Fair Lawn

Public Schools

Fair Lawn, NJ

Honors Algebra 2

Adopted August

2017

Revised August 2017
Developed August 2012

The purpose of Algebra 2 Honors is to expand the students' knowledge and understanding of algebraic skills in preparation for the Geometry Honors and the subsequent PreCalculus course. Students will be given the opportunity to apply their critical thinking skills in conjunction with their algebraic skills to solve unfamiliar problems. Useful consumer and career topics are presented, helping students understand the uses of mathematics in their everyday life. Students will be introduced to new mathematical language and a variety of mathematical topics which will result in a greater appreciation for the method of problem solving. This course will lay the foundations as outlined by the Student Learning Standards in order to prepare students for the PARCC exam.

Honors Algebra 2

Fair Lawn School District

Committee Credits

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Honors Algebra 2

I. Course Synopsis

In Algebra 2, instructional time should focus on eight critical areas: (1) Review of Basic Algebra; (2) Polynomial Functions; (3) Advanced Functions; (4) Introduction to Trigonometry; (5) Probability and Statistics; (6) Sequences and Series. Throughout the course, mathematical concepts will be taught with an emphasis on enduring understandings, essential questions, real-world application, technology, and cross-curricular interaction.

II. Philosophy & Rationale

The purpose of the math curriculum for Algebra 2 Honors is to help students develop and enhance mathematical abilities required for Geometry and Pre-Calculus. Students should be able to reason logically and apply mathematical skills to real-world activities. Communicating about and through mathematics will enable students to view mathematics as relevant to their lives and understand it as it connects to other areas. Student should be able to make connections among the different strands of mathematics while feeling confident in using quantitative and spatial information to make decisions. The curriculum will enable students to become independent learners with a desire for lifelong learning. Technology will be infused through the curriculum.

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report Adding It Up: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

MATH.PRACTICE.MP1 - Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if

necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

MATH.PRACTICE.MP2 - Reason abstractly and quantitatively.
Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

MATH.PRACTICE.MP3 - Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

MATH.PRACTICE.MP4 - Model with mathematics.
Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as

writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

MATH.PRACTICE.MP5 - Use appropriate tools strategically.
Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

MATH.PRACTICE.MP6 - Attend to precision.
Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

MATH.PRACTICE.MP7 - Look for and make use of structure.
Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well-remembered $7 \times 5 + 7 \times 3$, in

preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

MATH.PRACTICE.MP8 - Look for and express regularity in repeated reasoning.
Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

III. Scope & Sequence

Unit 1: The Number System (2 Weeks):

Simplifying Radicals
Rational Exponents
Radical Equations
Complex Numbers
-Simplify
-Addition and Subtraction
-Multiplication and Conjugates
-Absolute Value

Unit 2: Polynomial Functions (8 Weeks):

Graphing Quadratics
-Standard Form
- Vertex Form
- Inequalities (Linear Review into Quadratic)
Solving Quadratic Equations
-Square Roots
-Factoring
-Complete the Square
-Quadratic Formula
Transformations of Parent Functions
- Function vs Relation
-Domain and Range (including operations)
- Shape of Parent Functions
- Vertical Translation
-Horizontal Translations
- Vertical Stretch and Compression
- Horizontal Stretch and Compression
Operations with Polynomials
Factoring and Solving Polynomials
Graphing Polynomials
-Intercepts
- Zeroes
- End Behavior
-Increasing/Decreasing

Even and Odd Functions

Unit 3: Advanced Functions (7 weeks):

Properties of Exponential and Logarithmic Expressions/Functions
- -Exponential (Graphing)
- -Logs as inverses
- -Properties of Logarithms
- -Exponential functions base *e*
- -Natural Logarithms
- -Domain and Range
- -Intervals of Increasing and Decreasing
- -Solving exponential equations
- -Solving Logarithmic equations

Word Problems
- -Exponential Growth/Decay (Interest)

Operations with Rational Expressions

Solving Rational Functions

Rational Functions
- -Graphing
- -Holes and Asymptotes
- -Intervals of Increasing and Decreasing

Unit 4: Introduction to Trigonometry (5 weeks):

Right Triangle Trigonometric Ratios

Special Right Triangles

Applications of Right Triangle Trigonometry
- -Angle of Elevation
- -Angle of Depression

Angle Measure
- -Degrees
- -Radians

The Unit Circle
- -Angles in Standard Position
- -Co-terminal Angles
- -Reference Angles
- -Exact Values of Major Angles

Graphing Trig Functions
- -Sine

-Cosine
-Tangent
-Domain and Range

Trig Identities

Unit 5: Probability and Statistics (5 weeks) :

Measures of Central Tendency
Standard Deviation
Normal Curve
Z-Scores
Probability using Z-Scores
Independent and Dependent Probability
Probability of Multiple Events
Combinations and Permutation
Set Theory with Notation

Unit 6: Sequences and Series (2 weeks):

Arithmetic
Geometric

IV. Unit Descriptions

Unit 1: Review of Basic Algebra

Enduring Understanding

1. A pairing of items from two sets is special if each item from one set pairs with exactly one item from the second set.
2. A relation is a set of pairs of input and output values.
3. Relations can be represented with ordered pairs, mapping diagrams, tables of values, and graphs.
4. Slope can be calculated by finding the ratio of the difference in the y-coordinates to the difference in the x-coordinates from any two points on the line.
5. The graph of a linear inequality contains all points on one side of a line and may or may not include the points on a line.
6. A system of equations is solved by finding a set of values that replace the variables in the equations and make each equation true.
7. The imaginary unit is the complex number whose square is negative one.

Essential Question(s)

1. Does it matter which form of a linear equation you use?
2. How do you use transformations to help graph absolute value functions?
3. How do you solve an equation or inequality?
4. How does representing functions graphically help you solve a system of equations?

Learning Objectives

Students will be able to:

1. Solve a Linear Equation.
2. Solve a Quadratic Equation.
3. Solve an Absolute Value Equation.
4. Graph Linear, Quadratic and Absolute Value equations in two variables.
5. Find the y - intercept of the graph of any equation with two variables.
6. Find the Roots or Zeros of a Quadratic Equation with two variables.

New Jersey Student Learning Standards

- HSA.REI.D.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).
- HSF.LE.A.1.A– Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
- HSF.LE.A.1.B– Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- HSF.BF.A.1– Write a function that describes a relationship between two quantities.

- HSF.IF.A.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*).
- HSF.IF.A.2– Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- HSF.IF.B.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*.*
- HSF.IF.B.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.**
- HSF.IF.B.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.
- HSF.BF.B.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.
- HSF.BF.A.1– Write a function that describes a relationship between two quantities.
- HSA.REI.D.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.*
- HSA.REI.D.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.*
- HSN.CN.A.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.
- HSN.CN.A.2– Use the relation *i*2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
- HSN.CN.A.3– Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

<u>Suggested Activities/Modifications</u>

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to:

1. Activities
    a. Do Now activities
    b. Classwork
    c. Homework
    d. Use of white boards
    e. Unit Test (extended time when needed)
    f. Review Game
    g. Project
    h. Graphic Organizer
    i. Calculator Use
    j. Assistive Technology
2. English Language Learners.
    a. Students may use a bilingual dictionary.
    b. Read written instructions.
    c. Students may be provided with note organizers / study guides to reinforce key topics.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
    a. Students may be provided with note organizers / study guides to reinforce key topics.
    b. Extended time on assessments when needed.
    c. Preferred seating to be determined by student and teacher.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
    f. Establish a non-verbal cue to redirect student when not on task.
    g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
    a. Provide enrichment activities to expand upon the curriculum.
    b. Use higher level questioning techniques in class and on assessments.

<u>New Jersey Student Learning Standards – Technology</u>

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP 6. Demonstrate creativity and innovation.
- CRP 7. Employ valid and reliable research strategies.
- CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them.

NJSLS Standard 9.2 – Career Awareness, Exploration, and Preparation

- 9.2.12.C.3 Identify transferable career skills and design alternate career plans.
- 9.2.12.C.4 Analyze how economic conditions and societal changes influence employment trends and future education.
- 9.2.12.C.9 Analyze the correlation between personal and financial behavior and employability.

NJSLS Standard 9.3 – Career and Technical Education

- 9.3.ST.2 -- Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-ET.2 -- Display and communicate STEM information.
- 9.3.ST-ET.4 -- Apply the elements of the design process.

Unit 2: Polynomial Functions

Enduring Understanding

1. There are a set of functions called families in which each function is a transformation of a special function called the parent.
2. A parent function is the simplest form of a set of functions that form a family. Each function in the family is a transformation of the parent function.
3. The values of a, h, and k in the form $y=a|x-h|+k$ determine how the parent function $y=|x|$ can be transformed.
4. Any quadratic function is a stretch, compression, reflection, and/or translation of the parent quadratic function.
5. Standard form is calculator ready!
6. Completing a perfect square trinomial allows the completed trinomial to be factored as the square of a binomial.
7. The real solutions of a quadratic equation show the “zeros” of the related quadratic function and the x-intercepts of its graph.
8. Every quadratic equation has complex number solutions (that sometimes are real numbers).
9. A polynomial function has distinguishing behaviors.
10. The shape and end-behavior of the graph of a polynomial is determined by the degree of the polynomial and by the sign of the leading coefficient.
11. (x-a) is a linear factor if and only if a is a zero.

Essential Question(s)

1. What are the advantages of a quadratic function in vertex form?
2. What are the advantages of a quadratic function in standard form?
3. How is any quadratic function related to the parent quadratic function?
4. What does the degree of a polynomial tell you about its related polynomial function?
5. For a polynomial function how are factors, zeros, and x-intercepts related?
6. For a polynomial function how are factors and roots related?

Learning Objectives

Students will be able to:

1. Determine the type of Function by the Function Rule.
2. Understand the shape of the graph of the function by its type.
3. Find the Domain of a Function.
4. Accurately Graph a function.
   -Linear, Quadratic, Absolute Value, Radical, Rational, Piecewise
5. Find the Range of a Function.
6. Determine intervals of increasing a decreasing of a function.
7. Find the Domain restrictions of a functions.
8. Determine Extrema of a Function.

New Jersey Student Learning Standards

- HSA.REI.B.4– Solve quadratic equations in one variable.
- HSA.REI.D.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).
- HSF.IF.C.8.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.
- HSF.IF.C.7– Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- HSF.IF.C.7.A– Graph linear and quadratic functions and show intercepts, extrema.
- HSF.IF.C.7.C– Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
- HSA.APR.B.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.
- HSA.CED.A.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*.

- HSA.CED.A.2– Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- HSF.IF.C.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*.

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to:

1. Activities
    a. Do Now activities
    b. Classwork
    c. Homework
    d. Use of white boards
    e. Unit Test (extended time when needed)
    f. Review Game
    g. Project
    h. Graphic Organizer
    i. Calculator Use
    j. Assistive Technology
2. English Language Learners.
    a. Students may use a bilingual dictionary.
    b. Read written instructions.
    c. Students may be provided with note organizers / study guides to reinforce key topics.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
    a. Students may be provided with note organizers / study guides to reinforce key topics.
    b. Extended time on assessments when needed.
    c. Preferred seating to be determined by student and teacher.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
    f. Establish a non-verbal cue to redirect student when not on task.
    g. Maintain strong teacher / parent communication.

4. Gifted and Talented Students.
    a. Provide enrichment activities to expand upon the curriculum.
    b. Use higher level questioning techniques in class and on assessments.

New Jersey Student Learning Standards – Technology

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP 6. Demonstrate creativity and innovation.
- CRP 7. Employ valid and reliable research strategies.
- CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them.

NJSLS Standard 9.2 – Career Awareness, Exploration, and Preparation

- 9.2.12.C.3 Identify transferable career skills and design alternate career plans.
- 9.2.12.C.4 Analyze how economic conditions and societal changes influence employment trends and future education.
- 9.2.12.C.9 Analyze the correlation between personal and financial behavior and employability.

NJSLS Standard 9.3 – Career and Technical Education

- 9.3.ST.2 -- Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-ET.2 -- Display and communicate STEM information.
- 9.3.ST-ET.4 -- Apply the elements of the design process.

Unit 3: Advanced Functions

Enduring Understanding

1. Transformations of the parent reciprocal function include stretches, compressions or shrinks, reflections, and horizontal and vertical translations.
2. A rational function is a ratio of polynomial functions. If a rational function is in simplified form and the polynomial in the denominator is not constant, the graph of the rational function features asymototic behavior. It looks quite different from the graphs of either of its polynomial components.
3. You can use much of what you know about adding, subtracting, multiplying, and dividing fractions to add, subtract, multiply, and divide rational functions
4. To solve an equation containing rational expressions, first multiply each side by the least common denominator of the rational expressions. Doing this, however, can introduce extraneous solutions.

5. Solving a square root equation may require that you square each side of the equation, this may introduce extraneous solutions.
6. You can add, subtract, multiply, and divide functions based on how you perform these operations with real numbers. One difference however, is that you must consider the domain of each function.
7. You can combine like radicals using properties of real numbers.
8. You can represent repeated multiplication with an exponential function.
9. You can use logarithms to solve exponential equations and exponential equation to solve logarithmic equations.

Essential Question(s)

1. Are two quantities inversely proportional if an increase in one corresponds to a decrease in the other?
2. What kinds of asymptotes are possible for a rational function?
3. Are a rational expression and its simplified form equivalent?
4. To simplify the nth root of an expression, what must be true about the expression?
5. When you square each side of an equation, is the resulting equation equivalent to the original?
6. How do you model a quantity that changes regularly over time by the same percentage?
7. How are exponents and logarithms related?
8. How are exponential functions and logarithmic functions related?

Learning Objectives

Students will be able to:

1. Identify and describe inverse and direct variation functions.
2. Identify if a rational function has asymptotes, then graph the function.
3. Differentiate between vertical, horizontal, and oblique asymptotes.
4. Define the domains of simplified rational expressions to make them equivalent to the originals.

New Jersey Student Learning Standards

- HSF.IF.C.7– Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- HSF.IF.C.7.B– Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
- HSF.IF.C.7.D– Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
- HSF.IF.C.7.E– Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

- HSF.IF.C.8.B– Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^t/10$, and classify them as representing exponential growth or decay.

Suggested Activities/Modifications

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    c. Homework
    d. Use of white boards
    e. Unit Test (extended time when needed)
    f. Review Game
    g. Project
    h. Graphic Organizer
    i. Calculator Use
    j. Assistive Technology
2. English Language Learners.
    a. Students may use a bilingual dictionary.
    b. Read written instructions.
    c. Students may be provided with note organizers / study guides to reinforce key topics.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
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    b. Extended time on assessments when needed.
    c. Preferred seating to be determined by student and teacher.
    d. Provide modified assessments when necessary.
    e. Student may complete assessments in alternate setting when requested.
    f. Establish a non-verbal cue to redirect student when not on task.
    g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
    a. Provide enrichment activities to expand upon the curriculum.

b. Use higher level questioning techniques in class and on assessments.

New Jersey Student Learning Standards – Technology

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP 6. Demonstrate creativity and innovation.
- CRP 7. Employ valid and reliable research strategies.
- CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them.

NJSLS Standard 9.2 – Career Awareness, Exploration, and Preparation

- 9.2.12.C.3 Identify transferable career skills and design alternate career plans.
- 9.2.12.C.4 Analyze how economic conditions and societal changes influence employment trends and future education.
- 9.2.12.C.9 Analyze the correlation between personal and financial behavior and employability.

NJSLS Standard 9.3 – Career and Technical Education

- 9.3.ST.2 -- Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-ET.2 -- Display and communicate STEM information.
- 9.3.ST-ET.4 -- Apply the elements of the design process.

Unit 4: Introduction to Trigonometry

Enduring Understanding

1. Periodic behavior is a behavior that repeats over intervals of constant length.
2. The measure of an angle in standard position is the input for two important functions. The outputs are the coordinates (called cosine and sine) of the point of the terminal side of the angle that is one unit from the origin.
3. An angle with a full circle rotation measures 2πradians. An angle with a semicircle rotation measures πradians.
4. You can translate periodic functions in the same way that you can translate other functions.

Essential Question(s)

1. How can you model periodic behavior?
2. What function has as its graph a sine curve with amplitude 4, period π, and minimum at the origin?

3. If you know the value of $sin(\theta)$, how can you find $cos(\theta), tan(\theta), sec(\theta), csc(\theta)$, and $cot(\theta)$?

Learning Objectives

Students will be able to:

1. Identify and explore periodic behavior.
2. Graph periodic functions.
3. Write the formulas of trigonometric equations.
4. Find amplitude, period, minimums, and maximums of trigonometric functions.
5. Find the value of the reciprocal trigonometric functions based on the corresponding trigonometric functions.

New Jersey Student Learning Standards

- HSG.SRT.C.6– Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
- HSG.SRT.C.7– Explain and use the relationship between the sine and cosine of complementary angles.
- HSG.SRT.C.8– Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*
- HSF.TF.A.1– Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- HSF.TF.A.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.
- HSF.TF.A.3– Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for x, π + x, and 2π - x in terms of their values for x, where x is any real number.
- HSF.TF.A.4– Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
- HSF.TF.B.5– Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to:

1. Activities
    a. Do Now activities

   b. Classwork
   c. Homework
   d. Use of white boards
   e. Unit Test (extended time when needed)
   f. Review Game
   g. Project
   h. Graphic Organizer
   i. Calculator Use
   j. Assistive Technology
2. English Language Learners.
   a. Students may use a bilingual dictionary.
   b. Read written instructions.
   c. Students may be provided with note organizers / study guides to reinforce key topics.
   d. Provide modified assessments when necessary.
   e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
   a. Students may be provided with note organizers / study guides to reinforce key topics.
   b. Extended time on assessments when needed.
   c. Preferred seating to be determined by student and teacher.
   d. Provide modified assessments when necessary.
   e. Student may complete assessments in alternate setting when requested.
   f. Establish a non-verbal cue to redirect student when not on task.
   g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
   a. Provide enrichment activities to expand upon the curriculum.
   b. Use higher level questioning techniques in class and on assessments.

<u>New Jersey Student Learning Standards – Technology</u>

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

<u>Career Readiness Practices</u>

- CRP 6. Demonstrate creativity and innovation.
- CRP 7. Employ valid and reliable research strategies.
- CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them.

NJSLS Standard 9.2 – Career Awareness, Exploration, and Preparation

- 9.2.12.C.3 Identify transferable career skills and design alternate career plans.
- 9.2.12.C.4 Analyze how economic conditions and societal changes influence employment trends and future education.
- 9.2.12.C.9 Analyze the correlation between personal and financial behavior and employability.

NJSLS Standard 9.3 – Career and Technical Education

- 9.3.ST.2 -- Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-ET.2 -- Display and communicate STEM information.
- 9.3.ST-ET.4 -- Apply the elements of the design process.

Unit 5: Probability and Statistics

Enduring Understanding

1. You can use multiplication to quickly count the number of ways certain things can happen.
2. The probability of an impossible event is 0 (or 0%). The probability of a certain event is 1 (or 100%). Otherwise, the probability of an event is a number between 0 and 1 (or a percent between 0% and 100%).
3. To find the probability of two events occurring together, you have to decide whether one event occurring affects the other event.
4. Conditional probability exists when two events are dependant.
5. You can use probability models to analyze situations and make fair decisions.
6. You can describe and compare sets of data using various statistical measures, depending on what characteristics you wish to study.
7. Standard deviation is a measure of how far the numbers in a data set deviate from the mean.

Essential Question(s)

1. What is the difference between a combination and a permutation?
2. What is the difference between experimental and theoretical probability?
3. How are measures of central tendency different than standard deviation?

Learning Objectives

Students will be able to:

1. Find permutations and combinations of data sets using formulas.
2. Find theoretical probability of events using a formula.

3. Find and analyze the measures of central tendency of given data sets.
4. Find the standard deviation of given data sets.

New Jersey Student Learning Standards

- HSS.MD.A.1– Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.
- HSS.MD.A.2– Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
- HSS.MD.A.2– Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
- HSS.MD.A.3– Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.
- HSS.MD.A.4– Use probability to evaluate outcomes of decision.
- HSS.MD.B.5.A– Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.
- HSS.MD.B.5.B– Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.
- HSS.MD.B.6– Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
- HSS.MD.B.7– Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).
- HSS.ID.A.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.
- HSS.ID.A.3- Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- HSS.ID.A.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.
- HSS.ID.B.6- Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
- HSS.ID.B.6.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, quadratic, and exponential models.
- HSS.ID.B.6.B- Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

- HSS.ID.B.6.C- Fit a linear function for a scatter plot that suggests a linear association.
- HSS.ID.C.7- Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- HSS.ID.C.8- Compute (using technology) and interpret the correlation coefficient of a linear fit.
- HSS.ID.C.9- Distinguish between correlation and causation.
- HSS.IC.A.1- Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- HSS.IC.A.2- Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, 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*?
- HSS.IC.B.3- Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- HSS.IC.B.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.
- HSS.IC.B.5- Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
- HSS.IC.B.6- Evaluate reports based on data.
- HSS.CP.A.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").
- HSS.CP.A.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.
- HSS.CP.A.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*.
- HSS.CP.A.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.*
- HSS.CP.A.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.*
- HSS.CP.B.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.

- HSS.CP.B.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.
- HSS.CP.B.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.
- HSS.CP.B.9- (+) Use permutations and combinations to compute probabilities of compound events and solve problems.
- HSS.MD.A.1- Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.

<u>Suggested Activities/Modifications</u>

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to:

1. Activities
    a. Do Now activities
    b. Classwork
    c. Homework
    d. Use of white boards
    e. Unit Test (extended time when needed)
    f. Review Game
    g. Project
    h. Graphic Organizer
    i. Calculator Use
    j. Assistive Technology
2. English Language Learners.
    a. Students may use a bilingual dictionary.
    b. Read written instructions.
    c. Students may be provided with note organizers / study guides to reinforce key topics.
    d. Provide modified assessments when necessary.
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3. Special Education/504 Students.
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f. Establish a non-verbal cue to redirect student when not on task.
g. Maintain strong teacher / parent communication.

4. Gifted and Talented Students.
    a. Provide enrichment activities to expand upon the curriculum.
    b. Use higher level questioning techniques in class and on assessments.

New Jersey Student Learning Standards – Technology

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP 6. Demonstrate creativity and innovation.
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NJSLS Standard 9.2 – Career Awareness, Exploration, and Preparation

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Unit 6: Sequences and Series

Enduring Understanding

1. If the numbers in a list follow a pattern, variables may be used to relate each number in the list to its numerical position in the list with a rule.
2. In Arithmetic sequence, the difference between any two consecutive terms is always the same number. This number can be represented by a variable.
3. When two terms and the number of terms in a finite arithmetic sequence are known, they can be substituted for variables in a formula to find the sum of the terms.

4. In a geometric sequence, the ratio of any term (after the first) to its preceding term is a constant value, no matter what terms are compared. A geometric sequence can be built by multiplying each term by that constant.
5. Just as with finite arithmetic series, the sum of a finite geometric series can be found using a formula. The first term, the number of terms, and the common ratio must be known.

Essential Question(s)

1. How can you represent the terms of a sequence explicitly? How can you represent them recursively?
2. What are equivalent explicit and recursive expressions for an arithmetic sequence?
3. How can you model a geometric sequence? how can you model its sum?

Learning Objectives

Students will be able to:

1. Identify mathematical patterns in a sequence.
2. Find a rule to describe a pattern.
3. Find the common difference of an arithmetic sequence.
4. Find the common ratio of a geometric sequence.
5. Determine whether a geometric series converges.

New Jersey Student Learning Standards

- HSA.SSE.B.4– Derive and/or explain the derivation of 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
- HSF.IF.A.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 $n \geq 1$.

Suggested Activities/Modifications

Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to:

1. Activities
    a. Do Now activities
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    c. Homework
    d. Use of white boards
    e. Unit Test (extended time when needed)

f. Review Game
g. Project
h. Graphic Organizer
i. Calculator Use
j. Assistive Technology

2. English Language Learners.
    a. Students may use a bilingual dictionary.
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V. Course Materials

1. Textbook Algebra 2: Prentice-Hall 2007
2. Supplemental materials PH SuccessNet Teacher Online Access Pack PH SuccessNet online textbook Phschool.com online Homework Tutor Big Ideas Algebra 2
3. Graph paper
4. Rulers
5. Calculators TI-Nspire
6. Lab gear CBR/CBL
7. PARCC material Algebra 2 PARCC extended constructed responses Algebra 2 PARCC practice tests

VI. Assessments

1. Quizzes
2. Unit tests
3. Notebook assessments
4. Computer labs
5. Discovery labs
6. Homework
7. Midterm Exam and Final Exam

VII. Cross Curricular Aspects

Students will investigate concepts that appear in various other subjects. Some of these concepts include:

- *While exploring topics within exponential functions we will discuss how the growth of bacteria can be modeled by an exponential function.*
- *When investigating quadratic functions we will be modeling the flight path of projectiles similarly to physics.*
- *Trigonometric functions involve sinusoidal functions that can model sound waves, radio waves, and periodic motion that is prevalent in a physics course.*