neq 0$.) Compose functions.

- **MULTIPLE REPRESENTATIONS OF FUNCTIONS**

- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.
- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

Unit 20: Trigonometry and Trigonometric Functions

- **RADIANS AND THE UNIT CIRCLE**

- **TRIGONOMETRIC FUNCTIONS**

- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.BF.B.3: Building Functions Build new functions from existing functions 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 x given the graphs of the transformed functions. Experiment with multiple transformations and illustrate an explanation of the effects on the graph with or without technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Unit 21: Parent Functions and Transformations

- **PARENT FUNCTIONS**

- HSF.IF.B.4: Interpreting Functions Interpret functions that arise in applications in terms of the context 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.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are

available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.

- HSF.IF.B.5: Building Functions Build new functions from existing functions Relate the domain of a function to its graph. Relate the domain of a function to the quantitative relationship it describes.
- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

• TRANSFORMATIONS OF PARENT FUNCTIONS

- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.
- HSF.BF.B.3: Building Functions Build new functions from existing functions 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 given the graphs of the transformed functions. Experiment with multiple transformations and illustrate an explanation of the effects on the graph with or without technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

• MULTIPLE TRANSFORMATIONS OF PARENT FUNCTIONS

- HSF.BF.B.3: Building Functions Build new functions from existing functions 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 given the graphs of the transformed functions. Experiment with multiple transformations and illustrate an explanation of the effects on the graph with or without technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
- HSF.IF.C.7: Interpreting Functions Analyze functions using different representations Graph functions expressed algebraically and show key features of the graph, with and without technology. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior. Graph trigonometric functions, showing period, midline, and amplitude.

- HSF.BF.B.3: Building Functions Build new functions from existing functions 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 given the graphs of the transformed functions. Experiment with multiple transformations and illustrate an explanation of the effects on the graph with or without technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Unit 22: Linear Inequalities

• GRAPHS OF LINEAR INEQUALITIES

- HSA.REI.D.12: Reasoning with Equations and Inequalities Solve systems of equations Solve linear inequalities and systems of linear inequalities in two variables by graphing.

• SOLVING SYSTEMS OF LINEAR INEQUALITIES

- HSA.CED.A.3: Creating Equations Create equations that describe numbers or relationships Represent and interpret constraints by equations or inequalities, and by systems of equations and/or inequalities. Interpret solutions as viable or nonviable options in a modeling and/or real-world context.
- HSA.REI.D.12: Reasoning with Equations and Inequalities Solve systems of equations Solve linear inequalities and systems of linear inequalities in two variables by graphing.

Unit 23: Systems of Equations

• SOLVING THREE-VARIABLE SYSTEMS OF LINEAR EQUATIONS

- HSA.CED.A.2: Creating Equations Create equations that describe numbers or relationships Create equations in two or more variables to represent relationships between quantities. Graph equations, in two variables, on a coordinate plane.
- HSA.CED.A.3: Creating Equations Create equations that describe numbers or relationships Represent and interpret constraints by equations or inequalities, and by systems of equations and/or inequalities. Interpret solutions as viable or nonviable options in a modeling and/or real-world context.
- HSA.REI.C.5: Reasoning with Equations and Inequalities Solve systems of equations and inequalities graphically. Solve systems of equations in two variables using substitution and elimination. Understand that the solution to a system of equations will be the same when using substitution and elimination.
- HSA.REI.C.6: Reasoning with Equations and Inequalities Solve systems of equations and inequalities graphically. Solve systems of equations algebraically and graphically.

• SYSTEMS OF NONLINEAR EQUATIONS

- HSA.REI.C.6: Reasoning with Equations and Inequalities Solve systems of equations and inequalities graphically. Solve systems of equations algebraically and graphically.
- HSA.REI.C.7: Reasoning with Equations and Inequalities Solve systems of equations and inequalities graphically. Solve systems of equations consisting of linear equations and nonlinear equations in two variables algebraically and graphically.

- HSA.REI.C.5: Reasoning with Equations and Inequalities Solve systems of equations and inequalities graphically. Solve systems of equations in two variables using substitution and elimination. Understand that the solution to a system of equations will be the same when using substitution and elimination.
- HSA.REI.D.11: Reasoning with Equations and Inequalities Solve systems of equations 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 by using technology to graph the functions, making tables of values, finding successive approximations. Include cases (but not limited to) where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, exponential (Introduction in Algebra 1, Mastery in Algebra 2), logarithmic functions.
- HSA.CED.A.3: Creating Equations Create equations that describe numbers or relationships Represent and interpret constraints by equations or inequalities, and by systems of equations and/or inequalities. Interpret solutions as viable or nonviable options in a modeling and/or real-world context.
- HSF.LE.A.2: Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems Construct linear and exponential equations, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

Unit 24: Statistical Design and Analysis

• ANALYZING STATISTICAL SAMPLES

- HSS.IC.A.1: Making Inferences and Justifying Conclusions Understand and evaluate random processes underlying statistical experiments Recognize statistics as a process for making inferences about population parameters based on a random sample from that population.

• EXPERIMENTAL AND OBSERVATIONAL DESIGN

- HSS.IC.B.3: Making Inferences and Justifying Conclusions Make inferences and justify conclusions from sample surveys, experiments and observational studies Recognize the purposes of and differences among sample surveys, experiments, and observational studies. Explain how randomization relates to sample surveys, experiments, and observational studies.

Unit 25: Statistics

• SCATTERPLOTS AND MODELING

- HSS.ID.B.6: Interpreting Categorical and Quantitative Data Make inferences and justify conclusions from sample surveys, experiments and observational studies Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. Fit a function to the data; use functions fitted to data to solve problems in the context of the data.

• CONCLUSIONS IN DATA

- HSS.IC.B.6: Making Inferences and Justifying Conclusions Make inferences and justify conclusions from sample surveys, experiments and observational studies Read and explain, in context, the validity of data from outside reports by identifying the variables as quantitative or

categorical, describing how the data was collected, indicating any potential biases or flaws, identifying inferences the author of the report made from sample data.

- **NORMAL DISTRIBUTION**

- HSS.ID.A.4: Interpreting Categorical and Quantitative Data Summarize, represent, and interpret data on a single count or measurement variable Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators and/or spreadsheets to estimate areas under the normal curve.

Unit 26: Probability

- **INTRODUCTION TO PROBABILITY**
- **CONDITIONAL PROBABILITY**
- **GEOMETRIC PROBABILITIES**