TRUMBULL PUBLIC SCHOOLS

Trumbull, Connecticut

HONORS ALGEBRA II
Grades 9-12
Mathematics Department

2020

(Last revision date: 2014)

Curriculum Writing Team

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Honors Algebra II
Grades 9-12
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CORE VALUES AND BELIEFS

The Trumbull High School community engages in an environment conducive to learning which believes that all students will **read and write effectively**, therefore communicating in an articulate and coherent manner. All students will participate in activities **that present problem-solving through critical thinking**. Students will use technology as a tool applying it to decision making. We believe that by fostering self-confidence, self-directed and student-centered activities, we will promote **independent thinkers and learners**. We believe **ethical conduct** to be paramount in sustaining the welcoming school climate that we presently enjoy.

Approved 8/26/2011

INTRODUCTION & PHILOSOPHY

Honors Algebra II is designed for students who have successfully completed ACP or Honors Algebra I and Geometry. The content and skills in Algebra II strengthen and extend students' knowledge of algebra and geometry. The study of functions and their characteristics serves as the theme for this course. In particular, polynomial functions, rational functions, trigonometric functions and their applications, exponential functions, and logarithmic functions are examined. Students will learn to solve equations and develop models to help explore practical applications. Students will be presented mathematical tasks that require the application of mathematics in new and unfamiliar situations and to real-world scenarios. After successful completion of Honors Algebra II, students will be prepared to enroll in Honors PreCalculus or ACP PreCalculus as well as other mathematics electives.

The textbook *Algebra and Trigonometry*, 4th edition, by Stewart, Redlin, and Watson (2016) offers an abundance of features to assist students in learning vocabulary, problem-solving, skill-building, and engaging in applications and extensions. The pacing and sequence of this curriculum is suited to meet the content standards and the eight mathematical practices of the Connecticut Core Standards for Mathematics. This revised curriculum guide reflects the new resources provided by the textbook, including technology, online resources, and relevant mathematical modeling examples.

Success in mathematics depends upon active involvement in a variety of interrelated experiences. When students participate in stimulating learning opportunities, they can reach their full potential.

The Trumbull Mathematics Program embraces these goals for all students.
The successful mathematician will:

- Acquire the factual knowledge necessary to solve problems
- Gain procedural proficiency in problem solving
- Demonstrate a perceptual understanding of problems posed
- Make meaningful mathematical connections to his or her world
- Solve problems utilizing a variety of strategies
- Utilize technology to improve the quality of the problem-solving process
- Communicate effectively using mathematical terminology, both independently and collaboratively

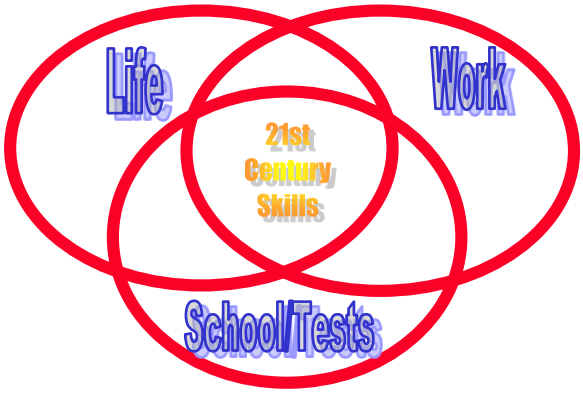
- Use sound mathematical reasoning by utilizing the power of conjecture and proof in his or her thinking
- Become a reflective thinker through continuous self-evaluation
- Become an independent, self-motivated, lifelong learner

The Trumbull Mathematics Program promotes the empowerment of students and encourages students to embrace the skills needed to become successful in the 21st century. Students expand their mathematical abilities by investigating real-world phenomena. Through such experiences, students can access the beauty and power of mathematics and truly appreciate the impact mathematics has on the world in which they live.

Developed by Trumbull K-12 Math Committee, June 2004; revised and approved April 2011

Mathematics instruction must:

- Blend the concrete with the abstract, the practical with the theoretical, and the routine with the non-routine.
- Teach students to search for, find, and represent patterns.
- Instill in students an appreciation for the intrinsic beauty of mathematics.
- Encourge students to reason, analyze, make connections, and self-assess.
- Immerse students in the learning process through questioning, technology, manipulatives, cooperative, and individual activities.



Information, Media and Technology Skills

1. Use real-world digital and other research tools to access, evaluate, and effectively apply information appropriate for authentic tasks.

Learning and Innovation Skills

2. Work independently and collaboratively to solve problems and accomplish goals
3. Communicate information clearly and effectively using a variety of tools/media in varied contexts for a variety of purposes.
4. Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions.
5. Effectively apply the analysis, synthesis, and evaluative processes that enable productive problem solving.

Life and Career Skills

6. Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior.

COURSE GOALS

The following Course Goals derive from the 2010 Connecticut Core Standards for Mathematical Practice, which describe varieties of expertise that all teachers of mathematics will develop in their students. These practices rest on important "processes and proficiencies" that have long been valued in mathematics education.

At the completion of this course, students will:

1. 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.

2. 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.

3. 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.

4. Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.

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.

5. 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 the tools' 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.

They are able to use technological tools to explore and deepen their understanding of concepts.

6. 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, expressing numerical answers with a degree of precision appropriate for the problem context. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure.

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.

8. 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. 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.

COURSE ENDURING UNDERSTANDINGS

Students will understand that . . .

- number sets, domain, and range have roles in restricting function values.
- various equations can be diagnosed and solved using the appropriate techniques.
- functions can be analyzed and applied to real-world situations.

- operations can be performed to factor higher-degree polynomials.
- there is an important relationship between exponential and logarithmic functions.
- mathematical connections can be made among trigonometry, the unit circle, and the coordinate plane.
- conic sections can be analyzed both as functions and as mathematical models.

COURSE ESSENTIAL QUESTIONS

- How can we use various techniques to solve any equation?
- What are the properties of polynomial, quadratic, rational, exponential, and logarithmic functions, and how can these functions be used to solve applied problems?
- What are the similarities and differences between conic sections and functions?
- How can the development of the trigonometric functions be explore through two approaches: the use of right triangles and the unit circle?

COURSE KNOWLEDGE & SKILLS

Students will know . . .

- polynomial, quadratic, rational, exponential, and logarithmic functions and their graphs.
- the six trigonometric functions and the unit circle.
- when to apply right-triangle trigonometry, the Law of Sines, and/or the Law of Cosines to solve application problems.

Students will be able to . . .

- analyze and graph a rational or quadratic function.
- use properties of exponents and logarithms to solve equations.
- define the six trigonometric functions and use them in right-triangle trigonometry.
- use trigonometric functions to solve applied problems involving right and oblique triangles.
- perform operations on functions and polynomials.
- solve a variety of equations using the appropriate techniques.
- find the equation of and graph a conic section.

COURSE SYLLABUS

Course Name

Algebra II

Level

Honors

Prerequisites

Grade of B- or better in Honors Geometry and teacher recommendation

Materials Required

TI-84 graphing calculator

General Description of the Course

Honors Algebra II is designed to develop the eight standards of mathematical practices in students. Algebra II includes the study of functions and inverse functions, the analysis and building of functions, polynomials, including complex numbers and analyzing functions using different representations, rational expressions and functions, with a focus on explaining reasoning, trigonometric functions, and exponential and logarithmic functions, with an emphasis on constructing and comparing linear, quadratic, and exponential models.

Assured Assessments

Formative Assessments:

- Warm-up problems, exit slips, group problem sets (Units 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)

Summative Assessments:

- Common assessment (Units 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
- Checkpoint quizzes (Units 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)
- Journal questions (Units 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)

Core Text

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

UNIT 1
Foundational Skills

Unit Goals

Reinforcement of Algebra I skills provides a foundation for the increased rigor needed for Algebra II topics. In this unit, these skills will be reviewed and further developed and applied to higher-level applications such as rational exponents, rational expressions, factoring cubic expressions, and solving a system of three equations.

At the completion of this unit, students will:

CCS.MC.8.NS.1	Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion.
CCS.MC.HS.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.
CCS.MC.HS.N-RN.2	Rewrite expressions involving radicals and rational exponents uising the properites of exponents.
CCS.MC.HS.A-SSE.1.a	Interpret parts of an exporession, such as terms, factors, and coefficients.
CCS.MC.HS.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.
CCS.MC.HS.A-CED.1	Create equations and inequalities in one variable and use them to solve problems.
CCS.MC.HS.A-REI.6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Unit Essential Questions

- What is the importance of number sets while solving equations?
- How are the laws of exponents applied to rational exponents?
- How is a polynomial factored, and when is it completely factored?
- What is the role of factoring while simplifying rational expressions?
- How can algebra model real-world situations?
- What methods are used to solve a system of equations in three variables?

Scope and Sequence

- Real numbers
- Interval notation
- Scientific notation
- Rational exponents and radicals
- Factoring with various methods
- Rational expressions
- Modeling with equations
- Solving systems of equations in three variables

Assured Assessment

Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources

Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 15 days

UNIT 2
Circles and Quadratics

Unit Goals

Graphing and analyzing circles and quadratic functions will be presented with the understanding of the relationship between real and complex numbers and their roles on the Cartesian plane. Students will make connections between the graphs of quadratic functions and their properties.

At the completion of this unit, students will:

CCS.MC.HS.F-IF.7.a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
CCS.MC.HS.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.
CCS.MC.HS.F-IF.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.
CCS.MC.HS.A-REI.4.b	Solve quadratic equations by inspections (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.
CCS.MC.HS.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.
CCS.MC.HS.N-CN.3	Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.
CCS.MC.HS.N-CN.7	Solve quadratic equations with real coefficients that have complex solutions.
CCS.MC.HS.N-CN.8	Extend polynomial identities to the complex numbers.

Unit Essential Questions

- What is the role of distance and midpoint in the equation of a circle?
- What are the properties of quadratic functions?
- How does the graph of a quadratic function relate to its properties?

- What is the meaning of complex solutions to quadratic equations?

Scope and Sequence

- Distance and midpoint
- Quadratic functions
- Graphs of quadratic functions
- Operations of complex numbers

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources
Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 10 days

UNIT 3
Solving Equations

Unit Goals

Solving a variety of equations requires students to diagnose each equation before applying the appropriate strategy. Students will learn to recognize the type of equation and the operations needed to solve it. Formulating two cases for absolute value equations demonstrates an understanding of the definition of absolute value. Students will be able to explain why absolute value equations and inequalities require the formulation of two cases, and will then complete the process.

At the completion of this unit, students will:

CCS.MC.HS.A-REI.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the prvious step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
CCS.MC.HS.A-REI.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
CCS.MC.HS.A-REI.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
CCS.MC.HS.A-CED.1	Create equations and inequalities in one variable and use them to solve problems.
CCS.MC.HS.A-CED.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Unit Essential Questions

- What are the differences and similarities in the processes of solve a variety of equations?
- What is the difference between an equation and an inequality?
- Why does an absolute value equation or inequality always have two cases?
- How can variation be used to model real-world situations?

Scope and Sequence

- Solving basic, radical, rational, and absolute value equations
- Solving literal equations
- Solving linear and absolute value inequalities
- Modeling variation

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources
Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 20 days

UNIT 4
Graphing Functions

Unit Goals

Functions can be described and represented in a variety of ways. Students will develop a complete understanding of the definition of a function, as well as the importance of domain and range in a function, and will be able to identify the special functions. Emphasis will be placed on piecewise functions and real-world applications.

At the completion of this unit, students will:

CCS.MC.HS.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.
CCS.MC.HS.F-IF.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 $y = f(x)$.
CCS.MC.HS.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; symmetires; end behavior; and periodicity.*
CCS.MC.HS.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.*
CCS.MC.HS.F-IF.7.b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

Unit Essential Questions

- What are the properties of a function?
- What are the four ways a function can be represented?
- What are the graphs of special functions, including piecewise?

- How is a function defined by its domain and range?

Scope and Sequence

- Identifying functions
- Graphing functions by hand and by calculator
- Graphs of special functions
- Piecewise functions and applications
- Domain and range

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources
Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 12 days

UNIT 5
Transforming and Combining Functions

Unit Goals

Functions can be transformed by shifting the vertex and by using parameters and multipliers. Students will be able to graph functions using transformations rather than points or a table. The combination of functions using the four operations leads to new functions. The relationship between a function and its inverse can be used for graphing and determining whether a one-to-one relationship exists.

At the completion of this unit, students will:

CCS.MC.HS.F-IF.2	Use function notation, evalute functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
CCS.MC.HS.F-BF.1.b	Combine standard function types using arithmetic operations.
CCS.MC.HS.F-BF.4	Find inverse functions.
CCS.MC.HS.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.
CCS.MC.HS.F-BF.4.b	Verify by composition that one function is the inverse of another.

Unit Essential Questions

- What are the effects on the graph of adding, subtracting, or multiplying a function?
- How do functions combine?
- Why is one-to-one important?
- How is the inverse of a function found algebraically and graphically?

Scope and Sequence

- Transformation of functions
- Combing functions
- One-to-one functions
- Inverse functions
- Testing function inverses using composites

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources
Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 15 days

UNIT 6
Quadratic Functions and Zeros of Polynomials

Unit Goals

Symmetry and the characteristics of quadratics can be used to graph functions. Students will make connections among the various representations of quadratic functions: vertex form, standard form, and graphically. Long and synthetic division is an important part of the process when finding the zeros of a polynomial. Students will understand the importance of factoring to determine the zeros of a polynomial.

At the completion of this unit, students will:

CCS.MC.HS.F-IF.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.
CCS.MC.HS.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.
CCS.MC.HS.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.)*
CCS.MC.HS.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 $p(x)$.
CCS.MC.HS.A-APR.3	Identify zeros of polynomials when suitable factorizations are available . . . .

Unit Essential Questions

- How are quadratics defined by symmetry, maximum, and minimum?
- Why are both vertex and standard form important for quadratic equations?
- How are the zeros of polynomials found using long and synthetic division?
- Why do complex zeros appear only in conjugate pairs?

Scope and Sequence

- Quadratic functions, vertex and standard form
- Graphing quadratic functions
- Long and synthetic division

- Zeros of polynomials
- Conjugate pairs of complex numbers

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources
Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 15 days

UNIT 7
Polynomial and Rational Functions

Unit Goals

The analysis of rational functions requires deconstruction of the underlying polynomial functions. The deconstruction, factoring, and simplifying of a function leads to an understanding of how these discontinuities impact the graph of the function.

At the completion of this unit, students will:

CCS.MC.HS.F-IF.7.c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
CCS.MC.HS.F-IF.7.d	Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
CCS.MC.HS.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.
CCS.MC.HS.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.

Unit Essential Questions

- How are polynomial functions and rational functions related?
- What are the properties of polynomial functions and rational functions?
- How does the graph of a rational function relate to its properties?

Scope and Sequence

- Polynomial functions and models
- Properties of rational functions
- Graph of a rational function
- Polynomial and rational inequalities

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources

Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 14 days

UNIT 8
Exponential and Logarithmic Functions (Part I)

Unit Goals

The graphs of exponential, natural, and logarithmic functions require an understanding of the behavior of each of the parent functions and an understanding of how transformations impact them.

At the completion of this unit, students will:

CCS.MC.HS.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.
CCS.MC.HS.F-BF.5	Understand the inverse relationship between exponents and logarithms and use this relationshipo to solve problems involving logarithms and exponents.

Unit Essential Questions

- How are exponential and logarithmic functions related?
- In evaluating the graph of each function, what do the asymptotes represent?

Scope and Sequence

- Exponential functions
- The natural exponential function
- Logarithmic functions

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources

Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 15 days

UNIT 9
Exponential and Logarithmic Functions (Part II)

Unit Goals

Students will learn to use the Laws of Logarithms to evaluate and combine logarithmic expressions, and will then learn to use the Laws of Exponents and the Laws of Logarithms to solve exponential and logarithmic equations, applying the understanding that the two are inverse functions when solving. Finally, students will interpret findings of exponential functions when modeling real-world applications.

At the completion of this unit, students will:

CCS.MC.HS.F-LE.1.c	Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
CCS.MC.HS.F-LE.4	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.
CCS.MC.HS.F-LE.5	Interpret the paramters in a linear or exponentail function in terms of a context.
CCS.MC.HS.F-BF.5	Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

Unit Essential Questions

- How are the properties of exponential functions used to solve exponential equations?
- How are the properties of exponents used to solve logarithmic equations?
- How are exponential and logarithmic functions related?

Scope and Sequence

- Laws of Logarithms
- Expanding and combining logarithmic expressions
- Change of base formula
- Solving exponential and logarithmic equations
- Application problems using exponential growth and decay

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources

Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 15 days

UNIT 10
Applications of Trigonometric Functions

Unit Goals

At the completion of this unit, students will be able to define trigonometric functions using right triangles and then use the trigonometric functions to solve applied problems. This unit deals with applications involving right triangles and oblique triangles. To solve problems involving oblique triangles, students will apply the Law of Sines and the Law of Cosines.

At the completion of this unit, students will:

CCS.MC.HS.G-SRT.7	Explain and use the relationship between the sine and cosine of complementary angles.
CCS.MC.HS.G-SRT.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
CCS.MC.HS.G-SRT.9	Dervier the formula $A = 1/2\ ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
CCS.MC.HS.G-SRT.10	Prove the Laws of Sines and Cosines and use them to solve problems.
CCS.MC.HS.G-SRT.11	Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

Unit Essential Questions

- What are the six trigonometric ratios, and how are they related to each other?
- How are the properties of right triangles and trigonometry used in the real world?
- How are inverse trigonometric ratios used to find angle measures of a right triangle?
- How are the Laws of Sines and Cosines used in finding side and angle measures in an oblique triangle?
- Given SSA, what determines if there can be more than one solution in the triangle?
- How is trigonometry used to find the area of a triangle?

Scope and Sequence

- Right-triangle trigonometry
- Inverse trigonometric functions
- Area of a triangle
- Law of Sines
- Law of Cosines
- Applications of trigonometric functions

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources
Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 15 days

UNIT 11
Trigonometry and the Unit Circle

Unit Goals

At the completion of this unit, students will have learned that the trigonometric functions are far more than tools for finding the dimensions of right triangles. Students will come to understand the functions' value in analyzing the relationship of circles and right triangles and their value in portraying natural phenomena.

At the completion of this unit, students will:

CCS.MC.HS.F-TF.2	Explain how the unit cricle 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.
CCS.MC.HS.F-TF.3	Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for x, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.
CCS.MC.HS.F-TF.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

Unit Essential Questions

- How are the properties of special right triangles relevant to the unit circle?
- How can the trigonometric functions be represented with right triangles in circles?
- What are the fundamental relationships between the trigonometric functions?

Scope and Sequence

- Converting from degrees to radians, and radians to degrees
- Draw angles (+/-) in standard position
- Find angles that are coterminal with a given angle
- Use reference angles to evaluate trigonometric functions
- Finding exact values of the trigonometric functions using a point on the unit circle
- Finding exact values of the trigonometric functions of $\pi/3$, $\pi/4$ and $\pi/6$
- Evaluating trigonometric functions

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources

Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 16 days

UNIT 12
Conic Sections

Unit Goals

At the completion of this unit, students will have learned to find equations whose graphs are conic sections by analyzing the geometric properties of conic sections. Students will come to identify the specific curve through analysis of its equation and then use those properties to graph the relation. Students will come to understand how the properties make conic sections useful for many real-world applications, particularly in architecture and construction.

At the completion of this unit, students will:

CCS.MC.HS.G-GPE.1	Dervie the equation of a cirlce of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
CCS.MC.HS.G-GPE.2	Derive the eqaution of a parabola given a focus and directrix.
CCS.MC.HS.G-GPE.3	Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.

Unit Essential Questions

- How is the maximum/minimum value of a parabola determined?
- How is the orientation of a parabola determined?
- How can the type of conic section be determined by its equation?
- What are the fundamental differences between an ellipse and a hyperbola?
- What is the role of the foci in an ellipse and a hyperbola?

Scope and Sequence

- Finding the equation of a parabola with a vertical or horizontal axis
- Finding the focus and directrix of a parabola
- Graphing the parabola
- Finding the vertices, major and minor axes, and foci of an ellipse
- Sketching the ellipse
- Finding the equation of the ellipse given the vertices, major and minor axes, and/or foci
- Finding the vertices, transverse axis, asymptotes, and foci of a hyperbola
- Sketching the hyperbola
- Finding the equation of the hyperbola given the vertices, asymptotes, and/or foci
- Applying the properties of shifting to sketch each of the conic sections
- Completing the square when the equation of a conic section is not in vertex form

Assured Assessment
Formative Assessment:

- Warm-up problems, exit slips, group problem sets

Summative Assessment:

- Within the unit, students will take an assessment common to all teachers and assessed via a common scoring guide.
- Checkpoint quizzes will be administered to assess students' understanding of essential concepts and skills.
- Journal questions will require students to explain processes and make mathematical connections.

Resources
Core

- Stewart, James, Lothar Redlin, and Saleem Watson. *Algebra and Trigonometry*. 4th ed. Boston: Cengage, 2016. Print.

Time Allotment

- Approximately 12 days

TEACHER GUIDE

Unit One: Foundational Skills

Sections:

P.2 Real Numbers
P.4 Rational Exponents and Radicals
P.6 Factoring, Sum/Difference Cubes, Factoring by Grouping
P.7 Rational Expressions
P.9 Modeling with Equations
Supp. Solving Systems of Equations in Three Variables

Unit Two: Circles and Quadratics

1.1 Distance and Midpoint Formula
1.2 Graphing Circles, Finding the Equation of a Circle
1.4 Solving Quadratic Equations
1.5 Complex Numbers

Unit Three: Solving Equations

P.8 Solving Basic Equations
1.6 Solving Other Types of Equations
1.7 Solving Inequalities (skip solving nonlinear inequalities and modeling)
1.8 Solving Absolute Value Equations and Inequalities
1.10 Modeling Variation

Unit Four: Graphing Functions

2.1 Functions
2.2 Graphs of Functions (supplement piecewise word problems)
2.3 Information from the Graph of a Function (value, domain, and range)

Unit Five: Transforming and Combining Functions

2.6 Transformations of Functions
2.7 Combining Functions
2.8 One-to-One Functions and Their Inverses (focus on modeling – p. 273)

Unit Six: Quadratic Functions and Zeros of Polynomials

3.1 Quadratic Functions and Models
3.3 Dividing Polynomials
3.4 Real Zeros of Polynomials
3.5 Complex Zeros

***Midterm exam**

Unit Seven: Polynomial and Rational Functions

3.2 Polynomial Functions and Their Graphs
3.6 Rational Functions

Unit Eight: Exponential and Logarithmic Functions (Part I)

4.1 Exponential Functions
4.2 The Natural Exponential Function
4.3 Logarithmic Functions

Unit Nine: Exponential and Logarithmic Functions (Part II)

4.4 Laws of Logarithms
4.5 Exponential and Logarithmic Equations
4.6 Modeling with Exponential Functions

Unit Ten: Applications of Trigonometric Functions

5.2 Trigonometry of Right Triangles
5.4 Inverse Trigonometric Functions and Right Triangles
5.3 Area of a Triangle
5.5 The Law of Sines
5.6 The Law of Cosines (focus on modeling – p. 499)

Unit Eleven: Trigonometry and the Unit Circle

5.1 Angle Measure
5.3 Trigonometric Functions of Angles
6.1 The Unit Circle
6.2 Trigonometric Functions of Real Numbers

Unit Twelve: Conic Sections

12.1 Parabolas
12.2 Ellipses
12.3 Hyperbolas
12.4 Shifted Conics

***Final exam**

COURSE CREDIT

One credit in mathematics
One class period daily for a full year

PREREQUISITES

Grade of B- or better in Honors Geometry and teacher recommendation

ASSURED STUDENT PERFORMANCE RUBRICS

- Trumbull High School School-Wide Writing Rubric (attached)
- Trumbull High School School-Wide Problem-Solving Rubric (attached)
- Trumbull High School School-Wide Independent Learning and Thinking Rubric (attached)

Trumbull High School School-Wide Writing Rubric

Category/ Weight	Exemplary 4 Student work:	Goal 3 Student work:	Working Toward Goal 2 Student work:	Needs Support 1-0 Student work:
Purpose X_____	• Establishes and maintains a clear purpose • Demonstrates an insightful understanding of audience and task	• Establishes and maintains a purpose • Demonstrates an accurate awareness of audience and task	• Establishes a purpose • Demonstrates an awareness of audience and task	• Does not establish a clear purpose • Demonstrates limited/no awareness of audience and task
Organization X_____	• Reflects sophisticated organization throughout • Demonstrates logical progression of ideas • Maintains a clear focus • Utilizes effective transitions	• Reflects organization throughout • Demonstrates logical progression of ideas • Maintains a focus • Utilizes transitions	• Reflects some organization throughout • Demonstrates logical progression of ideas at times • Maintains a vague focus • May utilize some ineffective transitions	• Reflects little/no organization • Lacks logical progression of ideas • Maintains little/no focus • Utilizes ineffective or no transitions
Content X_____	• Is accurate, explicit, and vivid • Exhibits ideas that are highly developed and enhanced by specific details and examples	• Is accurate and relevant • Exhibits ideas that are developed and supported by details and examples	• May contain some inaccuracies • Exhibits ideas that are partially supported by details and examples	• Is inaccurate and unclear • Exhibits limited/no ideas supported by specific details and examples
Use of Language X_____	• Demonstrates excellent use of language • Demonstrates a highly effective use of standard writing that enhances communication • Contains few or no errors. Errors do not detract from meaning	• Demonstrates competent use of language • Demonstrates effective use of standard writing conventions • Contains few errors Most errors do not detract from meaning	• Demonstrates use of language • Demonstrates use of standard writing conventions • Contains errors that detract from meaning	• Demonstrates limited competency in use of language • Demonstrates limited use of standard writing conventions • Contains errors that make it difficult to determine meaning

Trumbull High School School-Wide Problem-Solving Rubric

Category/ Weight	Exemplary 4	Goal 3	Working Toward Goal 2	Needs Support 1-0
Understanding X_____	• Student demonstrates clear understanding of the problem and the complexities of the task	• Student demonstrates sufficient understanding of the problem and most of the complexities of the task	• Student demonstrates some understanding of the problem but requires assistance to complete the task	• Student demonstrates limited or no understanding of the fundamental problem after assistance with the task
Research X_____	• Student gathers compelling information from multiple sources including digital, print, and interpersonal	• Student gathers sufficient information from multiple sources including digital, print, and interpersonal	• Student gathers some information from few sources including digital, print, and interpersonal	• Student gathers limited or no information
Reasoning and Strategies X_____	• Student demonstrates strong critical thinking skills to develop a comprehensive plan integrating multiple strategies	• Student demonstrates sufficient critical thinking skills to develop a cohesive plan integrating strategies	• Student demonstrates some critical thinking skills to develop a plan integrating some strategies	• Student demonstrates limited or no critical thinking skills and no plan
Final Product and/or Presentation X_____	• Solution shows deep understanding of the problem and its components • Solution shows extensive use of 21st-century technology skills	• Solution shows sufficient understanding of the problem and its components • Solution shows sufficient use of 21st-century technology skills	• Solution shows some understanding of the problem and its components • Solution shows some use of 21st-century technology skills	• Solution shows limited or no understanding of the problem and its components • Solution shows limited or no use of 21st-century technology skills

Trumbull High School School-Wide
Independent Learning and Thinking Rubric

Category/ Weight	Exemplary 4	Goal 3	Working Toward Goal 2	Needs Support 1-0
Proposal X_____	• Student demonstrates a strong sense of initiative by generating compelling questions, creating uniquely original projects/work	• Student demonstrates initiative by generating appropriate questions, creating original projects/work	• Student demonstrates some initiative by generating questions, creating appropriate projects/work	• Student demonstrates limited or no initiative by generating few questions and creating projects/work
Independent Research & Development X_____	• Student is analytical, insightful, and works independently to reach a solution	• Student is analytical, and works productively to reach a solution	• Student reaches a solution with direction	• Student is unable to reach a solution without consistent assistance
Presentation of Final Product X_____	• Presentation shows compelling evidence of an independent learner and thinker • Solution shows deep understanding of the problem and its components • Solution shows extensive and appropriate application of 21st-century skills	• Presentation shows clear evidence of an independent learner and thinker • Solution shows adequate understanding of the problem and its components • Solution shows adequate application of 21st-century skills	• Presentation shows some evidence of an independent learner and thinker • Solution shows some understanding of the problem and its components • Solution shows some application of 21st-century skills	• Presentation shows limited or no evidence of an independent learner and thinker • Solution shows limited or no understanding of the problem and its components • Solution shows limited or no application of 21st-century skills