ALGEBRA 32

Description

This second course in algebra furthers the students' skills in operation with real numbers, variables and algebraic properties. Algebra 32 extends the topics studied in Algebra 12 and prepares the students to take the new SATs that began in 2005. The concepts of relation and function are broadly expanded, while additional topics include a further exploration of powers and roots, expansion and application of systems of equations, exponential growth and geometric sequences, probability, matrices, negative and fractional exponents, exponential functions, complex numbers, absolute value, polynomial functions and their graphs, and quadratic relations and systems with an emphasis on problem solving and real-life applications.

Course Overview

Course Goals	**Essential Questions**	**Assessments**
Students should:	• How do patterns and functions help us describe data and physical phenomena and solve a variety of problems? • How are quantitative relationships represented by numbers? • How can collecting, organizing and displaying data help us analyze information and make reasonable predictions and informed decisions?	*Common Assessments* *Skill Assessments*

Content Outline
   I. Unit 1 - Algebraic Connections
   II. Unit 2 - Algebraic Expressions, Equations and Inequalities
   III. Unit 3 - Functions and Relations
   IV. Unit 4 - Graphing
   V. Unit 5 - Exponents, Radicals, and Logarithms
	Standards
	
	 State of Connecticut Mathematics Curriculum Frameworks
	
	 Connecticut State Standards are met in the following areas:
	 • *Algebraic Reasoning: Patterns And Functions*
	 • *Numerical and Proportional Reasoning*
	 • *Working with Data: Probability and Statistics*
		Grade Level Skills
		 Students will:
		 • Skills Matrix

Pacing Guide				
1st Marking Period		2nd Marking Period	3rd Marking Period	4th Marking Period
September October November		December January	February March April	May June
Unit 1 **Algebraic Connections** 5 weeks	Unit 2 **Algebraic Expressions, Equations and Inequalities** 7 weeks	Unit 3 **Functions and Relations** 6 weeks	Unit 4 **Graphing** 8 weeks	Unit 5 **Exponents, Radicals, and Logarithms** 7 weeks

Unit 1 - Algebraic Connections, 5 weeks top

Standards

Algebraic Reasoning: Patterns and Functions - Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technology.

1.1 Students should understand and describe patterns and functional relationships.
Core   1.1a Students should describe relationships and make generalizations about patterns and functions.
1.2 Students should represent and analyze quantitative relationships in a variety of ways.
Core   1.2a Students should represent and analyze linear and non-linear functions and relations symbolically and with tables and graphs.
1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.
Core   1.3a Students should manipulate equations, inequalities, and functions to solve problems.
Extended   1.3a Students should use and extend algebraic concepts to include real and complex numbers, vectors, and matrices.

Numerical and Proportional Reasoning - Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technology.

2.1 Students should understand that a variety of numerical representations can be used to describe quantitative relationships.
Core   2.1a Students should extend the understanding of number to include integers, rational numbers, and real numbers.
              2.1b Students should interpret and represent large sets of numbers with the aid of technology.
2.2 Students should use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.
Core   2.2a Students should develop strategies for computation and estimation using properties of number systems to solve problems.
              2.2b Students should solve proportional reasoning problems.
Extended   2.2a Students should investigate mathematical properties and operations related to objects that are not numbers.

Working with Data: Probability and Statistics - Data can be analyzed to make informed decisions using a variety of strategies, tools and technology.

4.1 Students should collect, organize and display data using appropriate statistical and graphical methods.
Core   4.1a Students should create the appropriate visual or graphical representation of real data.
4.2 Students should analyze data sets to form hypotheses and make predictions.
Core   4.2a Students should analyze real world problems using statistical techniques.
4.3 Students should understand and apply basic concepts of probability.
Core   4.3a Students should understand and apply the principles of probability in a variety of situations.

Unit Objective	Essential Questions	Assessment
Students will be able to: identify, describe, create and generalize numeric, geometric, and statistical patterns with tables, graphs, words, and symbolic rules.	- How do patterns and functions help us describe data and physical phenomena and solve a variety of problems? - How are quantitative relationships represented by numbers? - How can collecting, organizing and displaying	

	data help us analyze information and make reasonable predictions and informed decisions? **Focus Questions** • How are matrices added, subtracted and multiplied? • How are inverse matrices used to solve linear systems? • How are counting principals applied to probability calculations?	
Lesson Planning Resources • Matrices • Probability • Pascal's Triangle	**Suggested Materials/Resources** •	**Skill Objectives** Students will: • apply the concepts of limits to sequences and asymptotic behavior of functions. • judge the reasonableness of the results of symbolic manipulations as related to authentic contexts. • make and justify predictions based on patterns. • investigate the patterns and express the relationship between two variables in an equation. • find the theoretical and experimental probability of an event. • use simulation as a method for estimating probability. Estimate an unknown value between data points on a graph (interpolation) and make predictions by extending the graph (extrapolation). • translate data into matrices and perform matrix addition and scalar multiplication. • perform matrix multiplication. • compare and contrast the properties of numbers and number systems including rational, real and complex numbers. • find the number of ways an event can occur using tree diagrams and the multiplication counting principle.

		• find the number of ways that items in a set can be arranged when all of the items are different and when some of the items are the same. • find the number of combinations of items without regard to order. • use Pascal's Triangle to expand binomials.
Technology Resources	**Differentiated Instruction**	**Enrichment/ELL**

Unit 2 – Algebraic Expressions, Equations and Inequalities, 7 weeks <u>top</u>

Standards

Algebraic Reasoning: Patterns and Functions - Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technology.

1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.

Core   1.3a Students should manipulate equations, inequalities, and functions to solve problems.

Numerical and Proportional Reasoning - Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technology.

2.1 Students should understand that a variety of numerical representations can be used to describe quantitative relationships. .

Core   2.1a Students should extend the understanding of number to include integers, rational numbers, and real numbers.

     2.1b Students should interpret and represent large sets of numbers with the aid of technology.

2.2 Students should use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.

Core   2.2a Students should develop strategies for computation and estimation using properties of number systems to solve problems.

     2.2b Students should solve proportional reasoning problems.

Unit Objective	Essential Questions	Assessment
Students will be able to: • model and solve problems with linear inequalities, linear, quadratic, and absolute value equations.	• How do patterns and functions help us describe data and physical phenomena and solve a variety of problems? • How are quantitative relationships represented by numbers? **Focus Questions** • How are the base ten number system and fractions, decimals, percents and ratios related? • How are numerical and algebraic expressions evaluated and simplified? • How are linear and absolute value equations and inequalities solved? • How is algebra used to model and solve real life problems? • How are operations performed on rational expressions and how are they simplified? • How are rational equations graphed and solved? • How are variation and rational models used in real life situations?	•

	• How are sequences defined and their terms found? • How is summation notation used and how are the sums of arithmetic and geometric series found?	
Lesson Planning Resources • Numeric, Algebraic, Absolute Value and Rational expressions, equations and inequalities • Literal Equations • Sequences and Series • Modeling	**Suggested Materials/Resources** •	**Skill Objectives** Students will: • solve systems of two linear equations using algebraic or graphical methods. • solve equations algebraically, graphically and with technology. • solve and graph one variable inequalities. • solve and graph absolute value equations and inequalities. • graph and solve linear and absolute value inequalities in two variables. • solve linear systems by substitution and linear combination. • solve linear systems using matrices. • solve a system of linear inequalities by graphing. • find the next term in a sequence by looking for a pattern. Find the nth term of an arithmetic sequence. Find arithmetic means. • find sums of arithmetic series. Find specific terms in an arithmetic series. Use sigma notation to express sums. • find the nth term of a geometric sequence. Find geometric means. • find the sum of a geometric series. Use sigma notation to express sums. • find the sum of an infinite geometric series. • identify the field properties of our real number system. • define and use imaginary and complex

		numbers. • graph complex numbers and find their absolute value. Find the sum of complex numbers graphically. • solve a quadratic equation by factoring using GCF, difference of two squares, factoring a trinomial with leading coefficient of "a". • solve a quadratic equation using the quadratic formula. Find the vertex of a parabola by using the equation $x = -b/(2a)$. • use the discriminate to determine the nature of the roots of quadratic equation. • solve quadratic-linear systems graphically and algebraically. • simplify rational expressions. Multiply and divide rational expressions. Evaluate rational expressions. Factor sum and difference of cubes. • add and subtract rational expressions. • solve rational equations. Solve word problems that elicit rational equations such as work problems or rate problems.
Technology Resources	**Differentiated Instruction**	**Enrichment/ELL**

Unit 3 - Functions and Relations, 6 weeks [top]

Standards

Algebraic Reasoning: Patterns and Functions - Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technology.

1.1 Students should understand and describe patterns and functional relationships.
Core   1.1a Students should describe relationships and make generalizations about patterns and functions.
Extended   1.1a Students should model real world situations and make generalizations about mathematical relationships using a variety of patterns and functions.

1.2 Students should represent and analyze quantitative relationships in a variety of ways.
Core   1.2a Students should represent and analyze linear and non-linear functions and relations symbolically and with tables and graphs.
Extended   1.2a Students should relate the behavior of functions and relations to specific parameters and determine functions to model real world situations.

1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.
Core   1.3a Students should manipulate equations, inequalities, and functions to solve problems.

Numerical and Proportional Reasoning - Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technology.

2.1 Students should understand that a variety of numerical representations can be used to describe quantitative relationships. .
Core   2.1a Students should extend the understanding of number to include integers, rational numbers, and real numbers.
                 2.1b Students should interpret and represent large sets of numbers with the aid of technology.
Extended   2.1a Students should extend the understanding of number to include the set of complex numbers.

2.2 Students should use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.
Core   2.2a Students should develop strategies for computation and estimation using properties of number systems to solve problems.
                 2.2b Students should solve proportional reasoning problems.

Working with Data: Probability and Statistics - Data can be analyzed to make informed decisions using a variety of strategies, tools and technology.

4.1 Students should collect, organize and display data using appropriate statistical and graphical methods.
Core   4.1a Students should create the appropriate visual or graphical representation of real data.

4.2 Students should analyze data sets to form hypotheses and make predictions.
Core   4.2a Students should analyze real world problems using statistical techniques.

4.3 Students should understand and apply basic concepts of probability.
Core   4.3a Students should understand and apply the principles of probability in a variety of situations.

Unit Objectives	Essential Questions	Assessments
Students will be able to: • compare the characteristics of functions and relations including domain and range.	• How do patterns and functions help us describe data and physical phenomena and solve a variety of problems?	•

• combine, compose, and invert functions. • solve systems of two linear equations using algebraic or graphical methods. • analyze essential relations in a problem to determine possible functions that could model the situation. • recognize the effect of changes in parameters on the graphs of functions.	• How are quantitative relationships represented by numbers? • How can collecting, organizing and displaying data help us analyze information and make reasonable predictions and informed decisions? **Focus Questions** • How are equations of lines written? • How are operations performed on polynomials? • How are polynomial equations evaluated, graphed, and solved? • How are the distance and midpoint formulas used? • How are the equations of conic sections written, classified and graphed? • How are systems of quadratic equations solved?	
Lesson Planning Resources • Linear equations • Conic Sections • Systems of equations	**Suggested Materials/Resources** •	**Skill Objectives** Students will: • add, subtract and multiply functions. • operations on functions (addition, subtraction and multiplication). • define a function, domain, range and use function notation. • determine if a function is linear and if it is also a direct variation. Determine the slope of the linear function as a rate of change. • write an equation of a line in slope-intercept form given the slope and one or two points. Write the equation of a line in point-slope form. Write the equation of a line that is parallel or perpendicular to a given equation. • graph quadratic functions using technology. Identify vertex, maximum, minimum and line of symmetry. • graph parabolas of the form $y = ax^2$. Determine how "a" affects the graph.

		• graph parabolas by using translations to identify features.
		• write a quadratic function in the form y = a (x-h)^2 + k by completing the square.
		• find the distance and midpoint between two points in the coordinate plane. Write equations of circles in standard form. Use completing the square to write equations of circles in standard form in order to find the center and radius.
		• identify conic sections from their equation.
Technology Resources	**Differentiated Instruction**	**Enrichment/ELL**

Unit 4 - Graphing, 8 weeks top

Standards

Algebraic Reasoning: Patterns and Functions - Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technology.

1.1 Students should understand and describe patterns and functional relationships.

Core   1.1a Students should describe relationships and make generalizations about patterns and functions.

1.2 Students should represent and analyze quantitative relationships in a variety of ways.

Core   1.2a Students should represent and analyze linear and non-linear functions and relations symbolically and with tables and graphs.

1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.

Core   1.3a Students should manipulate equations, inequalities, and functions to solve problems.

Numerical and Proportional Reasoning - Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technology.

2.1 Students should understand that a variety of numerical representations can be used to describe quantitative relationships.

Core   2.1a Students should extend the understanding of number to include integers, rational numbers, and real numbers.

              2.1b Students should interpret and represent large sets of numbers with the aid of technology.

2.2 Students should use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.

Core   2.2a Students should develop strategies for computation and estimation using properties of number systems to solve problems.

              2.2b Students should solve proportional reasoning problems.

Working with Data: Probability and Statistics - Data can be analyzed to make informed decisions using a variety of strategies, tools and technology.

4.1 Students should collect, organize and display data using appropriate statistical and graphical methods.

Core   4.1a Students should create the appropriate visual or graphical representation of real data.

4.2 Students should analyze data sets to form hypotheses and make predictions.

Core   4.2a Students should analyze real world problems using statistical techniques.

4.3 Students should understand and apply basic concepts of probability.

Core   4.3a Students should understand and apply the principles of probability in a variety of situations.

Unit Objectives	Essential Questions	Assessments
Students will be able to: • represent functions and relations on the coordinate plane. • explore conic sections and their applications graphically and symbolically. • recognize the effect of changes in parameters on the graphs of functions.	• How do patterns and functions help us describe data and physical phenomena and solve a variety of problems? • How are quantitative relationships represented by numbers? • How can collecting, organizing and displaying data help us analyze information and make reasonable predictions and informed decisions?	•

	Focus Questions	
	• How are ordered pairs, relations, functions, linear equations and inequalities in two variables, piecewise functions, and absolute value functions graphed? • How are graphs and equations used to solve real life problems? • How are algebraic methods used to solve linear systems in two or three variables by graphing? • How are linear systems written and used to solve real life problems? • How are quadratic equations solved? • How are quadratic functions and inequalities graphed?	
Lesson Planning Resources • Writing equations and inequalities • Graphing equations and inequalities • Solving equations, inequalities and systems by graphing	**Suggested Materials/Resources** •	**Skill Objectives** Students will: • solve systems of two linear equations using algebraic or graphical methods. • solve and graph one variable inequalities. • solve and graph absolute value equations and inequalities. • graph and solve linear and absolute value inequalities in two variables. • solve linear systems by graphing. • solve a quadratic equation graphically and find the real roots. • identify, graph and write the equation of ellipses and hyperbolas with the center at the origin. • write equations of hyperbolas in standard form. Graph rectangular hyperbolas of the form $xy = k$. • relate the graphical representation of a parabola to a quadratic function and find intercepts, maximum or minimum values and line of symmetry. • recognize and explain the meaning of the

		slope and x- and y-intercepts as they relate to a context, graph, table or equation.
		• graph a relationship between two sets of data, identify any trend, and describe any association. Find and use the equation of a trend line to make predictions.
		• find and use the equation of the linear regression line using technology.
		• graph rational functions. Determine the discontinuities. Find the vertical asymptotes and the "holes" if they exist.
Technology Resources	**Differentiated Instruction**	**Enrichment/ELL**

Unit 5 - Exponents, Radicals, and Logarithms, 7 weeks [top](top)

Standards

Algebraic Reasoning: Patterns and Functions - Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technology.

1.1 Students should understand and describe patterns and functional relationships.

Core   1.1a Students should describe relationships and make generalizations about patterns and functions.

1.2 Students should represent and analyze quantitative relationships in a variety of ways.

Core   1.2a Students should represent and analyze linear and non-linear functions and relations symbolically and with tables and graphs.

1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.

Core   1.3a Students should manipulate equations, inequalities, and functions to solve problems.

Numerical and Proportional Reasoning - Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technology.

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2.2 Students should use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.

Core   2.2a Students should develop strategies for computation and estimation using properties of number systems to solve problems.

                 2.2b Students should solve proportional reasoning problems.

Unit Objectives	Essential Questions	Assessment
Students will be able to: • describe and compare properties and classes of linear, quadratic, exponential, and logarithmic functions.	• How do patterns and functions help us describe data and physical phenomena and solve a variety of problems? • How are quantitative relationships represented by numbers? **Focus Questions** • How are rational exponents and nth roots of numbers used? • How are operations performed on functions and their inverses? • How are radical equations graphed and solved? • How are the definitions and properties of logarithms and the number *e* used? • How are exponential and logarithmic	•

	equations solved, graphed and related?	
Lesson Planning Resources • Simplify and convert between radical expressions and rational exponents • Direct, inverse and joint variation • Definition of Logarithms	**Suggested Materials/Resources** •	**Skill Objectives** Students will: • identify the subsets of the real numbers. Simplify radical expressions. • graph power functions of the form $y = x^n$. Identify point and line symmetry of the graphs. • graph exponential functions. Solve equations by expressing each term as a power with the same base. • use tables, graphs, and formulas to model exponential growth and decay. • solve problems involving financial applications including compound interest, and investments. • select and use an appropriate form of number (integer, fraction, decimal, ratio, percent, exponential, scientific notation, irrational, complex) to solve practical problems involving order, magnitude, measures, labels, locations and scales. • solve problems involving direct, inverse, and joint variation. • use properties of exponents to simplify expressions. • convert radical expressions to exponential expressions and vice versa. • model data with real number exponents. • solve radical equations algebraically and using technology. Solve literal equations. • use exponential functions to model exponential growth and decay. • use exponential regression to model real world data. • use the formulas for compound interest and continuous compounding to find the value of an investment. • use the definition of logarithmic functions to convert between logarithmic and exponential form and vice versa.
Technology Resources	**Differentiated Instruction**	**Enrichment/ELL**