Unit 1: Representations of Functions

Essential Questions:
- How do you identify the appropriate domain and range of a function?
- How does identifying the key features of a graph help in explain the story of a graph?
- In a given context, how do you choose the most useful representation of a function (graph/table/equation/description)?

Enduring Understandings:
- Functions and relations define a relationship between two changing quantities

What will students be able to DO at the end of this unit? (summative assessment)
- Identify appropriate units for a problem based on context.
- Use units as a guide to help solve multistep problems.
- Interpret key features of graphs (scale, origin, intercepts, range, intervals on which a function is increasing or decreasing)
- Use information from a given situation or story to sketch a graph.
- Identify an appropriate graphical representation and/or function for a problem in context.
- Determine whether a given relation is a function both graphically and symbolically.
- Use and interpret statements which use function notation in context. Choose appropriate function notation for a given context.
- A-REI.11 HELP!

What KNOWLEDGE will students attain in this unit?
Students will know that….
- Units are important to effective communication and problem solving
- $y = f(x)$
- The meaning of x and y intercepts.
- Domain is the set of inputs (x) of a function and the range is the set of outputs ($f(x)$) of a function
- The domain is the x values of a function and the range is the y values of a function.
- The solution to two functions can be found by setting them equal to each other.

What UNDERSTANDINGS will students attain in this unit?
Students will understand that…..

- Unit analysis is a useful problem solving tool
- Solutions of a function are coordinate pairs which satisfy the conditions of the function
- The solution of a systems of functions is where the graphs of the functions intersect (the coordinate pair which satisfies **both** functions)
- Functions can be expressed numerically (table of values or set of ordered pairs), graphically, written, algebraically. These methods of expression are interchangeable.

Mathematical Practices
1) Make sense of problems and persevere in solving them. 2) Reason abstractly and quantitatively. 3) Construct viable arguments and critique the reasoning of others. 4) Model with mathematics. 5) Use appropriate tools strategically.
6) Attend to precision.
7) Look for and make use of structure. 8) Look for and express regularity in repeated reasoning.

Pacing	Standards	Resources including activities	Assessments	Comments (be nice)
10 – 12	N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. N-Q.2 Define appropriate quantities for the purpose of descriptive modeling. **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.*** **A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.**	Algebra Teachers' Activities kit (ATAK) 3-2 Solving 1 Step equations Cooperative Learning & Algebra (CL&A) 4.1.5 p.235 CL&A 5.1.2, 5.1.3, 5.1.9 (Systems of equations) ATAK 3-20 Verifying solutions of systems of linear equations Text 5.1 Graphing Systems of Equations ATAK 4-14 Solving systems of equations by graphing	Pre-Assessment Formative Assessment Quiz(es) Unit Test	

	A-CED.3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* A-REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). **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.** **F-IF.1Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f*(*x*) denotes the output of f corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f*(*x*).** F-IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F-IF.4 For a function that models a relationship	ATAK 3-21 Solving systems of linear equations Text 5-1 Graphing Calculator Lab p.259 ATAK 3-22 Solving word problems by writing systems of equations Station Activities for Algebra I Reasoning with Equations and Inequalities Set 8 p. 191 Text 3.1 Relations – focus on domain and range, example problems, inverses LTF – Introduction to Function Notation Text 3.2 Representing Functions - function notation, definition, function value, inputs, outputs, vertical line test, ignore mapping ATAK 7-2 Identifying Functions ATAK 7-3 Finding values of functions ATAK 7-4 Identifying domain and range of a function or relation Rule of 4 Sheets connecting verbal description of a function to table, graph, and equation (and point set)		

	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.* 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.* 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.* ***MA.FIF-8.C* Translate between different representations of functions and relations: graphs, equations point sets, and tabular.**	LTF- Applying Piecewise Functions #Need additional resources for comparing functions represented differently Station Activities for Algebra I Interpreting Functions Set 1 p. 262		

Unit 2: Reasoning with Linear Equations

Essential Questions:
- How can functions be used to represent observable phenomena?
- What's going on in an equation and what do you need to do to isolate the variable?
- What does solve for *x* mean?

Enduring Understandings:
- Linear functions have a constant rate of change
- Linear functions have 2 variables (of degree 1)

What will students be able to DO at the end of this unit? (summative assessment)
- Construct linear equations in slope-intercept and point-slope forms.
- Identify transformations of a function given a graph and a transformation rule
- Describe a transformation give a rule
- Graph linear functions showing intercepts
- Calculate slope over a specified interval and estimate slope from a graph
- Calculate and interpret the average rate of change of a function over a specified interval
- Use technology to explore transformations of functions
- Solve an equation for a specified variable
- Write the inverse of a linear function
- Interpret the parameters (slope and y-intercept) of a linear function in context

What KNOWLEDGE will students attain in this unit?
- Slope the rate of change of a function
- Average rate of change is a slope
- *x*-intercept is where *f(x)* = 0 and the y-intercept is where *x* = 0
- Slope is constant for linear functions
- For functions in one variable can have infinite, zero, or 1 solution
- Characteristics of slope
    - Positive slope = function is increasing
    - negative slope = function is decreasing

- Zero slope = function is neither increasing nor decreasing
- Undefined slope = not a function

What UNDERSTANDINGS will students attain in this unit?
Students will understand that…..

- Linear equations grow by equal differences over equal intervals (slope), and have a constant rate of change.
- Linear functions can be represented by tables, graphs, equations, or descriptions.
- Inverse operations are used to solve equations**.**

Mathematical Practices
1) Make sense of problems and persevere in solving them. 2) Reason abstractly and quantitatively. 3) Construct viable arguments and critique the reasoning of others. 4) Model with mathematics. 5) Use appropriate tools strategically.
6) Attend to precision.
7) Look for and make use of structure. 8) Look for and express regularity in repeated reasoning.

Pacing	Standards	Resources including activities	Assessments	Comments
10 – 12 days	**A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. ** ACED.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.* F-IF.1 each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f*(*x*) denotes the output of f corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f*(*x*). F-IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.	Text 4.1 – Slope and rate of change ATAK 4-6 Finding the slope of a line LTF – Calculating Average Rates of Change Text 4.2 – Direct Variation ATAK 3-9 Writing and Using Direct Variations #Transformation of functions Text 4.5 – Writing Equations in Point-Slope Form	Pre-Assessment Formative Assessment Quiz(es) Unit Test	

	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.* 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.* F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root46, and piecewise-defined functions, including step functions and absolute value functions. 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.* A-REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).	ATAK 4-9 Writing the Equation of a line when given 2 points CL&A 4.1.2 Exploring Intercepts ATAK 4-7 Finding the x-and y-intercepts Text 4.3 – Graphing in slope-intercept form Text 4.4 – Writing equation in Slope-intercept form CL&A 4.2.11 Interpret My slope and intercepts Station Activities for Algebra 1 Reasoning with Equations and Inequalities Set 2 p.119 #Absolute Value and Step functions here?		

	F-BF.1.a Write a function that describes a relationship between two quantities. **a. Determine an explicit expression, a recursive process, or steps for calculation from a context.** **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.*** F-BF.4a Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. *For example, f(x) =2x3 or f(x) = (x+1)/(x-1) for x ≠ 1.* **F-LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.** a. **Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.** b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. **F-LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).**			

	F-LE.5 Interpret the parameters in a linear or exponential51 function in terms of a context. S-ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.			

Unit 3: Descriptive Statistics and Modeling Linear Data

Essential Questions:
- When is it appropriate to use a linear model?
- How do we make predictions and make informed decisions based on numerical information?

Enduring Understandings:
- Correlation does not imply causation
- Linear data can be modeled with a linear function

What will students be able to DO at the end of this unit? (summative assessment)
- Approximate a linear function for a data set by hand or by using technology
- Informally assess the fit of a function by plotting and analyzing residuals
- Compute and interpret the correlation coefficient of a linear fit.
- Distinguish between correlation and causation
- Use a regression line to interpolate and extrapolate
- Calculate mean, median, quartile 1, quartile 3.
- Use technology to calculate a standard deviation
- Use measures of center and spread to describe a data set
- Interpret the effects of outliers on a data set
- Use two-way frequency tables to summarize categorical data
- Create a variety of graphical interpretations of data (dot plots, histograms, and box plots).
- Interpret relative frequencies in the context of data (including joint, marginal, and conditional relative frequencies).

What KNOWLEDGE will students attain in this unit?
- What a regression line is
- What the correlation coefficient is
- What a residual is
- An outlier is a data point far removed in some way from the main grouping of data points
- Know the difference between a histogram and a bar graph
- The definitions of categorical and quantitative data

What UNDERSTANDINGS will students attain in this unit?

- How to assess the linearity of data and the appropriateness of a linear model
- A linear function can be used to model observed data
- Why a strong correlation between two variables does not imply causation
- What can be learned about a data set based on the shapes of various graphical representations of that data

Mathematical Practices
1) Make sense of problems and persevere in solving them. 2) Reason abstractly and quantitatively. 3) Construct viable arguments and critique the reasoning of others. 4) Model with mathematics. 5) Use appropriate tools strategically.
6) Attend to precision.
7) Look for and make use of structure. 8) Look for and express regularity in repeated reasoning.

Pacing	Standards	Resources including activities	Assessments	Comments
10 – 12	N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. N-Q.2 Define appropriate quantities for the purpose of descriptive modeling. N-Q.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). S-ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points	ATAK 4-11 Determining Whether data suggests a line Text 4.6 Statistics: Scatterplots and lines of fit ATAK 4-12 Finding the Equation of a line of fit Text 4-6 Graphing Calculator Lab: Regression and Median-Fit lines **#Resources for box-plots, histograms, dot-plots, measures of central tendency, outliers,**	Pre-Assessment Formative Assessment Quiz(es) Unit Test	

	(outliers). 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. S-ID.5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. **S-ID.6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.** **a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. *Emphasize linear, quadratic, and exponential models.*** **b. Informally assess the fit of a function by plotting and analyzing residuals.** **c. Fit a linear function for a scatter plot that suggests a linear association.** **S-ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.** **S-ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.** S-ID.9 Interpret linear models. Distinguish between correlation and causation.			

Unit 4: Linear Inequalities

Essential Questions:

- What purpose do inequalities serve?

Enduring Understandings:

- Inequalities model situations where there are many solutions for each value of the independent variable.
- Inequalities are useful for expressing constraints in functions.

What will students be able to DO at the end of this unit? (summative assessment)

- Graph linear inequalities and systems of linear inequalities
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- Solve inequalities in one variable
- Write inequalities to model situations and interpret solutions in context
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What KNOWLEDGE will students attain in this unit?

- The definition of a half plane
- The graph of a linear inequality consists of a boundary line (dashed or solid) and a half plane
- The shading of the half plane represents all solutions to the inequality
- The correct shading of the half plane is determined by the direction of the inequality
- Inequalities are not functions.

What UNDERSTANDINGS will students attain in this unit?

- Inequalities can be rewritten to identify key characteristics of the boundary line
- Inequalities model situations where there are a range of solutions.

Mathematical Practices

1) Make sense of problems and persevere in solving them. 2) Reason abstractly and quantitatively. 3) Construct viable arguments and critique the reasoning of others. 4) Model with mathematics. 5) Use appropriate tools strategically.
6) Attend to precision.
7) Look for and make use of structure. 8) Look for and express regularity in repeated reasoning.

Pacing	Standards	Resources including activities	Assessments	Comments

10 days	**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.** **A-REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method**. A-CED.3 Represent constraints by equations or inequalities 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.* **A-REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.** A-REI.6 . Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. A-REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). 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	Text 6.1 and 6.2 Solving 1 step inequalities ATAK 3-17 Solving one-step Inequalities Text 6.3 Solving multi-step inequalities ATAK 3-18 Solving multi-step inequalities ATAK 3-19 Writing and Solving Inequalities CL&A 5.2.1 Exploring solutions of inequalities CL&A 5.2.2 Am I A Solution? Text 6.7 Graph inequalities in 2 variables CL&A 5.2.3 Graph my linear inequality Text 6.8 Graph systems of linear inequalities CL&A 5.2.4 Graph my system of linear inequalities ATAK 4-15 Solving systems of inequalities by graphing CL&A 5.2.5 Find my Feasible region	Pre-Assessment Formative Assessment Quiz(es) Unit Test	

	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. A-REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. F-BF.4.a Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. *For example, f(x) =2x3 or f(x) = (x+1)/(x-1) for x ≠ 1.*	Station Activities Reasoning with Equations and Inequalities Set 9 p. 204		

Unit 5: Sequences and Functions (Stand alone or combine as intro to Exponential functions??)

Essential Questions:

- What patterns emerge in data sets and how do we use equations and functions to model patterns?

Enduring Understandings:

- Algebraic expressions and equations generalize relationships from specific cases.
- Algebraic expressions and equations allow us to find the value at any position in a sequence.

What will students be able to DO at the end of this unit? (summative assessment)

- Given a pattern, write an equation that yields any term in a sequence.
- Write recursive algorithms and explicit rules for sequences.
- Translate between recursive and explicit descriptions of sequences
- Identify arithmetic sequences from a graph, table of values, or collection of data points and write a function for the sequence.
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What KNOWLEDGE will students attain in this unit?

- The definitions of an arithmetic, geometric and recursive sequences (such as Fibonacci's Sequence)
- Formulas for writing explicit rules for sequences.
- Arithmetic sequences are linear functions and represent constant additive change.
- Successive values of arithmetic sequences have a common difference.
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What UNDERSTANDINGS will students attain in this unit?

- Patterns can be modeled with equations
- Sequences change by predictable quantities

Mathematical Practices
1) Make sense of problems and persevere in solving them. 2) Reason abstractly and quantitatively. 3) Construct viable arguments and critique the reasoning of others. 4) Model with mathematics. 5) Use appropriate tools strategically.
6) Attend to precision.
7) Look for and make use of structure. 8) Look for and express regularity in repeated reasoning.

Pacing	Standards	Resources including activities	Assessments	Comments
5 -7	F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. F*or example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n1.* ≥ F-BF.1a Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. **F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula50, use them to model situations, and translate between the two forms.** **F-LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.** **a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.** b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. **c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.**	Text 3.4 Arithmetic Sequences #Geometric Sequences #Fibbonacci Sequence **#Need many resources!**	Pre-Assessment Formative Assessment Quiz(es) Unit Test	

	F-LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).			

Unit 6: Exponential Functions

Essential Questions:

- How do you differentiate between exponential and linear data?

Enduring Understandings:

- Analyzing patterns and generalizing patterns allows you to make predictions.

What will students be able to DO at the end of this unit? (summative assessment)

- Identify independent and dependent variables and explain how they relate to domain and range of linear or exponential function describing a real-world problem.
- Recognize constant multiplicative change in a data set
- Compare and contrast linear and exponential growth
- Explain how changes to a and b in the exponential model $y = a(b^x)$ affect the graph of an exponential function.
- Recognize an exponential growth or decay function by its graph.

What KNOWLEDGE will students attain in this unit?

- Properties of exponents (eg. $x^a x^b = x^{a+b}$)
- Attributes of exponential functions $y = a(b^x)$ and how the value of b indicates growth or decay.
- Exponential functions represent constant multiplicative change.
- Shape, domain, range and intercept(s) of the graph of exponential functions.
- Geometric sequences are exponential functions.

What UNDERSTANDINGS will students attain in this unit?

- Successive values of linear functions have a constant difference whereas successive values of exponential functions have a constant ratio.
- Generalizing patterns and creating models allow you to make predictions.

Mathematical Practices
1) Make sense of problems and persevere in solving them. 2) Reason abstractly and quantitatively. 3) Construct viable arguments and critique the reasoning of others. 4) Model with mathematics. 5) Use appropriate tools strategically. 6) Attend to precision.

7) Look for and make use of structure. 8) Look for and express regularity in repeated reasoning.				
Pacing	**Standards**	**Resources including activities**	**Assessments**	**Comments**
12 days	A-SSE.1a Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. **A-SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.** **c. Use the properties of exponents to transform expressions for exponential functions.** ***For example the expression 1.15t can be rewritten as (1.151/12)12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*** **N-RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.** ***For example, we define 51/3 to be the cube root of 5 because we want (51/3)3 = 5(1/3) x 3 to hold, so (51/3)3 must equal 5.*** N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents. F-IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. F*or example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n1. ≥*	ATAK 5-1 Writing expressions in Exponential Form Text 7-1 ATAK 5-4 Multiplying monomials ATAK 5-5 Finding Powers of Monomials ATAK 5-6 Dividing Monomials Text 7.6 Multiplying Polynomials Text 7.7 Special Products ATAK 5-9 Multiplying Binomials Station activities for Algebra 1 Seeing Structure in Expressions Set 1 & 2 p. 28 Skittles Lab Text 9.5 Exponential Functions Explore 9.6 Investigating Exponential Functions Text 9.6 Growth and Decay ATAK 9-12 Borrowing and Repaying Money (with Interest)	Pre-Assessment Formative Assessment Quiz(es) Unit Test	

	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.* 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.* F-IF.7e . Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. F-IF.8bWrite 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 = 1.02t, y = (0.97)t, y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth and decay.* **F-IF.9 Compare properties of two functions each represented in a different way (algebraically,**	ATAK 9-13 Calculating Compound Interest		

	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.* F-BF.1. Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. 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.* F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula50, use them to model situations, and translate between the two forms. 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.* S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. *Emphasize linear, quadratic, and exponential models.*			

	F-LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. **a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.** **b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.** **c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.** **F-LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).** F-LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. F-LE.5 Interpret the parameters in a linear or exponential51 function in terms of a context.			

Unit 7: Quadratic Expressions and Functions

Essential Questions:

- What are the advantages and disadvantages of each of the 4 representations of a function (table of values, graph, equation, description)?
- What does the equation of a function tell you about its graph?

Enduring Understandings:

- Quadratic equations model real world phenomena such as falling objects.
- Formulas and theorems in mathematics can be proven.

What will students be able to DO at the end of this unit? (summative assessment)

- Factor a trinomial or classify it as prime
- Graph a quadratic equation and identify key characteristics from an equation
- Translate between standard form and vertex form of a quadratic equation
- Solve quadratic equations by factoring, completing the square and the quadratic formula
- Expand the product of two binomials
- Derive the quadratic formula by completing the square

What KNOWLEDGE will students attain in this unit?

- Definitions of monomial, binomial and trinomial
- Some trinomials factor as the product of two binomials
- Perfect square trinomial and difference of squares factoring patterns
- Characteristics of a quadratic function (intercepts, roots, vertex, axis of symmetry)
- Standard form of a quadratic equation is $y = ax^2 + bx + c$ and vertex form of a quadratic equation is $y = a(x - h)^2 + k$ where (h, k) is the vertex of the graph of the parabola.
- Quadratic functions have roots which may be real or imaginary
- The discriminant $b^2 - 4ac$ indicates how many real roots a quadratic equation has.
- The equation of the axis of symmetry for the graph of a quadratic equation is $x = \frac{-b}{2a}$.

What UNDERSTANDINGS will students attain in this unit?

- Quadratic functions change at a changing rate.

- The quadratic formula will yield one or two roots for all quadratic equations because it is derived from solving the equation $0 = ax^2 + bx + c$ for x.
- Factoring expressions and equations is a tool for solving or simplifying.
- The relationships between functions and their inverses is that the inputs and outputs are reversed.
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Mathematical Practices
1) Make sense of problems and persevere in solving them. 2) Reason abstractly and quantitatively. 3) Construct viable arguments and critique the reasoning of others. 4) Model with mathematics. 5) Use appropriate tools strategically.
6) Attend to precision.
7) Look for and make use of structure. 8) Look for and express regularity in repeated reasoning.

Pacing	Standards	Resources including activities	Assessments	Comments
15 Days	A-SSE.1 Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. **A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.** A-REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). F-LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. F-IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one	Text 8.2 Factoring using the distributive property Text Explore 8.3 Factoring trinomials with Algebra tiles (or Algeblocks) Text 8.3-8.6 Factoring Trinomials and special quadratics Text 9.1 Graphing Quadratic Functions Extend Text 9.1 Graphing Calculator Lab: The Family of Quadratic Functions p.478 CL&A 8.1.2 Can you define me? (Transformations) p.393 CL&A 8.2.1 Exploring the Role of A	Pre-Assessment Formative Assessment Quiz(es) Unit Test	

	element of the range. If *f* is a function and *x* is an element of its domain, then *f*(*x*) denotes the output of f corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f*(*x*). F-IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. 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.* 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.* **F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.** **a. Graph linear and quadratic functions and show intercepts, maxima, and minima.** **F-IF.8 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**	CL&A 8.2.2 Exploring the Role of H CL&A 8.2.4 Exploring the Role of K CL&A 8.2.5 Graph Me (Vertex Form) CL&A 8.2.6 Write my Equation Text 9.2 Solving Quadratic Equations by Graphing (check by factoring) ATAK 9-1 Solving Quadratic Equations by Factoring Station Activities for Algebra 1 Reasoning with Equations and Inequalities Set 10 p. 221 (Square roots) ATAK 9-2 Solving Simple Quadratic Equations Text 9.3 Solving Quadratic Equations by Completing the Square ATAK 9-3 Solving a Quadratic Equation by Completing the Square Text 9.4 Solving Quadratic Equations by using the Quadratic Formula CL&A 8.3.1 Exploring the Connection: Quadratic formula and x-intercepts ATAK 9-4 Using the Quadratic Formula		

	zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. 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.* **F-BF.1 Write a function that describes a relationship between two quantities.** **a. Determine an explicit expression, a recursive process, or steps for calculation from a context.** **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.*** 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.* F-BF.4 Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. *For example, f(x) =2x3 or f(x) = (x+1)/(x-1) for x ≠ 1.*	Station Activities for Algebra 1 Reasoning with Equations and Inequalities Set 11 p. 234 (Quad. Form.) Station Activities for Algebra 1 Interpreting Functions Set 2 p. 271 (Graphing) CL&A 8.3.6 Applications of Quadratics Station Activities for Algebra 1 Interpreting Functions Set 3 p 285		