

Topic: Solving 2-step equations, representation of steps to the solution in different forms.

Overview

This lesson uses Hands-On-Equations (knowing the rules and basic usage of the manipulatives is a pre-requisite) to solve 2-step equations using concrete materials and pictorial representations. They will solve problems with their own sets of materials and “teach” the class a problem using manipulatives and the document camera. Students will then, in groups, draw pictures (representations of the manipulatives used) to show pictorial representations.

Grade 8

Time Allotment

One 90-minute class period

Learning Objectives

On completion of this lesson students will be able to:

- Solve a two-step equation using manipulatives (Hands On Equations) and pictorial representations
- Apply understanding of the terms variable and coefficient
- Orally describe the process of solving a two-step equation
- Show how to solve a two-step equation using concrete materials and visual representation (preoperational and transitional stages)

This lesson addresses Va. SOLs Math 6.23, 7.21, 7.22, 8.15

Media Components

- Document camera
- Multimedia projector
- Screen

Materials and Student Handouts

- Hands On Equations materials (manipulatives sets for each student and teacher)
OR---
- Red number cubes (1-10)—2 sets per student
- Pawns (blue and white)—10 blue, 10 white per student
- Scale (paper handout for students)
- Teacher cubes—2 sets of 1-10
- Teacher pawns—10 blue, 10 white
- “Adding 2-step Equations” handout (attached)—1 per student
- “Pictorial 2-step Equations” handout (attached)—1 per student
- Paper (for under document camera)

Teacher Preparations

- Must be familiar and fluent with Hands On Equations program
- Solve each problem and draw a visual representation of answer/process
- Hook-up document camera, projector, and test images on screen
- Bag each students' manipulative sets together, if necessary
- Practice each problem using manipulatives and drawing visual representations
- Copy enough handouts for each student

Introductory Activity

1. **Focus:** SAY: What is an equation? (a math problem using a variable, numbers, and an equals sign). SAY: How do you solve it? (balance each side of it so the variable is on one and the value of it is on the other). SAY: We're going to solve equations with 2-steps using Hands-On-Equations—remember, it uses a scale diagram and that's like balancing two sides of something to make them equal.

Activity: Hand out 1 scale diagram and 1 bag of manipulatives per student. Place teacher scale diagram under the document camera and write the 1st problem on a piece of paper under the camera $3x + 2 = 8$. Ask students to set up the problem on their scale using their manipulatives. Allow students to solve the problem independently. Ask for a volunteer to verbally tell the teacher how to solve the problem under the camera and solve according to the student response. Model the steps to the problem as the student tells how to do each step.

Follow-up: Discuss and model each step after student volunteer goes through entire process. SAY: Let's review what (student) did. We have three blue pawns and a 2 cube on the left side of the scale and an 8 cube on the other side of the scale. We can get rid of out 2 on the left and take 2 from the 8 on the right. This leaves us with 3 blue pawns and a 6 cube. When we "guess & check" the answer—we get $x = 2$. Just like balancing something on a scale—both sides are equal. Does anyone have a question so far?

Learning Activities

1. **Focus:** SAY: Now that we've practiced one together, let's see if you can do it by yourself. Again, we need to eliminate things that are the same from each side until we cannot take out anything else. Then what do we need to do at the end? (make sure each side is balanced, x has to equal something).

Activity: Pass out "Adding 2-Step Equations" to students (1 per student). Instruct students to complete the problems on the sheet using their manipulatives. (Optional—can be done in groups, may check with partner to see if they have the same answer). Students may practice their problems using the document camera. When students are close to finishing their sheets, SAY: Please find a partner (or two partners—depending on number of students) and stand next to them. I am going to assign a problem to you to "teach" to the class. Assign problems 1-10 to groups.

Follow-up: In pairings or groups, allow students to discuss their solutions and continue practicing how they got them. SAY: It is okay if you have the same answer, but got it in a different way. You may teach the class both ways. Remember to be able to explain to the class what you are doing and especially what the last step of solving the equation is. (balancing, making x equal something). When students appear to have

practiced their problems and feel comfortable (approximately 5 minutes), ask them to have their seats and wait to be called on to present.

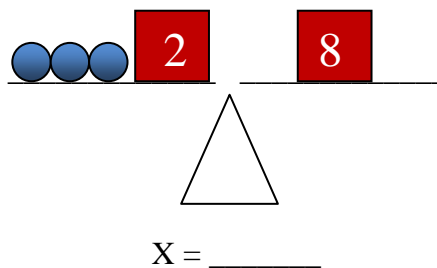
2. Focus: SAY: Here’s your chance to show me what you know about solving equations. Why do you think we are using manipulatives to solve these equations? (to use our hands to solve the problem, do a different way than paper-pencil, get more practice with equations) Correct. We need to make sure we understand what is happening when we’re solving a math problem, and this is a way to see it. Let’s see what you all can do. Ask for groups to volunteer to come up to the document camera.

Activity: Groups will come up to the document camera in the front of the room to teach their problem. Ensure that all students are doing the problem step-by-step with their manipulatives as they are being taught by their peers. Students may use the document camera lens to focus on students for answers (point the camera lens at a student to signify you want them to answer a question). Monitor the steps and solution of the “teachers”, as well as the students in the audience to make sure there are no questions or confusion. Redirect or assist as needed.

Follow-up: Discuss as a class the procedures used to solve a 2-step equation with manipulatives. Reiterate that the most important thing to remember in solving equations is that what you do to one side, you must do to the other—they must always be “balanced.”



Culminating Activities

1. Focus: SAY: Let me show you an example of our next activity. Now that you’ve mastered how to use manipulatives to solve an equation, let’s draw pictures instead of using manipulatives. Why do you think we are doing this? (to see different ways to solve equations, to have a visual of what the problem looks like, to be able to do this on the SOL test, since there are no manipulatives allowed). I’m going to model how to do $3x + 2 = 8$ in pictures. Write the following on paper under the document camera.



Say: Try your first problem with a partner. For each x, draw a filled-in circle. If you can eliminate from the dies, cross out the circle(s) or cube(s) and if you need to rewrite anything, do so. Don’t forget to fill in what x is equal to at the end. When you’ve solved the first one, continue with the remainder of the problems independently. Redirect and assist students, as needed.

Activity: Allow students to draw their pictorial representations on the “Pictorial 2-Step Equations” handout. Assist as needed.

	2-Step Equations—A Balancing Act Maggie Huffer Staunton City Public Schools	
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Follow-up: SAY: How do you think this will help you to solve equations in the future? (it can be easily used, you don't need extra materials to do it, it's easy to remember, it's a fast way to solve a problem). You're right, this is a great method to use—especially for your SOL test. Let me take your handouts and I'll look over them to see how you all did. Are there any questions?

Assessment

- Warm-up/Exit ticket (can be generated by the teacher or the students can make up their own problem) to show pictorial representation
- Each student models a problem for the teacher using manipulatives
- Students create their own 2-step equations (with even solutions) to be compiled for a test/quiz

Community Connections

- Invite someone from a bank to discuss how to plan out a budget and incorporate 2-step equations and graphing functional relationships.
- Invite an event planner to discuss how they find the best deals using math and equations in particular, students can solve real-life problems using equations

Cross-Curricular Extensions

- Language Arts—students can write out the steps to solving a two-step equation using Hands-On-Equations manipulatives or pictorial representations. This corresponds with SOL Reading 8.
- Art—students can create their own manipulatives using foam shapes (pawns, cubes, scale)

Adaptations (optional)

- Students may need to be grouped by the teacher prior to lesson for behavioral or academic reasons
- Allow students to create their own problems for an assessment (must come out evenly) to be compiled by the teacher for a test or quiz
- If the time is short, the pictorial representation activity may be moved to an alternate day

About the Author

Maggie Huffer is an 8th grade special education teacher for Staunton City Schools, Virginia.

This lesson was written as part of the Spring 2008 WVPT NTTI for the Virginia Enhancing Education Through Technology Ed Tech Grant awarded to the Shenandoah Valley Technology Consortium (SVTC).

Adding 2-Step Equations

Directions: Use your Hands-On-Equations manipulatives and scale diagram to solve the following problems. Be sure a teacher sees you doing them if you are doing VGLA!

1.) $2x + x = x + 8$

2.) $4x + 5 = 3x + 9$

3.) $5x + 2 = 2x + 14$

4.) $4x + 2 = 3x + 9$

5.) $4x + 5 = 2x + 13$

6.) $3x + 1 = x + 7$

7.) $2(x + 3) = x + 8$

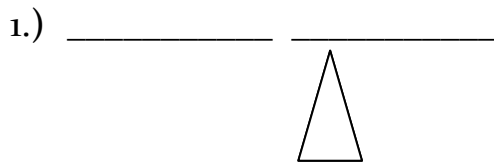
8.) $2(2x + 1) = 18$

9.) $2x + x + x + 2 = 2x + 10$

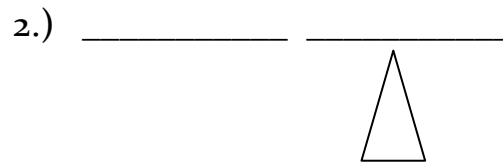
10.) $2(x + 4) + x = x + 16$

Pictorial 2-Step Equations

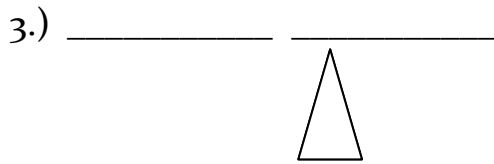
Directions: Using the equations from your “Adding 2-Step Equations” handout, draw a visual representation of how you used your manipulatives to solve the problems. Be sure to cross out things as you eliminate them and don’t forget to write your balanced answer at the bottom of the scale.



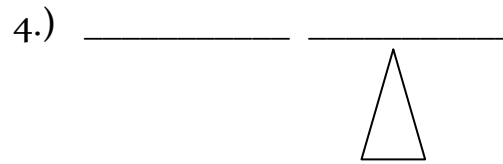
X = _____



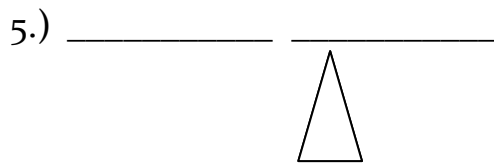
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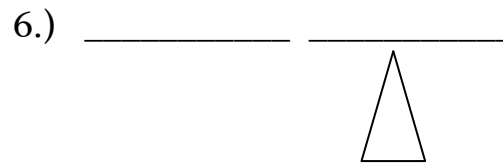
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X = _____




X = _____




X = _____

7.) _____




X = _____

8.) _____




X = _____

9.) _____



X = _____

10.) _____



X = _____