

M1.2 Linear Equations, Inequalities and Systems

- Explain each step in solving a simple equation in one variable.
- Create and solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- Model constraints and relationships between quantities by equations and inequalities, and by systems of equations and inequalities, and interpret solutions.
- Solve systems of linear equations approximately by graphing and exactly by algebraic methods.
- Understand the principles behind the method of elimination.
- Graph the solution set to a linear inequality in two variables as a half-plane.
- Graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Students begin learning about ratios and rates in Grade 6. In Grade 7, they represent proportional relationships by equations of the form $y = kx$, understanding k as the constant of proportionality or unit rate. In Grade 8, they recognize such equations as special kinds of linear equations $y = mx + b$ where m is the constant of proportionality and b is 0. They understand m as the slope of the line obtained from graphing the equation and b as the y -intercept of the line which is the value of y when $x = 0$.

By this point in their mathematical trajectory, then, students should be fairly comfortable with linear equations in two variables. They should be able to create and graph such equations to represent real-world situations that can be modeled by linear equations. Just as importantly, students should be able to describe the fundamental characteristic of linear functions, namely that they have a constant rate of change: the change in the output variable is proportional to the corresponding change in the input variable.

In grade 8, students analyzed and solved pairs of simultaneous linear equations (8.EE.C.8). Students should:

- know that the solutions to a system of two linear equations in two variables correspond to points of intersections of their graphs, because points of intersection satisfy both equations simultaneously (8.EE.C.8.a);
- know how to solve a system of two linear equations in two variables algebraically (8.EE.C.8.b);
- be able to estimate solutions by graphing the equations (8.EE.C.8.b);
- know how to solve real-world and mathematical problems leading to a system of two linear equations in two variables (8.EE.C.8.c).

In this unit, students build on what they know from middle school about linear equations and inequalities and systems of linear equations and expand their understanding to include systems of linear inequalities. They work with more complex modeling problems and become fluent in general methods of solution. They make more sophisticated use of graphical methods of representing and solving equations, inequalities, and systems, and they interpret points or regions in the plane in terms of the context.

Students will apply what they learn in this unit to the study of bivariate statistics. They will revisit the notion of a function and use the techniques learned here to study linear functions. They will come to view linear functions as one of many function families that display predictable characteristics. The technique of substitution, learned to find values that simultaneously satisfy two linear equations, is useful in more general situations, e.g., to solve a system consisting of a linear and a quadratic equation (A-REI.7) and in differential and integral calculus. For students who study calculus, linear functions will be an essential basis for their work with derivatives and differentiation.

M1.2.0 Pre-unit diagnostic assessment

Assess students' ability to

- **solve linear equations in one variable with rational number coefficients;**
- **solve word problems leading to linear inequalities of the form of the form $px + q \geq r$ with rational coefficients;**
- **graph linear equations of the form $y = mx + b$;**
- **solve a real-world problem that leads to a simple case of a system of two linear equations in two variables, where the same variable occurs with coefficient 1 in both equations.**

M1.2.1 Overview of linear equations and inequalities in two variables

Create and graph the solutions of linear equations and inequalities in two variables, and discuss their meaning in a real-world context.

This hook lesson provides an engaging context which allows students to exercise many of the skills they started to learn in middle school and will continue to apply in more sophisticated ways in this unit: setting linear equations in two variables to model a relationship between two quantities, solving for another variable, interpreting and graphing inequalities in two variables. It sets the stage for the units to come.

M1.2.2 Reason about linear equations and inequalities in one variable

- **Explain each step in solving a simple equation in one variable.**
- **Create and solve linear equations in one variable, including equations with coefficients represented by letters.**
- **Create and solve linear inequalities in one variable.**

As preparation for the work with two-variable equations, inequalities and systems in this unit, students must have a strong foundation in working with equations and inequalities in one variable and a clear understanding of what an equation is and what it means for a number to be a solution to the equation (it makes the two sides equal). This section gives students opportunities to practice reasoning, manipulating and solving equations and inequalities.

Tasks

[A-REI Same solutions?](#)

[A-REI How does the solution change?](#)

[A-REI Reasoning with linear inequalities](#)

M1.2.3 Model with systems of linear equations

- **Model constraints and relationships between quantities with systems of**

linear equations.

- **Solve systems of linear equations approximately by graphing and exactly by algebraic methods.**

Students have worked with systems of linear equations in middle school and solved simple problems with them. In high school they work with more complex modeling problems and become fluent in general methods of solution. This first section on systems focuses on the modeling aspect. The systems are either solved graphically or the algebraic manipulations required to solve them are relatively simple. Furthermore, the modeling emphasis supports conceptual understanding by emphasizing the quantitative meaning of the variables, the equations, and the solutions to the system. This prepares students to take a thinking approach the solution methods in the next section on systems, rather than a purely formal one.

Tasks

[A-REI, A-CED Cash Box](#)

[A-REI Quinoa Pasta 2](#)

M1.2.4 Mid-unit assessment

Assess students' ability to

- **solve equations and inequalities in one variable;**
- **explain each step in solving a simple equation;**
- **solve systems of equations graphically and algebraically;**
- **set up and solve systems of equations that model a context;**
- **interpret a solution to a system of equations in terms of the context.**

M1.2.5 Solve general systems of linear equations in two variables

- **Solve systems of linear equations exactly by algebraic methods.**
- **Understand the principles behind the method of elimination.**

Students were introduced to the basic methods of solving systems of equations in middle school. In Section 3 of this unit they used simple systems to solve modeling problems. In this section they become fluent in

general methods for solving systems algebraically and reason through the justification for these methods.

Tasks

[A-REI Accurately weighing pennies I](#)

[A-REI Estimating a Solution via Graphs](#)

[A-REI Solving Two Equations in Two Unknowns](#)

[A-REI Accurately weighing pennies II](#)

M1.2.6 Model with inequalities in two variables

- **Identify constraints from a context, choose relevant variables and model the context with an inequality or system of inequalities.**
- **Identify coordinates pairs or points in the plane as solutions or non-solutions and interpret them in terms of the context.**
- **Graph solution sets to a linear inequality or system of inequalities.**

In Grades 6–8 students learned about inequalities in one variable, and about equations and systems of equations in two variables. Here they tie these together and study inequalities, or systems of inequalities, in two variables. The emphasis is on modeling and interpreting solutions or non-solutions. Students also represent inequalities by shaded regions and interpret points in the plane; however, graphing should not be overemphasized or reduced to a procedure that does not engage the meaning of the inequality.

Tasks

[A-REI Solution Sets](#)

[A-REI Fishing Adventures 3](#)

M1.2.7 Summative assessment

Assess students' ability to

- **create and solve linear equations and inequalities in one variable;**
- **solve systems of linear equations exactly by algebraic methods;**
- **model relationships between quantities and compare different relationships;**
- **graph the solution set to a linear inequality in two variables as a half-**

plane, and to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.



[Unit Blueprint: Linear Equations, Inequalities and Systems](#)
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