Explore—Solving Equations 1-step equations.

We are going to do this with some one step equations first and then extend to two-step equations. Video of teacher doing the activity (around the 37 min mark):

http://www.learner.org/workshops/algebra/workshop1/index.html

Here is the direct link to the lesson itself. It has been modified to fit this learning outcome.

(Another exploration can be found here: http://illuminations.nctm.org/LessonDetail.aspx?id=L786)

Materials needed:

1. Several small cups (at least 5 per person or group).
2. Chips that preferably have red on one side and yellow on the other (color does not matter). (About 25 chips per student or group)
3. Whiteboards for each group (not required; they can just use blank paper)

Note: Be sure to have enough materials for YOU to have to demo to students

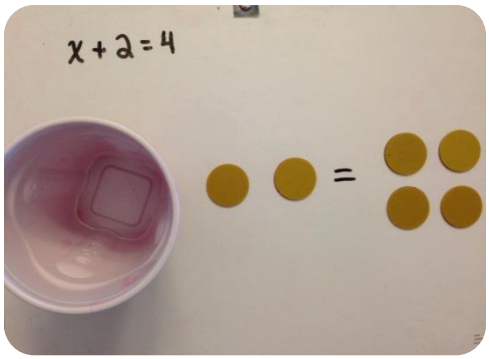
1. Give a bag of chips, a set of cups, and a large sheet of paper or dry-erase board to each group of students. { Keeping the numbers relatively small to cut down on the # of chips. Given the form $ax + b = c$, the minimum number of chips per group is given by $n = 2b + c$. }
2. Explain that students will be using a cups and chips activity to solve the equation $x + 2 = 4$.
3. Present the following directions to students:

    - If the variable is positive, place the cup(s) facing up.
    - If the variable is negative, place the cup(s) facing down.
    - The coefficient of the variable indicates the number of cups to use.

4. Then, ask students to show you the representation of x using the cups. They should all place one cup facing up on top of their paper or dry-erase board. Explain the following:

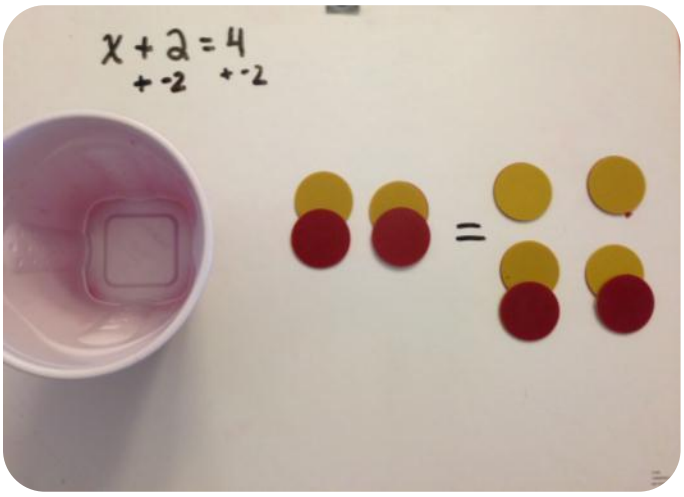
    - The chips represent the numbers.
    - If a number is positive, the chip should be yellow side up.
    - If a number is negative, the chip should be red side up.

5. Have students use two yellow chips to represent +2. They should place these chips next to their one cup. Then, have them draw an equal sign to the right of the cups and 2 yellow chips. Explain that they can represent +4 by placing 4 yellow chips on the other side of the equal sign.

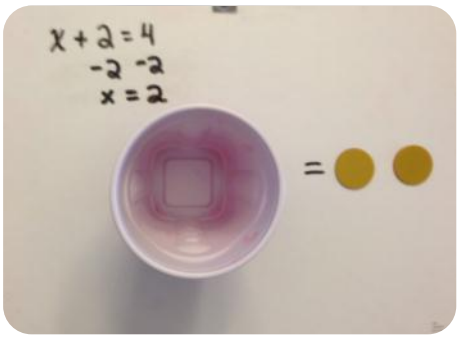


6. Ask students what can be done to both sides of the equation to get rid of the two yellow chips (+2) on one side of the equation. Elicit from students that -2 should be added to each side (i.e., add two red chips to both sides); alternatively, +2 could be subtracted from each side (i.e., take away two yellow chips from each side).

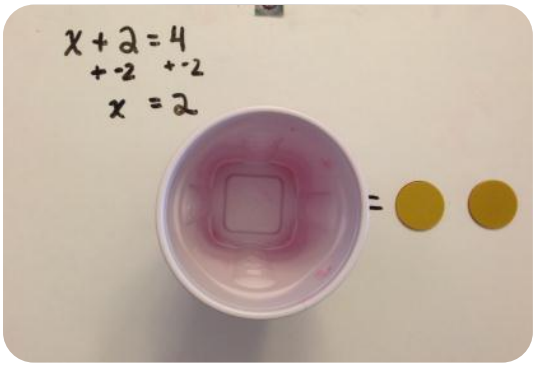
7. On the overhead, add two red chips to the side with two yellow chips. Also add two red chips to the side with 4 yellow chips, and have students repeat these actions in their groups. Ask, "When you pair each red chip with a yellow chip, what happens?" Call on a student to explain that each pair is equal to 0.



You could just have them remove 2 yellow chips from both sides, which is the equivalent of "subtracting a +2."



8. Have students remove the pairs of red and yellow chips, leaving just one cup facing up and five yellow chips. Ask, "What equation do we have now?" Elicit from students that the cups represent x, the remaining yellow chips represent +2, and the equation now left is x = 2. Write this new equation on the overhead below the original equation.



9. Give students the following problems to solve in their groups using cups and chips:
   A. x – 2 = 3
   B. x + 3 = -4
   C. x – 3 = -7

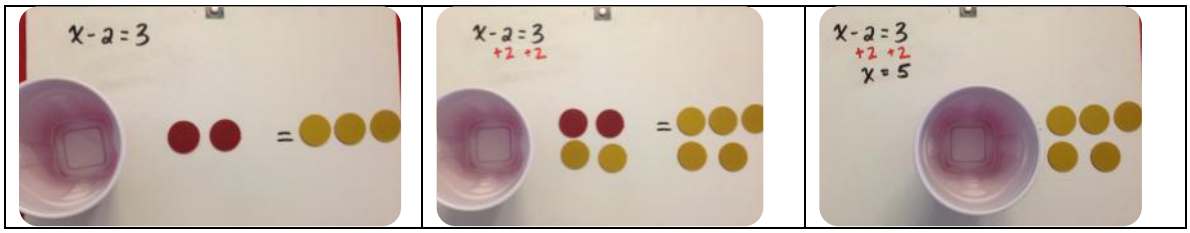
   Walk around while they are doing these.

When going over these problems in class with the cups and chips, be sure to show algebraically what is going on.

If practical, have students snap pictures of their steps, similar to what is shown below. Need to make sure that students are representing the equations (and steps) correctly. This way,

students don't have to wait for the teacher to come look at their steps; they can show them the pictures that they took.

A.



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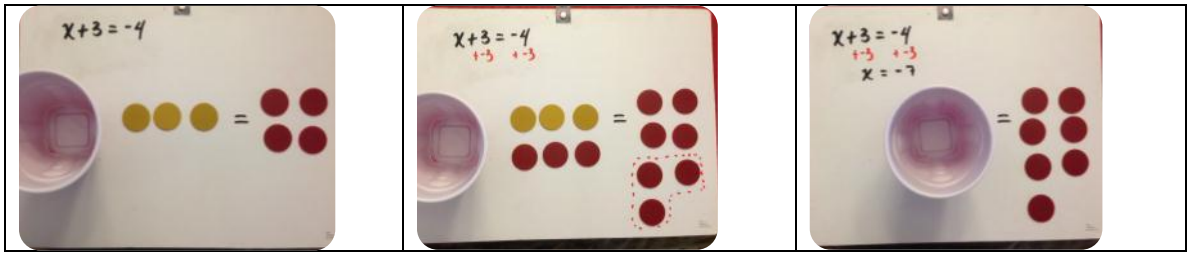

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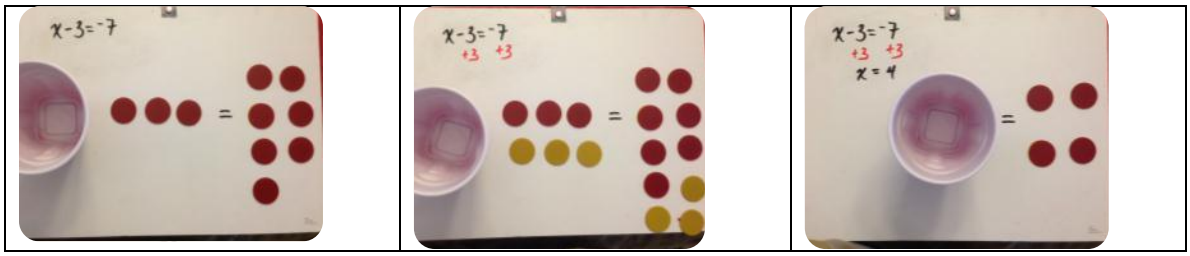
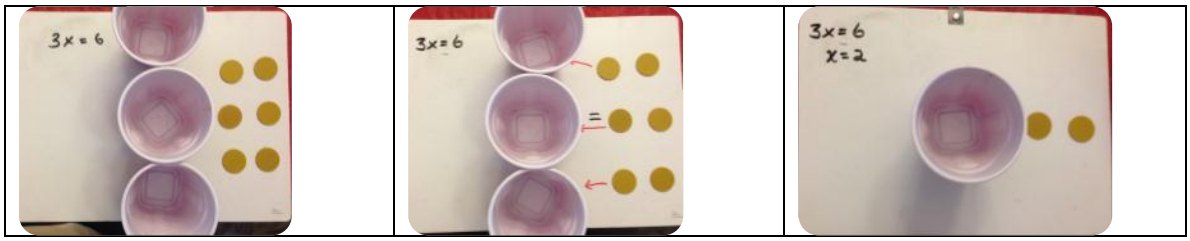


10. Now give them the following problems
    A. 3x = 6
    B. -2x = 8
    C. 4x = 2

A.



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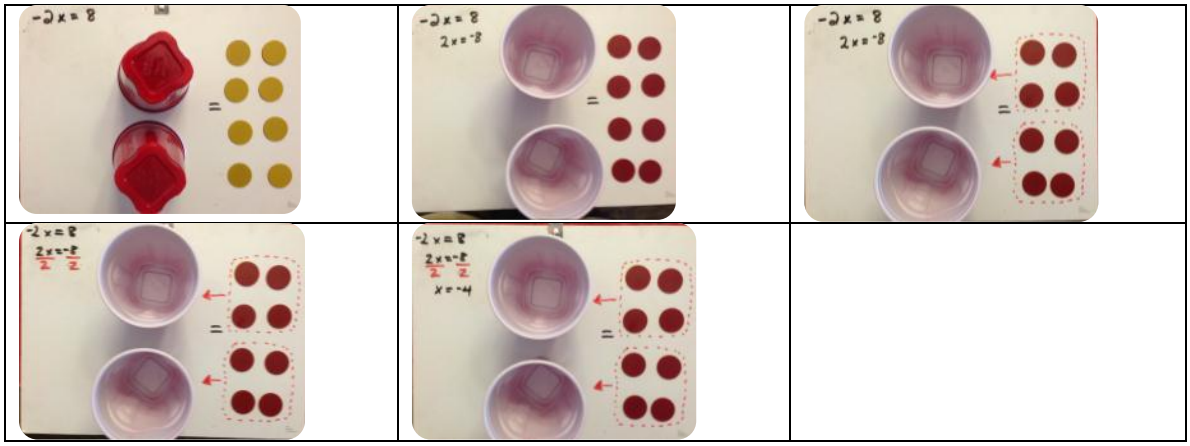
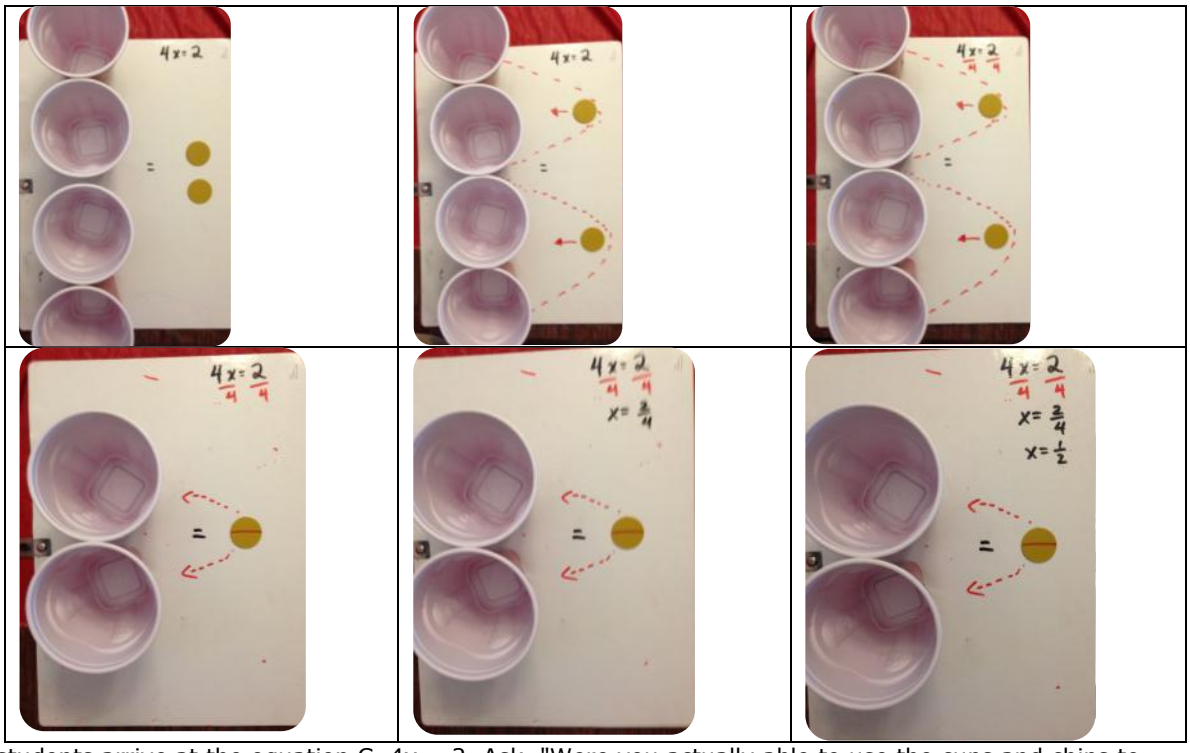


C.



When students arrive at the equation C. 4x = 2. Ask, "Were you actually able to use the cups and chips to solve the problem? When you had 4x = 2, what operation did we have to do?" Elicit from students that both sides had to be divided by 4 (or that the chip needed to be split in half), to yield the answer x = ½.

Note that this technique breaks down when you have fractional/decimal coefficients (e.g. (1/3)x = 12. Hence the need for the formal instruction in the "Flip."

Flip (something like the problems below):

I. Solving one step equations with the addition principle
   A. $x + 4 = 10$
   B. $x - 6 = -3$
   C. $4 + a = -9$
   D. $(\frac{1}{2}) + x = 2/3$

II. Solving one step equations with the multiplication principle
   A. $5x = 20$
   B. $3x = 13$
   C. $-2x = -10$
   D. $-6x = 9$
   E. $x/4 = 8$
   F. $(2/5)x = -10$

III. Possibly do some decimals ($3.2x - 1.5 = 9.8$). May also want to show further examples if needed.