Pojoaque Valley Schools

Math CCSS Pacing Guide

Algebra 2

**Skills adapted from*
Kentucky Department of Education
Math Deconstructed Standards
*** Evidence of attainment/assessment, Vocabulary, Knowledge, Skills and Essential Elements adapted from*
Wisconsin Department of Education and
Standards Insights Computer-Based Program

Version 3

2015-2016

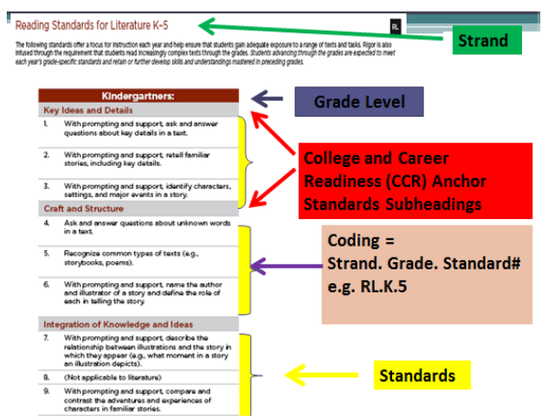
Pojoaque Valley Schools
ELA Common Core Pacing Guide Introduction

The Pojoaque Valley Schools pacing guide documents are intended to guide teachers' use of Common Core State Standards (CCSS) over the course of an instructional school year. The guides identify the **focus standards by quarter.** Teachers should understand that the **focus standards** emphasize deep instruction for that timeframe. However, because a certain quarter does not address specific standards, it should be understood that previously taught standards should be reinforced while working on the focus standards for any designated quarter. Some standards will **recur** across all quarters due to their importance and need to be addressed on an ongoing basis.

The CCSS are not intended to be a check-list of knowledge and skills but should be used as an integrated model of literacy instruction to meet end of year expectations.

The English Language Arts CCSS pacing guides contain the following elements:

- **College and Career Readiness (CCR) Anchor Standard**
- **Strand:** Identify the type of standard
- **Cluster:** Identify the sub-category of a set of standards.
- **Grade Level**: Identify the grade level of the intended standards
- **Standard:** Each grade-specific standard (as these standards are collectively referred to) corresponds to the same-numbered CCR anchor standard. Put another way, each CCR anchor standard has an accompanying grade-specific standard translating the broader CCR statement into grade-appropriate end-of-year expectations.
- **Standards Code:** Contains the strand, grade, and number (or number and letter, where applicable), so that RI.4.3, for example, stands for Reading, Informational Text, grade 4, standard 3
- **Skills and Knowledge:** Identified as subsets of the standard and appear in one or more quarters. Define the skills and knowledge embedded in the standard to meet the full intent of the standard itself.



The New Mexico Public Education Department published the Assessment Blueprints for End-of-Course Exams with those standards clearly identified that are measured. While students in grades 3 through 11 who take PARCC for reading, math and science are not required to take an End-of-Course Exam (unless required for a graduation requirement), the blueprints outline those standards and provide released items for practice. In this pacing guide, standards that are identified as being measured are highlighted in bold text for easy reference.

Version 3 of the Pojoaque Valley School District Pacing guides for Reading Language Arts and Mathematics are based on the done by staff and teachers of the school district using the Kentucky model, and a synthesis of the excellent work done by Wisconsin Cooperative Educational Service Agency 7 (CESA 7) School Improvement Services, Green Bay, WI. (2010), *Standards Insight project.*

> *Standards Insight* was developed to give educators a tool for in depth investigation of the Common Core State Standards (CCSS). The CCSS are "unpacked" or dissected, identifying specific knowledge, skills, vocabulary, understandings, and evidence of student attainment for each standard. *Standards Insight* may be used by educators to gain a thorough grasp of the CCSS or as a powerful collaborative tool supporting educator teams through the essential conversations necessary for developing shared responsibility for student attainment of all CCSS. . . . serves as a high-powered vehicle to help educators examine the standards in a variety of ways.

The Version 2 Pojoaque Valley School District Pacing guides present the standard with levels of detail and then the necessary skills by quarter based on the Kentucky model. On the second page for each standard, the synthesis of the *Standards Insight* project is presented in a way that further defines and refines the standard such that teachers may use the information to refine their teaching practices.

Based on this synthesis of work and the purpose for the unpacking, the following fields were selected as most helpful to aid in understanding of the Common Core Standards that will lead to shifts in instruction:

1. Evidence of Student Attainment: "What could students do to show attainment of the standard?"

2. Vocabulary: "What are key terms in the standard that are essential for interpretation and understanding in order for students to learn the content?"

3. Knowledge: "What does the student need to know in order to aid in attainment of this standard?"

4. Skills and Understanding: "What procedural skill(s) does the student need to demonstrate for attainment of this standard?", and "What will students understand to attain the standard?"

The following fields are included in Version 2:

Evidence of Student Attainment: This field describes what the standard may look like in student work. Specific expectations are listed in performance terms showing what students will say or do to demonstrate attainment of the standard.

Standards Vocabulary: This field lists words and phrases specific to each standard. Shared interpretation and in depth understanding of standards vocabulary are essential for consistent instruction across and within grade levels and content areas.

Knowledge: The knowledge field lists what students will need to know in order to master each standard (facts, vocabulary, definitions).

Skills and Understanding: The skills field identifies the procedural knowledge students apply in order to master each standard (actions, applications, strategies), as well as the overarching understanding that connects the standard, knowledge, and skills. Understandings included in *Standards Insight* synthesize ideas and have lasting value.

Instructional Achievement Level Descriptors: This field lists, by level what a teacher can expect to see in a student who achieves at a particular level. Additionally teachers can use this filed to differentiate instruction to provide further growth for student's in moving from one level to another. This field can be used to provide specific teaching approaches to the standard in question.

A Note About High School Standards: The high school standards are listed in conceptual categories. Conceptual categories portray a coherent view of high school instruction that crosses traditional course boundaries. We have done everything possible, with teacher input, to link individual standards to the appropriate pacing guides,

References to Tables: References to tables within the standards in the *Standards Insight* tool refer to Tables 1-5 found in the glossary of the Mathematics Common Core State Standards document found at www.corestandards.org.

Quarter	1	2	3	4
F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.(*Modeling standard) Quality Core: C.1.d, E.2.a, F.2.d, G.3.e (these QC standards concern the determination of range, although F.IF.5 does not explicitly do so; range can be addressed by F.IF.4 or F.IF.5)**	X	X	X	X
F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*(Modeling standard) Quality Core: (Interpreting functions throughout QC Algebra 2 course.)	X			
F.IF.7b Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*(Modeling standard) b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. Quality Core: E.2.b, F.2.b	X	X	X	X
F.IF.7e Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*(Modeling standard) e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. Quality Core: E.2.b, G.2.a, G.3.d, G.3.e, G.3.f				X
F.IF.8a Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. Quality Core: This KCASM standard undergirds many standards within the assessed QC conceptual areas, including, but not limited to: E.1.a, F.1.b, G.1.b, G.1.c, G.1.e		X	X	
F.IF.8b Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function: b. Use the properties of exponents to interpret expressions for exponential functions. For example: identify percent rate of change in functions such as $y= (1.02)^t$, $y=(.97)^t$, $y=(1.01)^{12t}$, $y=(1.2)^{t/10}$, and classify them as representing exponential growth or decay. Quality Core: E.1.a, F.1.b, G.1.b, G.1.c, G.1.e				X
F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*		X	X	X
F.BF.1b Write a function that describes a relationship between two quantities.*(Modeling standard)b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model. Quality Core: C.1.d, E.2.a (Determination of the domain and range of combined functions are not explicitly addressed by F.BF.1, but can be addressed by extending understanding from F.IF.5)	X	X	X	X
F.BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* Quality Core: E.2.b, E.3.b (this QC standard only requires studying translations on circles and parabolas)	X	X	X	X

Quarter	1	2	3	4
F.BF. 4a Find the inverse functions a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example: $f(x) = 2x^3$ **or** $f(x) = (x+1)/(x-1)$ **for x ≠1. Quality Core: This KCASM standard undergirds many standards within the assessed QC conceptual areas, including: G.2.b, H.2.b, H.2.d**	X	X	X	X
F.LE.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$**, where a, b, and d are numbers and the base is 2, 10, or e; evaluate the logarithm using technology. Quality Core: G.2.b**				X
S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve. *Statistics and Probability is a Modeling Conceptual Category				X
S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. *Statistics and Probability is a Modeling Conceptual Category				X
S.IC.2 Decide if a specified model is consistent with results from a given data-generating process, eg., using simulation. ***For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model? *Statistics and Probability is a Modeling Conceptual Category***				X
S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*Statistics and Probability is a Modeling Conceptual Category				X
S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. *Statistics and Probability is a Modeling Conceptual Category				X
S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between two parameters are significant. *Statistics and Probability is a Modeling Conceptual Category				X
S.IC.6 Evaluate reports based on data. * *Statistics and Probability is a Modeling Conceptual Category Quality Core:				X
S.MD.6 (+) Use probabilities to make fair decisions (e.g. drawing by lots, using a random number generator.) *Statistics and Probability is a Modeling Conceptual Category Quality Core: All components of QC Section H can be applied to both MD standards				X
S.MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game.) *Statistics and Probability is a Modeling Conceptual Category **Quality Core: All components of QC Section H can be applied to both MD standards.**				X

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard: N.CN.1 Know there is a complex number i such that i2 = -1, and every complex number has the form a + bi with a and b real numbers.

Quality Core C.1.a</td></tr>
<tr><td colspan="2">Domain: The Complex Number System</td><td colspan="6">Cluster: Perform arithmetic operations with complex numbers</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="3">Quarter 2:

Define i as √-1 or i2 = -1.

Define complex numbers.

Write complex numbers in the form a + bi with a and b being real numbers.</td><td colspan="3">Quarter 3:

Define i as √-1 or i2 = -1.

Define complex numbers.

Write complex numbers in the form a + bi with a and b being real numbers.</td><td colspan="2">Quarter 4:</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given an equation where x^2 is less than zero, Explain by repeated reasoning from square roots in the positive numbers what conditions a solution must satisfy, how defining a number *i* by the equation $i^2 = -1$ would satisfy those conditions, and extend the real numbers to a set called the complex numbers, Explain how adding and/or multiplying i by any real number results in a complex number and is real when the multiplier is zero.	Complex number	Students know: Which manipulations of radicals produce equivalent forms, for example, $\sqrt{8} + \sqrt{18} \neq \sqrt{26}$ *but* $2\sqrt{2} + 3\sqrt{2} = 5\sqrt{2}$, That the extension of the real numbers which allows equations such as $x^2 = -1$ to have solutions is known as the complex numbers and the defining feature of the complex numbers is a number *i*, such that $i^2 = -1$.	Students understand/are able to: Perform manipulations of radicals, including those involving square roots of negative numbers, to produce a variety of forms, for example, $\sqrt{(-8)} = i\sqrt{(8)} = 2i\sqrt{(2)}$. When quadratic equations do not have real solutions, the number system must be extended so that solutions exist, and the extension must maintain properties of arithmetic in the real numbers.	**EEN-CN.1.** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

Quality Core: C.1.b</td></tr>
<tr><td colspan="2">Domain: The Complex Number System</td><td colspan="6">Cluster: Perform arithmetic operations with complex numbers</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:

Know that the commutative, associative, and distributive properties extend to the set of complex numbers over the operations of addition and multiplication.

Use the relation i2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.</td><td colspan="2">Quarter 3:

Know that the commutative, associative, and distributive properties extend to the set of complex numbers over the operations of addition and multiplication.

Use the relation i2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.</td><td colspan="2">Quarter 4:</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
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Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Produce equivalent expressions in the form a + bi, where a and b are real for combinations of complex numbers by using addition, subtraction, and multiplication and justify that these expressions are equivalent through the use of properties of operations and equality (Tables 3 and 4).		Students know: Combinations of operations on complex number that produce equivalent expressions, Properties of operations and equality that verify this equivalence.	Students understand/are able to: Perform arithmetic manipulations on complex numbers to produce equivalent expressions. Complex number calculations follow the same rules of arithmetic as combining real numbers and algebraic expressions.	**Level IV Students will:** **EEN-CN.2.** Apply the operations of addition, subtraction, and multiplication in real world situations using money as the standard units ($50, $20, $10, $5, $1, $0.25, $0.10, $0.05, and $0.01). Ex. Using a checkbook register: $55.55 – 10.10 = _____. Ex. Using a checkbook register: $20 X 0.05 = _____. Ex. If you have $20, how much change will you receive if you spend $11.75? Ex. Calculate the cost of six movie tickets that are $7.50 each. Ex. If I have $4.20 cents and I buy an item for $3.50, how much change will I get? Ex. Jean earns $7.50 an hour. She worked six hours. How much did she earn? **Level III Students will:** **EEN-CN.2.** Use the operations of addition, subtraction, and multiplication with decimals (decimal value x whole number) in real-world situations using money as the standard units ($20, $10, $5, $1, $0.25, $0.10, $0.05, and $0.01). Ex. Using a checkbook register: Add $6.50 + $3 (e.g., If you have $6.50 in your bank account and you receive a gift for $3.00, how much money do you have in your bank account?) Ex. Calculate the cost of two movie tickets that are $6.50 each. Ex. Find the cost of two pizzas if each pizza is $5.50. **Level II Students will:** **EEN-CN.2.** Use the operations of addition, subtraction, and multiplication up to the tenths place with decimals. Ex. If I have a nickel and two dimes, how much money do I have? Ex. If I have $3.50 and I spend $2.50, how much money do I have? **Level I Students will:** **EEN-CN.2.** Use the operations of addition, subtraction, multiplication, and multiplication with whole numbers less than 20. Ex. If Sam got three cats and they each cost $2, how much did he pay for all three cats (3 x 2 = 6).

				Ex. 4 + 36 = __. Ex. 67 – 33 = __. Ex. 20 x 3 = __. Ex. Mary got $2 from her uncle and $5 from her sister for her birthday, how much money did she receive?

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: N.CN.7 Solve quadratic equations with real coefficients that have complex solutions.

Quality Core: E.1.c</td></tr>
<tr><td colspan="2">Domain: The Complex Number System</td><td colspan="6">Cluster: Use complex numbers in polynomial identities and equations</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:

Solve quadratic equations with real coefficients that have complex solutions.

Note from Appendix A: Limit to polynomials with real coefficients.</td><td colspan="2">Quarter 3:

Solve quadratic equations with real coefficients that have complex solutions.

Note from Appendix A: Limit to polynomials with real coefficients.</td><td colspan="2">Quarter 4:</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
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Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation in which a quadratic solution is necessary find all solutions real or complex.	complex solution	Students know: strategies for solving quadratic equations	Students understand/are able to: apply the quadratic equation provide solutions in complex form all quadratic equations have two solutions: real or imaginary some contextual situations are better suited to quadratic solutions	**EEN-CN.7.** N/A

Grade Level/ Course (HS): Algebra 2 Unit 1							
Standard with code: N.CN.8 (+) Extend polynomial identities to the complex numbers. For example, rewrite $x^2 + 4$ as $(x + 2i)(x – 2i)$. Quality Core:							
Domain: The Complex Number System		**Cluster: Use complex numbers in polynomial identities and equations**					
Quarter 1: Explain that an identity shows a relationship between two quantities, or expressions, that is true for all values of the variables, over a specified set.		**Quarter 2:** Explain that an identity shows a relationship between two quantities, or expressions, that is true for all values of the variables, over a specified set.		**Quarter 3:** Explain that an identity shows a relationship between two quantities, or expressions, that is true for all values of the variables, over a specified set. Give examples of polynomial identities. Extend polynomial identities to the complex numbers. *Note from Appendix A: Limit to polynomials with real coefficients*		**Quarter 4:** Explain that an identity shows a relationship between two quantities, or expressions, that is true for all values of the variables, over a specified set.	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Use properties of operations on polynomials and the definition of *I* to justify that: $a^2 + b^2 = (a+bi)(a-bi)$	Polynomial identity	Students know: The definition of *i* (*i*2 = -1). Polynomial identities over the real numbers, specifically the difference of two squares.	Students understand/are able to: Accurately perform algebraic manipulations on polynomial expressions. Write real and complex numbers in equivalent forms (e.g., $x^2 + 9 = x^2 - (-9) = x^2 - (3i)^2 = (x-3i)(x+3i)$). The properties of polynomial identities developed for real numbers also work for complex numbers. Mathematical manipulations which generate equivalent forms of expressions aid in extending properties of one number system to another.	**EEN-CN.8.** N/A (+)

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Quality Core:</td></tr>
<tr><td colspan="3">Domain: The Complex Number System</td><td colspan="5">Cluster: Use complex numbers in polynomial identities and equations</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:

State, in written or verbal form, the Fundamental Theorem of Algebra.

Verify that the Fundamental Theorem of Algebra is true for second degree quadratic polynomials.

Note from Appendix A: Limit to polynomials with real coefficients.</td><td colspan="2">Quarter 4:</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
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Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: br> Given a polynomial, Determine the number of possible roots realizing that some of them may be complex or used more than once. Given a quadratic polynomial, Show that it has two roots (real or complex) and find them.	Fundamental Theorem of Algebra Quadratic Polynomial	Students know: The definition of the degree of a polynomial. The difference between real and complex roots.	Students understand/are able to: Find roots of a quadratic polynomial. Rewrite an imaginary number as a complex number. The degree of a polynomial determines the number of roots, some which may be real, complex, or used more than once. Only real roots will be x-intercepts on a graph.	**EEN-CN.9.** N/A (+)

Grade Level/ Course (HS): Algebra 2 Unit 1							
Standard with code: A.SSE.1a Interpret expressions that represent a quantity in terms of its context.*(*Modeling standard)a. Interpret parts of an expression, such as terms, factors, and coefficients. Quality Core: A.SSE.1a and A.SSE.1b undergird many standards within the assessed QC conceptual areas, including, but not limited to: F.1.a, F.1.b, G.1.c							
Domain: Seeing Structure in Expressions		**Cluster: Interpret the structure of expressions**					
Quarter 1: For expressions that represent a contextual quantity, define and recognize parts of an expression, such as terms, factors, and coefficients. For expressions that represent a contextual quantity, interpret parts of an expression, such as terms, factors, and coefficients in terms of the context. *Note from Appendix A: extend to polynomial & rational expressions*		**Quarter 2:** For expressions that represent a contextual quantity, define and recognize parts of an expression, such as terms, factors, and coefficients. For expressions that represent a contextual quantity, interpret parts of an expression, such as terms, factors, and coefficients in terms of the context. *Note from Appendix A: extend to polynomial & rational expressions*		**Quarter 3:** For expressions that represent a contextual quantity, define and recognize parts of an expression, such as terms, factors, and coefficients. For expressions that represent a contextual quantity, interpret parts of an expression, such as terms, factors, and coefficients in terms of the context. *Note from Appendix A: extend to polynomial & rational expressions*		**Quarter 4:**	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: br> Given a polynomial, Determine the number of possible roots realizing that some of them may be complex or used more than once. Given a quadratic polynomial, Show that it has two roots (real or complex) and find them.	Fundamental Theorem of Algebra Quadratic Polynomial	Students know: The definition of the degree of a polynomial. The difference between real and complex roots.	Students understand/are able to: Find roots of a quadratic polynomial. Rewrite an imaginary number as a complex number. The degree of a polynomial determines the number of roots, some which may be real, complex, or used more than once. Only real roots will be x-intercepts on a graph.	**EEN-CN.9.** N/A (+)

Grade Level/ Course (HS): Algebra 2 Unit 1							
Standard with code A.SSE.1b Interpret expressions that represent a quantity in terms of its context.*(Modeling standard) b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P. Quality Core: A.SSE.1a and A.SSE.1b undergird many standards within the assessed QC conceptual areas, including, but not limited to: F.1.a, F.1.b, G.1.c							
Domain: Seeing Structure in Expressions		**Cluster: Interpret the structure of expressions**					
Quarter 1: The underpinning knowledge for this standard is addressed in **A.SSE.1a:** For expressions that represent a contextual quantity, define and recognize parts of an expression, such as terms, factors, and coefficients.		**Quarter 2:** The underpinning knowledge for this standard is addressed in **A.SSE.1a:** For expressions that represent a contextual quantity, define and recognize parts of an expression, such as terms, factors, and coefficients.		**Quarter 3:** The underpinning knowledge for this standard is addressed in **A.SSE.1a:** For expressions that represent a contextual quantity, define and recognize parts of an expression, such as terms, factors, and coefficients. For expressions that represent a contextual quantity, interpret complicated expressions, in terms of the context, by viewing one or more of their parts as a single entity. *Note from Appendix A: extend to polynomial and rational expressions*		**Quarter 4:** The underpinning knowledge for this standard is addressed in **A.SSE.1a:** For expressions that represent a contextual quantity, define and recognize parts of an expression, such as terms, factors, and coefficients. For expressions that represent a contextual quantity, interpret complicated expressions, in terms of the context, by viewing one or more of their parts as a single entity. *Note from Appendix A: extend to polynomial and rational expressions*	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: br> Given a polynomial, Determine the number of possible roots realizing that some of them may be complex or used more than once. Given a quadratic polynomial, Show that it has two roots (real or complex) and find them.	Fundamental Theorem of Algebra Quadratic Polynomial	Students know: The definition of the degree of a polynomial. The difference between real and complex roots.	Students understand/are able to: Find roots of a quadratic polynomial. Rewrite an imaginary number as a complex number. The degree of a polynomial determines the number of roots, some which may be real, complex, or used more than once. Only real roots will be x-intercepts on a graph.	**EEN-CN.9.** N/A (+)

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: A.SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.

Quality Core: A.SSE.2 undergirds many standards within the assessed QC conceptual areas, including but not limited to: C.1.b, C.1.c, F.1.a, F.1.b, G.1.c, G.1.e</td></tr>
<tr><td colspan="2">Domain: Seeing Structure in Expressions</td><td colspan="6">Cluster: Interpret the structure of expressions.</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:
Identify ways to rewrite expressions, such as difference of squares, factoring out a common monomial, regrouping, etc.

Identify various structures of expressions (e.g. an exponential monomial multiplied by a scalar of the same base, difference of squares in terms other than just x)

Use the structure of an expression to identify ways to rewrite it.

Classify expressions by structure and develop strategies to assist in classification (e.g. use of conjugates in rewriting rational expressions, usefulness of Pythagorean triples, etc.).

Note from Appendix A: Extend to polynomial and rational expressions.</td><td colspan="2">Quarter 3:

Use the structure of an expression to identify ways to rewrite it.

Classify expressions by structure and develop strategies to assist in classification (e.g. use of conjugates in rewriting rational expressions, usefulness of Pythagorean triples, etc.).

Note from Appendix A: Extend to polynomial and rational expressions.</td><td colspan="2">Quarter 4:

Use the structure of an expression to identify ways to rewrite it.

Classify expressions by structure and develop strategies to assist in classification (e.g. use of conjugates in rewriting rational expressions, usefulness of Pythagorean triples, etc.).

Note from Appendix A: Extend to polynomial and rational expressions.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Make sense of algebraic expressions by identifying structures within the expression which allow them to rewrite it in useful ways.		Students know: Algebraic properties (including those in Tables 3, 4, and 5), When one form of an algebraic expression is more useful than an equivalent form of that same expression.	Students understand/are able to: Use algebraic properties to produce equivalent forms of the same expression by recognizing underlying mathematical structures. Generating simpler, but equivalent, algebraic expressions facilitates the investigation of more complex algebraic expressions.	**EEA-SSE.2.** N/A

Grade Level/ Course (HS): Algebra 2 Unit 1							
Standard with code: A.SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.*(Modeling standard) **QualityCore: F.1.a, H.2.c, H.2.d, H.2.e (KCASM does not address finding the sum of an arithmetic series, exploration and derivation of the sum of an arithmetic series could occur in connection to a variety of standards, including an application of SMP 8)**							
Domain: Seeing Structure in Expressions		**Cluster: Write expressions in equivalent forms to solve problems**					
Quarter 1:		**Quarter 2:**		**Quarter 3:**		**Quarter 4:** Find the first term in a geometric sequence given at least two other terms. Define a geometric series as a series with a constant ratio between successive terms. Use the formula $S = a\frac{(1-r^n)}{(1-r)}$ or an equivalent form to solve problems. Derive a formula (i.e. equivalent to the formula $S = a\frac{(1-r^n)}{(1-r)}$ for the sum of a finite geometric series (when the common ratio is not 1). *Note from Appendix A: Consider extending A.SSE.4 to infinite geometric series in curricular implementations of this course description.*	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Present and defend the derivation of the formula for the sum of a finite geometric series. One approach: $S = a + ar + ar^2 + ar^3 + \ldots + ar^n$ $rS = ar + ar^2 + ar^3 + \ldots + ar^{n+1}$ $rS - S = ar^{n+1} - a = a(r^{n+1} - 1)$ $S = a(r^{n+1} - 1)/(r - 1)$, Recognize geometric series which exist in problem situations and use the sum formula to simplify and solve problems.	Geometric series	Students know: Characteristics of a geometric series, Techniques for performing algebraic manipulations and justifications for the equivalence of the resulting expressions (including Tables 3, 4, and 5).	Students understand/are able to: Identify the regularity that exists in a series as being that which defines it as a geometric series. Accurately perform the procedures involved in using geometric series to solve contextual problems, Explain with mathematical reasoning why each step in the derivation of the formula for the sum of a finite geometric series is legitimate, including explaining why the formula does not hold for a common ratio of 1. When each term of a geometric series is multiplied by a value, the result is a new geometric series, When many problems exist with the same mathematical structure, formulas are useful generalizations for efficient solution of problems, (e.g., mortgage payment calculation with geometric series).	**Level IV Students will:** **EEA-SSE.4.** Find the missing components when given various ratios that form proportions. Ex. Complete ratios such as 2:5 is equivalent to (4):10. Ex. Complete the ratio table.* **Level III Students will:** **EEA-SSE.4.** Identify the missing part in any other equivalent ratio when given any ratio. Ex. If there are two worms for every bird, how many worms would three birds get?* Worms Ex. Complete a ratio table.* Ex. Complete the ratio table with symbols or objects.* **Level II Students will:** **EEA-SSE.4.** Identify the missing part in the next ratio using concrete objects when given a ratio (1:_). Ex. Find the pattern that exists between two-colored chips with the pattern of BBBB. Ex. A student has one red dot and two blue dots. If another red dot is given to the student, the student will identify how many blue dots should be added to maintain the ratio of 1:2. Ex. Bead a necklace with a given ratio (three red beads, four yellow beads, three red beads, etc.). **Level I Students will:** **EEA-SSE.4.** Identify or demonstrate a ratio relationship (See the recommendation for 6.RP.1 Level II). Ex. Set out 10 envelopes; match three pieces of correspondence to each envelope to complete task. ***Refer to the Common Core Essential Elements document for diagram.**

Grade Level/ Course (HS): Algebra 2 Unit 1							
Standard with code: A.APR. 2 Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x). **Quality Core: F.1.a, F.1.b, F.2.a, F.2.b, F.2.c**							
Domain: Arithmetic with polynomials and rational expressions		**Cluster: Understand the relationship between zeros and factors of polynomials**					
Quarter 1:		**Quarter 2:**		**Quarter 3:**		**Quarter 4:** Define the remainder theorem for polynomial division and divide polynomials. Given a polynomial p(x) and a number a, divide p(x) by (x – a) to find p(a) then apply the remainder theorem and conclude that p(x) is divisible by x – a if and only if p(a) = 0.	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a polynomial p(x): Identify when (x - a) is a factor of the given polynomial p(x), Identify when (x - a)is not a factor, then the remainder when p(x) is divided by (x - a) is p(a).	If and only if Remainder theorem	Students know: Procedures for dividing a polynomial p(x) by a linear polynomial (x - a), (e.g., long division and synthetic division).	Students understand/are able to: Accurately perform procedures for dividing a polynomial p(x) by a linear polynomial (x - a), Evaluate a polynomial p(x) for any value of x. There is a structural relationship between the value of a in (x - a), as well as the remainder when p(x) is divided by (x - a).	**EEA-APR.2** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Quality Core: F.1.a, F,1,b</td></tr>
<tr><td colspan="2">Domain: Arithmetic with Polynomial and Rational Expressions</td><td colspan="6">Cluster: Perform arithmetic operations on polynomials</td></tr>
<tr><td colspan="2">Quarter 1:

Define “closure”.</td><td colspan="2">Quarter 2:

Define “closure”.</td><td colspan="2">Quarter 3:

Identify that the sum, difference, or product of two polynomials will always be a polynomial, which means that polynomials are closed under the operations of addition, subtraction, and multiplication.

Define “closure”.

Apply arithmetic operations of addition, subtraction, and multiplication to polynomials.

Note from Appendix A: Algebra 2 should extend beyond the quadratic polynomials found in Algebra I.</td><td colspan="2">Quarter 4:

Define “closure”.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Use the repeated reasoning from prior knowledge of properties of arithmetic on integers to progress consistently to rules for arithmetic on polynomials, Accurately perform combinations of operations on various polynomials.	Polynomials Closure	Students know: Corresponding rules of arithmetic of integers, specifically what it means for the integers to be closed under addition, subtraction, and multiplication, and not under division, Procedures for performing addition, subtraction, and multiplication on polynomials.	Students understand/are able to: Communicate the connection between the rules for arithmetic on integers and the corresponding rules for arithmetic on polynomials, Accurately perform combinations of operations on various polynomials. There is an operational connection between the arithmetic on integers and the arithmetic on polynomials.	**EEA-APR.1** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: A.APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Quality Core: F.1.b, F.2.a, F.2.b, F.2.c, F.2.d</td></tr>
<tr><td colspan="2">Domain: Arithmetic with Polynomial and Rational Expressions</td><td colspan="6">Cluster: Understand the relationship between zeros and factors of polynomials</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:

When suitable factorizations are available, factor polynomials using any available methods.

Create a sign chart for a polynomial f(x) using the polynomial’s x-intercepts and testing the domain intervals for which f(x) greater than and less than zero.

Use the x-intercepts of a polynomial function and the sign chart to construct a rough graph of the function.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given any polynomial, Analyze and determine if suitable factorizations exist, Use the root determined by these factorizations to construct a graph of the given polynomials. The graph should include all real roots, Utilize techniques such as plotting points between and outside roots or use technology to find the general shape of the graph.	Zeros of polynomial Factorization	Students know: When a factorization of a polynomial reveals a root of that polynomial, When a rearrangement of the terms of a polynomial expression can reveal a recognizable factorable form of the polynomial, Relationships of roots to points on the graph of the polynomial.	Students understand/are able to: Use techniques for factoring polynomials. Important features of the graph can be revealed by inputting values between the identified roots of the given polynomial.	**EEA-APR.3** N/A

Grade Level/ Course (HS): Algebra 2 Unit 1							
Standard with code: A.APR.4 Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples. Quality Core: F.1.a (A component of this KCASM can be addressed through F.1.a, although the "proof" component is not addressed by any QC objectives.)							
Domain: Arithmetic with Polynomial and Rational Expressions		**Cluster: Use polynomial identities to solve problems**					
Quarter 1:		**Quarter 2:**		**Quarter 3:** Explain that an identity shows a relationship between two quantities, or expressions, that is true for all values of the variables, over a specified set. Prove polynomial identities. Use polynomial identities to describe numerical relationships.		**Quarter 4:** Explain that an identity shows a relationship between two quantities, or expressions, that is true for all values of the variables, over a specified set. Prove polynomial identities. Use polynomial identities to describe numerical relationships.	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Use properties of operations on polynomials to justify identities such as: $(a+b)^2 = a^2 + 2ab + b^2$ $(a+b)(c+d) = ac + ad + bc + bd$ $a^2 - b^2 = (a+b)(a-b)$ $x^2 + (a+b)x + ab = (x + a)(x + b)$ $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$, Use these identities to describe numerical relationships (e.g., identity 3 can be used to mentally compute 79 x 81, or identity 5 can be used as a generator for Pythagorean triples).	Polynomial identity	Students know: Distributive Property of multiplication over addition.	Students understand/are able to: Accurately perform algebraic manipulations on polynomial expressions. Reasoning with abstract polynomial expressions reveals the underlying structure of the Real Number System, Justification of generalizations is necessary before using these generalizations in applied settings.	**EEA-APR.4** N/A

Grade Level/ Course (HS): Algebra 2 Unit 1							
Standard with code: A.APR.5 (+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle. Quality Core: F.1.a							
Domain: Arithmetic with Polynomials and Rational Expressions		**Cluster: Use polynomial identities to solve problems**					
Quarter 1:		**Quarter 2:**		**Quarter 3:** Define the Binomial Theorem and compute combinations. Apply the Binomial theorem to expand (x+y)n, when *n* is a positive integer and *x* and *y* are any number, rather than expanding by multiplying. Explain the connection between Pascal's Triangle and the determination of the coefficients in the expansion of (x+y)n, when *n* is a positive integer and *x* and *y* are any number.		**Quarter 4:** Define the Binomial Theorem and compute combinations. Apply the Binomial theorem to expand (x+y)n, when *n* is a positive integer and *x* and *y* are any number, rather than expanding by multiplying. Explain the connection between Pascal's Triangle and the determination of the coefficients in the expansion of (x+y)n, when *n* is a positive integer and *x* and *y* are any number.	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Expand $(x + y)^n$ for sequential cases n = 1,2,3... that indicate a pattern, note the regularity in the pattern of exponents and coefficients, and generalize the expansion to the Binomial Theorem by, for example, connecting the pattern of Pascal's Triangle to the pattern of coefficients in the binomial expansion or through combinatory, Use the patterns present in the Binomial Theorem to expand binomials and identify coefficients of particular terms.	Binomial Theorem Pascal's Triangle Combinatory	Students know: Distributive Property of multiplication over addition for polynomials, The generation pattern for Pascal's Triangle and which Binomial Expansion term has coefficients corresponding to each row.	Students understand/are able to: Accurately perform algebraic manipulations on polynomial expressions, Generate rows of Pascal's Triangle. Regularities noted in one part of mathematics may also be seen in very different areas of mathematics, (i.e., Pascal's Triangle from counting procedures and the Binomial Theorem) and these regularities are useful in computing or manipulating mathematical expressions.	**EEA-APR.5** N/A (+)

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: A.APR.6 Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

Quality Core: F.1.b, G.1.e</td></tr>
<tr><td colspan="2">Domain: Arithmetic with Polynomials and Rational Expressions</td><td colspan="6">Cluster: Rewrite rational expressions</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:
Use inspection to rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$.

Use long division to rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$.

Use a computer algebra system to rewrite complicated rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$.</td><td colspan="2">Quarter 4:
Use inspection to rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
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Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a rational expression in the form a(x)/b(x), Rewrite rational expressions of the form q(x) + r(x)/b(x) with the degree of r(x) less than the degree of b(x),choosing the most appropriate technique from inspection when b(x)is a common factor of the terms of a(x), long division for other examples and a computer algebra system for more complicated examples.	Rational expression Degree of polynomial Inspection	Students know: Techniques for long division of polynomials, Techniques for utilizing a computer algebra system.	Students understand/are able to: Accurately perform polynomial long division, Efficiently and accurately use a computer algebra system to divide polynomials. The role of the remainder in polynomial division is analogous to that of the remainder in whole number division, Different forms of rational expressions are useful to reveal important features of the expression.	**EEA-APR.6** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Quality Core: G.1.a, G.1.b, G.1.c, G.1.d, G.1.e, G.1.f, G.1.g</td></tr>
<tr><td colspan="2">Domain: Reasoning with Equations and Inequalities</td><td colspan="6">Cluster: Understand solving equations as a process of reasoning and explain the reasoning</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:

Determine the domain of a radical function.

Solve radical equations in one variable.

Give examples showing how extraneous solutions may arise when solving rational and radical equations.</td><td colspan="2">Quarter 4:

Determine the domain of a rational function.

Determine the domain of a radical function.

Solve radical equations in one variable.

Solve rational equations in one variable.

Give examples showing how extraneous solutions may arise when solving rational and radical equations.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Solve problems involving rational and radical equations in one variable, Identify extraneous solutions to these equations if any, Produce examples of equations that would or would not have extraneous solutions and communicate the conditions that lead to the extraneous solutions.	Rational equations Radical equations Extraneous solutions	Students know: Algebraic rules for manipulating rational and radical equations, Conditions under which a solution is considered extraneous.	Students understand/are able to: Accurately rearrange rational and radical equations to produce a set of values to test against the conditions of the original situation and equation, and determine whether or not the value is a solution, Explain with mathematical and reasoning from the context (when appropriate) why a particular solution is or is not extraneous. The structure of mathematics present in the properties of the operations can be used to maintain equality while rearranging equations, as well as to justify steps in the finding of solutions of equations. Values which arise from solving equations may not satisfy the original equation, Values which arise from solving the equations may not exist due to considerations in the context.	**EEA-REI.1-2.** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: A.APR.7 (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

QualityCore: G.1.a, G.1.e</td></tr>
<tr><td colspan="2">Domain: Arithmetic with Polynomials and Rational Expressions</td><td colspan="6">Cluster: Rewrite rational expressions</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:

Add, subtract, multiply, and divide rational expressions.

Informally verify that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Will explain with mathematical reasoning why adding, subtracting, multiplying, or dividing a rational expression by a nonzero rational expression must yield a rational expression. Alternatively, the sum, product, difference, or quotient of rational expression must be rational. Given two rational expressions, Accurately produce a single rational expression that is the sum, product. difference, or quotient (nonzero divisor) of the two rational expressions.	Rational expression Closed under an operation	Students know: Techniques for performing the operations on polynomials.	Students understand/are able to: Accurately perform addition, subtraction, multiplication, and division of rational expressions. They can communicate a mathematical justification for all four operations on rational expressions being closed, The structure of mathematics (closed under the four operations) present in the system of rational numbers is also present in the system of rational expressions.	**EEA-APR.7** N/A (+)

Grade Level/ Course (HS): Algebra 2 Unit 1

Standard with code: A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*(*Modeling standard)

Quality Core: E.1.d, F.2.a, F.2.b, F.2.d, (This KCASM connects to QC F.2.a, b, and d objectives if function f(x) or g(x) are defined as the zero polynomial) G.1.f, (A.REI.11 is an underpinning standard for QC D.2.a and E.2.c.)

Domain: Reasoning with Equations and Inequalities	**Cluster: Represent and solve equations and inequalities graphically**

Quarter 1:	**Quarter 2:**	**Quarter 3:**	**Quarter 4:**
Recognize and use function notation to represent linear, polynomial, rational, absolute value, exponential, and radical equations. Approximate/find the solution(s) using an appropriate method for example, using technology to graph the functions, make tables of values or find successive approximations. *Note from Appendix A:* *Include combinations of linear, polynomial, rational, radical, absolute value, and exponential functions.*	Recognize and use function notation to represent linear, polynomial, rational, absolute value, exponential, and radical equations. Approximate/find the solution(s) using an appropriate method for example, using technology to graph the functions, make tables of values or find successive approximations. *Note from Appendix A:* *Include combinations of linear, polynomial, rational, radical, absolute value, and exponential functions.*	Recognize and use function notation to represent linear, polynomial, rational, absolute value, exponential, and radical equations. Explain why the x-coordinates of the points where the graph of the equations y=f(x) and y=g(x) intersect are the solutions of the equations f(x)=g(x). Approximate/find the solution(s) using an appropriate method for example, using technology to graph the functions, make tables of values or find successive approximations. *Note from Appendix A:* *Include combinations of linear, polynomial, rational, radical, absolute value, and exponential functions.*	Recognize and use function notation to represent linear, polynomial, rational, absolute value, exponential, and radical equations. Explain why the x-coordinates of the points where the graph of the equations y=f(x) and y=g(x) intersect are the solutions of the equations f(x)=g(x). Approximate/find the solution(s) using an appropriate method for example, using technology to graph the functions, make tables of values or find successive approximations. *Note from Appendix A:* *Include combinations of linear, polynomial, rational, radical, absolute value, and exponential functions.*

Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given two functions (linear, polynomial, rational, absolute value, exponential, and logarithmic) that intersect (e.g., $y= 3x$ and $y= 2^x$), - Graph each function and identify the intersection point(s), - Explain solutions for $f(x) = g(x)$ as the x-coordinate of the points of intersection of the graphs, and explain solution paths (e.g., the values that make $3x = 2^x$ true, are the x-coordinate intersection points of $y=3x$ and $y=2^x$, - Use technology, tables, and successive approximations to produce the graphs, as well as to determine the approximation of solutions.	Functions Successive approximations Linear functions Polynomial functions Rational functions Absolute value functions Exponential functions Logarithmic functions	Students know: Defining characteristics of linear, polynomial, rational, absolute value, exponential, and logarithmic graphs, Methods to use technology, tables, and successive approximations to produce graphs and tables for linear, polynomial, rational, absolute value, exponential, and logarithmic functions.	Students understand/are able to: Determine a solution or solutions of a system of two functions, Accurately use technology to produce graphs and tables for linear, polynomial, rational, absolute value, exponential, and logarithmic functions, Accurately use technology to approximate solutions on graphs. When two functions are equal, the x coordinate(s) of the intersection of those functions is the value that produces the same output (y-value) for both functions, Technology is useful to quickly and accurately determine solutions and produce graphs of functions.	**Level IV Students will:** **EEA-REI.10.** Make a prediction using the graph of an equation with two variables that form a line when plotted using the trend of the line. Ex. Given the graph of a linear function based on real-world situations (e.g., How much money do I earn (y) if I work a given number of hours (x) at $5 dollars per hour; (y = 5 x hours), use this information to make predictions (e.g., If you work six hours, how much will you make?). Ex. Given the graph of a linear function based on cost per pizza and the number of pizzas bought [e.g., If pizza is $5, then the total cost (y) = 5 x the number bought (x)], use this information to make predictions. **Level III Students will:** **EEA-REI.10.** Determine the two pieces of information that are plotted on a graph of an equation with two variables that form a line when plotted. Ex. Follow the line on the graph to tell the two pieces of information in each point (total cost and Items bought). Ex. Given the graph of a linear function based on cost per pizza and the number of pizzas bought (e.g., number of pizzas bought and total price), follow the line on the graph to tell the two pieces of information at a given point. **Level II Students will:** **A-REI.10.** Use a graph of two variables to find the answer to a real-world problem. Ex. Locate objects using a map with pictorial cues using two coordinates to find one position on a simple map. Ex. Gain basic information from a graph (total cost of two items). **Level I Students will:** **A-REI.10.** Identify major parts of a graph. Ex. Point to the numbers that tell me how many items I bought. Ex. Point to the numbers that tell me how much the total cost is. Ex. Trace the line with your finger – show where the line would go if it continued.

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 2</td></tr>
<tr><td colspan="8">Standard with code: F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

Quality Core: G.3.b, G.3.c, G.3.g (While this standard does not make an explicit connection to degree measurement, there is a progression from KCASM G.C.5 towards F.TF.5 that this connection would strengthen, and then clearly connect to G.3.c).</td></tr>
<tr><td colspan="2">Domain: Trigonometric Functions</td><td colspan="6">Cluster: Extend the domain of trigonometric functions using the unit circle.</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:

Explain the relationship between a counterclockwise radian measure of an angle along the unit circle, terminal coordinate on the unit circle of that angle, and the associated real number.

Explain how radian measures of angles of the unit circle in the coordinate plane enable the extension of trigonometric functions to all real numbers.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a unit circle and an angle in radians in the first quadrant of the coordinate plane, Use right triangles and the definitions of the trigonometric functions to find the trigonometric ratios for the angle in radian measure when the angle is defined on the unit circle. Given a unit circle and an angle measured in radians traversed counterclockwise around the circle in any quadrant, Determine a reference angle (smallest angle from the x-axis to the terminal ray of the original angle), and use congruent triangles and trigonometric ratios of the reference angle to define trigonometric ratios for angles of any real number size with an adjustment in sign.	Unit circle Radian measure	Students know: Trigonometric ratios for right triangles, The appropriate sign for coordinate values in each quadrant of a coordinate graph.	Students understand/are able to: Accurately find relationships of trigonometric functions for an acute angle of a right triangle to measures within the unit circle, Justify triangle similarity, Find the reference angle for any angle found by a revolution on a ray in the coordinate plane, Relate the trigonometric ratios for the reference angle to those of the original angle, Determine the appropriate sign for trigonometric functions of angles of any given size. Trigonometric functions may be extended to all real numbers from being defined only for acute angles in right triangles by using the unit circle, reflections, and logical reasoning.	**EEF-TF.1-2.** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 1</td></tr>
<tr><td colspan="8">Standard with code: F.IF.7c Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*(Modeling standard) c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

Quality Core: F.2.c, F.2.d</td></tr>
<tr><td colspan="2">Domain: Interpreting Functions</td><td colspan="6">Cluster: Analyze functions using different representations</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:
Graph polynomial functions, by hand in simple cases or using technology for more complicated cases, and show/label maxima and minima of the graph, identify zeros when suitable factorizations are available, and show end behavior.

Determine the difference between simple and complicated polynomial functions, and know when the use of technology is appropriate.

Relate the relationship between zeros of quadratic functions and their factored forms to the relationship between polynomial functions of degrees greater than two.

Notes from Appendix A: Relate F.IF.7c to the relationship between zeros of quadratic functions and their factored forms.</td><td colspan="2">Quarter 4:</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
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Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation that can be modeled by a trig function (i.e., tides, temperature, sunrise), Solve and interpret the solution using technology when appropriate. Given a trig function, Realize that the inverse operation will have multiple solutions that may not be appropriate to the context.	Inverse functions Trigonometric equations	Students know: Periodic situations are best modeled by trig functions. Solutions that are mathematically possible may not be physically possible in the context of the problem. Determine when technology is appropriate to finding a solution.	Students understand/are able to: Solve a trig equation. Interpret the meaning of the solution. Interpret a domain in a contextual situation. Use technology to solve a trig equation. Translate a computed solution to an equivalent solution that fits in the physical domain (i.e., If -30 degrees is a solution, then another solution can be 330 degrees). There are periodic phenomena in real life that can be modeled by trig functions. From the many solutions that result from a periodic function, only some may be logical given the context.	**EEF-TF.7.** N/A (+)

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 2</td></tr>
<tr><td colspan="8">Standard with code: F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

Quality Core: G.3.b, G.3.c, G.3.g (While this standard does not make an explicit connection to degree measurement, there is a progression from KCASM G.C.5 towards F.TF.5 that this connection would strengthen, and then clearly connect to G.3.c).</td></tr>
<tr><td colspan="3">Domain: Trigonometric Functions</td><td colspan="5">Cluster: Extend the domain of trigonometric functions using the unit circle.</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:

Define a radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

Define terminal and initial side of an angle on the unit circle.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a unit circle and an angle that is defined in terms of a fractional part of a revolution, Use the definition of one radian as the measure of the central angle of a unit circle which subtends (cuts off) an arc of length one to determine measures of other central angles as a fraction of a complete revolution (2π for the unit circle), Create a circle in the coordinate plane other than a unit circle, and show that an arc equal in length to the radius defines a triangle inside the circle, similar to one in the unit circle for an arc of length one, so the angle must have the same measure.	Radian measure Subtended Unit circle	Students know: The circumference of any circle is $2\pi r$ and therefore, the circumference of a unit circle is 2π.	Students understand/are able to: Translate between arc length and central angle measures in circles. Radians measure angles as a ratio of the arc length to the radius, The unit circle has a circumference of 2π which aids in sense making for angle measure as revolutions (one whole revolution measures 2π radians) regardless of radius, Use of the unit circle gives a one-to-one ratio between arc length and the measure of the central angle, putting the angle in direct proportion to the arc length, and that the circle can then be divided up to find the radian measure of other angles.	**EEF-TF.1-2.** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 2</td></tr>
<tr><td colspan="8">Standard with code: F.TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.*(*Modeling standard)

Quality Core: G.3.c, G.3.d, G.3.g</td></tr>
<tr><td colspan="2">Domain: Trigonometric Functions</td><td colspan="6">Cluster: Model periodic phenomena with trigonometric functions</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:

Define and recognize the amplitude, frequency, and midline parameters in a symbolic trigonometric function.

Interpret the parameters of a trigonometric function (amplitude, frequency, and midline) in the context of real-world situations.

Explain why real-world or mathematical phenomena exhibits characteristics of periodicity.

Choose trigonometric functions to model periodic phenomena for which the amplitude, frequency, and midline are already specified.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
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Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation of a periodic phenomenon that may be modeled by a trigonometric function, Create a trigonometric function to model the phenomena, Use features such as the specified amplitude, frequency, and midline of the function to justify the model.	Trigonometric functions Periodic phenomena Amplitude Frequency Midline	Students know: Key features of trigonometric functions (e.g., amplitude, frequency, and midline), Techniques for selecting functions to model periodic phenomena.	Students understand/are able to: Determine the amplitude, frequency, and midline of a trigonometric function, Develop a trigonometric function to model periodic phenomena. Trigonometric functions are periodic and may be used to model certain periodic contextual phenomena, Amplitude, frequency, and midline are useful in determining the fit of the function used to model the phenomena.	**EEF-TF.5.** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 2</td></tr>
<tr><td colspan="8">Standard with code: F.TF.8 Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find sin (θ), cos (θ), or tan (θ), given sin (θ), cos (θ), or tan (θ), and the quadrant of the angle.

Quality Core:</td></tr>
<tr><td colspan="2">Domain: Trigonometric Functions</td><td colspan="6">Cluster: Prove and apply trigonometric identities</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:

Define trigonometric ratios as related to the unit circle.

Prove the Pythagorean identity sin2(θ) + cos2(θ) = 1

Use the Pythagorean identity, sin2(θ) + cos2(θ) = 1, to find sin (θ), cos (θ), or tan (θ), given sin (θ), cos (θ), or tan (θ), and the quadrant of the angle.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a right triangle, Use the Pythagorean Theorem and the extensions of the trigonometric ratios using the unit circle to prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$. Given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle, Apply the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ to find the other two ratios ($\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$).		Students know: Methods for finding the sine, cosine, and tangent ratios of a right triangle, The Pythagorean Theorem, Properties of equality (Table 4). The signs of the sine, cosine, and tangent ratios in each quadrant.	Students understand/are able to: Use the unit circle, definitions of trigonometric functions, and the Pythagorean Theorem to prove the Pythagorean Identity $\sin^2(\theta) + \cos^2(\theta) = 1$, Accurately use the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ to find the $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ when given the quadrant and one of the values. There are periodic phenomena in real life that can be modeled by trig functions. From the many solutions that result from a periodic function, only some may be logical given the context.	**EEF-TF.8.** N/A

Grade Level/ Course (HS): Algebra 2 Unit 3

Standard with code: A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

Quality Core: E.1.a, G.3.g, H.2.d, H.2.e ((e.g. for $h(i) = i - 2,$). 4
åh(i) = (2 - 2) + (3 - 2) + (4 - 2)

Domain: Creating Equations*(*Modeling Domain)	**Cluster:** Create equations that describe numbers or relationships		
Quarter 1: Solve all available types of equations & inequalities, including root equations & inequalities, in one variable. Describe the relationships between the quantities in the problem (for example, how the quantities are changing or growing with respect to each other); express these relationships using mathematical operations to create an appropriate equation or inequality to solve. Create equations and inequalities in one variable and use them to solve problems. Create equations and inequalities in one variable to model real-world situations. Compare and contrast problems that can be solved by different types of equations. *Note from Appendix A: Use all available types of functions to create such equations, including root functions, but constrain to simple cases.*	**Quarter 2:** Solve all available types of equations & inequalities, including root equations & inequalities, in one variable. Describe the relationships between the quantities in the problem (for example, how the quantities are changing or growing with respect to each other); express these relationships using mathematical operations to create an appropriate equation or inequality to solve. Create equations and inequalities in one variable and use them to solve problems. Create equations and inequalities in one variable to model real-world situations. Compare and contrast problems that can be solved by different types of equations. *Note from Appendix A: Use all available types of functions to create such equations, including root functions, but constrain to simple cases.*	**Quarter 3:** Solve all available types of equations & inequalities, including root equations & inequalities, in one variable. Describe the relationships between the quantities in the problem (for example, how the quantities are changing or growing with respect to each other); express these relationships using mathematical operations to create an appropriate equation or inequality to solve. Create equations and inequalities in one variable and use them to solve problems. Create equations and inequalities in one variable to model real-world situations. Compare and contrast problems that can be solved by different types of equations. *Note from Appendix A: Use all available types of functions to create such equations, including root functions, but constrain to simple cases.*	**Quarter 4:** Solve all available types of equations & inequalities, including root equations & inequalities, in one variable. Describe the relationships between the quantities in the problem (for example, how the quantities are changing or growing with respect to each other); express these relationships using mathematical operations to create an appropriate equation or inequality to solve. Create equations and inequalities in one variable and use them to solve problems. Create equations and inequalities in one variable to model real-world situations. Compare and contrast problems that can be solved by different types of equations. *Note from Appendix A: Use all available types of functions to create such equations, including root functions, but constrain to simple cases.*

Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation that may include linear, quadratic, exponential, or rational functional relationships in one variable, Model the relationship with equations or inequalities and solve the problem presented in the contextual situation for the given variable. (Please Note: This standard must be taught in conjunction with the standard that follows).		Student know: When the situation presented in a contextual problem is most accurately modeled by a linear, quadratic, exponential, or rational functional relationship.	Students understand/are able to: Write equations or inequalities in one variable that accurately model contextual situations. Features of a contextual problem can be used to create a mathematical model for that problem.	**Level IV Students will:** **EEA-CED.1.** Solve an algebraic expression with more than one variable. Ex. If I have two bills, one of them is a $5 and one of them is unknown. What is the value of the unknown bill if I have $10 total? Ex. If I have some money in my pocket and some money in the other pocket and I still need $3 more to buy the bird that cost $10, how much money is in my pockets? **Level III Students will:** **EEA-SSE.3.** Solve an algebraic expression using subtraction. Ex. If I need $10 and I have $5, how much more money do I need? Ex. If I have two bills, one of them is a $5 and one of them is a $1, how much money do I need to have $10? **Level II Students will:** **EEA-SSE.3.** Solve simple equations with unknown/missing values (without variables). Ex. If I have three dogs and one runs away, how many dogs are left? Ex. I walked to the store to buy a book. I gave the cashier $10 and she gives me back $7. How much was the book? Ex. If I have two pens in my backpack when I get to school and I left home with five pens, how many pens were given away on the trip from home to school? Ex. 5 – [__] = 2. Ex. [__] x 2 = 8. **Level I Students will:** **EEA-SSE.3.** Identify what is unknown. Ex. John has three cats and some dogs. Do we know the number of dogs John has? Ex. Allen ate some apples. Do we know how many he ate?

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 3</td></tr>
<tr><td colspan="8">Standard with code: A.CED.2 Create equations in two or more variables to represent relationships between quantities, graph equations on a coordinate axes with labels and scales.
Quality Core: E.1.a, G.3.g, H.2.d, H.2.e (e.g. for $\sum_{i=2}^{4} h(i) = i - 2$, $h(i) = (2 - 2) + (3 - 2) + (4 - 2)$</td></tr>
<tr><td colspan="2">Domain: Create Equations*(*Modeling Domain)</td><td colspan="6">Cluster: Create equations that describe numbers or relationships</td></tr>
<tr><td colspan="2">Quarter 1:
Identify the quantities in a mathematical problem or real-world situation that should be represented by distinct variables and describe what quantities the variables represent.

Graph one or more created equation on a coordinate axes with appropriate labels and scales.</td><td colspan="2">Quarter 2:
Identify the quantities in a mathematical problem or real-world situation that should be represented by distinct variables and describe what quantities the variables represent.

Graph one or more created equation on a coordinate axes with appropriate labels and scales.

Create at least two equations in two or more variables to represent relationships between quantities
Justify which quantities in a mathematical problem or real-world situation are dependent and independent of one another and which operations represent those relationships.

Determine appropriate units for the labels and scale of a graph depicting the relationship between equations created in two or more variables.</td><td colspan="2">Quarter 3:
Identify the quantities in a mathematical problem or real-world situation that should be represented by distinct variables and describe what quantities the variables represent.

Graph one or more created equation on a coordinate axes with appropriate labels and scales.

Create at least two equations in two or more variables to represent relationships between quantities
Justify which quantities in a mathematical problem or real-world situation are dependent and independent of one another and which operations represent those relationships.

Determine appropriate units for the labels and scale of a graph depicting the relationship between equations created in two or more variables.</td><td colspan="2">Quarter 4:
Identify the quantities in a mathematical problem or real-world situation that should be represented by distinct variables and describe what quantities the variables represent.

Graph one or more created equation on a coordinate axes with appropriate labels and scales.

Note from Appendix A: (While functions used in A.CED.2will often be linear, exponential, or quadratic the types of problems should draw from more complex situations than those addressed in Algebra I. For example, finding the equation of a line through a given point perpendicular to another line allows one to find the distance from a point to a line.)</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation expressing a relationship between quantities with two or more variables, Model the relationship with equations and graph the relationship on coordinate axes with labels and scales. (Please Note: This standard must be taught in conjunction with the preceding standard).		Students know: When a particular two variable equation accurately models the situation presented in a contextual problem.	Students understand/are able to: Write equations in two variables that accurately model contextual situations, Graph equations involving two variables on coordinate axes with appropriate scales and labels. There are relationships among features of a contextual problem, a created mathematical model for that problem, and a graph of that relationship.	**Level IV Students will:** **EEA-CED.2-4.** Solve two-step inequalities with a variable. Ex. If I buy two movie tickets for $5 each and two drinks at $4 each, will $15 be enough money? Ex. I walked to the store to buy a book. I gave the cashier $10. She said, "You need twice this amount." How much is the book? Ex. I went to the store to buy two items that cost x dollars each plus a $5 membership fee. The total cost is more than $25. How much must each item cost? $2x + 5 > 25$. **Level III Students will:** **EEA-CED.2-4.** Solve one-step inequalities. Ex. Sally wants to buy a shirt that costs $15. She has $10. How much more money does she need? Ex. Mike has six apples. Two of his friends are joining him for snack. Mike wants to share his apples with his friends. Does he have enough to give each friend two apples? **Level II Students will:** **EEA-CED.2-4.** Verify the solution to an inequality with one variable. Ex. You have $10 and buy socks that cost $2. Will you get change? Ex. I walk to the store and buy a book. If I give the cashier $10 and she says I do not have enough money, is the book more or less than $10? Ex. You have $1 and your breakfast costs $2. Do you need more money? **Level I Students will:** **EEA-CED.2-4.** Identify quantities that are greater than or less than a given quantity. Ex. Using a number line indicate greater than or less than a given number. Ex. Mike has five oranges and Mary has two oranges. Who has more oranges? Ex. Sarah has $50 and Cindy has $30. Who has more money? Ex. Is five more or less than three? Ex. If Sue has baseball cards and Tim has five, who has the most/fewest baseball cards?

Grade Level/ Course (HS): Algebra 2 Unit 3

Standard with code: A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

Quality Core: D.1.b, D.1.c, D.2.a, E.1.d, E.2.c, G.3.g

Domain: Creating Equations* (*Modeling Domain)	**Cluster: Create equations that describe numbers or relationships**		
Quarter 1: Recognize when a modeling context involves constraints.	**Quarter 2:** Recognize when a modeling context involves constraints. Determine when a problem should be represented by equations, inequalities, systems of equations and/ or inequalities. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities. *Note from Appendix A: While functions used will often be linear, exponential, or quadratic the types of problems should draw from more complex situations than those addressed in Algebra I. For example, finding the equation of a line through a given point perpendicular to another line allows one to find the distance from a point to a line.*	**Quarter 3:** Recognize when a modeling context involves constraints. Interpret solutions as viable or nonviable options in a modeling context. Determine when a problem should be represented by equations, inequalities, systems of equations and/ or inequalities. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities. *Note from Appendix A: While functions used will often be linear, exponential, or quadratic the types of problems should draw from more complex situations than those addressed in Algebra I. For example, finding the equation of a line through a given point perpendicular to another line allows one to find the distance from a point to a line.*	**Quarter 4:** Recognize when a modeling context involves constraints. Interpret solutions as viable or nonviable options in a modeling context. Determine when a problem should be represented by equations, inequalities, systems of equations and/ or inequalities. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities. *Note from Appendix A: While functions used will often be linear, exponential, or quadratic the types of problems should draw from more complex situations than those addressed in Algebra I. For example, finding the equation of a line through a given point perpendicular to another line allows one to find the distance from a point to a line.*

Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation involving constraints, Write equations or inequalities or a system of equations or inequalities that model the situation and justify each part of the model in terms of the context, Solve the equation, inequalities or systems and interpret the solution in the original context including discarding solutions to the mathematical model that cannot fit the real world situation (e.g., distance cannot be negative), Solve a system by graphing the system on the same coordinate grid and determine the point(s) or region that satisfies all members of the system, Determine the point(s) of the region satisfying all members of the system that maximizes or minimizes the variable of interest in the case of a system of inequalities.	Constraint	Students know: When a particular system of two variable equations or inequalities accurately models the situation presented in a contextual problem, Which points in the solution of a system of linear inequalities need to be tested to maximize or minimize the variable of interest.	Students understand/are able to: Graph equations and inequalities involving two variables on coordinate axes, Identify the region that satisfies both inequalities in a system, Identify the point(s) that maximizes or minimizes the variable of interest in a system of inequalities, Test a mathematical model using equations, inequalities, or a system against the constraints in the context and interpret the solution in this context. A symbolic representation of relevant features of a real world problem can provide for resolution of the problem and interpretation of the situation and solution, Representing a physical situation with a mathematical model requires consideration of the accuracy and limitations of the model.	**Level IV Students will:** **EEA-CED.2-4.** Solve two-step inequalities with a variable. Ex. If I buy two movie tickets for $5 each and two drinks at $4 each, will $15 be enough money? Ex. I walked to the store to buy a book. I gave the cashier $10. She said, "You need twice this amount." How much is the book? Ex. I went to the store to buy two items that cost x dollars each plus a $5 membership fee. The total cost is more than $25. How much must each item cost? $2x + 5 > 25$. **Level III Students will:** **EEA-CED.2-4.** Solve one-step inequalities. Ex. Sally wants to buy a shirt that costs $15. She has $10. How much more money does she need? Ex. Mike has six apples. Two of his friends are joining him for snack. Mike wants to share his apples with his friends. Does he have enough to give each friend two apples? **Level II Students will:** **EEA-CED.2-4.** Verify the solution to an inequality with one variable. Ex. You have $10 and buy socks that cost $2. Will you get change? Ex. I walk to the store and buy a book. If I give the cashier $10 and she says I do not have enough money, is the book more or less than $10? Ex. You have $1 and your breakfast costs $2. Do you need more money? **Level I Students will:** **EEA-CED.2-4.** Identify quantities that are greater than or less than a given quantity. Ex. Using a number line indicate greater than or less than a given number. Ex. Mike has five oranges and Mary has two oranges. Who has more oranges? Ex. Sarah has $50 and Cindy has $30. Who has more money? Ex. Is five more or less than three? Ex. If Sue has baseball cards and Tim has five, who has the most/fewest baseball cards?

Grade Level/ Course (HS): Algebra 2 Unit 3

Standard with code: A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

Quality Core: This KCASM standard undergirds many standards within the assessed QC conceptual areas, including, but not limited to: F.1.a, G.1.a, G.1.g

Domain: Creating Equations*(*Modeling Domain)	**Cluster: Create equations that describe numbers and relationships**		
Quarter 1:	**Quarter 2:** Define a "quantity of interest" to mean any numerical or algebraic quantity (e.g. $2\left(\frac{a}{b}\right) = d$, in which 2 is the quantity of interest showing that d must be even; $\frac{\pi r^2 h}{3} = V_{cone}$ and $\pi r^2 h = V_{cylinder}$ showing that $V_{cylinder} = 3 * V_{cone}$) Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (e.g. π r2 can be re-written as (π r)r which makes the form of this expression resemble bh. *The quantity of interest could also be (a +b)n = a n b0 + a(n-1)b1 + … + a0b n*).	**Quarter 3:** Define a "quantity of interest" to mean any numerical or algebraic quantity (e.g. $2\left(\frac{a}{b}\right) = d$, in which 2 is the quantity of interest showing that d must be even; $\frac{\pi r^2 h}{3} = V_{cone}$ and $\pi r^2 h = V_{cylinder}$ showing that $V_{cylinder} = 3 * V_{cone}$) Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (e.g. π r2 can be re-written as (π r)r which makes the form of this expression resemble bh. *The quantity of interest could also be (a +b)n = a n b0 + a(n-1)b1 + … + a0b n*). *Note from Appendix A: While functions used will often be linear, exponential, or quadratic the types of problems should draw from more complex situations than those addressed in Algebra I. For example, finding the equation of a line through a given point perpendicular to another line allows one to find the distance from a point to a line. Note that the example given for A.CED.4 applies to earlier instances of this standard, not to the current course.*	**Quarter 4:** Define a "quantity of interest" to mean any numerical or algebraic quantity (e.g. $2\left(\frac{a}{b}\right) = d$, in which 2 is the quantity of interest showing that d must be even; $\frac{\pi r^2 h}{3} = V_{cone}$ and $\pi r^2 h = V_{cylinder}$ showing that $V_{cylinder} = 3 * V_{cone}$) Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (e.g. π r2 can be re-written as (π r)r which makes the form of this expression resemble bh. *The quantity of interest could also be (a +b)n = a n b0 + a(n-1)b1 + … + a0b n*).

Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Rearrange formulas which arise in contextual situations to isolate variables that are of interest for particular problems. For example, if the electric company charges for power by the formula COST = 0.03 KWH + 15, a consumer may wish to determine how many kilowatt hours they may use to keep the cost under particular amounts, by considering KWH< (COST - 15)/0.03 which would yield to keep the monthly cost under $75, they need to use less than 2000 KWH.		Students know: Properties of equality and inequality (Tables 4 and 5).	Students understand/are able to: Accurately rearrange equations or inequalities to produce equivalent forms for use in resolving situations of interest. The structure of mathematics allows for the procedures used in working with equations to also be valid when rearranging formulas, The isolated variable in a formula is not always the unknown and rearranging the formula allows for sense-making in problem solving.	**Level IV Students will:** **EEA-CED.2-4.** Solve two-step inequalities with a variable. Ex. If I buy two movie tickets for $5 each and two drinks at $4 each, will $15 be enough money? Ex. I walked to the store to buy a book. I gave the cashier $10. She said, "You need twice this amount." How much is the book? Ex. I went to the store to buy two items that cost x dollars each plus a $5 membership fee. The total cost is more than $25. How much must each item cost? $2x + 5 > 25$. **Level III Students will:** **EEA-CED.2-4.** Solve one-step inequalities. Ex. Sally wants to buy a shirt that costs $15. She has $10. How much more money does she need? Ex. Mike has six apples. Two of his friends are joining him for snack. Mike wants to share his apples with his friends. Does he have enough to give each friend two apples? **Level II Students will:** **EEA-CED.2-4.** Verify the solution to an inequality with one variable. Ex. You have $10 and buy socks that cost $2. Will you get change? Ex. I walk to the store and buy a book. If I give the cashier $10 and she says I do not have enough money, is the book more or less than $10? Ex. You have $1 and your breakfast costs $2. Do you need more money? **Level I Students will:** **EEA-CED.2-4.** Identify quantities that are greater than or less than a given quantity. Ex. Using a number line indicate greater than or less than a given number. Ex. Mike has five oranges and Mary has two oranges. Who has more oranges? Ex. Sarah has $50 and Cindy has $30. Who has more money? Ex. Is five more or less than three? Ex. If Sue has baseball cards and Tim has five, who has the most/fewest baseball cards?

Grade Level/ Course (HS): Algebra 2 Unit 3							
Standard with code: F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. *(Modeling standard) **Quality Core: G.3.e, G.3.f, G.3.g**							
Domain: Interpreting Functions		**Cluster: Interpret functions that arise in applications in terms of the context.**					
Quarter 1: Define and recognize the key features in tables and graphs of linear, exponential, and quadratic functions: intercepts; intervals where the function is increasing, decreasing, positive, or negative, relative maximums and minimums, symmetries, end behavior and periodicity. Identify the type of function, given its table or graph. Interpret key features of graphs and tables of functions in the terms of the contextual quantities the function represents. Sketch graphs showing key features of a function that models a relationship between two quantities from a given verbal description of the relationship. *Notes from Appendix A: Emphasize selection of a model function based on behavior of data and context.*		**Quarter 2:** Define and recognize the key features in tables and graphs of linear, exponential, and quadratic functions: intercepts; intervals where the function is increasing, decreasing, positive, or negative, relative maximums and minimums, symmetries, end behavior and periodicity. Identify the type of function, given its table or graph. Interpret key features of graphs and tables of functions in the terms of the contextual quantities the function represents. Sketch graphs showing key features of a function that models a relationship between two quantities from a given verbal description of the relationship. *Notes from Appendix A: Emphasize selection of a model function based on behavior of data and context.*		**Quarter 3:** Define and recognize the key features in tables and graphs of linear, exponential, and quadratic functions: intercepts; intervals where the function is increasing, decreasing, positive, or negative, relative maximums and minimums, symmetries, end behavior and periodicity. Identify the type of function, given its table or graph. Interpret key features of graphs and tables of functions in the terms of the contextual quantities the function represents. Sketch graphs showing key features of a function that models a relationship between two quantities from a given verbal description of the relationship. *Notes from Appendix A: Emphasize selection of a model function based on behavior of data and context.*		**Quarter 4:** Define and recognize the key features in tables and graphs of linear, exponential, and quadratic functions: intercepts; intervals where the function is increasing, decreasing, positive, or negative, relative maximums and minimums, symmetries, end behavior and periodicity. Identify the type of function, given its table or graph. Interpret key features of graphs and tables of functions in the terms of the contextual quantities the function represents. Sketch graphs showing key features of a function that models a relationship between two quantities from a given verbal description of the relationship. *Notes from Appendix A: Emphasize selection of a model function based on behavior of data and context.*	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a function that models a relationship between two quantities, Produce the graph and table of the function and show the key features (intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity) that are appropriate for the function. Given key features from verbal description of a relationship, Sketch a graph with the given key features.	Function Key features	Students know: Key features of function graphs (i.e., intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity), Methods of modeling relationships with a graph or table.	Students understand/are able to: Accurately graph any relationship, Interpret key features of a graph. The relationship between two variables determines the key features that need to be used when interpreting and producing the graph.	**Level IV Students will:** **EEF-IF.4-6.** Evaluate key features of a graph (e.g. increasing, decreasing, constant.). Ex. Determine parts of graph illustrating an increase or decrease in speed. Ex. Using a graph illustrating change in temperature over a day, indicate times when the temperature increased, decreased, or stayed the same. **Level III Students will:** **EEF-IF.4-6.** Interpret rate of change (e.g. higher/lower, faster/slower). Ex. Compare two graphs with different slopes to determine faster/slower rate Ex. Compare a bus schedule with two buses, look and determine if one bus runs more frequently than the next bus on the route. **Level II Students will:** **EEF-IF.4-6.** Graph a simple linear equation represented by a table of values. Ex. Match the graph to its corresponding story. Ex. Plot the points from a table of values less than 10. **Level I Students will:** **EEF-IF.4-6.** Read a table. Ex. From a given table, find information. Ex. Read a bus schedule. Ex. Given a daily schedule, determine the time of lunch during the school day.

Grade Level/ Course (HS): Algebra 2 Unit 3

Standard with code: F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.**(*Modeling standard)

Quality Core: C.1.d, E.2.a, F.2.d, G.3.e (these QC standards concern the determination of range, although F.IF.5 does not explicitly do so; range can be addressed by F.IF.4 or F.IF.5)

Domain: **Interpreting Functions**	**Cluster: Interpret functions that arise in applications in terms of a context**		
Quarter 1: Given the graph or a verbal/written description of a function, identify and describe the domain of the function. Identify an appropriate domain based on the unit, quantity, and type of function it describes. Relate the domain of the function to its graph and, where applicable, to the quantitative relationship it describes. Explain why a domain is appropriate for a given situation. *Notes from Appendix A: Emphasize the selection of a model function based on behavior of data and context.*	**Quarter 2:** Given the graph or a verbal/written description of a function, identify and describe the domain of the function. Identify an appropriate domain based on the unit, quantity, and type of function it describes. Relate the domain of the function to its graph and, where applicable, to the quantitative relationship it describes. Explain why a domain is appropriate for a given situation. *Notes from Appendix A: Emphasize the selection of a model function based on behavior of data and context.*	**Quarter 3:** Given the graph or a verbal/written description of a function, identify and describe the domain of the function. Identify an appropriate domain based on the unit, quantity, and type of function it describes. Relate the domain of the function to its graph and, where applicable, to the quantitative relationship it describes. Explain why a domain is appropriate for a given situation. *Notes from Appendix A: Emphasize the selection of a model function based on behavior of data and context.*	**Quarter 4:** Given the graph or a verbal/written description of a function, identify and describe the domain of the function. Identify an appropriate domain based on the unit, quantity, and type of function it describes. Relate the domain of the function to its graph and, where applicable, to the quantitative relationship it describes. Explain why a domain is appropriate for a given situation. *Notes from Appendix A: Emphasize the selection of a model function based on behavior of data and context.*
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation that is functional, Model the situation with a graph and construct the graph based on the parameters given in the domain of the context.	Function	Students know: Techniques for graphing functions, Techniques for determining the domain of a function from its context.	Students understand/are able to: Interpret the domain from the context, Produce a graph of a function based on the context given. Different contexts produce different domains and graphs, Function notation in itself may produce graph points which should not be in the graph as the domain is limited by the context.	**Level IV Students will:** **EEF-IF.4-6.** Evaluate key features of a graph (e.g. increasing, decreasing, constant.). Ex. Determine parts of graph illustrating an increase or decrease in speed. Ex. Using a graph illustrating change in temperature over a day, indicate times when the temperature increased, decreased, or stayed the same. **Level III Students will:** **EEF-IF.4-6.** Interpret rate of change (e.g. higher/lower, faster/slower). Ex. Compare two graphs with different slopes to determine faster/slower rate Ex. Compare a bus schedule with two buses, look and determine if one bus runs more frequently than the next bus on the route. **Level II Students will:** **EEF-IF.4-6.** Graph a simple linear equation represented by a table of values. Ex. Match the graph to its corresponding story. Ex. Plot the points from a table of values less than 10. **Level I Students will:** **EEF-IF.4-6.** Read a table. Ex. From a given table, find information. Ex. Read a bus schedule. Ex. Given a daily schedule, determine the time of lunch during the school day.

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 3</td></tr>
<tr><td colspan="8">Standard with code: F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*(Modeling standard)

Quality Core: (Interpreting functions throughout QC Algebra 2 course.)</td></tr>
<tr><td colspan="2">Domain: Interpreting Functions</td><td colspan="6">Cluster: Interpret functions that arise in applications in terms of a context</td></tr>
<tr><td colspan="2">Quarter 1:

Recognize slope as an average rate of change.

Calculate the average rate of change of a function (presented symbolically or as a table) over a specified interval.

Estimate the rate of change from a graph.

Interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.

Note from the Appendix A: Emphasize the selection of a model function based on behavior of data and context.</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given an interval on a graph or table, Calculate the average rate of change within the interval. Given a graph of contextual situation, Estimate the rate of change between intervals that are appropriate for the summary of the context.	Average rate of change	Students know: Techniques for graphing, Techniques for finding a rate of change over an interval on a table or graph, Techniques for estimating a rate of change over an interval on a graph.	Students understand/are able to: Calculate rate of change over an interval on a table or graph, Estimate a rate of change over an interval on a graph. The average provides information on the overall changes within an interval, not the details within the interval (an average of the endpoints of an interval does not tell you the significant features within the interval).	**Level IV Students will:** **EEF-IF.4-6.** Evaluate key features of a graph (e.g. increasing, decreasing, constant.). Ex. Determine parts of graph illustrating an increase or decrease in speed. Ex. Using a graph illustrating change in temperature over a day, indicate times when the temperature increased, decreased, or stayed the same. **Level III Students will:** **EEF-IF.4-6.** Interpret rate of change (e.g. higher/lower, faster/slower). Ex. Compare two graphs with different slopes to determine faster/slower rate Ex. Compare a bus schedule with two buses, look and determine if one bus runs more frequently than the next bus on the route. **Level II Students will:** **EEF-IF.4-6.** Graph a simple linear equation represented by a table of values. Ex. Match the graph to its corresponding story. Ex. Plot the points from a table of values less than 10. **Level I Students will:** **EEF-IF.4-6.** Read a table. Ex. From a given table, find information. Ex. Read a bus schedule. Ex. Given a daily schedule, determine the time of lunch during the school day.

Grade Level/ Course (HS): Algebra 2 Unit 3							
Standard with code: F.IF.7b Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*(Modeling standard) b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. Quality Core: E.2.b, F.2.b							
Domain: Interpreting Functions		**Cluster: Analyze functions using different representations**					
Quarter 1: Select the appropriate type of function, taking into consideration the key features, domain, and range, to model a real-world situation. *Note from the Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.*		**Quarter 2:** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions, by hand in simple cases or using technology for more complicated cases, and show/label key features of the graph. Analyze the difference between simple and complicated linear, quadratic, square root, cube root, and piecewise-defined functions, including step functions and absolute value functions and know when the use of technology is appropriate. Compare and contrast the domain and range of absolute value, step and piece-wise defined functions with linear, quadratic, and exponential. Select the appropriate type of function, taking into consideration the key features, domain, and range, to model a real-world situation. *Note from the Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.*		**Quarter 3:** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions, by hand in simple cases or using technology for more complicated cases, and show/label key features of the graph. Analyze the difference between simple and complicated linear, quadratic, square root, cube root, and piecewise-defined functions, including step functions and absolute value functions and know when the use of technology is appropriate. Compare and contrast the domain and range of absolute value, step and piece-wise defined functions with linear, quadratic, and exponential. Select the appropriate type of function, taking into consideration the key features, domain, and range, to model a real-world situation. *Note from the Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.*		**Quarter 4:** Analyze the difference between simple and complicated linear, quadratic, square root, cube root, and piecewise-defined functions, including step functions and absolute value functions and know when the use of technology is appropriate. Compare and contrast the domain and range of absolute value, step and piece-wise defined functions with linear, quadratic, and exponential. Select the appropriate type of function, taking into consideration the key features, domain, and range, to model a real-world situation. *Note from the Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.*	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a symbolic representation of a function (including linear, quadratic, square root, cube root, piecewise-defined functions, polynomial, exponential, logarithmic, trigonometric, and (+) rational), Produce an accurate graph (by hand in simple cases and by technology in more complicated cases) and justify that the graph is an alternate representation of the symbolic function, Identify key features of the graph and connect these graphical features to the symbolic function, specifically for special functions: quadratic or linear (intercepts, maxima, and minima), square root, cube root, and piecewise-defined functions, including step functions and absolute value functions (descriptive features such as the values that are in the range of the function and those that are not), polynomial (zeros when		Students know: Techniques for graphing, Key features of graphs of functions.	Students understand/are able to: Identify the type of function from the symbolic representation, Manipulate expressions to reveal important features for identification in the function, Accurately graph any relationship. Key features are different depending on the function, Identifying key features of functions aid in graphing and interpreting the function.	**EEF-IF.7.** N/A (See EEF-IF.1-3)

suitable factorizations are available, end behavior), (+) rational (zeros and asymptotes when suitable factorizations are available, end behavior), exponential and logarithmic (intercepts and end behavior), trigonometric functions (period, midline, and amplitude).				

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 3</td></tr>
<tr><td colspan="8">Standard with code: F.IF.7e Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*(Modeling standard) e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

Quality Core: E.2.b, G.2.a, G.3.d, G.3.e, G.3.f</td></tr>
<tr><td colspan="2">Domain: Interpreting Functions</td><td colspan="6">Cluster: Analyze functions using different representations</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="3">Quarter 2:</td><td colspan="2">Quarter 3:</td><td>Quarter 4:
Graph exponential, logarithmic, and trigonometric functions, by hand in simple cases or using technology for more complicated cases, and show intercepts and end behavior for exponential and logarithmic functions, and for trigonometric functions, show period, midline, and amplitude.

Analyze the difference between simple and complicated linear, quadratic, square root, cube root, piecewise-defined, exponential, logarithmic, and trigonometric functions, including step functions and absolute value functions and know when the use of technology is appropriate.

Compare and contrast the domain and range of exponential, logarithmic, and trigonometric functions with linear, quadratic, absolute value, step and piece-wise defined functions.
Select the appropriate type of function, taking into consideration the key features, domain, and range, to model a real-world situation.

Note from the Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a symbolic representation of a function (including linear, quadratic, square root, cube root, piecewise-defined functions, polynomial, exponential, logarithmic, trigonometric, and (+) rational), Produce an accurate graph (by hand in simple cases and by technology in more complicated cases) and justify that the graph is an alternate representation of the symbolic function, Identify key features of the graph and connect these graphical features to the symbolic function, specifically for special functions: quadratic or linear (intercepts, maxima, and minima), square root, cube root, and piecewise-defined functions, including step functions and absolute value functions (descriptive features such as the values that are in the range of the function and those that are not), polynomial (zeros when suitable factorizations are available, end behavior), (+) rational (zeros and asymptotes when suitable		Students know: Techniques for graphing, Key features of graphs of functions.	Students understand/are able to: Identify the type of function from the symbolic representation, Manipulate expressions to reveal important features for identification in the function, Accurately graph any relationship. Key features are different depending on the function, Identifying key features of functions aid in graphing and interpreting the function.	**EEF-IF.7.** N/A (See EEF-IF.1-3)

factorizations are available, end behavior), exponential and logarithmic (intercepts and end behavior), trigonometric functions (period, midline, and amplitude).				

Grade Level/ Course (HS): Algebra 2 Unit 3							
Standard with code: F.IF.8a Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. Quality Core: This KCASM standard undergirds many standards within the assessed QC conceptual areas, including, but not limited to: E.1.a, F.1.b, G.1.b, G.1.c, G.1.e							
Domain: Interpreting Functions		**Cluster: Analyze functions using different representations**					
Quarter 1:		**Quarter 2:** Identify how key features of a quadratic function relate to characteristics of in a real-world context. Given the expression of a quadratic function, interpret zeros, extreme values, and symmetry of the graph in terms of a real-world context. Write a quadratic function defined by an expression in different but equivalent forms to reveal and explain different properties of the function and determine which form of the quadratic (i.e. expanded, perfect square form) is the most appropriate for showing zeros, extreme and symmetry of a graph in terms of a real-world context. *Note from Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.*		**Quarter 3:** Identify how key features of a quadratic function relate to characteristics of in a real-world context. Given the expression of a quadratic function, interpret zeros, extreme values, and symmetry of the graph in terms of a real-world context. Write a quadratic function defined by an expression in different but equivalent forms to reveal and explain different properties of the function and determine which form of the quadratic (i.e. expanded, perfect square form) is the most appropriate for showing zeros, extreme and symmetry of a graph in terms of a real-world context. *Note from Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.*		**Quarter 4:**	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation containing a function defined by an expression, Use algebraic properties to rewrite the expression in a form that makes key features of the function easier to find, Manipulate a quadratic function by factoring and completing the square to show zeros, extreme values, and symmetry of the graph, Explain and justify the meaning of zeros, extreme values, and symmetry of the graph in terms of the contextual situation, Apply exponential properties to expressions and explain and justify the meaning in a contextual situation.	Zeros Extreme values Symmetry Exponential growth or decay	Students know: Techniques to factor and complete the square, Properties of exponential expressions, Algebraic properties of equality (Table 4).	Students understand/are able to: Accurately manipulate (e.g., factoring, completing the square) expressions using appropriate technique(s) to reveal key properties of a function. An expression may be written in various equivalent forms, Some forms of the expression are more beneficial for revealing key properties of the function.	**EEF-IF.8.** N/A

Grade Level/ Course (HS): Algebra 2 Unit 3

Standard with code: F.IF.8b Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function: b. Use the properties of exponents to interpret expressions for exponential functions. For example: identify percent rate of change in functions such as $y= (1.02)^t$, $y=(.97)^t$, $y=(1.01)^{12t}$, $y=(1.2)^{t/10}$, and classify them as representing exponential growth or decay.

Quality Core: E.1.a, F.1.b, G.1.b, G.1.c, G.1.e

Domain: Interpreting Functions

Cluster: Analyze functions using different representations

Quarter 1:

Quarter 2:

Quarter 3:

Quarter 4:
Identify how key features of an exponential function relate to characteristics of in a real-world context.

Given the expression of an exponential function, use the properties of exponents to interpret the expression in terms of a real-world context.

Write an exponential function defined by an expression in different but equivalent forms to reveal and explain different properties of the function, and determine which form of the function is the most appropriate for interpretation for a real-world context.

Note from Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.

Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation containing a function defined by an expression, Use algebraic properties to rewrite the expression in a form that makes key features of the function easier to find, Manipulate a quadratic function by factoring and completing the square to show zeros, extreme values, and symmetry of the graph, Explain and justify the meaning of zeros, extreme values, and symmetry of the graph in terms of the contextual situation, Apply exponential properties to expressions and explain and justify the meaning in a contextual situation.	Zeros Extreme values Symmetry Exponential growth or decay	Students know: Techniques to factor and complete the square, Properties of exponential expressions, Algebraic properties of equality (Table 4).	Students understand/are able to: Accurately manipulate (e.g., factoring, completing the square) expressions using appropriate technique(s) to reveal key properties of a function. An expression may be written in various equivalent forms, Some forms of the expression are more beneficial for revealing key properties of the function.	**EEF-IF.8.** N/A

Grade Level/ Course (HS): Algebra 2 Unit 3							
Standard with code: F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.* Quality Core:							
Domain: Interpreting Functions		**Cluster: Analyze functions using different representations**					
Quarter 1:		**Quarter 2:** Differentiate between different types of functions using a variety of descriptors (graphically, verbally, numerically, and algebraically) Use a variety of function representations (algebraically, graphically, numerically in tables, or by verbal descriptions) to compare and contrast properties of two functions Note from Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.		**Quarter 3:** Identify types of functions based on verbal , numerical, algebraic, and graphical descriptions and state key properties (e.g. intercepts, maxima, minima, growth rates, average rates of change, and end behaviors) Differentiate between different types of functions using a variety of descriptors (graphically, verbally, numerically, and algebraically) Use a variety of function representations (algebraically, graphically, numerically in tables, or by verbal descriptions) to compare and contrast properties of two functions Note from Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.		**Quarter 4:** Identify types of functions based on verbal , numerical, algebraic, and graphical descriptions and state key properties (e.g. intercepts, maxima, minima, growth rates, average rates of change, and end behaviors) Differentiate between different types of functions using a variety of descriptors (graphically, verbally, numerically, and algebraically) Use a variety of function representations (algebraically, graphically, numerically in tables, or by verbal descriptions) to compare and contrast properties of two functions Note from Appendix A: Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given two functions represented differently (algebraically, graphically, numerically in tables, or by verbal descriptions), Use key features to compare the functions, Explain and justify the similarities and differences of the functions.		Students know: Techniques to find key features of functions when presented in different ways, Techniques to convert a function to a different form (algebraically, graphically, numerically in tables, or by verbal descriptions).	Students understand/are able to: Accurately determine which key features are most appropriate for comparing functions, Manipulate functions algebraically to reveal key functions, Convert a function to a different form (algebraically, graphically, numerically in tables, or by verbal descriptions) for the purpose of comparing it to another function. Functions can be written in different but equivalent ways (algebraically, graphically, numerically in tables, or by verbal descriptions), Different representations of functions may aid in comparing key features of the functions.	**EEF-IF.9.** N/A

Grade Level/ Course (HS): Algebra 2 Unit 3

Standard with code: F.BF.1b Write a function that describes a relationship between two quantities.*(Modeling standard)b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

Quality Core: C.1.d, E.2.a (Determination of the domain and range of combined functions are not explicitly addressed by F.BF.1, but can be addressed by extending understanding from F.IF.5)

Domain: Building Functions	**Cluster: Build a function that models a relationship between two quantities**		
Quarter 1: Given a real-world situation or mathematical problem: • build standard functions to represent relevant relationships/ quantities • determine which arithmetic operation should be performed to build the appropriate combined function • relate the combined function to the context of the problem *Note from Appendix A: Develop models for more complex or sophisticated situations than in previous courses.*	**Quarter 2:** Given a real-world situation or mathematical problem: • build standard functions to represent relevant relationships/ quantities • determine which arithmetic operation should be performed to build the appropriate combined function • relate the combined function to the context of the problem *Note from Appendix A: Develop models for more complex or sophisticated situations than in previous courses.*	**Quarter 3:** Combine two functions using the operations of addition, subtraction, multiplication, and division Evaluate the domain of the combined function. Given a real-world situation or mathematical problem: • build standard functions to represent relevant relationships/ quantities • determine which arithmetic operation should be performed to build the appropriate combined function • relate the combined function to the context of the problem *Note from Appendix A: Develop models for more complex or sophisticated situations than in previous courses.*	**Quarter 4:** Combine two functions using the operations of addition, subtraction, multiplication, and division Evaluate the domain of the combined function. Given a real-world situation or mathematical problem: • build standard functions to represent relevant relationships/ quantities • determine which arithmetic operation should be performed to build the appropriate combined function • relate the combined function to the context of the problem *Note from Appendix A: Develop models for more complex or sophisticated situations than in previous courses.*

Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation containing two quantities, Express a relationship between the quantities through an explicit expression using function notation, recursive process, or steps for calculation, Explain and justify how the expression or process models the relationship between the given quantities, Create a new function by using standard function types and arithmetic operations to combine the original functions to model the relationship of the given quantities, (+) standards not covered.	Explicit expression Recursive process Decaying exponential	Students know: Techniques for expressing functional relationships (explicit expression, a recursive process, or steps for calculation) between two quantities, Techniques to combine functions using arithmetic operations.	Students understand/are able to: Accurately develop a model that shows the functional relationship between two quantities, Accurately create a new function through arithmetic operations of other functions, Present an argument to show how the function models the relationship between the quantities. Relationships can be modeled by several methods (e.g., explicit expression or recursive process), Arithmetic combinations of functions may be used to improve the fit of a model.	Level IV Students will: EEF.BF.1. Complete the appropriate graphical representation (first quadrant) given a situation involving constant rate of change. Ex. Given this scenario and a graphical representation with missing information: If I mow one lawn and I make $25 and if I mow three lawns and I make $75, how much will I make if I mow two lawns? Ex. Given this scenario and a graphical representation with missing information: If hamburgers are four for $1 and I buy four, it will cost $1; if I buy 12, it will cost $3 – complete the graph for eight hamburgers. Level III Students will: EEF-BF.1. Select the appropriate graphical representation (first quadrant) given a situation involving constant rate of change. Ex. Given this scenario and two completed graphs, show me the graph that shows the following: If I mow one lawn, I make $25; if I mow two lawns, I will make $50; and if I mow three lawns I will make $75. Ex. Given this scenario and two completed graphs, show me the graph that depicts that there are two cookies for every student. Level II Students will: EEF-BF.1. Select the appropriate graphical representation (first quadrant) given a situation involving constant rate of change where the difference is very clear. Ex. Every dog has one bone. Pick the graph that would represent this concept when given the following graphs.* Level I Students will: EEF-BF.1. Identify the terms in a sequence. Ex. Identify an ABABABABAB pattern out of two different pattern sets of colored blocks using black (B) and white (W) and one set is BWBWBWBWBW and the other pattern set is BBWBBWBBWBBW. Ex. Place two pencils in front of each student in the classroom. *Refer to the Common Core Essential Elements document for diagram.

Grade Level/ Course (HS): Algebra 2 Unit 3

Standard with code: F.BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*

Quality Core: E.2.b, E.3.b (this QC standard only requires studying translations on circles and parabolas)

Domain: Building Functions

Cluster: Build new functions from existing functions

Quarter 1:
Using technology, identify effects of single transformations on graphs of functions.

Quarter 2:
Using technology, identify effects of single transformations on graphs of functions.

Quarter 3:
Given a single transformation on a function (symbolic or graphic) identify the effect on the graph.

Using technology, identify effects of single transformations on graphs of functions.

Graph a given function by 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).

Describe the differences and similarities between a parent function and the transformed function.

Find the value of k, given the graphs of a parent function, f(x), and the transformed function: f(x) + k, k f(x), f (kx), or f(x + k).

Recognize even and odd functions from their graphs and from their equations.

Experiment with cases and illustrate an explanation of the effects on the graph using technology.

Note from Appendix A: Use transformations of functions to find models as students consider increasingly more complex situations. Note the effect of multiple transformations on a single graph and the common effect of each transformation across function types.

Quarter 4:
Given a single transformation on a function (symbolic or graphic) identify the effect on the graph.

Graph a given function by 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).

Describe the differences and similarities between a parent function and the transformed function.

Find the value of k, given the graphs of a parent function, f(x), and the transformed function: f(x) + k, k f(x), f (kx), or f(x + k).

Experiment with cases and illustrate an explanation of the effects on the graph using technology.

Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a function in algebraic form, Graph the function, f(x), conjecture how the graph of f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k(both positive and negative) will change from f(x), and test the conjectures, Describe how the graphs of the functions were affected (e.g., horizontal and vertical shifts, horizontal and vertical stretches, or reflections), Use technology to explain possible effects on the graph from adding or multiplying the input or output of a function by a constant value, Recognize if a function is even or odd. Given the graph of a function and the graph of a translation, stretch, or reflection of that function, Determine the value which was used to shift, stretch, or reflect the graph, Recognize if a function is even or odd.	Even and odd functions	Students know: Graphing techniques of functions, Methods of using technology to graph functions, Techniques to identify even and odd functions both algebraically and from a graph.	Students understand/are able to: Accurately graph functions, Check conjectures about how a parameter change in a function changes the graph and critique the reasoning of others about such shifts, Identify shifts, stretches, or reflections between graphs, Determine when a function is even or odd. Graphs of functions may be shifted, stretched, or reflected by adding or multiplying the input or output of a function by a constant value, Even and odd functions may be identified from a graph or algebraic form of a function.	**EEF-BF.3-4.** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 3</td></tr>
<tr><td colspan="8">Standard with code: F.BF. 4a Find the inverse functions a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example: $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for x ≠ 1.

Quality Core: This KCASM standard undergirds many standards within the assessed QC conceptual areas, including: G.2.b, H.2.b, H.2.d</td></tr>
<tr><td colspan="2">Domain: Building Functions</td><td colspan="6">Cluster: Build new functions from existing functions</td></tr>
<tr><td colspan="2">Quarter 1:

Define inverse function.</td><td colspan="2">Quarter 2:

Define inverse function.</td><td colspan="2">Quarter 3:

Define inverse function.

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.

Note from Appendix A: Extend the set of functions to simple rational, simple radical and simple exponential functions; connect F.BF.4a to F.LE.4.</td><td colspan="2">Quarter 4:

Define inverse function.

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.

Note from Appendix A: Extend the set of functions to simple rational, simple radical and simple exponential functions; connect F.BF.4a to F.LE.4.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given an invertible function in algebraic form, Use algebraic properties to find the inverse of the given function, (+) standards not covered.	Inverse	Students know: Algebraic properties of equality (Table 4).	Students understand/are able to: Accurately perform algebraic properties to find the inverse. The inverse of a function interchanges the input and output values from the original function, The inverse of a function must also be a function to exist and the domain may need to be restricted to make this occur.	**EEF-BF.3-4.** N/A

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 3</td></tr>
<tr><td colspan="8">Standard with code: F.LE.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$, where a, b, and d are numbers and the base is 2, 10, or e; evaluate the logarithm using technology.

Quality Core: G.2.b</td></tr>
<tr><td colspan="2">Domain: Linear and Exponential Models*</td><td colspan="6">Cluster: Construct and compare linear and exponential models and solve problems.</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:

Recognize the laws and properties of logarithms, including change of base.

Recognize and describe the key features logarithmic functions.

Recognize and know the definition of logarithm base b.

Evaluate a logarithm using technology

For exponential models, express as a logarithm the solution to $ct\ a \times b = d$, where a, b, and d are numbers and the base is 2, 10, or e.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a contextual situation involving exponential growth or decay, Develop an exponential function which models the situation, Rewrite the exponential function as an equivalent logarithmic function, Use logarithmic properties to rearrange the logarithmic function, to isolate the variable, and use technology to find an approximation of the solution.	Exponential models	Students know: Methods for using exponential and logarithmic properties to solve equations, Techniques for rewriting algebraic expressions using properties of equality (Table 4).	Students understand/are able to: Accurately use logarithmic properties to rewrite and solve an exponential equation, Use technology to approximate a logarithm. Logarithmic and exponential functions are inverses of each other, and may be used interchangeably to aid in the solution of problems	**Level IV Students will:** **EEF-LE.1-4.** Plot points using pictures in first quadrant on a graph using whole numbers and explain how y increases/decreases as x changes. Ex. If you go to the store where every item is one dollar, students should state y = x (the number of items I buy will tell me the cost). Students will then plot this on the graph. Ex. If I get two apples for every orange I buy, students should state that y = 2x, or for every orange I buy (x), I will get two apples (y), therefore x times two tells me the number of apples each time. Students should then plot this on the graph. **Level III Student will:** **EEF-LE.1-4.** Model a simple linear function such as y = mx to show functions grow by equal factors over equal intervals. Ex. Determine a simple relationship of y to x by looking at the first quadrant of a graph. Ex. Identify the cost per item on a simple graph where every item in the store cost the same amount and state the relationship between x and y. Ex. Look at a graph that shows a constant ratio of boys to girls and state the relationship between x and y. **Level II Students will:** **EEF-LE.1-4.** Identify a specific data point in the first quadrant and explain the meaning behind it. Ex. Given data points in the first quadrant, identify the named point and state the two pieces of information that one dot provides. Ex. When given a simple graph that shows the total cost of items purchased at a store where every item is $1, tell the cost of four items, the cost of two items, etc. **Level I Students will:** **EEF-LE.1-4.** Interpret major ideas of a graph with linear functions. Ex. When shown two lines on a graph, tell which one is rising faster. Ex. When shown a graph of distance driven and gas left in tank, explain that the further one drives the less gas one has left.

Grade Level/ Course (HS): Algebra 2 Unit 4							
Standard with code: S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve. *Statistics and Probability is a Modeling Conceptual Category QualityCore:							
Domain: Interpreting Categorical and Quantitative Data*(Modeling Conceptual Category)		**Cluster: Summarize, represent, and interpret data on a single count or measurement variable.**					
Quarter 1:		**Quarter 2:**		**Quarter 3:**		**Quarter 4:** Describe the characteristics of a normal distribution. Use a calculator, spreadsheet, and table to estimate areas under the normal curve. Use the mean and standard deviation of a data set to fit it to a normal distribution. Use a normal distribution to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. From Appendix A: While students may have heard of the normal distribution, it is unlikely that they will have prior experience using it to make specific estimates. Build on students' understanding of data distributions to help them see how the normal distribution uses area to make estimates of frequencies (which can be expressed as probabilities). Emphasize that only some data are well described by a normal distribution.	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a data set, Find the mean and standard deviation of the set and use them to fit data to a normal distribution (when appropriate) to estimate population percentages, Estimate areas under the normal curve using calculators, spreadsheets, and standard normal distribution tables.	Normal distribution Population Percentages Normal curve	Students know: Techniques to find the mean and standard deviation of data sets, Techniques to use calculators, spreadsheets, and standard normal distribution tables to estimate areas under the normal curve.	Students understand/are able to: Accurately find the mean and standard deviation of data sets, Make reasonable estimates of population percentages from the normal distribution, Read and use normal distribution tables and use calculators and spreadsheets to accurately estimate the areas under the normal curve. The mean and standard deviation of a data set can be used to fit the data set to a normal distribution, Population percentages can be estimated by areas under the normal curve using calculators, spreadsheets, and standard normal distribution tables.	**Level IV Students will:** **EES-ID.4.** Calculate the mean of a given data set (more than five data points). Ex. Calculate the mean of price lists for a video in six different stores. Ex. Calculate the mean number of hours students spend watching TV over a week. **Level III Students will:** **EES-ID.4.** Calculate the mean of a given data set (limit data points to less than five). Ex. Given rainfall amounts for four days, determine the average rainfall. Ex. Given the price of each pair, determine the average price of four pairs of shoes. **Level II Students will:** **EES-ID.4** Identify the average between two consecutive numbers. Ex. Given two consecutive numbers on a number line, determine the mean value. (Determine the mean value of 2 and 3.) **Level I Students will:** **EES-ID.4.** Identify the missing number between two data points. Ex. Given two consecutive even numbers or two consecutive odd numbers, determine the number in the middle.

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 4</td></tr>
<tr><td colspan="8">Standard with code: S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. *Statistics and Probability is a Modeling Conceptual Category

Quality Core:</td></tr>
<tr><td colspan="2">Domain: Making Inferences and Justifying Conclusions*(Modeling Conceptual Category)</td><td colspan="6">Cluster: Understand and evaluate random processes underlying statistical experiments</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:

Explain that statistics is a process for making inferences about population parameters, or characteristics.

Explain that statistical inferences about population characteristics are based on random samples from that population.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a statistical question about a population, Describe and justify a data collection process that would result in a random sample from which inferences about the population can be drawn, Explain and justify their reasoning concerning data collection processes that do not allow generalizations (e.g., non-random samples) from the sample to the population.	Population parameters Random samples	Students know: Techniques for selecting random samples from a population.	Students understand/are able to: Accurately compute the statistics needed, Recognize if a sample is random, Reach accurate conclusions regarding the population from the sample. Statistics generated from an appropriate sample are used to make inferences about the population.	**Level IV Students will:** **EES-IC.1-2.** Determine the likelihood of an event occurring when the outcomes are not equally likely to occur. Ex. You have a bag of marbles with five red, four blue, six white, and five yellow marbles. What is the probability of choosing a white marble? Ex. Your drawer contains seven pairs of white socks and three pairs of black socks. What is the probability of choosing a white pair? **Level III Students will:** **EES-IC.1-2.** Determine the likelihood of an event occurring when the outcomes are equally likely to occur. Ex. A spinner contains four colors: blue, red, green, and yellow. What is the probability of landing on red? Ex. A die is rolled. What is the probability of landing on a four? Ex. You have three blue candies, seven green candies, and four red candies in a bag. Which color are you most likely to draw out of the bag? **Level II Students will:** **EES-IC.1-2.** Determine the possible outcomes of an event occurring. Ex. A spinner contains four colors (blue, red, green, and yellow). List all of the possible outcomes. Ex. What are the possible outcomes of rolling a die? Ex. What are the possible outcomes when flipping a coin? **Level I Students will:** **EES-IC.1-2.** Identify one event or outcome of an event occurring. Ex. Given a spinner with four colors, identify one color as a possible outcome. Ex. Given a die, identify five as a possible outcome.

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 4</td></tr>
<tr><td colspan="8">Standard with code: S.IC.2 Decide if a specified model is consistent with results from a given data-generating process, eg., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model? *Statistics and Probability is a Modeling Conceptual Category

Quality Core:</td></tr>
<tr><td colspan="2">Domain: Making Inferences and Justifying Conclusions*(Modeling Conceptual Category)</td><td colspan="6">Cluster: Understand and evaluate random processes underlying statistical experiments</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="3">Quarter 2:</td><td colspan="2">Quarter 3:</td><td>Quarter 4:

Use various, specified data-generating processes/models (e.g. computer models, physical recreations of experiments, etc.)

Recognize data that various models produce.

Identify data or discrepancies that provide the basis for rejecting a statistical model.

Decide if a specified model is consistent with results from a given data-generating process, eg., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?

From Appendix A: For S.IC.2, include comparing theoretical and empirical results to evaluate the effectiveness of a treatment.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
</table>

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	Instructional Achievement Level Descriptors
Students: Given a data-generating process, Identify a model that fits the data generating process, Find the theoretical probability or expected values generated by the model, Simulate the process and compare the results to theoretical probability or expected values.	Simulation Specified model	Students know: Methods to determine if results from simulations are consistent with theoretical models.	Students understand/are able to: Accurately find the theoretical values from a model of a data-generating process, Conduct a simulation that matches a given data-generating process, Identify and communicate the differences and similarities between a theoretical model and the simulation results. A data generating process yields results that may or may not fit the underlying theoretical model, and statistical methods are used to determine the accuracy of the fit.	**Level IV Students will:** **EES-IC.1-2.** Determine the likelihood of an event occurring when the outcomes are not equally likely to occur. Ex. You have a bag of marbles with five red, four blue, six white, and five yellow marbles. What is the probability of choosing a white marble? Ex. Your drawer contains seven pairs of white socks and three pairs of black socks. What is the probability of choosing a white pair? **Level III Students will:** **EES-IC.1-2.** Determine the likelihood of an event occurring when the outcomes are equally likely to occur. Ex. A spinner contains four colors: blue, red, green, and yellow. What is the probability of landing on red? Ex. A die is rolled. What is the probability of landing on a four? Ex. You have three blue candies, seven green candies, and four red candies in a bag. Which color are you most likely to draw out of the bag? **Level II Students will:** **EES-IC.1-2.** Determine the possible outcomes of an event occurring. Ex. A spinner contains four colors (blue, red, green, and yellow). List all of the possible outcomes. Ex. What are the possible outcomes of rolling a die? Ex. What are the possible outcomes when flipping a coin? **Level I Students will:** **EES-IC.1-2.** Identify one event or outcome of an event occurring. Ex. Given a spinner with four colors, identify one color as a possible outcome. Ex. Given a die, identify five as a possible outcome.

Grade Level/ Course (HS): Algebra 2 Unit 4							
Standard with code: S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*Statistics and Probability is a Modeling Conceptual Category **Quality Core:**							
Domain: Making Inferences and Justifying Conclusions*(Modeling Conceptual Category)		**Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies**					
Quarter 1:		**Quarter 2:**		**Quarter 3:**		**Quarter 4:** Recognize the purpose of surveys, experiments, and observational studies in making statistical inferences and justifying conclusions and explain how randomization relates to each of these methods of data collection. Recognize the differences among surveys, experiments, and observational studies in making statistical inferences and justifying conclusions explain how randomization relates to each of these methods of data collection. Note from Appendix A: In earlier grades, students are introduced to different ways of collecting data and use graphical displays and summary statistics to make comparisons. These ideas are revisited with a focus on how the way in which data is collected determines the scope and nature of the conclusions that can be drawn from that data. The concept of statistical significance is developed informally through simulation as meaning a result that is unlikely to have occurred solely as a result of random selection in sampling or random assignment in an experiment.	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	CCSS Standard
Students: Given a scenario in which a statistical question needs to be investigated, Select an appropriate method of data collection (sample surveys, experiments, and observational studies) and justify the selection, Show randomization leads to more accurate inferences to the population.	Sample surveys Experiments Observational studies Randomization	Students know: Key components of sample surveys, experiments, and observational studies, Procedures for selecting random samples.	Students understand/are able to: Use key characteristics of sample surveys, experiments, and observational studies to select the appropriate technique for a particular statistical investigation. Sample surveys, experiments, and observational studies may be used to make inferences made about the population, Randomization is used to reduce bias in statistical procedures.	**EES-IC.3-6.** N/A (See EES-ID.1-2)

Grade Level/ Course (HS): Algebra 2 Unit 4							
Standard with code: S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. *Statistics and Probability is a Modeling Conceptual Category **Quality Core:**							
Domain: Making Inferences and Justifying Conclusions*(Modeling Conceptual Category)		**Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies**					
Quarter 1:		**Quarter 2:**		**Quarter 3:**		**Quarter 4:** Define margin of error Explain the connection of margin of error to variation within a data set or population. Use a simulation model to generate data for random sampling, assuming certain population parameters/ characteristics. Use data from a sample survey to estimate a population mean or proportion. Interpret the data generated by a simulation model for random sampling in terms of the context the simulation models. Develop a margin of error, assuming certain population parameters/ characteristics, through the use of simulation models for random sampling. *From Appendix A: Focus on the variability of results from experiments—that is, focus on statistics as a way of dealing with, not eliminating, inherent randomness.*	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	CCSS Standard
Students: Given a scenario in which a statistical question may be investigated by a sample survey, Use random sampling to gather survey data and use the sample mean or proportion to estimate the corresponding population values, Design a simulation for the situation, carry out the simulation, explain what the results mean about variability in population means or proportions, and use results to calculate margins of error for these estimates.	Sample survey Population mean Proportion Margin of error Random sampling	Students know: Techniques for conducting a sample survey, Techniques for conducting a simulation of a sample survey situation.	Students understand/are able to: Design and conduct sample surveys, Accurately calculate the point estimate of the population mean or proportion, Design, conduct, and use the results from a simulation model to develop a margin of error for a sample survey. Results of sample surveys are used to find an estimate of a population mean or proportion, Using sample values to estimate population values must be done with a consideration of the error in the estimate, Statistical analysis and data displays often reveal patterns in data or populations, enabling predictions.	**EES-IC.3-6.** N/A (See EES-ID.1-2)

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 4</td></tr>
<tr><td colspan="8">Standard with code: S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between two parameters are significant. *Statistics and Probability is a Modeling Conceptual Category

Quality Core:</td></tr>
<tr><td colspan="2">Domain: Making Inferences and Justifying Conclusions*(Modeling Conceptual Category)</td><td colspan="6">Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:
Using an established level of significance, determine if the difference between two parameters is significant.

Use data from a randomized experiment to compare two treatments.

Choose appropriate method to simulate a randomized experiment.
Establish a reasonable level of significance.

From Appendix A: Focus on the variability of results from experiments—that is, focus on statistics as a way of dealing with, not eliminating, inherent randomness.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
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Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	CCSS Standard
Students: Given a scenario in which a statistical question may be investigated by a randomized experiment, Design and conduct a randomized experiment to evaluate differences in two treatments based on data from randomized experiments, Interpret and explain the results in the context of the original scenario, Design, conduct, and use simulations to generate data simulating application of the two treatments, Use results of the simulation to evaluate significance of differences in the parameters of interest.	Randomized experiment Significant	Students know: Techniques for conducting randomized experiments, Techniques for conducting simulations of randomized experiment situations.	Students understand/are able to: Design and conduct randomized experiments with two treatments, Draw conclusions from comparisons of the data of the randomized experiment, Design, conduct, and use the results from simulations of a randomized experiment situation to evaluate the significance of the identified differences. Differences of two treatments can be justified by a significant difference of parameters from a randomized experiment, Statistical analysis and data displays often reveal patterns in data or populations, enabling predictions.	**EES-IC.3-6.** N/A (See EES-ID.1-2)

Grade Level/ Course (HS): Algebra 2 Unit 4							
Standard with code: S.IC.6 Evaluate reports based on data. * *Statistics and Probability is a Modeling Conceptual Category Quality Core:							
Domain: Making Inferences and Justifying Conclusions*(Modeling Conceptual Category)		**Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies**					
Quarter 1:		**Quarter 2:**		**Quarter 3:**		**Quarter 4:** Define the characteristics of experimental design (control, randomization, and replication). Evaluate the experimental study design, how the data was gathered, what analysis (numerical or graphical) was used (ex: use of randomization, control, replication). Draw conclusions based on graphical and numerical summaries. Support with graphical and numerical summaries how "appropriate" the report of data was (ex: consider the existence of outliers, correlation coefficient with both linear and non-linear data, and margin of error).	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	CCSS Standard
Students: Given data based reports, Evaluate the data collection procedures and the interpretations of results in the context that yielded the data.		Students know: Experimental designs that are appropriate for situations present in reports.	Students understand/are able to: Interpret the data and the results presented in a report. Statistical analysis and data displays often reveal patterns in data or populations, enabling predictions, Misleading data displays and biased sampling procedures can be used in published reports and must be carefully analyzed.	**EES-IC.3-6.** N/A (See EES-ID.1-2)

<table>
<tr><td colspan="8">Grade Level/ Course (HS): Algebra 2 Unit 4</td></tr>
<tr><td colspan="8">Standard with code: S.MD.6 (+) Use probabilities to make fair decisions (e.g. drawing by lots, using a random number generator.) *Statistics and Probability is a Modeling Conceptual Category

Quality Core: All components of QC Section H can be applied to both MD standards.</td></tr>
<tr><td colspan="2">Domain: Using Probability to Make Decisions*(Modeling Conceptual Category)</td><td colspan="6">Cluster: Use probability to evaluate outcomes of decisions</td></tr>
<tr><td colspan="2">Quarter 1:</td><td colspan="2">Quarter 2:</td><td colspan="2">Quarter 3:</td><td colspan="2">Quarter 4:

Recall previous understandings of probability.

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

From Appendix A: Extend to more complex probability models. Include situations such as those involving quality control, or diagnostic tests that yield both false positive and false negative results.</td></tr>
<tr><td>Make sense of problems and persevere in solving them.</td><td>Reason abstractly and quantitatively.</td><td>Construct viable arguments and critique the reasoning of others.</td><td>Model with mathematics.</td><td>Use appropriate tools strategically.</td><td>Attend to precision.</td><td>Look for and make use of structure.</td><td>Look for and express regularity in repeated reasoning.</td></tr>
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Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	CCSS Standard
Students: Given a contextual situation in which a decision needs to be made, Use a random probability selection model to produce unbiased decisions.	Fair decisions	Students know: The characteristics of a random sample.	Students understand/are able to: Randomly select a sample from a population (using technology when appropriate). Multiple factors may ultimately determine the decision one makes other than the probability of events, such as ethical constraints, social policy, or feelings of others. Probabilities can be used to explain why a decision was considered to be fair or objective.	**EES-MD.1-7** N/A (+)

Grade Level/ Course (HS): Algebra 2 Unit 4							
Standard with code S.MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game.) *Statistics and Probability is a Modeling Conceptual Category Quality Core: All components of QC Section H can be applied to both MD standards.							
Domain: Using Probability to Make Decisions*(Modeling Conceptual Category)		**Cluster: Use probability to evaluate outcomes of decisions**					
Quarter 1:		**Quarter 2:**		**Quarter 3:**		**Quarter 4:** Recall previous understandings of probability. Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). *From Appendix A: Extend to more complex probability models. Include situations such as those involving quality control, or diagnostic tests that yield both false positive and false negative results.*	
Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**	**Construct viable arguments and critique the reasoning of others.**	**Model with mathematics.**	**Use appropriate tools strategically.**	**Attend to precision.**	**Look for and make use of structure.**	**Look for and express regularity in repeated reasoning.**

Evidence of Student Attainment/Assessment	Vocabulary	Knowledge	Skills	CCSS Standard
Students: Given a contextual situation in which a decision needs to be made, Use probability concepts to analyze, justify, and make objective decisions.		Students know: Techniques for finding probabilities of simple, compound, and conditional events and from probability distributions.	Students understand/are able to: Choose the appropriate probability concept for the given situation. Use and apply the selected probability rule. Communicate the reasoning behind decisions. Objective decision making can be mathematically based, often using analysis involving probability concepts. Multiple factors may ultimately determine the decision one makes other than the probability of events, such as ethical constraints, social policy, or feelings of others.	**EES-MD.1-7** N/A (+)