Topic: Modeling with Functions Unit 1					
Essential Questions: How can we model real life situations with a graph? What situations can be modeled with a function? When will the relationship between to quantities be linear? When will it not?					
Performance Indicators	Guided questions		Essential Knowledge and Skills	Classroom Ideas (Instructional Strategies)	Assessment Ideas (evidence of understanding)
Quantities N-Q **Reason quantitatively and use units to solve problems.** 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. 2. Define appropriate quantities for the purpose of descriptive modeling. 3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **Interpreting Functions F-IF** **Understand the concept of a function and use function notation.** 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 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 $y = f(x)$. 2. Use function notation, evaluate			Students will know : Rate relates to 2 quantities The difference between constant rates of change and non-linear rates of change and be able to explain why a line results from a constant rate of change Graphs show the relationship between 2 quantities The definition of a function and explain how functional relationships are different from other relationships Students will be able to : Select appropriate units and round correctly Calculate rates of change form verbal descriptions and from graphs Use dimensional analysis and/or proportions to convert from 1 unit to another Choose and create an appropriate scale in a graph Identify key features of a graph (rate, intercepts, maximums and minimums, quadrant and end behavior) and interpret these in the context of the given quantities Identify and relate the domain of a function to its graph and why a domain is appropriate for a given situation		Quizzes Test P.O.D. In-class activities HW

functions for inputs in their domains, and interpret statements that use function notation in terms of a context. 3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.* **Interpret functions that arise in applications in terms of the context.** 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*._ 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* 9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For*			Write the given domain and range as an interval or using set builder notation Identify functions and non-functions in graphs, tables and sets of points		

example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum **Linear, Quadratic, & Exponential Models F-LE** **Construct and compare linear, quadratic, and exponential models and solve problems.** 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. 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. 5. Interpret the parameters in a linear or exponential function in terms of a context.					
Connections to Text (Resources):					Time: 3 weeks
Connections to Technology:					
Key Vocabulary: domain, range, function, relation, maximum, minimum, slope, intercept					

Topic: Linear Functions Unit 2					
Essential Questions: How do patterns and functions help us solve a variety of problems? How do graphical representations of patterns, data and functional relationships help us better understand the world in which we live?					
Performance Indicators	Guided Questions		Essential Knowledge and Skills	Classroom Ideas (Instructional Strategies)	Assessment Ideas (evidence of understanding)
Interpreting Functions F-IF 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._ **Analyze functions using different representations.** 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 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.* **Build a function that models a relationship between two quantities.** 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			Students will know : Data is required to create a linear function A linear function is a mathematical relationship with a uniform scale factor Linear slope can be interpreted as a uniform rate of change Geometrically a linear function is a line Students will be able to : Explain slope as a rate of change between independent and dependent variables Determine the slope of a line given the coordinates of 2 points on the line Write the equation of a line given the slope and a point on the line Write the equation of a line given 2 points on the line Write the equation of a line parallel to the x- or y-axis Determine the slope of a line given its equation in any form Determine if 2 lines are parallel given their equations in any form Determine whether a given point is on a line given the equation of the line Determine when a relation is a function by examining ordered pairs and inspecting graphs of relations		Quizzes Test P.O.D. In-class activities HW

context 2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms 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,* $f(x) = 2x^3$ *or* $f(x) = (x+1)/(x-1)$ *for* $x \neq 1$. **Linear, Quadratic, & Exponential Models F-LE** **Construct and compare linear, quadratic, and exponential models and solve problems.** 1. Distinguish between situations that can be modeled with linear functions and 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 with exponential functions			Investigate and generalize how changing coefficients of a function affects its graph Solve an equation in the form of f(x) = c for a simple function f that has an inverse and write the expression as an inverse Use a calculator to input and collet data Build inverse functions from existing functions Determine when a relation is a function		
Connections to Text (Resources):					Time: 3 weeks
Connections to Technology:					
Key Vocabulary: relation, function, domain, range, slope, intercept, inverse, coefficient, parallel, rate of change, dependent variable, independent variable					

Topic: Linear Equations and Inequalities in One Variable Unit 3					
Essential Questions: How do equations and inequalities differ from expressions? How are linear equations related to linear functions? Do we use different mathematical procedures when working with inequalities? What does it mean to solve an equation or inequality? What does it mean to balance an equation or inequality? What type of problems require you to use a different procedure for solving equations?					
Performance Indicators	Guided Questions		Essential Knowledge and Skills	Classroom Ideas (Instructional Strategies)	Assessment Ideas (evidence of understanding)
Reasoning with Equations & Inequalities A-REI **Understand solving equations as a process of reasoning and explain the reasoning.** 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. **Solve equations and inequalities in one variable.** 3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters 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._			Students will understand : How to create an equation from information (verbal, graph, table etc) What each part of an equation represents Different types of equations can be used to model different situations How to manipulate equations in order to solve for a specific quantity Solutions mean different things in different contexts What absolute value is Linear equations connect to linear functions The difference between equations and expressions Students will be able to: Solve 1 variable linear equations Solve 1 variable inequalities Determine which types of equations can be used to model different situations Translate sentences into equations and inequalities Manipulate equations Identify solutions to an equation or inequality given a replacement set Solve absolute value linear		Quizzes Test P.O.D. In-class activities HW

Creating Equations A-CED **Create equations that describe numbers or relationships.** 1. Create equations and inequalities in one variable and use them to solve problems. 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.* 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. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*			inequalities		
Connections to Text (Resources):					Time: 4 weeks
Connections to Technology:					
Key Vocabulary: inverse operation, equation, inequality, expression, absolute value, variable					

Topic: Linear Equations and Inequalities in Two Variables Unit 4					
Essential Questions: How do we apply our knowledge of solving equations to model real life situations? Can we interpret equations or inequalities viable or nonviable options in a modeling context? How can we represent and analyze algebraically a wide variety of problem solving situations?					
Performance Indicators	Guided Questions		Essential Knowledge and Skills	Classroom Ideas (Instructional Strategies)	Assessment Ideas (evidence of understanding)
Creating Equations A-CED 2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. 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.* 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.* **Reasoning with Equations & Inequalities A-REI** **Solve systems of equations.** 5. Prove that, given a system of two equations in two variables, replacing one equation by the sum			Students will understand : How to identify differences among solutions of a single equation with 1 unknown and 2 unknowns and 2 equations with 2 unknowns How to explore linear functions in 2 variables and their 3 dimensional graphs The graph of an equation in 2 variables is the set of all the solutions plotted in the coordinate plane How to connect equations of 1 variable with functions That simultaneous equations can be solved symbolically That linear equations and inequalities can be used to solve problems in an applied context Student will be able to : Use a formula to solve for a specific variable Create equations in 2 or more variables to represent relationships between quantities Graph and solve systems of linear equation and inequalities with rational coefficients in 2 variables Solve systems of 2 linear equations algebraically Use a system of equations to model, solve and interpret solutions in real life problems		

of that equation and a multiple of the other produces a system with the same solutions. 6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables **Represent and solve equations and inequalities graphically.** 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) 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					
Connections to Text (Resources):					Time: 3 weeks
Connections to Technology:					
Key Vocabulary:					

Topic: Triangles Unit 5					
Essential Questions: How far is the projector from the wall? What is the height of the wall? What is the angle of projection? What is the size of the original shape? What is the size of the projected area? How will you manipulate the architectural elements? How many different images are necessary?					
Performance Indicators	Guided Questions		Essential Knowledge and Skills	Classroom Ideas (Instructional Strategies)	Assessment Ideas (evidence of understanding)
No CCLS NYS Algebra Standards A.A.42 A.A.43 A.A.44 A.A.45 A.G.1 A.G.2			Students will understand that : Pythagorean Theorem holds true for all right triangles and only for right triangles Trigonometric ratios can be used to solve many problems that can be modeled using right triangles Trig ratios are used in solving right triangle problems involving angle and Pythagorean Theorem is used in right triangle problems involving only sides Trig ratios are fixed ratios because of the connection to similarity Perimeter is 1-dimensional, area is 2-dimensional, and volume is 3-dimensional. The units for these values correlate dimensionally. Students will be able to : Find the missing side of a right triangle using Pythagorean Theorem or trig ratios Find sine, cosine or tangent of an angle given 2 sides Find perimeter, area, volume and surface area of various figures		Quizzes Test P.O.D. In-class activities HW
Connections to Text (Resources):					Time: 2 weeks
Connections to Technology:					
Key Vocabulary: sine, cosine, tangent, leg, hypotenuse, adjacent, opposite, perimeter, area, volume, surface area					

Topic: Quadratic Functions Unit 6					
Essential Questions: How are quadratic functions used in the real world? What do quadratic functions look like and how do they compare to other functions?					
Performance Indicators	Guided Questions		Essential Knowledge and Skills	Classroom Ideas (Instructional Strategies)	Assessment Ideas (evidence of understanding)
Interpreting Functions F-IF **Interpret functions that arise in applications in terms of the context.** 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*._ 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.*_ 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._ **Analyze functions using**			Students will understand that : Quadratics are represented by the equation ax^2 + bx +c = 0 and are shaped like a parabola. The graph of a quadratic is central in figuring out important parts such as vertex and nature of the function. There are many different variations of quadratic functions and ways to solve them (graphically and algebraically). Parabolas can be used for max and min problems as well as revenue in real life. Students will be able to : Define a quadratic function Know that a quadratic makes a parabola when graphed Find the meaning of key features of a parabola within context		Quizzes Test P.O.D. In-class activities HW

different representations. 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 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 zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. 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.* **Building Functions F-BF** **Build a function that models a relationship between two quantities.** 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* **Build new functions from existing functions.** 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.					
Connections to Text (Resources):					Time: 4 weeks
Connections to Technology:					
Key Vocabulary: vertex, maximum, minimum, axis of symmetry, zeros, parabola, quadratic					

Topic: Quadratic Equations Unit 7

Essential Questions: Where do we see quadratic functions in the real world? Why is it important to understand and break down a parabola? What does the vertex of a parabola tell us? How is changing the lead coefficient of a parabola similar to changing the coefficient of a line? What other characteristics are similar? The y- intercept is important for a line but why is the x- intercept important for a parabola?

Performance Indicators	Guided Questions		Essential Knowledge and Skills	Classroom Ideas (Instructional Strategies)	Assessment Ideas (evidence of understanding)
The Complex Number System N-CN **Use complex numbers in polynomial identities and equations.** 7. Solve quadratic equations with real coefficients that have complex solutions **Seeing Structure in Expressions A-SSE** **Write expressions in equivalent forms to solve problems.** 3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression._ a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines **Reasoning with Equations & Inequalities A-REI** 4. Solve quadratic equations in one variable. a. Use the method of completing the square to transform any			Students will understand how to: Factor a quadratic to find the zeros Find properties of a quadratic equation (vertex, maximum, minimum, roots, axis of symmetry) Solve a quadratic/linear system graphically and algebraically Solve a quadratic by factoring, taking square roots, completing the square Students will be able to : Use factors of a quadratic to find roots and solve the equation Use a table to graph a parabola Use inverse properties to manipulate an equation so that it is in quadratic form Use the quadratic equation to describe the properties of an equation		Quizzes Test P.O.D. In-class activities HW

quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b. 7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.					
Connections to Text (Resources):					Time: 5 weeks
Connections to Technology:					
Key Vocabulary: same as Unit 6 plus discriminant					

Topic: Statistics and Probability Unit 8					
Essential Questions: How can you strategically display data to support your argument? How much manipulation of data is "ok" to support your argument? If a relationship exists between 2 events does that mean one caused the other to happen? How likely/unlikely is a given outcome? What are the chances? What do we know? Why might a prediction differ from results obtained in an experiment?					
Performance Indicators	Guided Questions		Essential Knowledge and Skills	Classroom Ideas (Instructional Strategies)	Assessment Ideas (evidence of understanding)
Interpreting Categorical & Quantitative Data S-ID **Summarize, represent, and interpret data on a single count or measurement variable** 1. Represent data with plots on the real number line (dot plots, histograms, and box plots). 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. 3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). 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. **Summarize, represent, and interpret data on two categorical and quantitative variables** 5. Summarize categorical data for two categories in two-way			Students will understand : Data tools are used to organize, present and compare data Context can change data interpretation Different representations yield different stories and interpretations of data that can produce distinct conclusions Correlation does not imply causation How to make predictions of outcomes of an event The probability of an event must be between 0 and 1 The outcome of prior events can affect future events Students will be able to: Distinguish between different types of variables Analyze effects of bias and design on conclusions made from data Represent data with plots Compare center and spread of 2 or more sets of data Predict, determine, interpret and compare theoretical and experimental probability of events Determine whether an event is dependent or independent Represent, analyze and solve		Quizzes Test P.O.D. In-class activities HW

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. 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. **Interpret linear models** 7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. 8. Compute (using technology) and interpret the correlation coefficient of a linear fit. 9. Distinguish between correlation and causation. 69			counting problems Find the number of permutations/combinations of an event Use probability to make predictions		
Connections to Text (Resources):					Time: 6 weeks
Connections to Technology:					
Key Vocabulary: permutation, combination, univariate, bivariate, dependent, independent, causal, correlation, bias, mutually exclusive histogram, frequency, cumulative frequency, box and whisker plots, quartile, percentile, mean, median, mode, range, standard deviation,					