Readington Township Public Schools

Algebra 1
(Honors 7th and Advanced 8th)

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Algebra I Mathematics

Overview

This full-year Algebra 1 course is designed to provide Advanced 8th grade and Honors 7th grade students with the opportunity to explore and solidify algebra skills in the areas of linear, exponential, and quadratic functions. Students will extend their content base and knowledge in the following topics: solving, writing, and graphing equations and inequalities, solving systems of equations and inequalities, solving exponential equations, simplifying and factoring higher-degree polynomial functions, graphing and solving quadratic equations, simplifying and solving rational exponents and radical functions, calculating probability, and interpreting data analysis and statistics.

In addition to these topics, and in keeping with the New Jersey Student Learning Standards, students will experience the course content as an integrated, useful, and coherent whole. This course aims to encourage students to model with mathematics, reason abstractly and quantitatively while attending to precision both in calculations and vocabulary, and to make sense of problem situations as an essential part of the solution process.

STUDENT OUTCOMES

(Linked to New Jersey Student Learning Standards for Mathematics 2023)

Quantities (N.Q)

A. 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.

Seeing Structure in Expressions (A.SSE)

A. Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.
    a. Interpret parts of an expression, such as terms, factors, and coefficients.
    b. Interpret complicated expressions 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.

B. 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.
    c. Use the properties of exponents to transform expressions for exponential functions. For example, the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

Creating Equations (A.CED)

A. Create equations that describe numbers or relationships

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.
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 and Inequalities (A.REI)

A. 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.

B. Solve equations and inequalities in one variable

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
4. Solve quadratic equations in one variable.
    a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. 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.

C. Solve systems of equations

6. Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.

D. 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).
11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = f(x)$ 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.
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.

Interpreting Functions (F.IF)

A. 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 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 $n \geq 1$.

B. 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.

C. 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.
    b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
    e. Graph exponential and logarithmic functions, showing intercepts and end behavior.
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)

A. 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. Build new functions from existing functions

3. Identify the effect on the graph of replacing *f(x)* by *f(x) + k, kf(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.

Linear and Exponential Models (F.LE)

A. Construct and compare linear 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.
    c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

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).
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.

Interpreting Categorical and Quantitative Data (S.ID)

A. 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).

B. Summarize, represent, and interpret data on two categorical and quantitative variables

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 (including with the use of technology); 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 and exponential models.
    b. Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.
    c. Fit a linear function for a scatter plot that suggests a linear association.

C. 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.

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.

Strategies

- Teacher presentation
- Teacher read-aloud
- Group discussion
- Small Group instruction
- Group presentations
- Interactive Smartboard Lessons
- Interactive Digital Tools (e.g. Desmos, edPuzzle, etc.)
- Partner work
- Museum walks
- Math talk (students explain their thinking)
- Small Group Work (e.g. Investigation)

Accommodations

Accommodations and Modification Addendum

Assessments

Formative	Summative
• Independent student work • Ready Classroom Lesson Quizzes • Teacher Observations • Class Participation • Class Discussions • Class Assignments • Homework Assignments • Notebooks • Anecdotal Records	• Mid-Unit Test • Unit Test
Benchmark	**Alternative**
• I-Ready Diagnostic • Performance Assessments	• Live Online Assessment Tools (Kahoot, Brainpop) • Student Projects • Student Presentations • Self-Assessments

Resources

Required/Primary	Supplemental
• *McDougal Littell Algebra 1.* Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2004 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.	• iReady • Desmos • Brain Pop • IXL • Big Ideas Math Materials • Online Tutorials (Learnzillion, Khan Academy, Math Antics) • Online Math Games (Math is Fun, Funbrain, Cool Math Games, Math Playground) • Illustrative Mathematics (www.illustratviemathematics.org) • Explore Learning Gizmos • Estimation 180

Essential Questions And Content

Quantities

How do we appropriately define units, limitations, and reasonable quantities for a multi-step problem modeling real-world scenarios?

- 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.
- Define appropriate quantities for the purpose of descriptive modeling.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Seeing Structure in Expressions

How can we manipulate algebraic expressions to create equivalent forms?
What properties exist that allow us to maintain equivalence while rewriting linear, quadratic, and exponential expressions?

- Interpret and understand the parts of an expression, such as the terms, factors, and coefficients.

- Interpret complicated expressions by viewing one or more of their parts as a single entity. (i.e. P(1+r) as the product of P and a factor not depending on P).
- Use the structure of an expression to identify ways to rewrite it
- Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- Factor a quadratic expression to reveal the zeros of the function it defines.
- Complete the square in a quadratic expression to reveal the max or min value of the function it defines.
- Use the properties of exponents to transform expressions for exponential functions.

Creating Equations

How do we represent real world scenarios algebraically to convey equality or inequality between values/ expressions?
What constraints might exist on equations and inequalities, and why?

- Create equations and inequalities in one variable and use them to solve problems (including equations arising from linear, quadratic, and exponential functions).
- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in modeling context.
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Reasoning With Equations and Inequalities

What strategies exist to find the value of an unknown quantity in a linear or quadratic equation?
How do we represent solution sets of an equation, inequality, or system both graphically and symbolically?

- 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 linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions.
- Solve quadratic equations 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.
- Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
- 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).
- 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 $f(x) = g(x)$. Include cases where $f(x)$ and/or $g(x)$ are linear, quadratic, or absolute value functions.
- Graph the solutions to a linear inequality in two variables as a half plane with an appropriate boundary line, and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Interpreting Functions

What are linear functions? Quadratic functions? Exponential functions? How do we graph them?
What are the key features of functions and how do we find them? (e.g. domain & range, maximum/minimum, positive/negative trend, intercepts, etc.)? Which features exist on linear functions? Quadratic? Exponential? All three?

- 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
  $y = f(x)$.

- Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- 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; maximums and minimums.
- Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval for linear, quadratic, and exponential functions. Estimate the rate of change from a graph.
- Graph linear and quadratic functions and show intercepts, maxima, and minima
- Graph piecewise-defined functions, including step functions and absolute value functions.
- Graph exponential functions, showing intercepts and end behavior
- 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.
- Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Building Functions

How do we represent a pattern between two quantities algebraically when given a graph or table of values?

- Write a linear function that describes a relationship between two quantities
- Determine an explicit expression, a recursive process, or steps for calculation from a context using function notation
- 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.

Linear and Exponential Models

What are the distinguishing features of linear versus exponential models?
How do we recognize, write, and graph exponential functions?

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

Interpreting Categorical and Quantitative Data

How can we use a linear model to interpret a set of values in context and make predictions?
How might we represent data sets visually to display their shape, distribution, and center?

- Represent data with plots on the real number line (dot plots, histograms, and box plots).
- Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two different data sets.
- Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- Fit a function to the data (including with the use of technology); 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 and exponential models.

- Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.
- Fit a linear function for a scatter plot that suggests a linear association.
- Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- Compute (using technology) and interpret the correlation coefficient of a linear fit
- Distinguish between correlation and causation.

Pacing and Interdisciplinary Connections

A. Expressions, Equations, and Functions (7 days)

1. Apply Order of Operations
2. Write Expressions
3. Represent Functions as Rules and Tables
4. Represent Functions as Graphs
5. Distinguish relations from functions
6. Domain and Range

Interdisciplinary Connections:

W.AW.8.1 Write arguments on discipline-specific content (e.g. social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence.

Activity: Students will create a written summary of key topics and details in this unit, which can be used by other students to learn the material at another time. Students will include practice problems and answer keys. Organization, clear description, and proper voice will be important details on which to focus.

B. Properties of Real Numbers (5 days)

1. Use Integers and Rational Numbers
2. Add, Subtract, Multiply, and Divide Real Numbers
3. Apply the Distributive Property
4. Find Square Roots and Compare Real Numbers

Interdisciplinary Connections:

Social Studies

6.3.8.EconET.1: Using quantitative data, evaluate the opportunity cost of a proposed economic action, and take a position and support it (e.g., healthcare, education, transportation).

Activity: Students will consider an improvement they'd like to see at the Middle School and plan a budget. Will consider various stakeholders and develop a proposal that best meets the needs of the parties with attached calculations of all aspects of the plan using each topic from the unit at least once.

C. Solving Linear Equations (18 days)

1. Solve One-Step Equations
2. Solve Two-Step Equations
3. Solve Multi-Step Equations
4. Solve Equations with Variables on Both Sides
5. Write Ratios and Proportions
6. Solve Proportions Using Cross Products
7. Solve Percent Problems
8. Rewrite Equations and Formulas

Interdisciplinary Connections:

6.3.8.EconET.1: Using quantitative data, evaluate the opportunity cost of a proposed economic action, and take a position and support it (e.g., healthcare, education, transportation).

Activity: Students will use ratios and proportions to analyze the number of people in the district that would meet certain conditions if our school district were representative of the country at large.

D. Graphing Linear Equations and Functions (18 days)

1. Graph Linear Equations
2. Graph Using Intercepts
3. Find Slope and Rate of Change
4. Graph Using Slope-Intercept Form
5. Model Direct Variation

6. Graph Linear Functions

Interdisciplinary Connections:

Science MSESS2-1 Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.

Activity: Students will analyze data depicting changes in the ecosystem and graph using a variety of strategies. They will then identify if the trend is direct variation, and other key features such as intercepts, rate of change, etc.

E. Writing Linear Equations (18 days)

1. Write Linear Equations in Slope-Intercept Form
2. Use Linear Equations in Slope-Intercept Form
3. Write Linear Equations in Point-Slope Form
4. Relate Arithmetic Sequences to Linear Functions
5. Write Linear Equations in Standard Form
6. Write Equations of Parallel and Perpendicular Lines
7. Fit a Line to Data
8. Predict with Linear Models

Interdisciplinary Connections:

Science MS-ETS1 Analyze and interpret data to determine similarities and differences in findings.

Activity: Students will use linear models to make predictions. Using publicly available Census Data, students will create a table of values and graph depicting the relationship between the level of education and earned income. They will then use their model to make predictions for hypothetical scenarios and create a linear model to predict income for any number of years of education with appropriate domain and range.

F. Solving and Graphing Linear Inequalities (16 days)

1. Solve Inequalities Using Addition and Subtraction
2. Solve Inequalities Using Multiplication and Division
3. Solve Multi-Step Inequalities
4. Solve Compound Inequalities
5. Solve Absolute Value Equations
6. Solve Absolute Value Inequalities
7. Graph Linear Inequalities in Two Variables

Interdisciplinary Connections:

Science MS-ESS3-4 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Activity: Students will write, simplify, and graph linear inequalities in 2-variables to express the appropriate amount of land space required for particular animal habitats in order to maintain population levels. Students will then use this data to write a statement describing the danger (if any) to various species.

G. Systems of Equations and Inequalities (16 days)

1. Solve Linear Systems by Graphing
2. Solve Linear Systems by Substitution
3. Solve Linear Systems by Adding or Subtracting
4. Solve Linear Systems by Multiplying First
5. Solve Special Types of Linear Systems
6. Solve Systems of Linear Inequalities

Interdisciplinary Connections:

Science MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Activity: Students will graph inequalities depicting acceptable ranges of cost, fuel usage, and passenger capacity on a coordinate plane (repeated for various modes of transportation). They will use this information to make decisions that will maximize or minimize particular variables while remaining within the restraints provided.

H. Exponents and Exponential Functions (17 days)

1. Apply Exponent Properties Involving Products
2. Apply Exponent Properties Involving Quotients
3. Define and Use Zero and Negative Exponents
4. Use Scientific Notation
5. Write and Graph Exponential Growth Functions

6. Write and Graph Exponential Decay Functions
7. Calculate and interpret the average rate of change of a function
8. Relate Geometric Sequences to Exponential Functions

Interdisciplinary Connections:

Science MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.

Activity: Students will use operations in scientific notation to determine quantities of elements within particular compounds (e.g. quantity of carbon in gasoline, trace amounts of gold in seawater, etc.)

I. Polynomials and Factoring (20 days)

1. Add and Subtract Polynomials
2. Multiply Polynomials
3. Find Special Products of Polynomials
4. Solve Polynomial Equations in Factored Form
5. Factor x^2+bx+c
6. Factor ax^2+bx+c
7. Factor Special Products
8. Factor Polynomials Completely

Interdisciplinary Connections:

Science MS-LS3- 1 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

W.IW.8.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

Activity: Students will multiply polynomials together using 2 different strategies. They will write a brief statement comparing these strategies to those used when solving for potential genetic possibilities found from using punnett squares. Students will then be asked to model and solve for the percent of likelihood of a particular genetic makeup.

J. Quadratic Equations and Functions (18 days)

1. Graph $y=ax^2+c$
2. Graph $y=ax^2+bx+c$
3. Calculate and interpret the average rate of change of a quadratic function
4. Solve Quadratic Equations by Graphing
5. Use Square Roots to Solve Quadratic Equations
6. Solve Quadratic Equations by Completing the Square
7. Solve Quadratic Equations by the Quadratic Formula
8. Interpret the Discriminant
9. Compare Linear, Exponential, and Quadratic Models

Interdisciplinary Connections:

Science MS-PS2- 2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

Activity: Students will use a quadratic function to model the height of a jumping animal as a function of time. Students can answer the question, "How does changing the initial vertical velocity (initial force) of the jumping animal affect its maximum height and time to reach the ground?"

K. Probability and Data Analysis (10 days)

1. Find Probabilities and Odds
2. Find Probabilities Using Permutations
3. Find Probabilities Using Combinations
4. Find Probabilities of Compound Events
5. Analyze Surveys and Samples
6. Use Measures of Central Tendency and Dispersion
7. Interpret Stem-and-Leaf Plots and Histograms
8. Interpret Box-and-Whisker Plots

Interdisciplinary Connections:

W.WR.8.5 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
Activity*:* Students pick a topic of interest and research. Can be a mathematician or a topic of interest which would lend itself to surveys and the creation of charts and tables to display the results.

Career, Computer Science, and Key Skills

Seeing Structure in Expressions

- **Career Ready Practices**
  - Utilize critical thinking to make sense of problems and persevere in solving them.
    Activity: Given information about the dimensions of a city block north-south versus east-west, students can model the number of blocks to run in each direction in order to reach a set distance goal. They will then be able to solve for one of the distances when given the other.

- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.6:** Compare the costs of postsecondary education with the potential increase in income from a career of choice.
    Activity: Students will use linear models to make predictions. Using publicly available Census Data, students will create a table of values and graph depicting the relationship between level of education and earned income. They will then use their model to make predictions for hypothetical scenarios and create a linear model to predict income for any number of years of education with appropriate domain and range.

- **9.4 Life Literacies and Key Skills**
  (Critical Thinking/ Problem Solving, Technology Literacy, Information Literacy, Digital Citizenship)
  - **9.4.8.CT.2:** Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
    9.4.8.TL.1: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making
    9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping
    9.4.8.DC.7: Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys
    Activity: Given information about the dimensions of a city block north-south versus east-west, students can model the number of blocks to run in each direction in order to reach a set distance goal. They will then digitally model the variety of paths the runner could use with descriptions of why one path may be chosen over another even though they total the same distance.

- **Computer Science**
  - **8.1.8.DA.1:** Organize and transform data collected using computational tools to make it usable for a specific purpose.
    Activity: When given a set of data points from a survey or sample, students will be able to create multiple data displays (e.g. box and whisker plot, histogram, stem-and-leaf, etc.) to show how the data display can represent the same data set differently depending on the feature they wish to highlight (distribution, center, frequencies, etc.).

Creating Equations

- **Career Ready Practices**
  - Demonstrate creativity and innovation.
    Activity: Given a table of values students will be asked to write the linear function depicted using any strategy and show their thinking on a poster. Students will do a gallery walk to see that while all solutions are the same, the process to solve can look very different (graphically, using formulas, identifying key features from the table, etc.)

- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.11**: Analyze potential career opportunities by considering different types of resources, including occupation databases, and state and national labor market statistics.
  - **Activity:** Students will use occupation databases and labor market statistics as the data source for creating linear, quadratic, or exponential equations.

- **9.4 Life Literacies and Key Skills**
  (Creativity & Innovation, Technology Literacy, Information Literacy, Digital Citizenship)
  - **9.4.8.CI.1**: Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions
  - **9.4.8.DC.8**: Explain how communities use data and technology to develop measures to respond to effects of climate change
  - **9.4.8.IML.8**: Apply deliberate and thoughtful search strategies to access high-quality information on climate change.
  - **9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem.
    Activity: Students will research credible sources for data on climate change and use it to create a linear, quadratic, or exponential equation that can help predict key moments in time or potential solutions for populations that may have differing views based on the data.

- **Computer Science**
  - **8.1.8.DA.1**: Organize and transform data collected using computational tools to make it usable for a specific purpose.
    Activity: Students will use a spreadsheet, with formulas, to create an equation with a specified number of input values from each unit of measure recorded.

Reasoning with Equations and Inequalities

- **Career Ready Practices**
  - Utilize critical thinking to make sense of problems and persevere in solving them.
    Activity: Through the daily course work required, students will be expected to clearly articulate, using proper mathematical vocabulary, the impact of slope and y-intercept on a graph, as well as what those values mean in relation to the original problem setting. As new vocabulary is introduced, students will be asked to reflect upon prior topics, terminology, and symbols to make connections and derive meaning of the new concepts.

- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.10**: Evaluate how careers have evolved regionally, nationally, and globally.
    Activity: Students will choose 2 careers and research the presence of that profession in the overall workforce over the past 20 years so that they may graph and interpret the trend of the results found.

- **9.4 Life Literacies and Key Skills**
  (Critical Thinking/ Problem Solving, Technology Literacy, Information Literacy, Digital Citizenship)
  - **9.4.8.CT.3**: Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
  - **9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
  - **9.4.8.IML.12**: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
  - **9.4.8.DC.2:** Analyze the resource citations in online materials for proper use.
    Activity: Using accurate and official Census data on the number of voting-age Americans, students will create graphs and equations to represent the data. They will then use those models to make predictions for the population in future years.

Interpreting Functions

- **Career Ready Practices**
  - Utilize critical thinking to make sense of problems and persevere in solving them.
    Daily coursework requires the investigation and derivation of patterns existing in linear, quadratic, and exponential functions. Students will be asked to identify key features of functions and their importance to a graph by connecting concepts to prior skills

- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.10**: Evaluate how careers have evolved regionally, nationally, and globally.
    Activity: Students will choose 2 careers and research the presence of that profession in the overall workforce over the past 20 years so that they may graph and interpret the trend of the results found.

- **9.4 Life Literacies and Key Skills**
  (Creativity & Innovation, Technology Literacy, Information Literacy, Digital Citizenship)
  - **9.4.8.CI.3:** Examine challenges that may exist in the adoption of new ideas.
  - **9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
  - **9.4.8.IML.13:** Identify the impact of the creator on the content, production, and delivery of information
  - **9.4.8.DC.1:** Analyze the resource citations in online materials for proper use.
  - **9.4.8.DC.2:** Provide appropriate citation and attribution elements when creating media products
    Activity: Students will be given data to show the number of passengers that wear their seatbelts starting in 1968 up to today. They will be asked to use a graphing calculator to model the data and describe the set as linear, quadratic, exponential, or none of those as well as describe why they believe the trend follows the path it does. They will then interpret key components (e.g. maximum, minimum, intercepts, etc.) of the function in context of the situation.

- **Computer Science**
  - **8.1.8.DA.6:** Analyze climate change computational models and propose refinements.
    Activity: Students will be given climate data and will be asked to use a graphing calculator to model the quadratic regression. They will be asked to use a graphing calculator to model the data and describe the set as linear, quadratic, exponential, or none of those as well as describe why they believe the trend follows the path it does. They will then interpret key components (e.g. maximum, minimum, intercepts, etc.) of the function in context of the situation.

Building Functions

- **Career Ready Practices**

- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.10**: Evaluate how careers have evolved regionally, nationally, and globally.
    Activity: Students will choose 2 careers and research the presence of that profession in the overall workforce over the past 20 years so that they may graph and interpret the trend of the results found.

- **9.4 Life Literacies and Key Skills**
  (Creativity & Innovation, Technology Literacy, Information Literacy, Digital Citizenship)
  - **9.4.8.CI.3:** Examine challenges that may exist in the adoption of new ideas.
  - **9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
  - **9.4.8.IML.13:** Identify the impact of the creator on the content, production, and delivery of information
  - **9.4.8.DC.1:** Analyze the resource citations in online materials for proper use.
  - **9.4.8.DC.2:** Provide appropriate citation and attribution elements when creating media products
    Activity: Students will be given data to show the number of passengers that wear their seatbelts starting in 1968 up to today. They will be asked to use a graphing calculator to model the data and describe the set as linear, quadratic, exponential, or none of those as well as describe why they believe the trend follows the path it does. They will then do their best to model the function using proper notation.

- **Computer Science**

- **8.1.8.DA.6:** Analyze climate change computational models and propose refinements.

  Activity: Students will be given climate data and will be asked to use a graphing calculator to model the quadratic regression. They will be asked to use a graphing calculator to model the data and describe the set as linear, quadratic, exponential, or none of those as well as describe why they believe the trend follows the path it does. They will then do their best to model the function using proper notation.

Linear and Exponential Models

- **Career Ready Practices**
  - Demonstrate creativity and innovation.

    Activity: Given a table of values students will be asked to write the linear function depicted using any strategy and show their thinking on a poster. Students will do a gallery walk to see that while all solutions are the same, the process to solve can look very different (graphically, using formulas, identifying key features from the table, etc.)
- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.6:** Compare the costs of postsecondary education with the potential increase in income from a career of choice.

    Activity: Using publicly available Census Data, students will create a table of values and graph depicting the relationship between level of education and earned income. They will explain what function family this model falls into with evidence from its rate of change between the data points and model it with an equation in function form.

- **9.4 Life Literacies and Key Skills**
  (Creativity & Innovation, Technology Literacy, Information Literacy, Digital Citizenship)
  - **9.4.8.CI.3:** Examine challenges that may exist in the adoption of new ideas.
  - **9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
  - **9.4.8.IML.13:** Identify the impact of the creator on the content, production, and delivery of information
  - **9.4.8.DC.1:** Analyze the resource citations in online materials for proper use.
  - **9.4.8.DC.2:** Provide appropriate citation and attribution elements when creating media products

    Activity: Students will be given data to show the number of passengers that wear their seatbelts starting in 1968 up to today. They will be asked to use a graphing calculator to model the data and describe the set as linear, quadratic, exponential, or none of those as well as describe why they believe the trend follows the path it does. They will then interpret key components (e.g. maximum, minimum, intercepts, etc.) of the function in context of the situation.

Interpreting Categorical & Quantitative Data

- **Career Ready Practices**
  - Demonstrate creativity and innovation.

    Activity: Given a table of values students will be asked to write the linear function depicted using any strategy and show their thinking on a poster. Students will do a gallery walk to see that while all solutions are the same, the process to solve can look very different (graphically, using formulas, identifying key features from the table, etc.)
- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.6:** Compare the costs of postsecondary education with the potential increase in income from a career of choice.

    Activity: Using publicly available Census Data, students will create a table of values and graph depicting the relationship between level of education and earned income. They will explain what function family this model falls into with evidence from its rate of change between the data points and model it with an equation in function form.

- **9.4 Life Literacies and Key Skills**
  (Creativity & Innovation, Technology Literacy, Information Literacy, Digital Citizenship)
  - **9.4.8.CI.3:** Examine challenges that may exist in the adoption of new ideas.
  - **9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.

- **9.4.8.IML.13:** Identify the impact of the creator on the content, production, and delivery of information
- **9.4.8.DC.1:** Analyze the resource citations in online materials for proper use.
- **9.4.8.DC.2:** Provide appropriate citation and attribution elements when creating media products

Activity: Students will be given data to show the number of passengers that wear their seatbelts starting in 1968 up to today. They will be asked to use a graphing calculator to model the data and describe the set as linear, quadratic, exponential, or none of those as well as describe why they believe the trend follows the path it does. They will then interpret key components (e.g. maximum, minimum, intercepts, etc.) of the function in context of the situation.