Richmond Public Schools

Curriculum Framework

Algebra 1

Strand: Equations and Inequalities

A.4 The student will solve

a. multistep linear equations in one variable algebraically;

b. quadratic equations in one variable algebraically;

c. literal equations for a specified variable;

d. systems of two linear equations in two variables algebraically and graphically; and

e. practical problems involving equations and systems of equations.

EOC Algebra I assessments will include a Desmos Calculator

Suggested Pacing

Second Nine Weeks - Equations and Inequalities Unit
A.4a,c,e 6 blocks

Third Nine Weeks- Systems of Equations Unit
A.4d 3 blocks

Fourth Nine Weeks - Quadratic Unit
A.4b 2 blocks

Related Standards

Spiral Down

7.2 The student will solve practical problems involving operations with rational numbers.

7.3 The student will solve single-step and multistep practical problems, using proportional reasoning.

Spiral Up

G.10 The student will solve problems, including practical problems, involving angles of convex polygons. This will include determining the

a) sum of the interior and/or exterior angles;

b) measure of an interior and/or exterior angle; and

c) number of sides of a regular polygon.

7.12 The student will solve two-step linear equations in one variable, including practical problems that require the solution of a two-step linear equation in one variable. **8.4** The student will solve practical problems involving consumer applications. **8.17** The student will solve multistep linear equations in one variable with the variable on one or both sides of the equation, including practical problems that require the solution of a multistep linear equation in one variable.	**G.13** The student will use surface area and volume of three-dimensional objects to solve practical problems. **G.14** The student will apply the concepts of similarity to two- or three-dimensional geometric figures. This will include; **b)** determining how changes in one or more dimensions of a figure affect area and/or volume of the figure; **c)** determining how changes in area and/or volume of a figure affect one or more dimensions of the figure; and **d)** solving problems, including practical problems, about similar geometric figures. **AII.3** The student will solve **a)** absolute value linear equations and inequalities; **b)** quadratic equations over the set of complex numbers; **c)** equations containing rational algebraic expressions; and **d)** equations containing radical expressions. **AII.4** The student will solve systems of linear-quadratic and quadratic-quadratic equations, algebraically and graphically.
Essential Questions	**Common Misconceptions**
Essential Questions **A.4a** ● How can you determine whether a linear equation has one, an infinite number, or no solution? *A linear equation has one solution when the variable can be isolated and a solution is available. A linear equation has infinite number of solutions when the variable is canceled out and each side of the equation is equal. A linear equation*	● Confusing negative and minus ● Assuming subtraction is commutative : Since 5 + 4 and 4 + 5 both equal 9, it is understandable how students may assume that 10 – 25 and 25 – 10 are equivalent expressions. However, unlike its inverse operation, subtraction is NOT commutative. This misconception presents itself in secondary mathematics as well, when students start to write algebraic expressions from words. For example, it is all too common to see “5 less than $3x$” written as $5 – 3x$. Students correctly

has no solution when the variable is canceled out and each side of the equation is not equal.

- Why is it important to understand the properties of real numbers and properties of equality?
  It is important to understand the properties of real numbers and the properties of equality so each step in solving the equation is justified.

A.4b

- What methods can you use to solve a quadratic equation algebraically?
  The methods that can be used to in solving quadratic equations are factoring, completing the square, quadratic formula, and graphing.

A.4c

- How would solving a literal equation for a specified variable be helpful?
  Solving a literal equation for a specified variable can be helpful when information has been provided for all the other variables except for the variable that is isolated so basic computation maybe or the equation is being placed inside another literal equation to replace said variable.

A.4d

- How is the graph of a system of equations related to its solution?
  When the system of equations is graphed the lines may or may not intersect or overlap, giving the solution as one, infinite or no solution.
- What does it mean if a system of two linear equations has one solution?
  There is one solution when the two linear equations intersect at one point on the graph. An infinite number of solutions? *When the two linear equations lay on top of one*

interpret "less than" to indicate subtraction, but do not realize that the 5 should be subtracted *from* $3x$ to produce the expression "5 less than $3x$" and not the other way around. These misconceptions can be overcome by ensuring that students have a solid mathematical understanding of subtraction in the early grades, so they do not have to rely on shortcuts or memorized algorithms later on.

- Applying Properties correctly when solving equations and how to use them?
- When you solve an equation, what are you trying to find and understanding variables are unknown numbers.
- How do you begin the process of solving an equation; how to undo operations.

another(same slope and y intercept), the solutions are infinite. No solutions? *When the two linear equations run parallel (same slope, different y-intercept), there are no solutions.* ● How can you determine the most efficient method for solving a system of linear equations? *Graphing: Graphing is the best method to use when introducing a new student to solving systems of two equations in two variables, because it gives them a visual to recognize what they are looking for. Graphing is less exact and often takes more time than the other methods.* *Substitution: Substitution gives that advantage of having an equation already written for the second variable when you find the first one. Substitution is best used when one (or both) of the equations is already solved for one of the variables. It also works well if one of the variables has a coefficient of 1.* *Elimination: Elimination is best used when both equations are in standard form (Ax + By = C). Elimination is also the best method to use if all of the variables have a coefficient other than 1.* **A.4e** ● Why is it important to interpret the solution to a system of equations? *It is important to interpret the solution to a system of equation because the solution shows if there is one, infinity or no solution.* ● How can you determine if the solution to a system of two linear equations is reasonable for a practical situation? *Determining if the solution is reasonable for a system of two linear equations for a practical situation by understanding if*	

the equations share two or more unknowns and if there is one, infinite or no solution. Why is this important? *It is important to understand if the solution is reasonable for a practical situation because the equations may be wrong, the unknowns may not be shared, ect.* ● How can a system of equations be used to solve a practical problem? *Systems of equations can be used to solve practical problems if they are share two or more unknowns. (business, sports stats, etc.)*	
Understanding the Standard	**Essential Knowledge and Skills**
● A solution to an equation is the value or set of values that can be substituted to make the equation true. ● Each point on the graph of a linear or quadratic equation in two variables is a solution of the equation. ● Practical problems may be interpreted, represented, and solved using linear and quadratic equations. ● The process of solving linear and quadratic equations can be modeled in a variety of ways, using concrete, pictorial, and symbolic representations. ● Properties of real numbers and properties of equality are applied to solve equations. ● Properties of Real Numbers: Associative Property of Addition Associative Property of Multiplication Commutative Property of Addition Commutative Property of Multiplication Identity Property of Addition (Additive Identity) Identity Property of Multiplication (Multiplicative Identity)	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** ● Determine whether a linear equation in one variable has one, an infinite number, or no solutions. (a) ● Apply the properties of real numbers and properties of equality to simplify expressions and solve equations. (a, b) ● Solve multistep linear equations in one variable algebraically. (a) ● Solve quadratic equations in one variable algebraically. Solutions may be rational or irrational. (b) ● Solve a literal equation for a specified variable. (c) ● Given a system of two linear equations in two variables that has a unique solution, solve the system by substitution or elimination to identify the ordered pair which satisfies both equations. (d) ● Given a system of two linear equations in two variables that has a unique solution, solve the system graphically by identifying the point of intersection. (d)

Inverse Property of Addition (Additive Inverse) Inverse Property of Multiplication (Multiplicative Inverse) Distributive Property ● Properties of Equality: Multiplicative Property of Zero Zero Product Property Reflexive Property Symmetric Property Transitive Property of Equality Addition Property of Equality Subtraction Property of Equality Multiplication Property of Equality Division Property of Equality Substitution ● Quadratic equations in one variable may be solved algebraically by factoring and applying properties of equality or by using the quadratic formula over the set of real numbers (Algebra I) or the set of complex numbers (Algebra II). ● Literal equations include formulas. ● A system of linear equations with exactly one solution is characterized by the graphs of two lines whose intersection is a single point, and the coordinates of this point satisfy both equations. ● A system of two linear equations with no solution is characterized by the graphs of two parallel lines that do not intersect. ● A system of two linear equations having an infinite number of solutions is characterized by two lines that coincide (the lines appear to be the graph of one line), and the coordinates of all	● Solve and confirm algebraic solutions to a system of two linear equations using a graphing utility. (d) ● Determine whether a system of two linear equations has one, an infinite number, or no solutions. (d) ● Write a system of two linear equations that models a practical situation. (e) ● Interpret and determine the reasonableness of the algebraic or graphical solution of a system of two linear equations that models a practical situation. (e) ● Solve practical problems involving equations and systems of equations. (e)

points on the line that satisfy both equations. These lines will have the same slope and y-intercept.

- Systems of two linear equations can be used to model two practical conditions that must be satisfied simultaneously.
- Equations and systems of equations can be used as mathematical models for practical situations.
- Solutions and intervals may be expressed in different formats, including set notation or using equations and inequalities.

  - Examples may include:

Equation/ Inequality	Set Notation
$x = 3$	$\{3\}$
$x = 3$ or $x = 5$	$\{3, 5\}$
$y \geq 3$	$\{y: y \geq 3\}$
Empty (null) set $\varnothing$	$\{\ \}$

Vocabulary

Literal Equations:
Isolate
Solve for
Multi-variable equation
Reciprocal (Divide by ½ = Multiply by 2)
Formula
Solving Multi-Step Equations:
Solve for
Combine Like Terms (Substitution Property)
Properties of Real Numbers
Properties of Equality
Properties of Real Numbers:

Instructional Activities Organized by Learning Objective

Resources

- **Eureka**

Eureka - (Insert Lesson Title)			
Eureka Grade	**Module**	**Topic**	**Lesson(s)**

Commutative Property (+, x)
Associative Property (+, x)
Distributive Property
Substitution Property
Inverse Property (+, x)
Identity Property (+, x)
Zero Product Property
Properties of Equality:
Addition Property of Equality
Multiplication Property of Equality
Symmetric Property
Reflexive Property
Transitive Property
Quadratic Equations
Roots
Zeros
X-Intercepts
Solution
Axis of Symmetry
Characteristics of a Quadratic Equation
Factor
Quadratic Formula
Polynomial
Systems of Equations
Substitution
Linear Equation
Linear Inequality
System of Equations
System of Inequalities
Elimination Method
Solve Graphically
Evaluate
Solution

- **Print**
  Textbook
  Virginia Glencoe, Algebra I, ©2012, Carter, et al, McGraw-Hill School Education Group, page(s) 126 –130 (A.4a), 16–30 (A.4b), 83–102 (A.4d)
  Coach book, Virginia edition, page(s) 58 – 63, 67- 71
- **Notes**
  Powerpoint
  YouTube: Properties

- **Technology-based**
  Quizziz
  Properties
  Literals
  Multi - Step Equations
  Systems of Equations

- **Station Activities**

  Station 1
  Quia - Math: Number Properties
  Connect 4 : Solving Literal Equations
  Gallery Walk Variables on Both Sides – Teacher will post a worksheet with 3 problems around the room and give each student an answer sheet. Students work with a partner and rotate among the 10 sheets of problems, choosing one problem from each sheet to complete. Ask students to challenge themselves to complete the "hardest" problem on each sheet if they are able.

  Google Form- Multi-step equation

Satisfy the equation Set Builder notation One Solution No Solution Infinite Solutions Solution set	
Assessment	
Mastery Check: Properties A Properties B Properties C Properties D Literal Equations A Literal Equations B Literal Equations C Literal Equations D Linear Equations A Linear Equations B Linear Equations C Linear Equations D Systems Of Equations A Systems Of equations B Student Performance Analysis	
Cross-Curricular Connections	**Tiered Differentiations**

English – Have students write a step-by-step instruction document on how to solve a linear equation using the properties of real numbers and equality to justify the steps.

Science

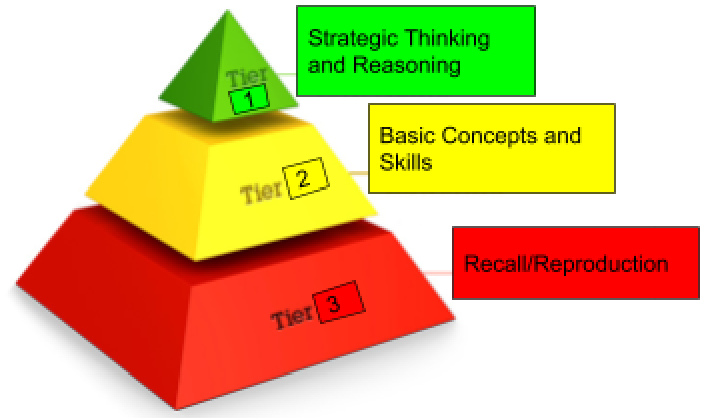
The formula for volume can be solved for mass or density to help with the solving process.

History

Students need to justify and defend arguments when holding a debate. History also deals with determine what is fair and how to balance supplies which relates to balancing an equation.

Science/Engineering: Projectile Motion

Quadratic Equations represent many real-world situations. Have students research how they are used in theme parks, sports, travel, etc. and display their finding in a creative way.



Tier 3 Recall and Reproduction

Students will create anchor charts for properties including the 3 new properties included in algebra 1 standards.

Solve 10 one-step literal equations and/or 10 multi-step equations given by the teacher to understand the inverse operations used to solve equations.

Tier 2 Basic Concepts and Skills

Student use knowledge of literal equations to solve multi-step equations given a mat divided in half example.

Students will complete a partially filled in answer sheet to justify steps when solving equations to help guide students.

Tier 1 Strategic Thinking and Reasoning

Students will justify the steps when solving equations.