Solving Linear Equations Using Pictures
By Tiffany Bryant
Pre-Algebra (Grades 6-8)

Objectives:

Students will…

- •Solve two-step linear equations using pictures.
- •Enhance understanding of linear relationships and concepts.

Rationale:

For weeks, students tried to solve linear relationships using hands-on equations and the numerical method, without much success. After attending a conference and hearing that addition has been taught in the elementary years using pictures, a worksheet was created using stickers that represented the variable and other symbols representing the numbers. After 20 minutes using this method, 6th graders grasped the concept. Interesting and humorous stickers increased motivation and made an abstract concept more concrete. The kinesthetic and visual use of the stickers and symbols helped students gain knowledge on a different level.

Materials List:

- •Overhead projector for overview
- •Pre-algebra worksheet
- •Pre-algebra worksheet answer key
- •Blank pre-algebra worksheet
- •Transparency film (or sample problems can be written on board)

Directions:

1. Write the following example on a transparency (or on the board):

$$☺☺ - \begin{matrix} ● \\ ● \\ ● \end{matrix} \quad = \quad \begin{matrix} ●●● \\ ●● \\ ●● \end{matrix}$$

2. Explain that the ☺ stickers represent the variable (x) and the dots represent numbers.
3. Continue explanation: "In this example, you have 2 ☺ minus 3 dots equals 7 dots. You can't subtract dots from ☺, because they are not the same unit; therefore, you must move the dots to the right side of the equal sign (=)." Ask students: "How can you do that? How can you get rid of the dots from the left side of the equal sign and move them to the right side?" Students may say, "We can subtract three dots from both sides." If students do, then show them what happens if they subtract three dots from both sides.

$$☺☺ - \begin{matrix} ● \\ ● \\ ● \end{matrix} \quad = \quad \begin{matrix} ●●● \\ ●● \\ ●● \end{matrix}$$

Illustrate subtracting 3 dots from both sides (feel free to modify the problem-solving format below to match the preferred method/style of your curriculum):

$$☺☺ \ - \ \begin{matrix} ● \\ ● \\ ● \end{matrix} \ - \ \begin{matrix} ● \\ ● \\ ● \end{matrix} \ = \ \begin{matrix} ●●● \\ ●● \\ ●● \end{matrix} \ - \ \begin{matrix} ● \\ ● \\ ● \end{matrix}$$

$$☺☺ \ - \ \begin{matrix} ●● \\ ●● \\ ●● \end{matrix} \ = \ \begin{matrix} ●● \\ ● \\ ● \end{matrix}$$
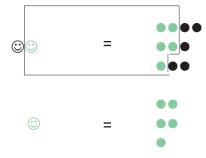
This does NOT work! It does not eliminate the dots from the left side.

Now, ask students, "What will work?"
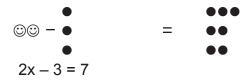(At this time, students will say add three dots to both sides.)

Demonstrate what happens when three dots are added to both sides.

$$☺☺ \ - \ \begin{matrix} ● \\ ● \\ ● \end{matrix} \quad \begin{matrix} = \\ = \\ = \end{matrix} \quad \begin{matrix} ●●● \\ ●● \\ ●● \end{matrix}$$

$$☺☺ \ - \ \begin{matrix} ● \\ ● \\ ● \end{matrix} \ + \ \begin{matrix} ● \\ ● \\ ● \end{matrix} \ = \ \begin{matrix} ●●● \\ ●● \\ ●● \end{matrix} \ + \ \begin{matrix} ● \\ ● \\ ● \end{matrix}$$

(This cancels out!)

You are left with:

$$☺☺ \qquad = \qquad \begin{matrix} ●●●● \\ ●●● \\ ●●● \end{matrix}$$

Now, ask students, "If 2 ☺ are worth 10 dots, how much is one ☺ worth?"
Students will be able to see that 1 ☺ is worth 5 dots by cutting the amount in half.

$$☺☺ \qquad = \qquad \boxed{\begin{matrix} ●●●● \\ ●●● \\ ●●● \end{matrix}}$$

$$☺ \qquad = \qquad \begin{matrix} ●● \\ ●● \\ ● \end{matrix}$$

4. Next, demonstrate all of this numerically.
Explain that ☺ are x and dots are numbers.

$$☺☺ - \begin{array}{c} ● \\ ● \\ ● \end{array} = \begin{array}{c} ●●● \\ ●● \\ ●● \end{array}$$

2x – 3 = 7

Add 3 to both sides:
    2x – 3 + 3 = 7 + 3

Simplify:
         2x + 0 = 10
           2x = 10

Divide by 2:
        2x ÷ 2 = 10 ÷ 2
             x = 5

5. Next, hand out the pre-algebra ☺ worksheet. Remind students that the stickers represent x and the symbol represents numbers. Have students solve the equations first by using the "picture" method (see student sample). Do #1 together.

1. ☺☺ + ♥♥♥♥♥♥   =   ♥♥♥♥♥♥♥♥♥♥

   ☺☺ + ♥♥♥♥♥♥ – ♥♥♥♥♥♥   =   ♥♥♥♥♥♥♥♥♥♥ – ♥♥♥♥♥♥

Subtract 6 ♥ from both sides. (This can be demonstrated by crossing them out.)

   ☺☺ + ♥♥♥♥♥♥   =   ♥♥♥♥♥♥♥♥♥♥

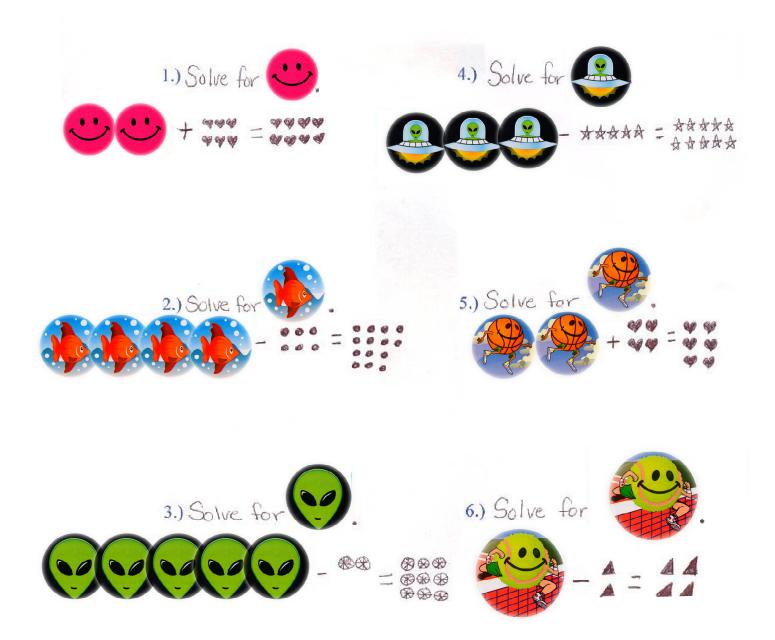What is left?

            ☺☺   =   ♥♥

If 2 ☺☺ are equal to 2 ♥♥, what is 1☺ equal to?

Divide by 2.
   ☺☺   =   ♥♥
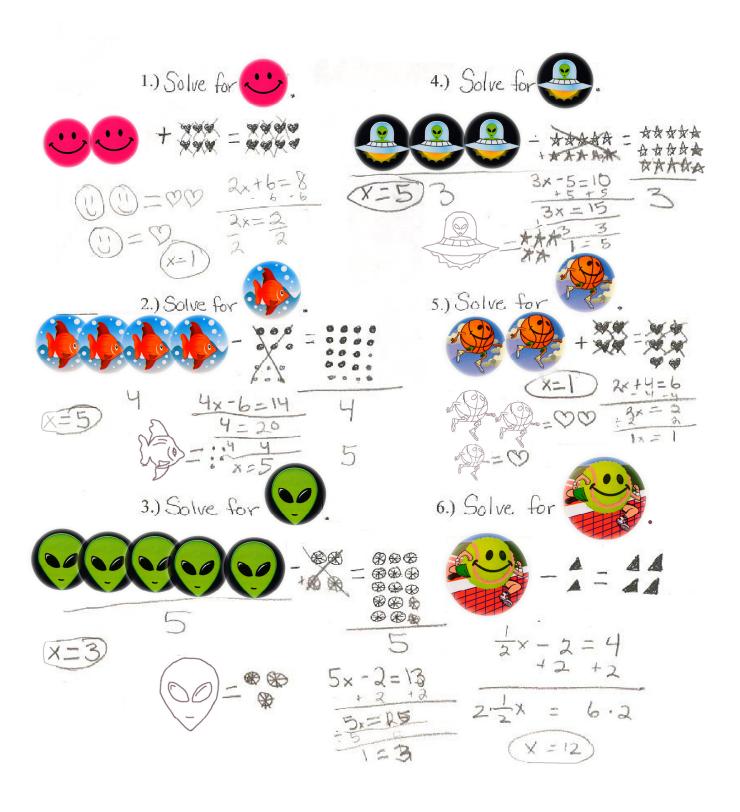
            x = 1

 6. Allow students to continue to complete the worksheet in pairs.
 7. After students complete the worksheet, rework it on the overhead.
 8. Instruct each student to make up their own linear equation worksheets, using stickers and symbols, for a partner to solve. This will allow students to demonstrate understanding and have additional practice, as well as serving as a motivational tool.
 9. Once students have designed their worksheets, they should exchange papers with someone to solve equations. Allow students to select a partner or pair them up with other students, depending on readiness.

Pre-Algebra Worksheet
Two-Step Linear Equations

1.) Solve for 🙂.

2.) Solve for 🐟.

3.) Solve for 👽.

4.) Solve for 🛸.

5.) Solve for 🏀.

6.) Solve for 🎾.

Pre-Algebra Worksheet Answer Key
Two-Step Linear Equations

1.) Solve for 🙂.

$$2x + 6 = 8$$
$$-6 \quad -6$$
$$\frac{2x}{2} = \frac{2}{2}$$
$$x = 1$$

2.) Solve for 🐟.

$$x = 5$$

$$\frac{4x - 6 = 14}{4 = 20}$$
$$\frac{4}{4}$$
$$x = 5$$

3.) Solve for 👽.

$$x = 3$$

$$5x - 2 = 13$$
$$+2 \quad +2$$
$$\frac{5x = 15}{5}$$
$$1 = 3$$

4.) Solve for 🛸.

$$x = 5$$

$$3x - 5 = 10$$
$$+5 \quad +5$$
$$3x = 15$$
$$\frac{3}{3} \quad \frac{3}{3}$$
$$1 = 5$$

5.) Solve for 🏀.

$$x = 1$$

$$2x + 4 = 6$$
$$-4 \quad -4$$
$$\frac{2x}{2} = \frac{2}{2}$$
$$1x = 1$$

6.) Solve for 🙂.

$$\frac{1}{2}x - 2 = 4$$
$$+2 \quad +2$$
$$2\frac{1}{2}x = 6 \cdot 2$$
$$x = 12$$

Pre-Algebra Worksheet

Name: _____

1.

2.

3.

4.

5.

6.