



Grade 8 Pre-Algebra - Unit B - Linear Relationships, Equations and Systems

Unit Focus

In this unit, students learn the terms "slope" and "slope triangle," and use the similarity of slope triangles on the same line to understand that two distinct points on a line determine the same slope.

Students gain experience with linear relationships and their representations as graphs, tables, and equations. After a brief review of proportional relationships students move to those that are linear but not proportional. Students are introduced to "rate of change" as a way to describe the rate per 1 in a linear relationship and note that its numerical value is the same as that of the slope of the line that represents the relationship. Students analyze several linear relationships and establish ways to compute the slope of a line from any two distinct points on the line via repeated reasoning. Students consider situations with negative y-intercepts and/or slopes and interpret these graphs in context.

Next, students write and solve equations to represent a problem situation. In doing so, they state the meaning of symbols that represent unknowns, identify assumptions such as constant rate, select methods and representations to use in obtaining a solution, and reason to obtain a solution. Additionally, students interpret solutions in the contexts from which they arose and write them with appropriate units, communicating their reasoning to others, and identifying correspondence between verbal descriptions, tables, diagrams, equations, and graphs, and between different solution approaches. Students analyze groups of linear equations in one unknown, noting that they fall into three categories: no solution, exactly one solution, and infinitely many solutions. Given descriptions of real-world situations, students write and solve linear equations in one variable, interpreting solutions in the contexts from which the equations arose. Finally, students learn to use algebraic methods to solve systems of linear equations in two variables. Given descriptions of two linear relationships students interpret points on their graphs, including points on both graphs. Students categorize pairs of linear equations graphed on the same axes, noting that there are three categories: no intersection, exactly one point of intersection, and the same line.

Stage 1: Desired Results - Key Understandings

Standard(s)	Transfer	
Standards - Common Core - Mathematics: 8 - Understand the connections between proportional relationships, lines, and linear equations. (920571) - Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. (CCSS.MATH.CONTENT.8.EE.B.5) - Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the	<i>Students will be able to independently use their learning to...</i> T1 Identify and generalize patterns and structure in numbers, expressions, data and objects. (MP 7) T2 Represent situations using mathematical reasoning and symbols (MP 2)	
	Meaning	
	Understanding(s)	Essential Question(s)
	<i>Students will understand that...</i> U1 Mathematicians see patterns to make generalizations about structures and relationships. U2 Mathematicians attend to the underlying meaning of quantities and symbols. U3 That solving a system of equations means finding values of the variables that makes both equations true at the same time.	<i>Students will keep considering...</i> Q1 How can the relationship between quantities be represented? Q2 What do the quantities mean? Q3 What generalizations can be made from this pattern? Q4 Does my abstract representation of these quantities make sense in context?

Stage 1: Desired Results - Key Understandings

	Acquisition of Knowledge and Skill	
	Knowledge	Skill(s)
equation $y = mx + b$ for a line intercepting the vertical axis at b. (CCSS.MATH.CONTENT.8.EE.B.6) - Solve linear equations in one variable. (CCSS.MATH.CONTENT.8.EE.C.7) - Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers). (CCSS.MATH.CONTENT.8.EE.C.7A) - Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. (CCSS.MATH.CONTENT.8.EE.C.7B) - Analyze and solve pairs of simultaneous linear equations. (CCSS.MATH.CONTENT.8.EE.C.8) - 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. (CCSS.MATH.CONTENT.8.EE.C.8A) - Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6. (CCSS.MATH.CONTENT.8.EE.C.8B) - Mathematical Practices - Reason abstractly and quantitatively. (CCSS.MATH.MP.2) - Look for and make use of structure. (CCSS.MATH.MP.7) Madison Public Schools Profile of a Graduate - Analyzing: Examining information/data/evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)	<i>Students will know...</i> K1 In the proportional relationship given by $y = kx$, k represents the constant of proportionality. K2 Two graphs can be of the same relationship, even if the scales are different. K3 That a proportional relationship has a starting value of 0, while a linear relationship doesn't have to start at 0. K4 How the slope and vertical intercept influence the graph of a line. K5 The vertical intercept is the starting point of any linear relationship. K6 The slope represents the steepness and direction of a linear relationship. K7 A horizontal line has a slope of zero. K8 A vertical line has an undefined slope (no slope.) K9 That slope of any two points can be found by dividing the vertical distance by the horizontal distance. K10 That adding and removing equal items from each side of a hanger diagram or multiplying and dividing items on each side of the hanger by the same amount are moves that keep the hanger balanced. K11 The features of linear equations that have one solution, no solution, or many solutions. K12 How to find when two things are the same in a real-world situation. K13 The features of a system of linear equations that help to figure out how many solutions the system has. K14 Vocabulary: constant of proportionality, rate of change, slope, linear relationship, solution, vertical intercept, constant term, coefficient, system of equations K15 Slope is the quotient of the vertical distance and the horizontal distance. K16 Slope triangles on one line are similar by using transformations or Angle-Angle Similarity. K17 Points that lie on the graph of an equation represent the solution set to an equation.	<i>Students will be skilled at...</i> S1 Creating graphs and equations of proportional and/or linear relationships, in context, including an appropriate scale. S2 Comparing the rate of change for two proportional or linear relationships, given multiple representations. S3 Interpreting multiple representations of a proportional relationship in order to answer questions and explain the solution method. S4 Finding the rate of change of a linear relationship by figuring out the slope of the line representing the relationship. S5 Identifying and interpreting the slope and the vertical intercept of the graph of a linear relationship. S6 Writing equations in $y = mx + b$ form S7 Determining if the slope of a graph is positive or negative and explain how I know by looking at the graph. S8 Creating a graph of a line using a verbal description of its features. S9 Calculating slope when given two points on the line. S10 Solving puzzles using diagrams, equations, or other representations. S11 Representing balanced hangers with equations. S12 Solving an equation where the variable appears on both sides. S13 Determining if an equation or a system of equations has one solution, no solution, or infinite solutions. S14 Creating linear equations in one variable that have either no solution or infinitely many solutions, using structure. S15 Creating an equation in one variable to represent a situation in which two conditions are equal. S16 Identifying and interpreting ordered pairs that are solutions to an equation. S17 Solve systems of equations using algebra. S18 Creating a graph of two lines that represents a system of equation in context. S19 Draw a line on a grid with a given slope. S20 Find the slope of a line on a grid. S21 Plugging in a point to determine if it is a solution.