03 Equations and Inequalities (Linear & Nonlinear with systems)

Content Area: **TEMPLATE**
Course(s):
Time Period: **Full Year**
Length: **4 - 5 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This course is an extension of Algebra 1. Emphasis is upon the development of insights into the structure of algebra as a deductive process. The content includes function foundations, equations and inequalities, polynomial functions and equations, rational functions and equations, radical expressions and equations, exponential and logarithmic functions and equations, trigonometric functions and equations, introductory data analysis, and probability.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives:

- Linear refers to a constant rate of change.
- In non-constant functions, a change in one variable affects another variable.
- The solutions to a system of equations or inequalities are the values that make the system true.

Essential Questions:

- Why are linear inequalities useful?
- What methods can be used to solve systems of linear equations and inequalities?
- How are systems of linear equations and inequalities useful?
- How can linear equations be used to solve real world problems?
- How to variables help to model real world situations?
- How can the properties of real numbers be used to simplify algebraic expressions?
- Can I analyze, model, and solve mathematical situations using algebraic symbols?
- Why do we use system of equations for real-world applications?

Enduring Understanding:

- The characteristics of linear inequalities and their representations are useful in solving real-world problems.
- System of linear equations and/or inequalities are used to model and solve real-world

problems involving 2 variables.

- Real world situations can be modeled and solved by using equations and inequalities.
- Some mathematical relationships are always true; these relationships are used as the rules of arithmetic and algebra and are useful for writing equivalent forms of expressions and solving equations and inequalities.

CONTENT AREA STANDARDS

MA.A-CED.A.1	Create equations and inequalities in one variable and use them to solve problems.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-CED.A.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
MA.A-REI.A.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.
MA.A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
MA.A-REI.C.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.
MA.A-REI.C.6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
MA.A-REI.C.7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.
MA.A-REI.C.8	Represent a system of linear equations as a single matrix equation in a vector variable.
MA.A-REI.C.9	Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).
MA.A-REI.D.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).
MA.A-REI.D.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 tables 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.
MA.A-REI.D.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.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

CS.K-12.3.a	Identify complex, interdisciplinary, real-world problems that can be solved computationally.
CS.K-12.3.b	Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.
CS.K-12.3.c	Evaluate whether it is appropriate and feasible to solve a problem computationally.
CS.K-12.7.a	Select, organize, and interpret large data sets from multiple sources to support a claim.
LA.K-12.NJSLSA.R7	Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
TECH.K-12.P.1	Act as a responsible and contributing community members and employee.
TECH.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
TECH.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.

STUDENT LEARNING TARGETS

Refer to the 'Declarative Knowledge' and 'Procedural Knowledge sections.

Declarative Knowledge

Students will understand that:

- Linear equations can be expressed in different forms such as standard, slope-intercept, and point-slope form
- Interpret linear equations and inequalities and express them graphically
- Slope represents rate of change of a linear function and can allow for meaningful comparisons and identifications of lines
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- Slope represents rate of change of a linear function and can allow for meaningful comparisons and identifications of lines (positive, negative, horizontal, vertical, parallel, perpendicular).
- 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$(x) = g(x)$ and there are multiples methods for finding these intersections (graphing, elimination, substitution).
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- Interpret linear equations and inequalities and express them graphically.
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- 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 $f(x) = g(x)$ and there are multiples methods for finding these intersections (graphing, elimination, substitution).

- A set of possible solutions within a set of constraints is the feasible region.
- Polynomial functions can be expressed in standard form and used to sketch a graph and define characteristics.

Procedural Knowledge

Students will be able to:

- Construct a variable argument to justify a solution method
- Create equations in two or more variables to represent relationships between quantities
- Interpret solutions as viable or non-viable options in a modeling context
- Prove that, given a system of two equations in two variables, replacing one equations by the sum of that equation and a multiple of other produces a system with the same solutions the inverse of a matrix if it exists and use it to solve a system of linear equations.
- Represent a system of linear equations as a single matrix equation in a vector variable
- Creat equations and inequalities with one variable that describes numbers or relationships
- Explain each step in solving a simple equation ass following from the equality of numbers asserted at the previous step, starting from the assumption that the original equations as a solution
- 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 $f(x) = g(x)$
- Graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes
- Graph the solutions to a linear inequality in two variables as a self-plane
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations
- Represent constraints by equations or inequalities, and by systems of equations and/or inequalities in a modeling context
- Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically
- Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables
- Understand that the graph of an equation in two variables is the set of all its solutions ported in the coordinate plane, often forming a curve
- Use created equations and inequalities in one variable to solve problems
- Solve linear equations in one variable, including equations with coefficients represented by letters
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- Find the solution to the system $y = f(x)$ and $y = g(x)$ approximately.

- Apply linear equations/inequalities to solve real-life problems (coin, mixture, investment, work, wind current, distance
- Model problems with systems

EVIDENCE OF LEARNING

Refer to the 'Formative Assessments' and 'Summative Assessments' sections.

Formative Assessments

- Class Discussion
- Teacher observation
- Exit/Entrance Tickets
- Classwork
- Homework

Summative Assessments

- Quizzes
- Test
- Projects

RESOURCES (Instructional, Supplemental, Intervention Materials)

- Sullivan Algebra and Trigonometry Textbook (chapter 12)
- Illustrative Math
- Illustrative Mathematics Task by Standard
- Khan Academy
    - https://www.khanacademy.org/math/math-1-2-3/algebra/systems-of-linear-equations
- Deltamath
- Desmos
- Life of a Tree Project
- The Coin Project (3 Act)

- Movie Ticket Problem (3 Act)

INTERDISCIPLINARY CONNECTIONS

Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations such as financial planning, investment return, business revenue, concentration of solutions in chemistry and speed of objects. Examples can be found in topic specific textbook problems and digital resources.

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.