TRUMBULL PUBLIC SCHOOLS

Trumbull, Connecticut

ALGEBRA I

Grades 7-11
Mathematics Department
2016

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Algebra I
Table of Contents

The Trumbull Board of Education will continue to take Affirmative Action to ensure that no persons are discriminated against in its employment.

CORE VALUES AND BELIEFS

The Trumbull 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

Algebra I is a prerequisite for all high school and college mathematics and thus provides a necessary foundation for higher-level mathematics. Students develop abstract reasoning and critical thinking skills, develop a better understanding of the world in which they live, and become better able to correctly apply mathematical knowledge when required. The focus areas of Algebra I help students gain strong foundations, including a solid understanding of concepts, a high degree of procedural skill and fluency, and the ability to apply the math they know to solve problems inside and outside the classroom.

The *Algebra 1* textbook by Pearson (2015) offers a blended print and digital curriculum that is built on a foundation of problem solving and visual learning. This curriculum guide has been updated to reflect the new resources provided by the textbook, including technology. Additionally, some topics within the course have been reordered. Based upon student and teacher feedback from upper-level courses, student performance, and the requirements of the redesigned SAT, topics have been added to increase the rigor of Algebra I.

Students will have completed a Pre-Algebra course prior to Algebra I. After successful completion of Algebra I, students will be prepared to take Geometry and Algebra II.

Algebra I is offered at Trumbull High School as well as at both Hillcrest and Madison Middle Schools for students whose performance suggests that they are cognitively ready to attain the standards.

COURSE GOALS

Algebra I takes a balanced instructional approach to promote the understanding of important mathematical concepts, skills, procedures, and ways of thinking and reasoning.

The following course goals derive from the 2010 Connecticut Core Standards for Mathematical Content.

N-RN <u>The Real Number System</u>

Extend the properties of exponents to radical exponents. Use properties of rational and irrational numbers.

N-Q <u>Quantities</u>

Reason quantitatively and use units to solve problems.

A-SSE Seeing Structure in Expressions
Interpret the structure of expressions. Write expressions in equivalent forms to solve problems.

A-APR Arithmetic with Polynomials and Rational Expressions
Perform arithmetic operations on polynomials. Understand the relationship between zeros and factors of polynomials.

A-CED Creating Equations
Create equations that describe numbers or relationships.

A-REI Reasoning with Equations and Inequalities
Understand solving equations as a process of reasoning and explain the reasoning. Solve equations and inequalities in one variable. Solve systems of equations. Represent and solve equations and inequalities graphically.

F-IF Interpreting Functions
Understand the concept of a function and use function notation. Interpret functions that arise in applications in terms of the context. Analyze functions using different representations.

F-BF Building Functions
Build a function that models a relationship between two quantities. Build new functions from existing functions.

F-LE Linear, Quadratic, and Exponential Models
Construct and compare linear, quadratic, and exponential models and solve problems. Interpret expressions for functions in terms of the situation they model.

S-ID Interpreting Categorical and Quantitative Data
Summarize, represent, and interpret data on a single count or measurement variable. Summarize, represent, and interpret data on two categorical and quantitative variables. Interpret linear models.

S-IC Making Inferences and Justifying Conclusions
Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

S-CP Conditional Probability and the Rules of Probability
Understand independence and conditional probability and use them to interpret data.

The following course goals derive from the 2010 Connecticut Core Standards for Mathematical Practices, 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.

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.

The following course goals derive from the 2014 International Society for Technology in Education Standards.

1. Creativity and Innovation – Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
2. Communication and Collaboration – Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
3. Research and Information Fluency – Students apply digital tools to gather, evaluate, and use information.
4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
5. Digital Citizenship – Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

COURSE ENDURING UNDERSTANDINGS

Students will understand that . . .

- arithmetic and geometric sequences give rise to linear and exponential equations.

- linear, exponential, and quadratic equations can be used to model real-life situations, develop inferences, and make informed decisions.
- technology can help them analyze, organize, and display data to support their conclusions.

COURSE ESSENTIAL QUESTIONS

- How can arithmetic and geometric sequences be represented by equations?
- How can we take real-life data and model it mathematically?
- How can linear, exponential, and quadratic equations help us make informed decisions about the world around us?
- How can we use graphing calculators to translate real-life data into mathematical models?

COURSE KNOWLEDGE & SKILLS

Students will understand . . .

- the key vocabulary of algebraic mathematics:
  - arithmetic sequence, explicit rule, geometric sequence, integer, N^{th} term, recursive rule (Unit 1);
  - algebraic expression, coefficient, constant, distributive property, linear inequalities, real numbers, variable (Unit 2);
  - dependent variable, domain, function, function notation, independent variable, linear function, mapping diagram, non-linear function, parabola, range, relation, vertical line test (Unit 3);
  - causation, correlation, correlation coefficient, extrapolation, initial value, interpolation, line of best fit, linear model, parameter, point-slope form, rate of change, scale, scatterplot, slope, slope-intercept form, standard form, regression expression, regression line, trend line, unit rate, velocity, *x*-intercept, *y*-intercept (Unit 4);
  - break-even point, elimination method for solving systems of equations, fixed cost, graphing method for solving systems of equations, profit, revenue, solution of a system of linear equations, substitution method for solving systems, system of linear equations, system of linear inequalities (Unit 5);
  - compound interest, decay factor, doubling time, exponential decay, exponential function, exponential growth, growth factor, half life, laws of exponents, radical expressions, rate of change (Unit 6);
  - ascending order, axis of symmetry, binomial, degree, descending order, difference of two squares, discriminant, expanded form, factored form, factoring by grouping, leading coefficient, maximum, minimum, monomial, perfect square trinomial, quadratic, quadratic formula, quadratic function, quadratic equation, root, standard form of a quadratic equation, trinomial, vertex, zero product property (Unit 7); and
  - box-and-whisker plot, interquartile range (IQR), mean, measures of central tendency, median, mode, outlier, quartile, range (Unit 8).

Students will be able to . . .

- write linear and exponential equations from arithmetic and geometric sequences.
- solve multi-step equations and linear inequalities without a calculator.
- rewrite linear equations for a given variable.

- use graphing and statistical functions of a graphing calculator.
- represent functions using tables, equations, and graphs.
- use function notation.
- find, analyze, and describe the meaning of slope.
- write linear equations.
- find the line of best fit, analyze trend lines, and make scatterplots.
- solve systems of equations by graphing, substitution, and elimination.
- solve systems of inequalities by graphing.
- learn the rules of exponents and use them to simplify expressions.
- identify the parameters of exponential functions and how they affect the graph of a function.
- apply exponential functions to real-world situations.
- add, subtract, and simplify radicals.
- rationalize the denominator of radicals.
- add, subtract, and multiply polynomials.
- factor polynomials.
- solve quadratic equations.
- graph a parabola using the intercepts and vertex.
- describe a data set using measures of central tendency.
- organize data in displays such as frequency tables, histograms, and box-and-whisker plots.
- identify outliers and explain how they affect the spread of data.

COURSE SYLLABUS

Course Name

Algebra I

Level

at Trumbull High School: Advanced College-Preparatory

Prerequisites

Completion of Pre-Algebra

Materials Required

TI-84 graphing calculator

General Description of the Course

Algebra I is designed to develop the eight standards of mathematical practice in students. The course is broken into eight units of study. Students will model arithmetic and geometric patterns and solve linear equations and inequalities. They will explore functions and derive linear models in order to analyze situations, make predictions, and solve problems. Students will study scatterplots and trend lines as well as measures of central tendencies. They will solve systems of equations graphically, numerically, and algebraically and make choices between competing situations in real-world contexts. Geometric patterns are revisited while investigating exponents and exponential equations. The course concludes with the study of quadratic functions and equations and one-variable statistics.

Assured Assessments

Students will be evaluated by their performance on formative assessments (reflection/journal entries, exit slips, formative performance tasks) as well as summative assessments (common end-of-unit assessments) and departmental midterm and final examinations.

Core Text

Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.

UNIT 1
Patterns and Sequences

Unit Goals

At the completion of this unit, students will:

F-IF Interpreting Functions

Understand the concept of a function and use function notation.

1. 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 ≥ 1.*

F-BF Building Functions

Build a function that models a relationship between two quantities.

1. Write a function that describes a relationship between two quantities.
    a. Determine an explicit expression, a recursive process, or steps for calculation from a context.
2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.

Unit Essential Questions

- What is a sequence?
- How can patterns be represented?
- What are the advantages and disadvantages of a recursive rule compared to an explicit rule?

Scope and Sequence

- Students will create and analyze different representations of patterns: tables, graphs, and symbolic rules.
- Students will write the recursive and explicit rules for arithmetic sequences and geometric sequences, foreshadowing the later development of linear and exponential functions and their applications.
- Students will explore how ubiquitous patterns are, both in nature and in man-made objects.

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Algebra I teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Connecticut State Department of Education Moodle for Algebra I.

Supplemental

- Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.
    - Sections 1-9, 4-7, & 7-8

Time Allotment

- Approximately 10 days

UNIT 2
Linear Equations and Inequalities

Unit Goals

At the completion of this unit, students will:

A-SSE Seeing Structure in Expressions

Interpret the structure of expressions.

1. Interpret expressions that represent a quantity in terms of its context.
    a. Interpret parts of an expression, such as terms, factors, and coefficients.
    b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1 + r)^n$ *as the product of P and a factor not depending on P.*

A-CED Creating Equations

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

A-REI Reasoning with Equations and Inequalities

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

1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Solve equations and inequalities in one variable.

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

N-RN The Real Number System

Use properties of rational and irrational numbers.

3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

N-Q Quantities

Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Unit Essential Questions

- How can I use linear equations and linear inequalities to solve real-world problems?
- What is a solution set for a linear equation or linear inequality?
- How can models and technology aid in the solving of linear equations and linear inequalities?

Scope and Sequence

- Students will write, simplify, evaluate, and model situations involving linear equations.
- Students will then examine the concept of equality and use linear equations and linear inequalities to model and solve real-world problems.

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Algebra I teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.
    - Sections 2-1, 2-2, 2-3, 2-4, 2-5, 2-6, 2-7, 2-8, 2-9, 2-10, 3-1, 3-2, 3-3, & 3-4

Supplemental

- Connecticut State Department of Education Moodle for Algebra I.

Time Allotment

- Approximately 15 days

UNIT 3
Functions

Unit Goals

At the completion of this unit, students will:

N-Q Quantities

Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.

A-SSE Seeing Structure in Expressions

Interpret the structure of expressions.

1. Interpret expressions that represent a quantity in terms of its context.
    a. Interpret parts of an expression, such as terms, factors, and coefficients.
    b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1 + r)^n$ *as the product of P and a factor not depending on P.*

A-CED Creating Equations

Create equations that describe numbers or relationships.

2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A-REI Reasoning with Equations and Inequalities

Represent and solve equations and inequalities graphically.

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
11. Explain why the *x*-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make table 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.

Unit Essential Questions

- What is a function?
- What are the different ways in which functions may be represented?
- How can functions be used to model real-world situations, make predictions, and solve problems?

Scope and Sequence

- Students will be introduced to the concept of a function.

- After identifying relationships that are not functions, students will learn how to define the domain and range of a function.
- Students will organize and analyze data in tables and graphs and use the information to describe relationships.
- Students will be introduced to function notation and will evaluate functions.
- Students will be exposed to a variety of parent functions, with emphasis on distinguishing between linear functions (to be studied in depth in Unit 4) and non-linear functions (to be studied later in this course and in subsequent courses).

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Algebra I teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.
    - Sections 4-1, 4-2, 4-4, 4-5, & 4-6 (set builder and interval notation)

Supplemental

- Connecticut State Department of Education Moodle for Algebra I.

Time Allotment

- Approximately 15 days

UNIT 4
Linear Functions

Unit Goals

At the completion of this unit, students will:

N-Q Quantities

Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.

A-SSE Seeing Structure in Expressions

Interpret the structure of expressions.

1. Interpret expressions that represent a quantity in terms of its context.
    a. Interpret parts of an expression, such as terms, factors, and coefficients.
2. Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$.

A-CED Creating Equations

Create equations that describe numbers or relationships.

2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

F-IF Interpreting Functions

Interpret functions that arise in applications in terms of the context.

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*
6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Analyze functions using different representations.

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
    a. Graph linear and quadratic functions and show intercepts, maxima, and minima.
    b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

F-BF Building Functions

Build a function that models a relationship between two quantities.

1. Write a function that describes a relationship between two quantities.

a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

F-LE Linear, Quadratic, and Exponential Models

Interpret expressions for functions in terms of the situation they model.

5. Interpret the parameters in a linear or exponential function in terms of a context.

S-ID Interpreting Categorical and Quantitative Data

Interpret linear models.

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.
9. Distinguish between correlation and causation.

Unit Essential Questions

- What are the different ways in which linear functions and inequalities may be represented?
- What is the significance of a linear function's slope and *y*-intercept?
- How can linear functions model real-world situations?
- How can linear functions help me analyze real-world situations and solve practical problems?
- What are the advantages and disadvantages to analyzing data by hand versus by using technology?

Scope and Sequence

- Throughout Unit 4, students will derive linear models of real-world situations in order to analyze situations, make predictions, and/or solve problems.
  - Analyzing situations will often take the form of identifying the real-world meaning of the slope and the *x*- and *y*-intercepts of a linear model.
  - Making predictions will involve evaluating models for a given independent variable (given *x*, find *y*) and solving equations for the independent variable given the dependent variable (given *y*, find *x*).
  - Problem-solving will occur through the use of various representations: algebraic, tabular, graphic, and numeric.
- Students will graph a trend line by hand and by using technology.

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Algebra I teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.
    - Sections 5-1, 5-3, 5-4, 5-5, 5-6, 5-7, & 6-5

Supplemental

- Connecticut State Department of Education Moodle for Algebra I.

Time Allotment

- Approximately 22 days

UNIT 5
Systems of Linear Equations

Unit Goals

At the completion of this unit, students will:

N-Q Quantities

Reason quantitatively and use units to solve problems.

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

A-CED Creating Equations

Create equations that describe numbers or relationships.

3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

A-REI Reasoning with Equations and Inequalities

Solve systems of equations.

5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Represent and solve equations and inequalities graphically.

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 table of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
12. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Unit Essential Questions

- What does the number of solutions (none, one, or infinite) of a system of linear equations represent?
- What are the advantages and disadvantages to solving a system of linear equations graphically versus algebraically?
- How do I represent solutions of systems of linear inequalities?

Scope and Sequence

- Building on previous units, in which students studied linear functions and used a linear function to investigate the relationship between two variables, in Unit 5, students will represent, compare, and analyze two linear equations, look for common solutions, and use this information to make choices between competing situations in real-world contexts.
- Students will solve systems of equations numerically, graphically, and algebraically.
- Students will explain what the solution of a system of linear equations represents in the contexts of various applications such as those used by business leaders, economists, scientists, engineers, nutritionists, racecar drivers, and athletes.
- Students will explore the special cases of parallel lines (no solution) and identical lines (infinite solutions).

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Algebra I teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.
    - Sections 6-1, 6-2, 6-3, 6-4, & 6-6

Supplemental

- Connecticut State Department of Education Moodle for Algebra I.

Time Allotment

- Approximately 15 days

UNIT 6
Introduction to Exponential Functions

Unit Goals

At the completion of this unit, students will:

N-RN The Real Number System

Extend the properties of exponents to rational exponents.

1. Explain how the definition of the meaning of radical exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*
2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.

A-SSE Seeing Structure in Expressions

Interpret the structure of expressions.

1. Interpret expressions that represent a quantity in terms of its context.
    b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.*

Write expressions in equivalent forms to solve problems.

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
    c. Use the properties of exponents to transform expressions for exponential functions. *For example, the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*

A-CED Creating Equations

Create equations that describe numbers or relationships.

2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

A-REI Reasoning with Equations and Inequalities

Represent and solve equations and inequalities graphically.

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

F-BF Building Functions

Build new functions from existing functions.

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 graph. Experiment with

cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

4. Find inverse functions.
    a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. *For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.*
    b. (+) Verify by composition that one function is the inverse of another.
    c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.
    d. (+) Produce an invertible function from a non-invertible function by restricting the domain.
5. (+) Understand the inverse relationships between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

F-LE Linear, Quadratic, and Exponential Models

Interpret expressions for functions in terms of the situation they model.

10. Interpret the parameters in a linear or exponential function in terms of a context.

Unit Essential Questions

- What characterizes exponential growth and decay?
- What are real-world models of exponential growth and decay?
- What are the limitations of exponential growth models?
- How can I differentiate an exponential model from a linear model given a real-world data set?
- How can I simplify a radical expression?

Scope and Sequence

- Building on the concepts of a function and patterns of change, in Unit 6, students will revisit geometric sequences explored in Unit 1.
- Students will derive exponential models of real-world situations in order to analyze situations, make predictions, and/or solve problems.
    - Analyzing situations will often take the form of identifying the real-world meaning of the initial value and the growth/decay factor.
    - Making predictions will involve evaluating models for a given independent variable (given *x*, find *y*).
- Students will investigate properties of exponents.
- Students will simplify radical expressions, including those with variables.

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Algebra I teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.
    - Sections 7-1, 7-2, 7-3, 7-4, 7-6, 7-7, 10-2, & 10-3

Supplemental

- Connecticut State Department of Education Moodle for Algebra I.

Time Allotment

- Approximately 27 days

UNIT 7
Quadratic Functions and Equations

Unit Goals

At the completion of this unit, students will:

A-SSE Seeing Structure in Expressions

Interpret the structure of expressions.

1. Interpret expressions that represent a quantity in terms of its context.
    a. Interpret parts of an expression, such as terms, factors, and coefficients.
    b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1 + r)^n$ *as the product of P and a factor not depending on P.*
2. Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$.

Write expressions in equivalent forms to solve problems.

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
    a. Factor a quadratic expression to reveal the zeros of the function it defines.
    b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

A-APR Arithmetic with Polynomials and Rational Expressions

Perform arithmetic operations on polynomials.

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

Understand the relationship between zeros and factors of polynomials.

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

A-CED Creating Equations

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

F-IF Interpreting Functions

Interpret functions that arise in applications in terms of the context.

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*
5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*

F-LE Linear, Quadratic, and Exponential Models

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

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

Unit Essential Questions

- What can the zeros, intercepts, vertex, maximum, minimum, and other features of a quadratic function tell me about real-world relationships?
- How can technology support investigation of and experimentation with the ways that parameters affect functions?
- How do I choose the best method for solving a quadratic equation?
- How is the factoring of polynomials related to the multiplication of polynomials?

Scope and Sequence

- Students will learn to add, subtract, and multiply polynomials.
- Students will factor, solve, and graph quadratics.

- Students will explore the many applications of quadratics in everyday life.

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Algebra I teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.
    - Sections 8-1, 8-2, 8-3, 8-4, 8-5, 8-6, 8-7, 8-8, 9-1, 9-2, 9-3, 9-4, & 9-6

Supplemental

- Connecticut State Department of Education Moodle for Algebra I.

Time Allotment

- Approximately 40 days

UNIT 8
One-Variable Statistics

Unit Goals

At the completion of this unit, students will:

N-Q Quantities

Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.

S-ID Interpreting Categorical and Quantitative Data

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

1. Represent data with plots on the real number line (dot plots, histograms, and box plots).
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
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.

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

5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

S-IC Making Inferences and Justifying Conclusions

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

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

S-CP Conditional Probability and the Rules of Probability

Understand independence and conditional probability and use them to interpret data.

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").
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.

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*.
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.*
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.*

Unit Essential Questions

- How can I make predictions and informed decisions based on current numerical information?
- What are the advantages and disadvantages to analyzing data by hand versus by using technology?
- What is the potential impact of making a decision from data that contains one or more outliers?

Scope and Sequence

- Students will explore measures of central tendency and spread and displays of one-variable data, including box-and-whisker plots.
- Students will use the five-number summary to create box-and-whisker plots and identify outliers.
- Students will be introduced to using the STAT menu on the graphing calculator.

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Algebra I teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.
    - Sections 12-2, 12-3, & 12-4

Supplemental

- Connecticut State Department of Education Moodle for Algebra I.

Time Allotment

- Approximately 8 days

TEACHER GUIDE

Unit One: Patterns and Sequences (10 days, including mid-unit assessment and end-of-unit review & assessment)

	Topics	Text Sections
1	Representing Patterns	[Moodle documents]
2	Arithmetic Sequences	[Moodle documents]
3	Geometric Sequences	[Moodle documents]
		Supplemental: 1-9, 4-7, 7-8

Unit Two: Linear Equations and Inequalities (15 days, including mid-unit review & assessment and end-of-unit review & assessment)

NO CALCULATOR

1	Solving Equations	2-1, 2-2, 2-3, 2-4
2	Literal Equations	2-5
3	Ratios, Proportions, and Percents	2-6, 2-7, 2-8, 2-9, 2-10
4	Solving Inequalities	3-1, 3-2, 3-3, 3-4

Unit Three: Functions (15 days, including mid-unit review & assessment and end-of-unit review & assessment)

1	Using Graphs to Relate Two Functions	4-1
2	Patterns and Linear Functions	4-2
3	Graphing a Function Rule	4-4
4	Writing a Function Rule	4-5
5	Formalizing Relations and Functions (supplement function notation, and domain and range)	4-6 (set builder and interval notation)

Unit Four: Linear Functions (22 days, including two mid-unit reviews & assessments and end-of-unit review & assessment)

1	Rate of Change and Slope	5-1
2	Slope-Intercept Form	5-3
3	Point-Slope Form	5-4
4	Standard Form	5-5
5	Parallel and Perpendicular Lines	5-6
6	Scatterplots and Trend Lines	5-7
7	Graphing Linear Inequalities in Two Variables	6-5

Unit Five: Systems of Linear Equations (15 days, including mid-unit review & assessment and end-of unit review & assessment)

1	Solving Systems of Linear Equations by Graphing	6-1
2	Solving Systems of Linear Equations using Substitution	6-2
3	Solving Systems of Linear Equations using Elimination	6-3
4	Applications of Linear Systems	6-4
5	Graphing Systems of Linear Inequalities	6-6

***Midterm review & exam** (3-4 days)

Unit Six: Introduction to Exponential Functions (27 days, including two mid-unit reviews & assessments and end-of-unit review & assessment)

1	Exponent Properties – NO CALCULATOR	7-1, 7-2, 7-3, 7-4
2	Exponential Functions	7-6
3	Exponential Growth and Decay	7-7
4	Simplifying and Operations with Radicals (no conjugate) – NO CALCULATOR	10-2, 10-3

Unit Seven: Quadratic Functions and Equations (40 days, including three mid-unit reviews & assessments and end-of-unit review & assessment)

1	Adding and Subtracting Polynomials	8-1
2	Multiplying and Factoring	8-2
3	Multiplying Binomials	8-3
4	Multiplying Special Cases	8-4
5	Factoring (include By Grouping)	8-5, 8-6, 8-7, 8-8
6	Quadratic Graphs and Their Properties	9-1
7	Quadratic Functions	9-2
8	Solving Quadratic Functions	9-3, 9-4, 9-6

Unit Eight: One-Variable Statistics (8 days, including mid-unit assessment and end-of-unit review & assessment)

1	One-Variable Data	12-2, 12-3, 12-4
2	Technology	[Moodle documents]

Additional Topics, time permitting

	Unions and Intersections of Sets	3-8
	Organizing Data using Matrices	12-1
	Samples and Surveys	12-5
	Permutations and Combinations	12-6
	Theoretical and Experimental Probability	12-7

***Final review & exam** (3-4 days)

COURSE CREDIT

One credit in Mathematics

One class period daily for a full year

PREREQUISITES

Completion of Honors Algebra II with a B- or better and teacher recommendation.

TEXT

Charles, Randall I., et al. *Algebra 1*. New York: Pearson, 2015. Print.

SUPPLEMENTARY MATERIALS/RESOURCES/TECHNOLOGY

Department- and teacher-prepared materials

TI-84 Plus graphing calculators

CURRENT REFERENCES

2010 Connecticut Core Standards for Mathematics
http://www.corestandards.org/assets/CCSSI_Math%20Standards.pdf

CSDE CTHSS Moodle for Algebra I
http://tinyurl.com/cthssmoodle: CSDE-Mathematics-CT