MONMOUTH COUNTY VOCATIONAL SCHOOL DISTRICT
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Algebra I

School:	All Career Academies
Grade:	Ninth
Credits:	5
Subject Area:	Mathematics
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Course Philosophy

Mathematics provides an understanding of the world in which we live. It is not only a collection of theorems and calculations but also a multi-layered human endeavor. Mathematics is based on logic and encourages students to learn problem solving and analytical skills that can be used throughout their lives. This course makes it possible for students to reason, express their ideas, and learn how others have developed their own ideas. In addition, these skills enable students to further their intellectual knowledge. This course is designed for students to develop a deep understanding of algebraic concepts by applying skills learned to real life problems related to the individual themes of each academy.

Course Description and Materials

Course Description:

Algebra is the language of patterns and relationships, through which most of mathematics is communicated. It is a tool which people use to model real situations and answer questions about them. It is also a way of operating with concepts at an abstract level and then applying them, often leading to the development of generalizations and insights beyond the original context.

The algebra which is appropriate for all students in the twenty-first century moves away from a tight focus on manipulating symbols to include a greater emphasis on conceptual understandings, on algebra as a means of representations and on algebraic methods as problem-solving tools. Algebra is the gatekeeper for the future study of mathematics as well as science, social sciences, business and a host of other areas. (New Jersey Mathematics Curriculum Framework 1995)

Texts:

Larson, Ron, et al. Algebra I. Boston: Houghton Mifflin Company, 2001.

Methodology and Instructional Approach

To learn the essential mathematics needed for the twenty-first century, students need a non - threatening environment in which they are encouraged to ask questions and take risks. The learning climate should incorporate high expectations for all students, regardless of gender, race, handicapping condition, or socio - economic status. Students need to explore mathematics using manipulatives, measuring devices, models, calculators, and computers. They need to have opportunities to talk to each other and to write about mathematics. Students need to have modes of instruction that are suitable for the increased emphasis on problem-solving, applications, and higher-order thinking skills. For example, cooperative learning allows students to work together in problem-solving situations to pose questions, analyze solutions, try alternative strategies, and check for reasonableness of results. (NCSM 1988)

Course Goals

The Algebra I course developed for the Academies has the following goals:

1. Develop the students understanding of the basic principles of Algebra.

2. Develop the students understanding of how mathematical theories have developed and why such theories have been modified when necessary.

3. Develop the students' appreciation of the importance of Algebra concepts in everyday life.

4. Develop the students' awareness of the careers open to a person who has a degree in mathematics.

5. Develop the students' appreciation of the history of mathematics.

6. Students will use technology as a tool for developing mathematics skills and concepts, solving problems, etc.

7. Enhance the students' problem solving and critical thinking skills.

8. Students will use mathematical skills to solve and analyze problems arising from everyday experiences.

9. Develop strong conceptual foundations for a continuation of studies in mathematics.

Course Proficiencies

Students will be able to:

1. Utilize basic Pre-Algebra concepts.
2. Use five step problem solving method to solve word problems.
3. Use more than one method to solve problems and word problems.
4. Simplify numerical expressions and equations.
5. Evaluate variable expressions.
6. Translate word phrases and sentences into mathematical expressions and equations.
7. Order real numbers by comparison and graph real numbers.
8. Add, subtract, multiply and divide real numbers.
9. Solve equations using several transformations.
10. Solve equations containing one or more variables by applying the appropriate algebraic techniques.
11. Use algebraic concepts to solve word problems.
12. Identify and calculate additive and multiplicative inverses.
13. Solve problems and word problems containing direct and inverse variables.
14. Solve problems and word problems containing ratios and proportions.
15. Solve problems and word problems using percents and percent applications.
16. Solve simple and compound inequalities and graph their solution set.
17. Apply scientific notation.
18. Add, subtract, multiply, divide and simplify polynomials.
19. Factor all types of polynomials.
20. Apply various factoring methods to solve equations and word problems.
21. Simplify and evaluate rational and mixed expressions.
22. Transform formulas.
23. Differentiate between functions and relations.
24. Solve and graph linear equations and inequalities with two variables.
25. Determine the domain, range, and inverse of a set of ordered pairs.
26. Use tables and graphs to interpret expressions, equations and inequalities.
27. Determine the slope and y-intercept of a line.
28. Determine the equation of a line given the slope and one point on the line.
29. Determine the equation of a line given two points on the line.
30. Apply distance and midpoint formulas to problems and word problems.
31. Solve systems of equations in two variables by elimination, substitution and graphing.
32. Solve and graph systems of linear inequalities.
33. Solve mixture and word problems.
34. Classify a number according to the numerical hierarchy.
35. Solve quadratic equations by applying the quadratic formula.
36. Use the quadratic techniques to solve word problems.

Evaluative Measures

Algebra I students' performance can be assessed through use of the following:

1. Tests and quizzes
2. Examinations
3. Homework
4. Notebook
5. Computer and graphing calculator activities
6. Participation
7. Group projects and activities
8. Portfolio
9. Oral presentations
10. In class projects and activities
11. Teacher observation and evaluations
12. Classroom discussions
13. Students questions and answers
14. Journal

Sequence and Integration of Topics

A. Connections to Algebra
Outline:
1. Review pre-algebra concepts
2. Variables in Algebra
3. Exponents and Powers
4. Order of Operations
5. Equations and Inequalities
6. Problem Solving Plan Using Models
7. Tables and Graphs
8. An Introduction to Functions

Objectives: Upon completion of this unit the student will be able to:
1. Evaluate and write variable expressions. (CC 4.3.D.1)
2. Evaluate and write expressions containing exponents. (CC 4.1.B.2, 4.1.B.4)
3. Evaluate algebraic expressions using the order of operations. (CC 4.1.B.1)
4. Translate word sentences and word problems into expressions, equations, and inequalities. (CC 4.3.C.1)
5. Translate verbal models into algebraic models to solve problems. (CC 4.3.C.1)
6. Use verbal and algebraic models to represent real-life situations. (CC 4.3.C.1)
7. Use mental math to solve equations. (CC 4.1.C.1, 4.3.D.3)
8. Create variable expressions by finding patterns. (CC 4.3.C.1)
9. Use the five-step plan to solve a word problem. (CC 4.3.C.1, 4.3.D.2)
10. Organize data using tables and graphs. (CC 4.3.A.1)
11. Use functions to show the relationship between inputs and outputs. (CC 4.3.C.2)

Suggested Activities:
1. Application: Scuba Diving.
2. Group activity where students attempt to solve mind teasers.
3. Students will use the graphing calculator to construct a table.
4. Students will use the five-step problem-solving plan to solve, explain, and present word problems.
5. Group activity where students use algebra to describe a pattern.
6. Discovering activity where students will discover functions by analyzing data.
7. Math & History: Problem Solving.

B. Properties of Real Numbers
Outline:
1. The Real Number Line.
2. Basic Properties of Real Numbers (addition and subtraction).
3. Adding and Subtracting Matrices
4. Multiplication of Real Numbers (commutative property, associative property, identity property, property of zero, property of opposites).
5. The Distributive Property

6. Division of Real Numbers
7. Probability and Odds

Objectives: Upon completion of this unit the student will be able to:
1. Graph and compare real numbers. (CC 4.1.A.1, 4.1.A.2)
2. Find the absolute value and opposite of a real number. (CC 4.1.B.1)
3. Add, subtract, multiply, and divide real numbers. (CC 4.1.B.1)
4. Use the commutative property, associative property, identity property, property of zeros, and property of opposites. (CC 4.1.A.3, 4.1.B.1)
5. Organize data in a matrix. (CC 4.1.B.3)
6. Add and subtract two matrices. (CC 4.1.B.3)
7. Use the distributive property in algebraic expressions. (CC 4.1.B.1)
8. Simplify algebraic expressions by combining like terms. (CC 4.3.D.1)
9. Determine the likelihood of an event using probability and odds. (CC 4.4.B.5)

Suggested Activities:
1. Application: Helicopters.
2. Use algebra tiles to demonstrate addition and subtraction of integers.
3. Addition and subtraction of matrices using a graphing calculator.
4. Algebra tile activity modeling the distributive property.
5. Math & History: History of Negative Numbers.
6. Cooperative learning activity on finding the probability of an event (tossing a coin, rolling one die, and rolling two dice).

C. Solving Linear Equations
Outline:
1. Solving Equations Using Addition and Subtraction
2. Solving Equations Using Multiplication and Division
3. Solving Multi-Step Equations
4. Solving Equations with Variables on Both Sides
5. Linear Equations and Problem Solving
6. Solve Decimal Equations
7. Formulas and Functions
8. Rates, Ratios, and Percents

Objective: Upon completion of this unit the student will be able to:
1. Solve linear equations using addition and subtraction. (CC 4.3.D.2)
2. Solve linear equations using multiplication and division. (CC 4.3.D.2)
3. Solve linear equations using one of more transformations. (CC 4.3.D.2)
4. Solve linear equations with variables on both sides. (CC 4.3.D.2)
5. Solve linear equations involving decimals. (CC 4.3.D.2)
6. Write an equation using ratios. (CC 4.3.C.1)
7. Solve a formula for one of its variables. (CC 4.3.D.2)
8. Rewrite an equation in function form, and find the output given the input. (CC 4.3.C.1, 4.3.C.2)
9. Understand the concept of continuity of a function. (CC 4.3.B.2)

10. Use linear equations to model and solve real-life problems using a diagram, a table, and a graph. (CC 4.3.C.1)
11. Use linear equations to model and solve real-life problems involving rates, ratios, and percents. (CC 4.3.C.1)

Suggested Activities:
1. Application: Bald Eagles.
2. Algebra tile activity where the students will solve one-step equations.
3. Math & History: History of Stairs.
4. Algebra tile activity where the students will solve equations with variables on both sides.
5. Graphing calculator activity where students use a table or spreadsheet to solve equations.
6. Portfolios project where the students will compare the expenses and income of a business to determine profitability.

D. Graphing and Writing Linear Equations
Outline:
1. Coordinates and Scatter Plots
2. Graphing Linear Equations
3. Quick Graphs Using Intercepts
4. The Slope of a Line
5. Direct Variation
6. Quick Graphs Using Slope-Intercept
7. Solving Linear Equations Using Graphs
8. Functions and Relations

Objectives: Upon completion of this unit the student will be able to:
1. Plot points and draw scattered plots. (CC 4.4.A.1)
2. Graph a linear equation using a table of values, x- and y-intercepts, and slope-intercept form. (CC 4.3.A.1)
3. Calculate the slope of a line when given the coordinates of two points on the line. (CC 4.3.B.2)
4. Interpret slope as a rate of change. (CC 4.3.B.2)
5. Write and graph direct variation equations. (CC 4.3.A.1, 4.3.B.2)
6. Use a graph to check or approximate the solution of a linear equation. (CC 4.3.B.2)
7. Identify, evaluate, and graph functions. (CC 4.3.A.1, 4.3.B.2)

Suggested Activities:
1. Application: Transportation.
2. Students will use the graphing calculator to graph a scattered plot.
3. Math & History: Graphing Mathematical Relations.
4. Group activity where the students will investigate the concept of slope.
5. Group activity where the students will discover the relationship between members of a family of equations.
6. Students will use the graphing calculator to graph a linear equation.

E. Writing Linear Equations
Outline:
1. Writing Linear Equations in Slope-Intercept Form
2. Writing Linear Equations Given the Slope and a Point
3. Writing Linear Equations Given Two Points
4. Fitting a Line to Data
5. Point-Slope Form of a Linear Equation
6. The Standard Form of a Linear Equation
7. Predicting with Linear Models

Objectives: Upon completion of this unit the student will be able to:
1. Write an equation of a line in slope-intercept form given slope and y-intercept. (CC 4.3.A.1)
2. Write an equation of a line in slope-intercept form given slope and one point. (CC 4.3.A.1)
3. Write an equation of a line in slope-intercept form given two points. (CC 4.3.A.1)
4. Write equations of perpendicular and parallel lines. (CC 4.2.C.1)
5. Fit a line to data. (CC 4.4.A.4)
6. Write an equation of a line in point-slope form. (CC 4.3.A.1)
7. Write an equation of a line in standard form. (CC 4.3.A.1)
8. Create a linear model for a real-life situation. (CC 4.3.C.1)
9. Make a prediction using a linear model. (CC 4.4.A.4)

Suggested Activities:
1. Application: Archaeology.
2. Students will use the graphing calculator to find best-fitting lines.
3. Math & History: Archaeological Dating.
4. Group activity where the students will model possible combinations of two stocks you can buy with a limited amount of money.
5. Group activity where the students will investigate linear modeling using toothpicks.

F. Solving and Graphing Linear Inequalities
Outline:
1. Solving One-Step Linear Inequalities
2. Solving Multi-Step Linear Inequalities
3. Solving Compound Inequalities
4. Solving Absolute-Value Equations and Inequalities
5. Graphing Linear Inequalities in Two Variables
6. Stem-and-Leaf Plots and Mean, Median, and Mode
7. Box-and-Whisker Plots

Objective: Upon completion of this unit the student will be able to:
1. Write, solve, and graph inequalities in one variable. (CC 4.3.D.2)
2. Solve simple linear inequalities. (CC 4.3.D.2)
3. Solve multi-step linear inequalities. (CC 4.3.D.2)

4. Write, solve, and graph compound inequalities. (CC 4.3.D.2)
5. Solve absolute-values equations and inequalities. (CC 4.3.D.2)
6. Write, solve, and graph a linear inequality in two variables. (CC 4.3.D.2)
7. Use an inequality to model a real-life situation. (CC 4.3.C.1)
8. Make a stem-and-leaf plot for data. (CC 4.4.A.5)
9. Use measures of central tendency to represent data. (CC 4.4.A.5)
10. Draw a box-and-whisker plot of data. (CC 4.4.A.5)

Suggested Activities:
1. Application: Music.
2. Group activity where the students investigate inequalities.
3. Group activity where the students investigate problem solving.
4. Math & History: History of Communication.
5. Students will use the graphing calculator to graph absolute-value equations.
6. Students will use the graphing calculator to graph inequalities.
7. Students will use the graphing calculator to draw a box-and-whisker plot.
8. Portfolio project and presentation where students explore the relationship between the length of a rubber band and the weight suspended from it.

G. Systems of Linear Equations and Inequalities
Outline:
1. Solving Linear Systems by Graphing
2. Solving Linear Systems by Substitution
3. Solving Linear Systems by Linear Combinations
4. Applications of Linear Systems
5. Special Types of Linear Systems
6. Solving Systems of Linear Inequalities

Objective: Upon completion of this unit the student will be able to:
1. Solve a system of linear equations by graphing, substitution, and linear combinations. (CC 4.3.B.2)
2. Choose the best method to solve a system of linear equations. (CC 4.3.A.1, 4.3.D.2)
3. Identify the number of solutions of a linear system. (CC 4.3.D.2)
4. Use a system of linear equations to model a real-life situation. (CC 4.3.C.1)
5. Solve a system of linear inequalities. (CC 4.3.D.2)
6. Use a system of linear inequalities to model a real-life situation. (CC 4.3.C.1)

Suggested Activities:
1. Application: Housing.
2. Students will work as a class to investigate graphs of linear equations.
3. Students will use a graphing calculator to solve linear systems by graphing.
4. Math & History: Systems of Linear Equations.
5. Group activity where students will investigate special types of linear systems.)

H. Exponents and Exponential Functions
Outline:

1. Multiplication Properties of Exponents
2. Zero and Negative Exponents
3. Division Properties of Exponents
4. Scientific Notation
5. Exponential Growth Functions***
6. Exponential Decay Functions***

Objectives: Upon completion of this unit the student will be able to:
1. Evaluate exponential expressions using multiplication properties of exponents. (CC 4.1.B.4)
2. Evaluate exponential expressions that have negative and zero exponents. (CC 4.1.B.2)
3. Evaluate exponential expressions using division properties of exponents. (CC 4.1.B.4)
4. Convert numbers from scientific notation to decimal form. (CC 4.5.E.2)
5. Convert numbers from decimal form to scientific notation. (CC 4.5.E.2)
6. Perform operations with numbers in scientific notation. (CC 4.5.E.2)
7. Use scientific notation in problem solving. (CC 4.5.E.2)
8. Write and use models for exponential growth. (CC 4.3.C.1)
9. Write and use models for exponential decay. (CC 4.3.C.1)
10. Sketch the graphs of exponential growth and decay models. (CC 4.3.B.2, 4.3.C.1)***

Suggested Activities:
1. Application: Bicycle Racing.
2. Group activity where the students investigate how you can use addition and multiplication to multiply exponential expressions.
3. Students will use the graphing calculator to graph exponential functions.
4. Group activities where students investigate how linear growth models are different from exponential growth models.
5. Group activity where students investigate exponential decay.
6. Math & History: History of Microscopes.
7. Students will use graphing calculators to find a best-fitting exponential growth or decay model.

I. Quadratic Equations and Functions
Outline:
1. Solving Quadratic Equations by Finding Square Roots
2. Simplifying Radicals
3. Graphing Quadratic Functions
4. Solving Quadratic Equations by Graphing
5. Solving Quadratic Equations by the Quadratic Formula
6. Graphing Quadratic Inequalities***

Objectives: Upon completion of this unit the student will be able to:
1. Evaluate and approximate square roots. (CC 4.1.A.2, 4.3.D.1)
2. Solve a quadratic equation by finding square roots, sketching its graphs, and using the quadratic formula. (CC 4.3.D.2)

3. Use the properties of radicals to simplify radicals. (CC 4.3.D.1)
4. Sketch the graph of a quadratic function. (CC 4.3.B.2)
5. Sketch the graph of a quadratic inequality. (CC 4.3.D.2) ***

Suggested Activities:
1. Application: Baseball.
2. Group activity where the students investigate graphs of quadratic equations.
3. Graphing calculator activity where the students use a CBL unit to collect data then use the graphing calculator to graph quadratic curves of best fit.
4. Graphing calculator activity where the students solve quadratic equations by graphing.
5. Graphing calculator activity where the students program their calculators to use the quadratic formula to solve a quadratic equation.
6. Group activity where the students investigate applications of the discriminant.
7. Math & History: History of the Quadratic Formula.
8. Portfolios project where the students fit a model to data and then using the model to predict future outcomes

J. Polynomials and Factoring
Outline:
1. Adding and Subtracting Polynomials
2. Multiplying Polynomials
3. Special Products of Polynomials
4. Solving Polynomial Equations in Factored Form
5. Factoring $x^2 + bx + c$
6. Factoring $ax^2 + bx + c$
7. Factoring Special Products
8. Factoring Using the Distributive Property

Objectives: Upon completion of this unit the student will be able to:
1. Classify a polynomial by degree and by number of terms. (CC 4.3.B.4)
2. Add and subtract polynomials. (CC 4.3.D.1)
3. Multiply polynomials using the FOIL pattern and special product pattern. (CC 4.3.D.1)
4. Solve polynomial equations in factored form. (CC 4.3.D.2)
5. Factor quadratic trinomials. (CC 4.3.D.2)
6. Factor a quadratic polynomial using special product pattern. (CC 4.3.D.2)
7. Use the distributive property to factor a polynomial. (CC 4.3.D.2)
8. Solve polynomial equations by factoring. (CC 4.3.D.2)

Suggested Activities:
1. Application: Arecibo Observatory.
2. Algebra tile activity where the students model the addition and subtraction of polynomials.
3. Graphing calculator activity where the students graph polynomial functions.
4. Algebra tile activity where the students investigate binomial multiplication.

5. Math & History: Plant Genetics.
6. Algebra tile activity where the students model the factorization of $x^2 + bx + c$ and $ax^2 + bx + c$.
7. Graphing calculator activity where the students program their calculator to find the discriminant.

K. Rational Equations and Functions
Outline:
1. Ratio and Proportion
2. Percents
3. Simplifying Rational Expressions
4. Multiplying and Dividing Rational Expressions
5. Adding and Subtracting Rational Expressions

Objective: Upon the completion of this unit the student will be able to:
1. Solve proportions and use them to solve real-life problems. (CC 4.3.C.1, 4.3.D.2)
2. Use equations to solve percent problems. (CC 4.3.D.2)
3. Simplify a rational expression. (CC 4.3.D.1)
4. Use rational expressions to find geometric probability. (CC 4.4.B.2)
5. Multiply and divide rational expressions. (CC 4.3.D.1)
6. Add and subtract rational expressions that have like and unlike denominators. (CC 4.3.D.1)
7. Divide a polynomial by a monomial or by a binomial factor. (CC 4.3.D.1)
8. Solve rational equations. (CC 4.3.D.2)

Suggested Activities:
1. Application: Scale Models.
2. Group activity where the students investigate direct and inverse variation.
3. Graphing calculator activity where the students use the graphing calculator to model inverse variation.
4. Algebra tile activity where the students model polynomial division.
5. Graphing calculator activity where the students graph rational functions.
6. Math & History: History of Polling.

L. Radicals and Connections to Geometry
Outline:
1. Square-Root Functions
2. Operations with Radical Expressions
3. Solving Radical Equations***
4. The Distance and Midpoint Formulas

Objectives: Upon completion of this unit the student will be able to:
1. Evaluate and graph a square-root function. (CC 4.3.D.1, (CC 4.3.D.2))
2. Add, subtract, multiply, and divide radical expressions. (CC 4.3.D.1)
3. Solve a radical equation. (CC 4.3.D.2)***
4. Choose a method for solving a quadratic equation. (CC 4.3.D.2)

5. Calculate the distance and midpoint between two points in a coordinate plane. (CC 4.2.C.1)

Suggested Activities:
1. Application: Spinning Rides.
2. Graphing calculator activity where the students graph square-root functions.
3. Algebra tile activity where the students model completing the square.
4. Group activity where the students investigate the Pythagorean Theorem.
5. Group activity where the students investigate similar triangles.
6. Math & History: History of Pythagorean Theorem.
6. Portfolios project where the students explore what the golden ratio is and how it used.