Standard- New Jersey Student Learning Standards: A-SSE, A-APR, A-CED, A-REI, F-IF, F-BF, F-LE
Algebra, Graphs, and Functions (Chapter 6)

Strand

A-SSE: Seeing Structure of Expressions

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.

A-APR: Arithmetic with Polynomials and Rational Expressions

Use polynomial identities to solve problems.

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Understand the relationship between zeros and factors of polynomials.

2. Know and apply the remainder theorem: for a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x-a) is a factor of p(x).
1. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Rewrite rational expressions.

7. Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

A-CED: Creating Equations*

Creating 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 function.
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.*

A-REI: Reasoning with Equations and Inequalities

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.
2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Solve equations and inequalities in one variable.

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

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 = g(x) intersect are the solutions of the equation f(x) = g(x); find solutions approximately; e.g., using technology to graph 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.

F-IF: Interpreting Functions

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 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 statement that use function notation in terms of a context.

Interpret functions that arise in application 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 in 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 different representations.

7. Graph functions expressed symbolically and show key features of the graph, by hand in sample 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.

F-BF: Building Functions

Build a function relationship 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 calculations 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.*
   c. (+) Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.*

F-LE: Linear and Exponential Models*

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 rte 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).

Curriculum aligned with: 2009 New Jersey Core Curriculum Content Standards for 21st Century Skills (9.1 A-F)

21st Century Theme: *Global Awareness ☐,Financial, economic, business and entrepreneurial literacy X,Civic literacy ☐,Health literacy ☐Environmental Literacy ☐*

21st Century Skills: *Critical Thinking & Problem Solving X,Creativity and Innovation ☐,Collaboration, Teamwork and Leadership ☐,Cross-Cultural Understanding and Interpersonal Communications ☐ Communication and Media Fluency ☐,Accountability, Productivity and Ethics*

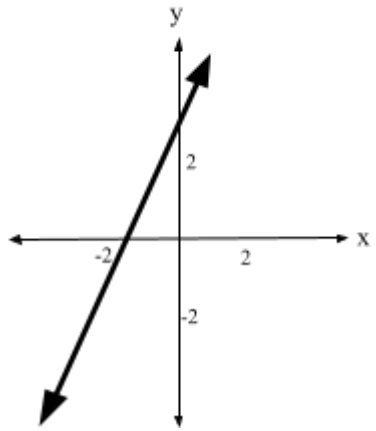
Interdisciplinary Connection: Math=MA, English=ELA, Science=SCI, Social Studies=SS, Physical Education=PE, Art=ART, Music=MU, Technology=TECH, World Language=WL, Business = BU

Essential Questions	Enduring Understandings	Activities, Investigation, and Student Experiences

1. What are the important concepts and techniques for graphing linear functions? 2. What are the important concepts and techniques for graphing quadratic functions? 3. What are the solutions to functions and what exactly do they mean?	*Students will understand….* ● Order of operations and solving equations. ● Formulas ● Applications of Algebra ● Variation ● Linear Inequalities ● Graphing Linear Equations ● Solving systems of Linear Equations. ● Solving Quadratic Equations. ● Functions and their Graphs
Content Statements	**Cumulative Progress Indicators**

Task 1:

The graph represents a function.



a. Write the equation for the graph in standard form, point-slope form, and slope-intercept form.
b. Which equation is the easiest to write by looking at the graph? Explain why.

Answer:

a. First step: Find two points from the graph. [(0, 3) and (-3, -3)]
Second step: Find the slope using the two points you found in step 1. (m = 2)
Third step: Use the points and the slope to write the equation in three forms.
(-2x + y = 3; y + 3 = 2(x + 3); y = 2x + 3)

Students will know…

- Order of operation
- Solving linear and quadratic equations
- Evaluating a formula
- Solving application problems involving linear, quadratic, and exponential equations.
- Solving application problems dealing with variation.
- Graphing equations and functions.
- Soling system of equations.
- Solving linear inequalities.
- Solving linear programming problems.

- Tests
- Quizzes
- Practice problems for homework
- Workbook pages
- Worksheets

Desired Results

- Order of operations and solving equations.
- Formulas
- Applications of Algebra
- Variation
- Linear Inequalities
- Graphing Linear Equations
- Solving systems of Linear Equations.
- Solving Quadratic Equations.
- Functions and their Graphs

b. The slope-intercept equation is the easiest equation to write because you can find the value of b directly from the graph.

Task 2: SCI

Boiling point of water	
Elevation F(t)	Boiling Point (°F)
Sea Level	212
1000	210.2
2000	208.4
3000	206.6
4000	204.8
5000	203

The table above shows the boiling point of water at various elevation.

a. Identify the independent and dependent quantities. Explain your choices.

Standards for 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.

b. Make a scatter plot that models this data.
c. Determine what kind of correlation is shown in your plot.
d. Write an equation of the line of best fit.
e. Use your equation to predict the temperature at which water boils at 8000 feet above seas level.
f. At what elevation would you expect water to boil at 207°F?

Answer:

a. The boiling point depends on the elevation so the elevation is the independent variable and the boiling point is the dependent variable.

b. Make a scatter plot. Let the x-values represent the elevation and the y-values the boiling point of water.

c. Describe the correlation. (As the elevation increases the boiling point decreases. The points appear to make a straight line from upper left to lower right. There is a strong negative correlation.)

d. First step: sketch a line that best suggest the trend line given by the data.

Second step: Choose two points on the trend line. [(1000, 210.2) and (4000, 204.8)]

Third step: Use the point slope formula to write an equation for the line that passes through the two points. (y = -0.0018x + 212)

e. First step: Substitute 8000 for x in the equation from part (d) and simplify. (approximately 197.6°)

f. Possible plan: You can use the equation you found in part (d). Substitute 207 for y and solve for x. (approximately 2778 feet)

Task 3:

Which of the following are the solutions for the equation $0 = x^2 - x + 1$?

a. $x = \frac{-1 + i\sqrt{3}}{2}$ and $x = \frac{-1 - i\sqrt{3}}{2}$

b. $x = \frac{-1 + i\sqrt{5}}{2}$ and $x = \frac{-1 - i\sqrt{5}}{2}$

c. $x = \frac{1 + i\sqrt{5}}{2}$ and $x = \frac{1 - i\sqrt{5}}{2}$

d. $x = \frac{1 + i\sqrt{3}}{2}$ and $x = \frac{1 - i\sqrt{3}}{2}$

Answer:

d. $x = \frac{1 + i\sqrt{3}}{2}$ and $x = \frac{1 - i\sqrt{3}}{2}$

Modifications and/or Accommodations:

- **Special Education:** Utilize a multi-sensory (VAKT) approach during instruction, provide alternate presentations of skills by varying the method (repetition, simple explanations, additional examples, modeling, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks.
- **English Language Learners:** Extend time requirements, preferred seating, positive reinforcement, check often for understanding/review, oral/visual directions/prompts when necessary, supplemental materials including use of online bilingual dictionary, and modified assessment and/or rubric.
- **Students at Risk of School Failure:** Deliver instruction utilizing varied learning styles including audio, visual, and tactile/kinesthetic, provide individual instruction as needed, modify assessments and/or rubrics, repeat instructions as needed.
- **Gifted Students:** Create an enhanced set of introductory activities, integrate active teaching/learning opportunities, incorporate authentic components, propose interest-based extension activities, and connect student to related talent development opportunities

Spot Light On: *Ask challenging questions equitably of all students.*

Teacher Resources

	Mymathlab.com http://achievethecore.org https://learnzillion.com https://www.khanacademy.org/ https://www.desmos.com/ http://www.ixl.com

LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*

NASA Employees

The mission is to ensure that every student is able to see themselves in our rich and diverse history.

Social and Emotional Learning: ***Competencies***	**Social and Emotional Learning:** ***Sub-Competencies***
Self-Awareness Social Awareness Self-Management Relationship Skills Responsible Decision-Making	• Recognizing the importance of self-confidence in handling daily tasks and challenges. • Demonstrate an awareness of the expectations for social interactions in a variety of ways. • Demonstrate an understanding of the need for mutual respect when viewpoints differ. • Recognize the skills needed to establish and achieve personal and educational goals. • Utilize positive communication and social skills to interact effectively with others. • Develop, implement, and model effective problem solving and critical thinking skills.

New Jersey Legislative Statutes and Administrative Code (place an "X" before each law/statute if/when present within the curriculum map)									
	Amistad Law: *N.J.S.A. 18A 52:16A-88*		Holocaust Law: *N.J.S.A. 18A:35-28*	**x**	LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*	**x**	Diversity & Inclusion: *N.J.S.A. 18A:35-4.36a*		Standards in Action: *Climate Change*