

Algebra Insight: Mapping across Multiple Representations

(Graphs, Equations, and Word Problems)

Focus on fluent recognition of key mathematical features in different representational formats and mapping among graphs, equations, and word problems.

The **Mapping across Multiple Representations PLM (MultiRep for short)** enables students to grasp structure and patterns in graphs, equations, and word problems and teaches them to map across these representations. The focus is on linear functions—crucial to much of middle and high school math and science. Students learn that equations of the form $y = mx + b$ can be interpreted visually as a graph on the coordinate plane and that these representations are interchangeable. Students also develop speed and fluency in identifying key information in word problems and recognizing corresponding equation and graph representations. By using the **MultiRep PLM**, students quickly come to recognize how features such as slope or rate and intercepts are encoded in each representation. They become expert at extracting meaningful information from these representations, which are often initially complex and confusing to them. The **MultiRep PLM** achieves this through many short trials in which students map across different representational formats (i.e., word problem to graph, graph to equation, etc.), encouraging students to see a problem from many different angles. As a result, students are not just learning a procedure; they are developing a deeper understanding of how word problems, graphs, and equations all relate to one another and encode common mathematical structures and relationships.

Like all of our other Insight PLMs, the **MultiRep PLM** adapts to each individual student, using his or her own performance data to pace and sequence the learning process and guide the learner to fully certified mastery, based on both accuracy and fluency criteria.

Alignment to Common Core Mathematics Standards

Standards for Mathematical Practices

- *Make sense of problems and persevere in solving them.*
- *Reason abstractly and quantitatively.*
- *Model with mathematics.*
- *Look for and make use of structure.*
- *Look for and express regularity in repeated reasoning.*

Common Core Mathematics Standards by Grade	
RATIOS AND PROPORTIONAL RELATIONSHIPS	
Grade 6.RP: Ratios and Proportional Relationships	<ul style="list-style-type: none">• Understand ratio concepts and use ratio reasoning to solve problems.<ul style="list-style-type: none">○ Describe a ratio relationship between two quantities.○ Use ratio and rate reasoning to solve problems.○ Solve unit rate problems.
Grade 7.RP: Ratios and Proportional	<ul style="list-style-type: none">• Analyze proportional relationships and use them to solve real-world and mathematical problems.<ul style="list-style-type: none">○ Identify the constant of proportionality (unit rate) in tables,

Relationships	graphs, equations, diagrams, and verbal descriptions of proportional relationships.
THE NUMBER SYSTEM	
Grade 6.NS: Number System	<ul style="list-style-type: none"> • Apply and extend previous understandings of numbers to the system of rational numbers. <ul style="list-style-type: none"> ○ Use positive and negative numbers to represent quantities in real-world contexts.
Grade 7.NS: Number System	<ul style="list-style-type: none"> • Apply and extend previous understandings operations with fractions to add, subtract, multiply, and divide rational numbers. <ul style="list-style-type: none"> ○ Interpret products of rational numbers by describing real-world contexts. ○ Interpret quotients of rational numbers by describing real-world contexts.
EXPRESSIONS AND EQUATIONS	
Grade 6.EE Expressions and Equations	<ul style="list-style-type: none"> • Represent and analyze quantitative relationships between dependent and independent variables. <ul style="list-style-type: none"> ○ Use variables to represent two quantities in a real-world problem that change in relationship to one another. ○ Analyze the relationship between the dependent and independent variables using graphs and relate these to the equation.
Grade 7.EE: Expressions and Equations	<ul style="list-style-type: none"> • Solve real-life and mathematical problems using numerical and algebraic expressions and equations. <ul style="list-style-type: none"> ○ Use variables to represent quantities in a real-world or mathematical problem.
Grade 8.EE: Expressions and Equations	<ul style="list-style-type: none"> • Understand the connections between proportional relationships, lines, and linear equations. <ul style="list-style-type: none"> ○ Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
FUNCTIONS	
Grade 8.F: Functions	<ul style="list-style-type: none"> • Define, evaluate, and compare functions. <ul style="list-style-type: none"> ○ Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). ○ Interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line. • Use functions to model relationships between quantities. <ul style="list-style-type: none"> ○ Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph.

STATISTICS AND PROBABILITY

Grade 8.SP: Statistics and Probability	<ul style="list-style-type: none">Investigate patterns of association in bivariate data.<ul style="list-style-type: none">Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
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ALGEBRA

High School A-SSE: Seeing Structure in Expressions	<ul style="list-style-type: none">Interpret the structure of expressions.<ul style="list-style-type: none">Interpret parts of an expression, such as terms, factors, and coefficients.
High School A-CED: Creating Equations	<ul style="list-style-type: none">Create equations that describe numbers or relationships.

FUNCTIONS

High School F-IF: Interpreting Functions	<ul style="list-style-type: none">Interpret functions that arise in applications in terms of the context.<ul style="list-style-type: none">For a function that models a relationship between two quantities, interpret key features of graphs in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.Analyze functions using different representations.<ul style="list-style-type: none">Graph functions expressed symbolically and show key features of the graph.Compare properties of two functions each represented in a different way (algebraically, graphically, or by verbal descriptions).
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