Solving Open Sentences with Addition and Subtraction

Student Probe

What number can replace ☐ in each of the following number sentences to make a true statement?

$5 + 7 = $ ☐

☐ $+ 4 = 9$

$12 - 5 = $ ☐

$9 = $ ☐ $- 3$

$13 - $ ☐ $= 6$

☐ $= 8 + 3$

Answers: 12, 5, 7, 12, 7, 12

Lesson Description

This lesson helps develop students' understanding that symbols and letters can represent a specific number or numbers in number sentences. Using a balance scale and counters to provide a concrete representation, the teacher and students will write the results using number sentences. Students are asked, "What goes in the box to make the sentence true?" As the symbol is replaced with a letter, the teacher asks, "What number could the letter stand for to make the sentence true?"

Rationale

Students are expected to write number sentences, or equations, and find solutions. Students may have difficulty understanding that the symbols represent a missing or unknown value. Initially, work with finding the 'variable' that makes the sentence true—solving the equation—should rely on relational thinking. Whether variables are symbols or letters, they are a powerful representational device that allows for the expression of generalizations. The ultimate goal is for students to work with expressions involving variables without thinking about the specific number or numbers that the letters may stand for.

Preparation

Provide linking cubes, tiles, or blocks in two colors for students.

At a Glance

What: Symbols and blanks (later letters) represent a missing value.

Common Core Standard: CC.1.OA.8 Determine the unknown whole number in an addition or subtraction equation relating three whole numbers.

Mathematical Practices: Look for and make use of structure.

Who: Students who cannot determine the missing value, represented by a symbol or letter, in a number sentence.

Grade Level: 1

Prerequisite Vocabulary: None

Prerequisite Skills: Addition and subtraction strategies

Delivery Format: Individual or small group

Lesson Length: 30 minutes

Materials, Resources, Technology: Linking cubes, tiles, or blocks in two colors, balance scale

Student Worksheets: None

Lesson

The teacher says or does…	Expect students to say or do…	If students do not, then the teacher says or does…
1. What number can we put in the square to make the number sentence 7 + 5 = ☐ true? How do you know? Rewrite the number sentence below the open number sentence: 7 + 5 = ☐ 7 + 5 = 12	12 7 + 5 = 12.	Use smaller numbers such as 4 + 1 = __.
2. Let's find the number we can use in the square to make this number sentence true. 5 + 6 = ☐ + 6 Using a balance scale, place 5 + 6 cubes of the same color in the left pan. Count aloud as each cube is placed. How many cubes are in the left pan? How do you know? Place 6 cubes of the same color in the right pan. Count aloud as each cube is placed.	11 5 + 6 = 11	Count the number of cubes in the left pan.

The teacher says or does…	Expect students to say or do…	If students do not, then the teacher says or does…
3. Let's see how many cubes we need to add to the right pan for the balance to be level. Add cubes of a different color to the right pan, counting each, until the balance is level. How many cubes did we add?	 5	 Count the number (second color) of cubes.
4. Rewrite the number sentence below the open sentence: 5 + 6 = ☐ + 6 5 + 6 = 5 + 6 If we replace the ☐ with 5, is the number sentence true? How do you know?	 Yes. 5 + 6 = 11.	Count the cubes in each pan of the balance.
5. Repeat Steps 2-4 with additional open number sentences using addition.		
6. What number can we put in the box to make a true number sentence: 14 - 6 = ☐ ? How do you know? Rewrite the number sentence below the open number sentence: 14 - 6 = ☐ 14 - 6 = 8	 8 14 - 6 = 8 or 6 + 8 = 14	Use smaller numbers such as 4 - 1 = __.

The teacher says or does…	Expect students to say or do…	If students do not, then the teacher says or does…
7. Let's find the number we can use in the square to make this number sentence true. 12 - 8 = 12 - ☐ Using a balance scale, place 12 cubes of the same color in the left pan. Place 12 cubes of a different color in the right pan. Count aloud as each cube is placed. Are the pans balanced? How do you know? How many cubes are in the left pan? How do you know? Place 6 cubes of the same color in the right pan. Count aloud as each cube is placed.	 Yes. The pans are level. 12 We counted 12 cubes.	
8. How many cubes do we need to remove from the left pan? How do you know?	 8 The problem is 12 "take away" 8, or something similar.	How many cubes do we need to take away?
9. Remove 8 cubes from the left pan. Are the pans balanced now?	 No.	Count the cubes in each pan of the balance.
10. How can we balance the pans?	Take 8 cubes out of the right pan.	Remove cubes one at a time from the right pan until the pans are balanced.

The teacher says or does…	Expect students to say or do…	If students do not, then the teacher says or does…
11. If we replace the ☐ with 8, then is this a true statement?	Yes.	Count the cubes in each pan of the balance. Is 12 – 8 = 4?
12. Rewrite the number sentence below the open sentence: 12 - 8 = 12 – ☐ 12 - 8 = 12 - 8		
13. Repeat Steps 7-11 with additional open number sentences using subtraction.		

Teacher Notes:

1. Use a wide assortment of open sentences such as $5 + \_\_ = 9$ or $12 - \_\_ = 3$. It is important to place the unknown in a variety of locations within the open sentence.
2. The balance scale is a powerful representation of equality. Allow students to use this concrete representation as long as they find it necessary.
3. Solving open number sentences requires students to develop relational thinking. Students can explain an open number sentence in at least two ways. Consider the open number sentence: $9 - \boxed{} = 8 - 3$

   Explanation 1: Since $8 - 3 = 5$, I need to take away from 9 to make 5. Since $9 - 5 = 4$, 4 goes in the ◇.
   Explanation 2: Nine is one more than 8 on the right side. That means that I need to take one more away on the left side to get the same number. One more than 3 is 4 so 5 goes in ◇.
   Students who successfully provide Explanation 2 are using relational thinking.

Variations
None

Formative Assessment :
What number can replace ☐ to make the number statement true?
$3 + 8 = \boxed{} + 5$

References
Mathematics Preparation for Algebra. (n.d.). Retrieved May 25, 2011, from Doing What Works.