Systems of Equations

Content Area: **Math**
Course(s):
Time Period: **MP4**
Length: **45**
Status: **Published**

Unit Overview

Unit Summary	Unit Rationale
In this unit, students will create, solve, and interpret equations and inequalities, focusing on both one-variable and two-variable contexts. They will learn to formulate equations that arise from various functions, including linear, quadratic, rational, and exponential functions, and apply these concepts to solve real-world problems. The unit emphasizes the representation of constraints through equations and inequalities, guiding students to analyze and interpret solutions within modeling contexts. Additionally, students will explore systems of linear equations, utilizing methods such as substitution and elimination, as well as graphical representations to identify points of intersection that correspond to solutions. They will also gain experience in graphing linear inequalities and understanding the solution sets as intersections of half-planes. Throughout the unit, students will develop their problem-solving skills and enhance their ability to model practical situations mathematically, preparing them for more complex mathematical concepts in th	The rationale for this unit lies in its fundamental role in equipping students with essential problem-solving and critical thinking skills that are vital in both academic and real-world contexts. By engaging with equations and inequalities, students learn to articulate and represent relationships and constraints, which are crucial for modeling various scenarios they may encounter in life. This unit fosters a deeper understanding of linear and quadratic functions, enabling students to navigate complex mathematical landscapes confidently. Additionally, the focus on systems of equations allows learners to grasp the interconnectedness of different mathematical concepts, promoting a holistic approach to mathematics. Graphing inequalities further enhances their ability to visualize solutions and understand the implications of constraints in real-life situations. Ultimately, this unit prepares students not only for advanced mathematical studies but also for informed decision-making and analytical reasoning in their everyday lives.

NJSLS

MATH.9-12.A.CED.A.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.
MATH.9-12.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.
MATH.8.EE.C.8	Analyze and solve pairs of simultaneous linear equations.
MATH.8.EE.C.8.a	Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
MATH.8.EE.C.8.b	Solve systems of two linear equations in two variables using the substitution method and estimate solutions by graphing the equations. Solve simple cases by inspection.
MATH.8.EE.C.8.c	Solve real-world and mathematical problems leading to two linear equations in two variables.
MATH.9-12.A.REI.C.6	Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.
MATH.9-12.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.

Standards for Mathematical Practice

MATH.K-12.1	Make sense of problems and persevere in solving them
MATH.K-12.2	Reason abstractly and quantitatively
MATH.K-12.3	Construct viable arguments and critique the reasoning of others
MATH.K-12.4	Model with mathematics
MATH.K-12.5	Use appropriate tools strategically
MATH.K-12.6	Attend to precision
MATH.K-12.7	Look for and make use of structure
MATH.K-12.8	Look for and express regularity in repeated reasoning

Unit Focus

Enduring Understandings	Essential Questions
• Understanding the characteristics of parallel and perpendicular lines helps us recognize how slopes determine their relationships. • Graphing linear equations and inequalities provides a visual way to understand mathematical relationships and solutions. • Systems of equations can be solved using various methods, and the point of intersection represents a solution that satisfies all equations involved. • Writing systems of equations allows us to	• What makes lines parallel and how can we find their slopes? • How can we graph parallel lines and what do their slopes tell us? • What defines perpendicular lines and how can we graph them to show their slopes? • How do we graph linear equations, and what do the slope and y-intercept represent? • What steps do we take to solve systems of equations by graphing, and how do we find

model real-world situations, making math relevant and applicable to everyday life. • Solutions to systems of equations can be interpreted in context, helping us determine their viability in real-life scenarios. • Representing constraints with equations and inequalities helps us understand limits and conditions in various situations. • Graphing solutions to linear inequalities allows us to see the range of possible solutions and how they relate to constraints. • Evaluating the viability of solutions in both equations and inequalities is essential for making informed decisions based on mathematical results. • There are multiple ways to solve systems of equations and inequalities, encouraging flexible thinking and problem-solving skills. • Engaging with these concepts develops critical thinking and analytical skills, which are valuable in both math and real-life problem-solving.	the intersection point? • How do we use the substitution method to solve systems of equations, and what does each step mean? • What is the elimination method, and how do we apply it to find solutions to systems of equations? • How can we create a system of linear equations to represent a real-world problem, and why is this useful? • What does it mean for a solution to a system of equations to make sense in a real-world context? • How can we represent constraints in a situation using a system of equations? • What is the process for graphing linear inequalities, and how do we determine the correct shaded area? • How do the solutions of linear inequalities apply to real-life situations, and what do they tell us? • What are the implications of using inequalities to represent constraints, and how do they affect possible solutions? • How do we graph the solution set of a system of linear inequalities, and what does the overlapping area represent? • Why is it important to analyze whether the solutions to inequalities are viable options for the problem we're solving?

Instructional Focus

Learning Targets

- Identify and describe the characteristics of parallel and perpendicular lines, including their slopes.
- Graph parallel lines and explain how their slopes are equal.
- Graph perpendicular lines and demonstrate how their slopes are negative reciprocals of each other.
- Graph linear equations to visualize their slopes and y-intercepts.
- Solve systems of equations by graphing and identifying the point of intersection as the solution.
- Solve systems of equations using the substitution method and explain each step of my reasoning.
- Solve systems of equations using the elimination method and provide a clear rationale for my approach.
- Write a system of linear equations to model real-world situations and explain the context.
- Interpret the solutions of systems of equations as viable or nonviable options for the given situation.
- Represent constraints in a modeling context using a system of equations.
- Graph linear inequalities in two variables and shade the appropriate regions for solutions.
- Interpret the solutions of linear inequalities in a modeling context and discuss their implications.
- Represent constraints with inequalities and explain how they affect possible solutions.
- Graph the solution set of a system of linear inequalities and identify the intersection of the shaded regions.
- Analyze the solutions of a system of inequalities and determine whether they are viable or nonviable options for the modeling scenario.

Prerequisite Skills

- Students should be familiar with the standard form of linear equations, slope-intercept form, and how to identify the slope and y-intercept.
- Students should know how to plot points on a coordinate plane and understand the concepts of the x-axis and y-axis.
- Students should understand what slope means, how to calculate it between two points, and the significance of positive, negative, zero, and undefined slopes.
- Students should be able to manipulate algebraic expressions, including combining like terms and distributing.
- Students should be comfortable solving one-variable equations to prepare for solving systems of equations.
- Students should have a basic understanding of inequalities, including how to solve and graph them.

- Students should know how to use function notation and understand concepts related to input and output in functions.
- Students should be able to graph linear functions and interpret their graphs.
- Students should possess basic critical thinking and problem-solving skills to analyze mathematical situations and apply concepts.
- Students should be able to work collaboratively with peers to discuss and solve mathematical problems, fostering a cooperative learning environment.

Common Misconceptions

- Students may need help distinguishing between parallel and perpendicular lines. They often think that both have similar slopes rather than recognizing that parallel lines have the same slope and perpendicular lines have negative reciprocals.
- Some students might need help to fully grasp the concept of slope, mistakenly believing that it only indicates direction rather than a ratio of change in (y) over change in (x).
- Students may misplace points while graphing linear equations or inequalities, leading to incorrect interpretations of the relationship between the equations.
- Students might think that systems of equations always have a single solution, not recognizing that they can also have infinitely many solutions or no solution at all.
- Some students may need to be more accurate with the solutions of systems of equations, believing that any point on a graph is a valid solution rather than understanding that only specific points satisfy all equations in the system.
- Students may need help with the differences between solving equations and inequalities, often misapplying methods from one to the other.
- Students might need help understanding the concept of constraints in real-world problems. They might not be able to see how they have limits or define the possible solutions.
- When graphing linear inequalities, students may need to remember to shade the appropriate region or may shade in the wrong direction.
- Students may need to remember to apply real-world context to their solutions, treating mathematical results as numbers without considering their significance in a given situation.
- Some students may find applying the substitution and elimination methods challenging. They often make algebraic mistakes or need help understanding when to use each technique.
- Students may mistakenly apply methods appropriate for linear equations to nonlinear systems, leading to incorrect conclusions.

Spiraling For Mastery

Current Unit Content/Skills	Spiral Focus	Activity
• Characteristics of Parallel and Perpendicular Lines • Graph lines to show an understanding of the relationship between the slopes of parallel and perpendicular lines • Solve Systems of Equations by Graphing • Solve Systems of Equations by Substitution • Solve Systems of Equations by Elimination • Write a system of linear equations in two variables to represent real-world problems • Interpret solutions to systems of equations as viable/nonviable options for the situation • Represent constraints with a system of equations in a modeling context • Graph solutions to linear inequalities in two variables • Represent constraints with inequalities and interpret solutions as viable or nonviable options in a modeling context • Graph the solution set of a system of linear inequalities in two	• Students will apply their understanding of how to calculate the slope between two points, reinforcing the concept of rate of change and its significance in linear relationships. • The skills learned in previous units about plotting points on the coordinate plane will be essential for graphing linear equations and inequalities accurately. • Students will utilize their skills in solving one-variable equations as they manipulate equations in systems of equations, particularly when using substitution and elimination methods. • Knowledge gained about functions will be applied when interpreting linear equations as functions and exploring their graphical representations. • Students will revisit their ability to distinguish between linear and nonlinear relationships, which is crucial for understanding the context of the equations they are working with. • Previous experience with solving and graphing inequalities will be essential for understanding	• iXL problems • iXL Diagnostic Assessment • Delta Math

variables • Interpret solutions of linear inequalities in a modeling context	and applying linear inequalities in this unit. • Skills developed in modeling real-world situations using mathematics will help students create systems of equations that represent various scenarios effectively. • The critical thinking skills students have been working on in earlier units will be applied to analyze the relationships between equations, interpret solutions, and evaluate the viability of those solutions in context. • Students will use their algebraic manipulation skills, such as combining like terms and distributing, to simplify expressions in systems of equations.	

Assessment

Formative Assessment	Summative Assessment
• Homework • Lesson Checks • MathXL • Quizzes • Exit Tickets • Lesson Reflections • Performance Tasks	• Topic Tests • Unit 4 Benchmark (Link-It)

Resources

Key Resources	Supplemental Resources
EnVision 8th Grade EnVision Algebra 1 Pacing Guide	iXL Delta Math ThatQuiz.org Desmos Khan Academy Teacher Made Worksheets

Career Readiness, Life Literacies, and Key Skills

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Interdisciplinary Connections

ELA.RL.CR.9–10.1	Cite a range of thorough textual evidence and make relevant connections to strongly support analysis of multiple aspects of what a literary text says explicitly and inferentially, as well as including determining where the text leaves matters uncertain.
ELA.W.AW.9–10.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence.
9-12.HS-LS3-3.3.1	Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
9-12.HS-PS2-4.5	Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.