The New Texas Two-Step

Summary

This activity gives a fun introduction to two-step equations.

Main Core Tie

Mathematics Grade 6

Strand: EXPRESSIONS AND EQUATIONS (6.EE) Standard 6.EE.2

Materials

- Algebra tiles (pdf)
  Transparency Algebra Tiles
  Math journals
  Colored pencils
  White piece of paper
- *Can You Use Algebra Tiles?* (pdf)
- *Can You Use Algebra Tiles? (Key)* (pdf)
- *Let's Do the Two-Step!* (pdf)
- *Let's Do the Two-Step! (Key)* (pdf)

Additional Resources
Books
Algebra Tiles for the Overhead Projector, by Hilde Howden; ISBN 0-914040-42-1

Background for Teachers

Solving two-step algebraic equations is a concept used throughout all of algebra. In order to be successful, students must understand equality and variables (which may be taught using the Pyramid Equality lesson), as well as the order of operations. They should be able to add and subtract integers, as well as understand the concept of zero pairs of tiles. This occurs when a negative x tile and a positive x tile are together, which create a sum of zero. For example, -2 + 2 = 0. Similarly, they should understand that addition and subtraction are the inverse operations of each other, just as multiplication and division are the inverse operations of one another.
Students must also understand exponents. The expression x^2 means x squared, or x times x.
Algebra tiles provide a useful way to introduce algebra operations to students of all ages. Students use the tiles as numbers to replace the variables, which provides a visual image of the equations. This will make the transition to paper and pencil much easier to understand. Using the manipulatives will also aid in retention of the concepts.

Instructional Procedures

Invitation to Learn
Write the following question on the board: If tickets to a high school football game cost $4 per person, explain in words, numbers, or pictures how you can calculate how much money it will cost your family to go to the game?
Give students a few minutes to work alone, and then pair them up to share their strategies. Discuss as a class. (Students should realize that the number of people per family would cause the cost of the tickets to vary.
Instructional Procedures
Day 1: Introduction to Algebra Tiles

Prior to this lesson, give each student two sheets of *Algebra Tiles Cut-Outs* on green and red cardstock if you are not using the commercial tiles. The students should cut them out at home, put them in a resealable plastic bag, and return them to school ready to be used. You may also have the students prepare the tiles in school prior to the lesson.

Using the transparency Algebra Tiles only, show the students the tiles and name them. The small squares are *units*, or *ones*; one of them stands for 1, and 5 of them stands for 5. The long rectangles are each an x, and therefore represent a variable. The large squares represent x2, x in other words, a variable multiplied by itself.

Explain that green tiles indicate addition and red tiles indicate subtraction. In other words, green tiles are positive and red tiles are negative, but it is not necessary for students to understand the term "negative" as they will not be used in the lesson.

Make a collection of pieces using all three types of tiles. For example, use one x2 tile, three x tiles, and 5 ones. Assemble the pieces on the overhead projector, then write down its name: x2 + 3x + 5. This collection represents an algebraic expression. (See figure one.)

Have students create their own expression of tiles using a maximum of 10 tiles. They should then draw their expressions in their math journals and write down the name of the expression using numbers and symbols. Remind the students of the commutative property; it does not matter what order the addition occurs: x2 + 3x + 5 is the same as 5 + x2 + 3x.

To introduce the idea of addition, have the students combine their expressions with a partner. The students should draw their new expression and show the addition using numbers and symbols. For example, the above expression of x2 + 3x + 5 combined with 2x2 + 8 would equal 3x2 + 3x + 13. (See figure two.)

To illustrate the idea of subtraction, have the students experiment with removing tiles. Using their expression from step 5, instruct them to remove three of any type of tiles. Ask, how can you write this new equation and answer? Students should draw their expression and represent it with numbers and symbols. Ask students to remove 2 more tiles from their new expression. Again, they should draw their new expression and represent it with numbers and symbols. Repeat the process of pairing up, adding, and subtracting if desired. The students do not need to use the red tiles for subtracting at this point.

After this brief introduction to the tiles, the students are now ready to solve linear equations.

Solving Two-Step Equations with Algebra Tiles

Have students take out a white piece of paper and draw a vertical line down the center. Ask them to model the equation x + 7 = 10 by placing one positive green x tile and seven positive green unit tiles on the left side of the line, and ten positive green unit tiles on the right side of the line. (See figure 3.)

Explain to the students that in order to maintain equality of the "sides," each action must be performed on both sides! Their goal is to isolate the variable, that is, to make sure the variable stands alone on one side of the equality sign.

Ask the students what needs to occur for the variable, or the positive green x tile, to stand-alone. After responses, remove seven tiles from each side of the equation. Now the x tile and 3 units remain, therefore signifying that x = 3. (See figure 4.)

Repeat the process with a new equation, 5x -- 1 = 9. Have students set up the equation on their own (5 positive green x tiles and 1 negative red unit on the left; 9 positive units on the right). Now how can they get the variable to standby itself? They will need to use the zero pair to remove the one from the left then add that positive unit to the right. In other words, adding a positive green unit tile on the left will remove itself and the 1, and another positive green unit tile also needs to be added to the right to maintain equality. This creates 5x = 10. Now the problem becomes much like the pyramid problem -- the students must evenly distribute the units on the right among the x tiles on the left to determine the value of x, which is 2. (See

figure 5.)
Pass out a *Can You Use Algebra Tiles*? Worksheet for each student. Have them work on the problems in groups of two or three, making sure to draw their tiles for each equation.
Correct and summarize strategies. Continue with the tiles, and move on to the paper and pencil method when ready. Students should remember the concept of equality: what you do on one side must be done on the other.
Day 2: Solving Two-Step Equations with Paper and Pencil
Review the *Can You Use Algebra Tiles*? Worksheet from Day 1. Look at problem one: 2x -- 4 = 10. Ask, how can I solve this problem without using the tiles? Remember, I must maintain equality!
Wait for responses. Then teach the two-step paper and pencil method while demonstrating with the above problem.
Step One: Add or subtract the inverse operation on each side of the equation.
2x -- 4 + 4 = 10 + 4. (After simplifying, 2x = 14.)
Step Two: Take the inverse (divide) from both sides of the equation. This will affect the number directly beside the variable.
2x / 2 = 14/2. (After simplifying, x = 7.)
Try problem two from *Can You Use Algebra Tiles* as a class. Allow students ownership in finding the answer.
Work in groups of two or three to solve the rest of the problems using the paper and pencil method.

Strategies for Diverse Learners

Provide extra algebra tiles instruction to students with special needs.
Allow advanced learners to bypass the algebra tiles when ready and move to paper and pencil.

Extensions

Try the activity named Algebraic Equations Gizmo on explorelearning.com to translate English sentences into equations and equations into English sentences.
Family Connections
Use the activity Algebraic Equations Gizmo on explorelearning. com to translate English sentences into equations and equations into English sentences.
Try an input-output game. Students create an equation and a list of possible variables and solutions. Now cover up your equation and see if your family can figure it out based on the other information!

Assessment Plan

- *Can You Use Algebra Tiles?*
  Worksheet. You may also revisit this worksheet after teaching the paper and pencil method of solving two-stop equations and have students solve each equation without using tiles.
- *Let's Do the Two-Step!*
  Worksheet to be completed after step 18 in the instructional procedures.
  Have students explain the steps to solving equations with algebra tiles and with paper and pencil in their math journals.

Bibliography

Leitze, A.R., & Kitt, N. A. (2000 September). Using homemade algebra tiles to develop algebra and prealgebra concepts. Mathematics Teacher, 93, 462-466, 520.
Algebra for all is possible by using algebra tiles as concrete models in the classroom. This article

describes how to use homemade tiles to reach a broader group of students for successful algebra thinking. Provides concepts appropriate for this approach.

Leinenbach, M., & Raymond, A.M. (1996). A two-year collaborative action research study on the effects of a "hands-on" approach to learning algebra. ERIC Source (ERIC ED398081). Retrieved November 30, 2006, from http://www.eric.ed.gov

A "hands-on" approach to algebra enhances students' confidence, interest in, and ability to solve and retain understanding of algebraic equations. This article describes a two-year research project focused on two phases and data collection.

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