Readington Township Public Schools

Algebra 2

Authored by: Douglas Ayers and Colleen Ogden

Reviewed by: Sarah Pauch
Supervisor of Math, Science, and Technology

Approval Date: January 18, 2022

Members of the Board of Education:
Carol Hample, President
Dr. Camille Cerciello, Vice President
Jodi Bettermann
Elizabeth Fiore
Randall J. Peach
Carolyn Podgorski
Thomas Wallace
Jennifer Wolf

Superintendent: Dr. Jonathan Hart

Readington Township Public Schools
Whitehouse Station, NJ 08889
www.readington.k12.nj.us

OVERVIEW

This full-year Algebra 2 course is designed to provide advanced 8th grade students with the opportunity to strengthen their skills in the areas of linear, quadratic, and exponential functions, while extending their content base and knowledge to include higher-degree polynomial functions (including now solving these over the set of complex numbers), rational exponents and radical functions, solving exponential and logarithmic equations, rational functions, arithmetic and geometric sequences and series, trigonometric ratios and functions, probability, 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, continually refining their abilities 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**)

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 $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.

N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

N.CN.1 Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real.

N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

N.CN.7 Solve quadratic equations with real coefficients that have complex solutions.

N.CN.8 (+) Extend polynomial identities to the complex numbers. For example, rewrite x2 + 4 as (x + 2i)(x – 2i).

N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

A.SSE.1 Interpret expressions that represent a quantity in terms of its context. (Linear, exponential, quadratic for Alg.1; Polynomial and rational for Alg. 2)

> 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.SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.

A.SSE.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% .

A.SSE.4 Derive and/or explain the derivation the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.

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

A.APR.2 Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).

A.APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

A.APR.4 Prove Polynomial identities and use them to describe numerical relationships and solve problems. For example, the difference of two squares; the sum and difference of two cubes; the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.

A.APR.5 (+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

A.APR.6 Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

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

A.CED.1, 2, 3, 4 Create equations that describe numbers or relationships. (This is an Alg. 1 cluster that limits discussion to linear, quadratic, and exponential functions with integer inputs only. Algebra 2 extends this to equations using all types of expressions, including simple root functions).

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.

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

A.REI.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 ± bi for real numbers a and b.

A-REI.6 Solve algebraically a system of *three* linear equations in three unknowns.

A-REI.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 $x^2 + y^2 = 3$.

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.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.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.

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.

    b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

    c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

    e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and

trigonometric functions, showing period, midline, and amplitude.

F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of 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.

F-BF.1 Write a function that describes a relationship between two quantities.

   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 formula, 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.

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, $f(x) = 2\,x3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.

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.4 Understand the inverse relationship between exponents and logarithms. For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

F.TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

F.TF.8 Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$, given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$, and the quadrant of the angle.

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 (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 (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.

S-ID.6a-1 Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in S-ID.6a, excluding normal distributions and limiting function fitting to exponential functions

S-ID.6a-2 Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course level knowledge and skills articulated in S-ID.6a limiting function fitting to

trigonometric functions.

S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

S.IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. E.g., a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?

S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.

S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

S.IC.6 Evaluate reports based on data.

S.CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").

S.CP.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

S.CP.3 Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.

S.CP.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.

**S.CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.

S.CP.6 Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.

S.CP.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.

S.CP.8 (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.

S.CP.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

S-CP.Int.1 Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in S-CP.

S.MD.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

S.MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

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

ESSENTIAL SKILLS AND CONTENT

Polynomial, Rational, and Radical Relationships

• Perform arithmetic operations with complex numbers.

• Use complex numbers in polynomial identities and equations.

• Interpret the structure of expressions.

• Write expressions in equivalent forms to solve problems.

• Perform arithmetic operations on polynomials.

• Understand the relationship between zeros and factors of polynomials.

• Use polynomial identities to solve problems.

• Rewrite rational expressions.

• Understand solving equations as a process of reasoning and explain the reasoning.

• Represent and solve equations and inequalities graphically.

• Analyze functions using different representations.

Trigonometric Functions

• Extend the domain of trigonometric functions using the unit circle.

• Model periodic phenomena with trigonometric function.

• Prove and apply trigonometric identities.

Modeling with Functions

• Create equations that describe numbers or relationships.

• Interpret functions that arise in applications in terms of a context.

• Analyze functions using different representations.

• Build a function that models a relationship between two quantities.

• Build new functions from existing functions.

• Construct and compare linear, quadratic, and exponential models and solve problems.

Inferences and Conclusions from Data

• Summarize, represent, and interpret data on single count or measurement variable.

• Understand and evaluate random processes underlying statistical experiments.

• Make inferences and justify conclusions from sample surveys, experiments and observational studies.

• Use probability to evaluate outcomes of decisions.

STRATEGIES

Intellectual engagement and active involvement of students in daily lessons will be achieved by a variety of teaching strategies, including:
Comprehensive direct instruction utilizing Interactive SmartBoard technology 2. Guided practice using worked-out study examples, followed immediately by 3. Independent Practice using 'Now You Try' examples 4. Student presentation of work and solutions, with explanation and justification of solutions 5. High-level questioning and encouragement of student participation 6. Student group discussion and mutual help as part of point 3 above 7. Regular written 'check for understanding' assessments. 8. End of unit formative assessments.

ACCOMMODATIONS
- **Accommodations and Modification Addendum**

ASSESSMENTS

- **Formative**
  - o Independent student work
  - o Homework assignments
  - o Notebooks
  - o Teacher observations
  - o
- **Summative**
  - o End of Year Test
  - o Unit Test
  - o Unit Quizes
- **Alternative**
  - o Student projects
  - **o**
- **Benchmark**
  - o Performance-based assessments

REQUIRED RESOURCES
- **Core**
  - o **Textbook for course:** *Big Ideas MATH Algebra 2*, Larson, R., Boswell, L. Copyright 2015 by Big Ideas Learning, LLC.
- **Supplemental resources for course:**
  - o Chapter Resource Books. Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2001 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.
  - o Standardized Test Practice Workbook. Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2001 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.
  - o *McDougal Littell Algebra 2.* Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2004 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.
- **Suggested supplemental Technology**
  - **o** www.classzone.com
  - **o** www.shmoop.com/common-core-standards/
  - o www.illustrativemathematics.org
  - o Gizmos

CAREER READINESS, LIFE LITERACIES, AND KEY SKILLS AND COMPUTER SCIENCE
Number and Quantity
- **Career Ready Practices**
  - o Utilize critical thinking to make sense of problems and persevere in solving them.
    Activity: Collect data on handedness and Male / Female population and enter into two-way tables to compute joint relative, marginal relative, and conditional relative frequencies

- **9.2 Career Awareness, Exploration, and Preparation**
  - o **9.2.8.CAP.18**: Explain how personal behavior, appearance, attitudes, and other choices may impact the job application process.
    Activity: Students will perform peer- and self-evaluations on their work effort and behavior during the above activity. Students will self-assess their work and the overall functioning of their work group during this project.

- **9.4 Life Literacies and Key Skills**
  - o **9.4.8.TL.1**: Construct a spreadsheet in order to analyze multiple data sets, identify relationships,and facilitate data-based decision-making.
    Activity: Collect data on handedness and Male / Female population and enter into two-way tables to compute joint relative, marginal relative, and conditional relative frequencies using Excel.
- **Computer Science**
  - o **8.1.8.DA.1**: Organize and transform data collected using computational tools to make it usable for a specific purpose.
    Activity: Collect data on handedness and Male / Female population and enter into two-way tables to compute joint relative, marginal relative, and conditional relative frequencies using Excel.

Algebra
- **Career Ready Practices**
  - o Utilize critical thinking to make sense of problems and persevere in solving them.
    Activity: Students will be asked to calculate height of a dropped object t seconds after release given gravity constant for earth vs. gravity constant for moon. (Ch. 3 of BI Algebra 2).

- **9.2 Career Awareness, Exploration, and Preparation**
  - o **9.2.8.CAP.14**: Evaluate sources of income and alternative resources to accurately compare employment options.
    Activity: Students will calculate how to maximize possible income.

- **9.4 Life Literacies and Key Skills**
  - o **9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem
    Activity: Students will persevere in solving real world problems involving functions - solving, graphing and interpreting. (Big Ideas Section 2.1, pgs 53-54).

- **Computer Science**
  - o **8.1.8.DA.1**: Organize and transform data collected using computational tools to make it usable for a specific purpose.
    Activity: Enter data pairs into TI graphing calculator using time, height data and use quadratic regression.

Functions
- **Career Ready Practices**
  - ○ Use technology to enhance productivity, increase collaboration and communicate effectively.
    Activity: Students will persevere in solving real world problems involving functions - solving, graphing and interpreting. (Big Ideas Section 2.1, pgs 53-54).

- **9.2 Career Awareness, Exploration, and Preparation**

- o **9.2.8.CAP.8**: Compare education and training requirements, income potential, and primary duties of at least two jobs of interest.
  Activity: Students will persevere in solving real world problems involving functions - solving, graphing and interpreting. (Big Ideas Section 2.1, pgs 53-54).

- ● **9.4 Life Literacies and Key Skills**
  - o **9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
    Activity: Students will use a graphing calculator to model transformations of quadratic functions. They will solve real world problems, e.g., modeling the path of water coming from a fire truck (Big Ideas. Section 2.1).
- ● **Computer Science**
  - o **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 graphing calculator to model transformations of quadratic functions. They will solve real world problems, e.g., modeling the path of water coming from a fire truck (Big Ideas. Section 2.1).

Statistics and Probability
- ● **Career Ready Practices**
  - o Use technology to enhance productivity, increase collaboration and communicate effectively.
    Activity: Students will design and execute a valid research survey, analyze its results on an issue pertaining to education and income . (Big Ideas Sections 11.1 - 11.3)

- ● **9.2 Career Awareness, Exploration, and Preparation**
  - o **9.2.8.CAP.6**: Compare the costs of postsecondary education with the potential increase in income from a career of choice.
    Activity: Through the group survey project above, students will participate fairly and effectively with their group members, to produce a coherent survey, analysis and presentation of its findings. (Big Ideas, Chapter 11).

- ● **9.4 Life Literacies and Key Skills**
  - o **9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem
    Activity: Through the group survey project above, students will participate fairly and effectively with their group members, to produce a coherent survey, analysis and presentation of its findings. (Big Ideas, Chapter 11).

- ● **Computer Science**
  - o **8.1.8.DA.5:** Test, analyze, and refine computational models.
    Activity: Students will analyze school-wide data on left-handedness, enter into a spreadsheet and program to calculate one-variable statistics on measures of central tendency and variability. Alternatively, they may use the research topic of their choice (see above).

IX.   PACING

A. Polynomials (Quadratics) (34 days)

a. Rewrite equations and formulas
b. Solve systems of two nonlinear equations algebraically using elimination and substitution methods
c. Graph quadratic functions from standard, vertex, and intercept (factored) form.
d. Solve quadratic functions by factoring
e. Solve quadratic functions by finding square roots
f. Perform operations with complex numbers
g. Solve quadratic functions by completing the square
h. Use the quadratic formula to solve equations. and the discriminant
i. Use the discriminant to determine the number and type of solutions to a quadratic equation.
j. Model with quadratic functions
k. Solve quadratic systems (i.e. a linear – quadratic system)
l. Parabolas as conic sections (derive equation of a parabola given a focus and directrix)

Interdisciplinary Connections:
● NJSLSA.R7 Integrate and evaluate content presented in Diverse media and formats, including visually and quantitatively, as well as in word.
Activity: Students will watch Dirt Bike Trajectory video and read its associated written performance task and complete problems relating to calculating the trajectory of a dirt bike launching from a ramp. (Big Ideas. Section 1.1).

B. Polynomials (Higher Order Polynomials) (20 days)

1. Evaluate and graph polynomial functions
2. Understand and apply properties of exponents
3. Add, subtract, and multiply polynomials
4. Factor and solve polynomial equations
5. Understand the Remainder and Factor Theorems and dividing polynomials
6. Apply the Rational Zero Theorem
7. Evaluate using the Fundamental Theorem of Algebra
8. Analyze graphs of polynomial functions
9. Evaluate and solve polynomial functions of degree 3 or higher.
10. Graph polynomial functions of degree 3 and above.

Interdisciplinary Connections:
● NJSLSA.R7 Integrate and evaluate content presented in Diverse media nad formats, including visually and quantitatively, as well as in word.
Activity: Students will watch the Parabolic Mirror video and read associated written

performance task and complete problems relating to building their own parabolic mirror that uses sunlight to generate electricity.. (Big Ideas. Section 2.3).

C. Radical and Rational Functions (19 days)

1. Understand Nth roots and rational exponents
2. Apply properties of rational exponents
3. Evaluate power functions and function operations (limited to arithmetic operations)
4. Evaluate inverse functions
5. Understand how to graph square root and cube root functions
6. Solve radical equations
7. Understand inverse and joint variation
8. Graph simple rational functions
9. Graph general rational functions
10. Multiply and divide rational expressions 1
11. Add and subtract rational expressions and simplify complex fractions
12. Solve rational equations

Interdisciplinary Connections:

- ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) Models of all kinds are important for testing solutions. (MS-ETS1-4)
  Activity: Through this unit, students will find equivalent expressions, solutions to functions and model their solutions.

D. Exponential and Logarithmic Functions (20 days)

1. Analyze and graph exponential growth
2. Analyze and graph exponential decay
3. Evaluate and apply the number *e*
4. Solve and graph logarithmic functions
5. Understand properties of Logarithms (cover only those needed to solve exp. and log. Equations, i.e. Power Property and Change-of-Base Formula. Cover others if time.)
6. Solve exponential and logarithmic equations (Suppl. same as C.8 above for solving *systems* of exponential and logarithmic equations)
7. Model exponential functions (and power functions – time allowing)

Interdisciplinary Connections:

- ETS1.A: Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

<u>Activity:</u> Throughout the unit, students will analyze limits and constraints in functions.

E. Arithmetic and Geometric Sequences and Series (12 days)
1. Introduce sequences and series
2. Write rules for arithmetic sequences and series
3. Write rules for geometric sequences and series
4. Find the sum of an infinite geometric series (Time-allowing. Not in PARCC PBA or EOY) 5.
5. Use recursive rules for sequences (8.5)

Interdisciplinary Connections:
- Patterns Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
  <u>Activity:</u> Throughout this unit, students will analyze sequences and series to determine the relationship between its terms. They will use these relationships to make predictions.

F. Probability (13 days)
1. Introduction to probability (Suppl. vocab.: outcomes, event, sample space, with Big Ideas Algebra 2, BI- 10.1)
2. Calculate the probability of compound events
3. Calculate the probability of independent and dependent events (Suppl. with Big Ideas Algebra 2 for 'Two-Way Tables and Probability')
4. Apply the Fundamental Counting Principle and permutations (Time-allowing)
5. Use Combinations and the Binomial Theorem to expand a binomial. (Time-allowing)
6. Construct and interpret binomial distributions (Time-allowing).

Interdisciplinary Connections:
- Science: Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)
  <u>Activity:</u> Students will meet this standard through their creation, execution and evaluation of their surveys.

G. Data Analysis and Statistics (24 days)
1. Interpret statistics and statistical graphs
2. Understand normal distributions (Optional - Suppl. with shmoop.com/precalculus-statistics-probability/z- scores.html)

3. Calculate populations, samples, and hypotheses
4. Collect data
5. Validate experimental design
6. Make inferences from sample surveys
7. Make inferences from experiments

Interdisciplinary Connections:
● Science: Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)
Activity: Throughout this unit and through the survey project, students will calculate and compare probabilities, noting similarities and differences.

H. Trigonometry (18 days)
1. Calculate right triangle trigonometry
2. Apply the unit circle (BI-Chpt.9 Mathematical Practices, p.460)
3. Understand general angles and radian measure
4. Calculate trigonometric functions of any angle
5. Graph sine, cosine, and tangent functions
6. Translate and reflect trigonometric graphs (Suppl. with BI-9.4 for 'midline' as vocab., and other points as needed)
7. Verify trigonometric identities (Suppl. with BI-9.7 unit circle discussion of why $\sin^2 + \cos^2 = 1$, p.514)
8. Solve trigonometric equations
9. Model trigonometric functions
10. Apply sum and difference formulas (time-allowing)

Interdisciplinary Connections:
● NJSLSA.R7 Integrate and evaluate content presented in Diverse media nad formats, including visually and quantitatively, as well as in word.
NJSLSA.W1 Write arguments to support claims ina n analysis of substantive topics or text, using valid reasoning and relevant and sufficient evidence.
Activity: Students will watch the Parasailing to Great Heights video and read associated written performance task and complete problems relating to calculating just how high a parasailer can fly. (Big Ideas. Section 9.1).

I. Introduction to Geometry, Logical Reasoning and Proofs (20 days)
1. Find patterns and use inductive reasoning (MLG-1.1) 1 (McDougal Littell Geometry 2004)
2. Understand points, lines, and planes (MLG-1.2) 1
3. Understand segments and calculate their measure (MLG-1.3) 1
4. Correlate angles and their measure (MLG-1.4) 1
5. Calculate segment and angle bisectors (MLG-1.5) 1

6. Associate angle pair relationships (MLG-1.6) 1
7. Introduce perimeter, circumference, and area (MLG-1.7) 1
8. Understand and apply conditional statements (MLG-2.1) 2
9. Interpret definitions and biconditional statements (MLG-2.2) 2
10. Deductive reasoning (MLG-2.3) 2
11. Reasoning with properties from algebra (MLG-2.4) 2
12. Prove statements about segments (MLG-2.5) 1
13. Prove statements about angles (MLG-2.6) 1
14. Argue indirect proofs (MLG-5.6) 2
15. Demonstrate logical reasoning (McDougal Littell Alg. 2 'Skills Review Handbook' pp. 924-929)

Interdisciplinary Connections:
- RI8.8. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced.
  RI.8.1 Cite the textual evidence and make relevant connections that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text.
  <u>Activity:</u> Throughout this unit, students will analyze and create arguments and proofs based on provided evidence.