

# SOLVING EQUATIONS AND DEVELOPING THE FOUNDATION FOR PROOFS

## TEACHER NOTES

This unit includes the following documents:

- ▶ Learning Map Information
- ▶ Instructional Activity (three lessons)
- ▶ Instructional Activity Student Handout (for Lesson 3)
- ▶ Student Activities (two total)
- ▶ Student Activity Solution Guide

In this unit, students will learn how to represent and to solve a simple one-step equation with nonnegative rational numbers from concrete models and from real world problems. The concept of a variable is reinforced, as well as the idea of equality and of keeping an equation balanced while operating to solve it.

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An option for introducing the idea of balance and equilibrium to students prior to the unit is to ask students to find synonyms for *balance*, *equilibrium*, or *equal*. Students should come up with words such as *equivalent*, *equitable*, *equalize*, *stabilize*, *steady*, etc. They could then draw a representation of these words, define these words, or use these words in a sentence to establish their meaning before they proceed through the lessons.

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Once students are comfortable solving a one-step equation, they will proceed to representing a real-world situation using an equation and solving that equation to answer the presented question. Students are asked to justify their work using the Addition, Subtraction, Multiplication, and Division Properties of Equality to emphasize the rationale behind the steps to solve and to develop the foundation for proofs, which will be expanded as they enter high-school-level math courses. In chapter one of their book, Ellis, Bieda, and Knuth (2012) recommended that proofs should be incorporated regularly into every student's mathematical experience.

### Properties of Equality

Addition Property of Equality	If $a = b$ , then $a + c = b + c$ .
Subtraction Property of Equality	If $a = b$ , then $a - c = b - c$ .
Multiplication Property of Equality	If $a = b$ , then $a \cdot c = b \cdot c$ .
Division Property of Equality	If $a = b$ and $c \neq 0$ , then $\frac{a}{c} = \frac{b}{c}$ .

The learning map section for this sequence of activities reflects students proceeding through various representations and explanations of the components of an equation. Initially, students must explain the concept of a variable to progress to a complete understanding of an expression. Understanding of

expressions is beneficial for students learning about equations because it helps the student move beyond early understandings of the equal sign as a symbol meaning “provide an answer” to an understanding of the equal sign as a relational symbol. The most basic level of understanding is the student’s ability to explain what an equation is. This understanding, along with knowledge of inverse operations, allows a student to move into situations where they are able to solve a simple, one-step equation with the use of concrete models. Students should then be able to progress beyond the use of models to justify solutions using the properties of equality and to use inverse operations without a concrete model. Once this ability is in place, students can begin representing a simple real-world problem with an equation and solving that equation to answer a question based on the context of the problem.

The activities in this unit are designed to introduce students to solving equations through concrete and algebraic representations. Students will first solve equations using concrete models, then solve without the use of a model, and finally represent and solve word problems. At each level, students are expected to justify the chosen operation using a property of equality and to maintain the concept of balance within the equation they are working with.

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## REFERENCES

Ellis, A., Bieda, K., & Knuth, E. (2012). *Developing essential understanding of proof and proving for teaching mathematics in grades 9–12* (R. M. Zbiek, Series Ed.). Reston, VA: National Council of Teachers of Mathematics.