Modeling One-step Linear Equations

Strand: Patterns, Functions, and Algebra

Topic: Solving one-step linear equations in one variable

Primary SOL: 6.13 The student will solve one-step linear equations in one variable, including practical problems that require the solution of a one-step linear equation in one variable.

Related SOL: 6.6a, b, c

Materials

- Inverse Operations activity sheet (attached)
- Solving One-Step Equations activity sheet (attached)
- Solving Equations Using Algebra Tiles Jigsaw Puzzle (attached)

Vocabulary

equation, expression, solve (earlier grades)
coefficient, equality, inverse, term, variable, zero pair (6.13)

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Display the term *inverse* and ask students for its meaning. Discuss the concept of inverse operations by reviewing the idea that addition and subtraction are inverse operations, as are multiplication and division. Ask students why this is true. Ask, *"If you have +3, what mathematical operation must you do to get zero?"* Their response should come easily: "Subtract 3." Then, ask, *"If you have −3, what mathematical operation must you do to get zero?"* Again, responses should come easily: "Add three." Because students have become familiar with integer operations (SOLs 6.6[a], [b], and [c]), they may more naturally think in terms of inverse operations, "adding the opposite," and making a zero pair. Teachers need to make sure they are discussing the properties of equality during this time.
2. Distribute Inverse Operations activity sheet. Have pairs or small groups of students work together to decide what operation and/or number should go in each blank to make each equation true. Instruct students to discuss why they chose their answers. Circulate around the room to listen to the discussions and push the students' thinking in order for individual students to be prepared to share thoughts with the class.
3. Have students share their solutions with the class. They should come up with the idea that when you add and then subtract the same amount, you are essentially adding zero, and you do not affect the original value. This would be a good place for teachers to discuss the Additive Identity Property with students. They should also come up with the concept that addition and subtraction are inverse operations. Ask students to share their thoughts about multiplication and division being inverse operations. They should come up with the concept that when you multiply and then divide a value by the same amount, you do not affect the original value.
4. Distribute the Solving One-Step Equations activity sheet, and go over the problems with the students, clarifying where necessary. Inform them that they must keep the scale "balanced" in each equation. Have students work in pairs to answer the problems.

Circulate around the room, supporting the students and identifying students who might share their thoughts/ideas.

5. When students are finished, have selected pairs of students share their solutions and strategies. Ensure that the class discussion includes the idea that in order to keep the scale balanced, you must "do the same thing" to each side of the balance (equation). (*Note: The equations created from the pictorial representations are equations involving only addition or multiplication. There are limitations to only subtracting the same number from both sides and to only dividing each side by the same number.*)
6. Distribute the Solving Equations Using Algebra Tiles Jigsaw Puzzle activity sheet. This activity requires students to model equations using algebra tiles. Students must also apply or create the algorithm based on the model. This would be a good time to discuss with students how the properties are being applied.

Assessment

- **Questions**
  - Solve the following equations using concrete or pictorial representations.
    - $-18 = 2a$
    - $x - 4 = 25$
    - $2 + x = -19$
- **Journal/Writing Prompts**
  - Explain how you can check to see whether you have solved an equation correctly.
  - Explain why the one-step equation method works.
  - Explain the importance of keeping an equation balanced.
- **Other Assessments**
  - Create a model of either an addition or subtraction one-step equation. Demonstrate and write out your process for solving. Check your solution using the algorithm.
  - Create a model of either a multiplication or division one-step equation. Demonstrate and write out your process for solving the equation. Check your solution using the algorithm.

Extensions and Connections

- Return to the Solving Equations Using Algebra Tiles Jigsaw Puzzle activity as properties of equality are taught in order for students to see the connections between concrete, pictorial, and abstract representations of one-step equations.
- Solve the following equations using concrete or pictorial representations.
  - $\frac{1}{3}y = 16$
  - $a - (-3) = 12$
  - $\frac{w}{8} = 0$
  - $15 = \frac{1}{3}p$
  - $10 = \frac{1}{5}b$

Strategies for Differentiation

- Have students use manipulatives (e.g., colored wooden blocks, two-color counters) to represent equations.
- If students work in small groups, ensure that students of varying ability are included in each group.
- Provide two to three completed examples for all four columns of the Jigsaw activity sheet for some students, if they are working independently.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

Inverse Operations

Name ______________________________________ **Date** _______________________

For each equation shown below, fill in the blank with an operation and/or number to make the equation true.

I. Addition and Subtraction

$4 - 4 + 9 =$ __________
-4 ____________ $+3 = 3$
5 ___________ $+ 20= 20$
15 ___________ $+ 25 = 25$
-45 __________ $+ 100 = 100$

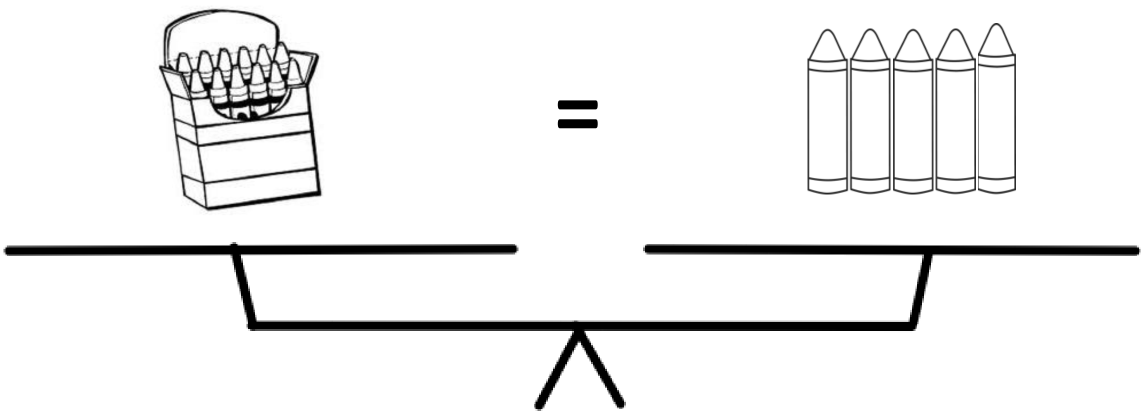
II. Multiplication and Division

$2 \div 2 \bullet 10 =$ __________
6 ____________ $\bullet -5 = -5$
5 ___________ $\div 30 = 30$
$(-8$ ___________$)25 = 25$
$\frac{100}{20}$ __________ $= 100$

Solving One-Step Equations

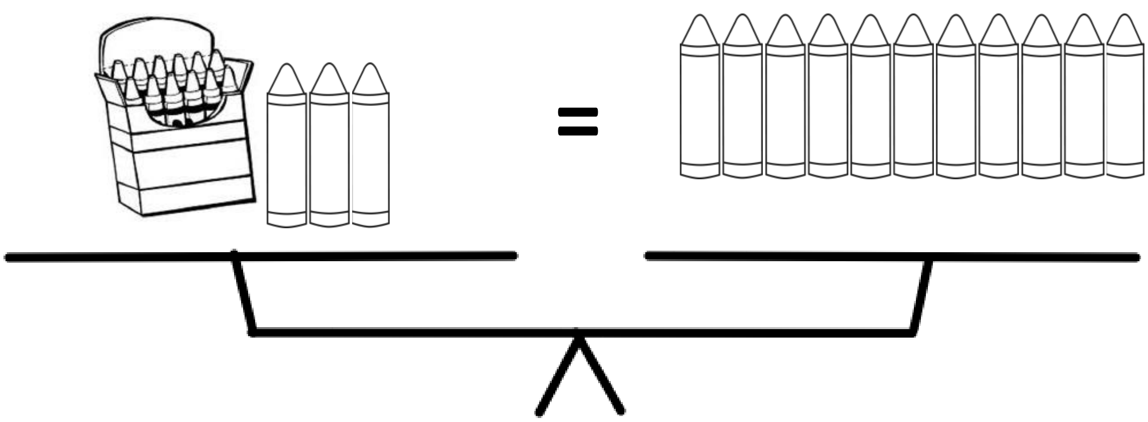
Name ________________________________ **Date** _______________________

On the following balance scales, you do not know how many crayons are in the crayon box.



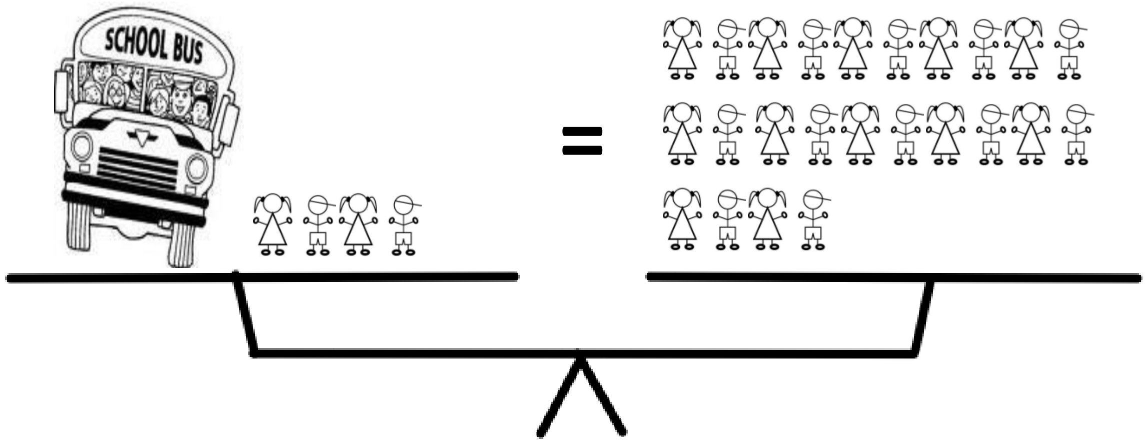
1. Write an equation to represent this balanced equation. _________________________
2. How can you determine how many crayons are in the box?

Now, try this one:



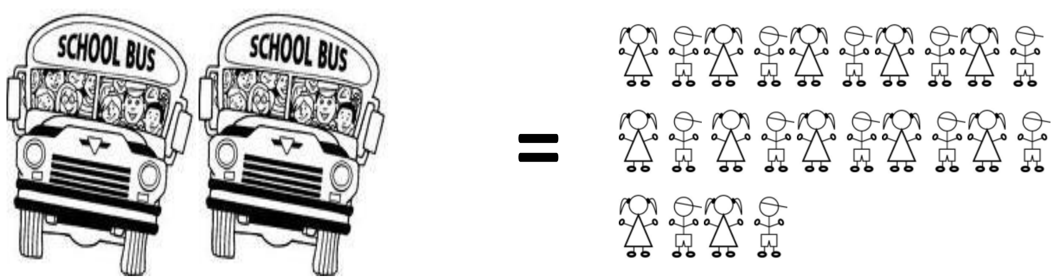
3. Write an equation to represent this balanced equation. _________________________
4. How can you determine how many crayons are in the box?

On the following balance scales, you do not know how many students are on the bus.



5. Write an equation to represent this balanced equation. ___________________________

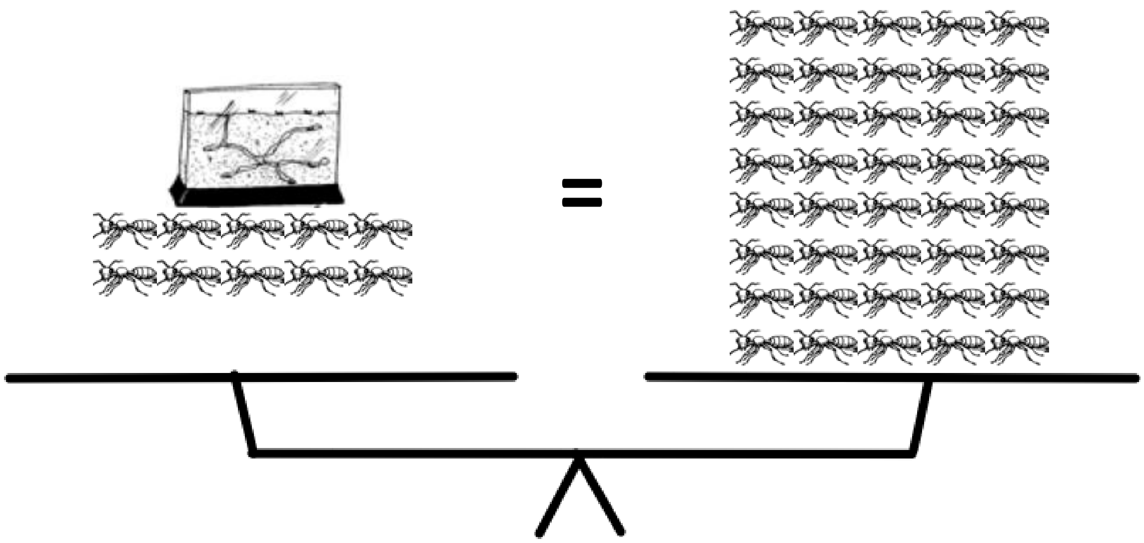
6. How can you determine how many students are on the bus?



7. Write an equation to represent this balanced equation.

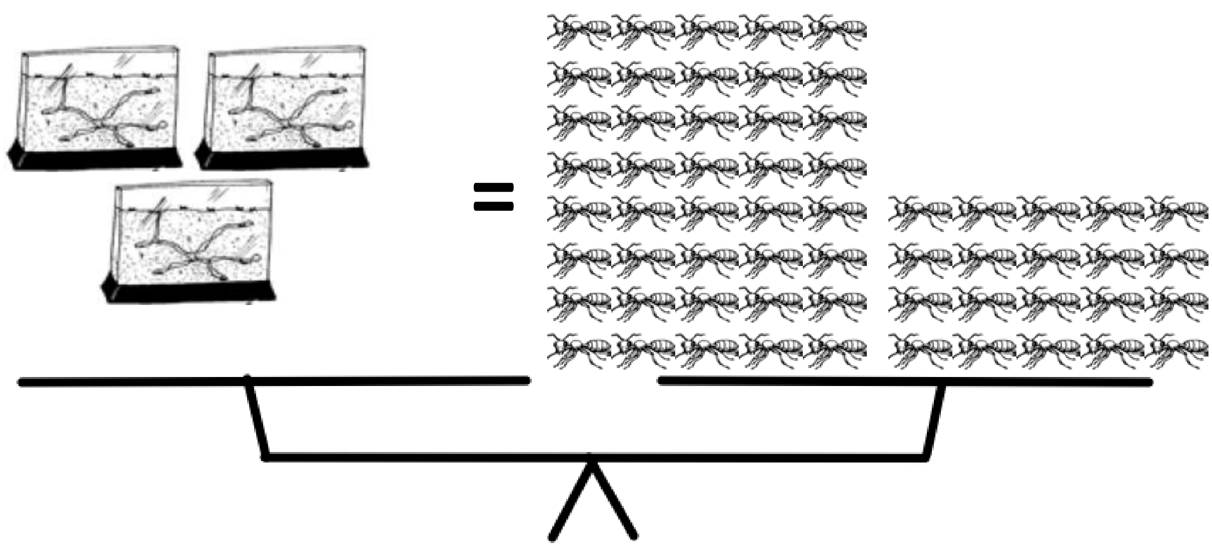
8. How can you determine how many students are on the buses?

On the following balance scales, you do not know how many ants are in the ant farm.



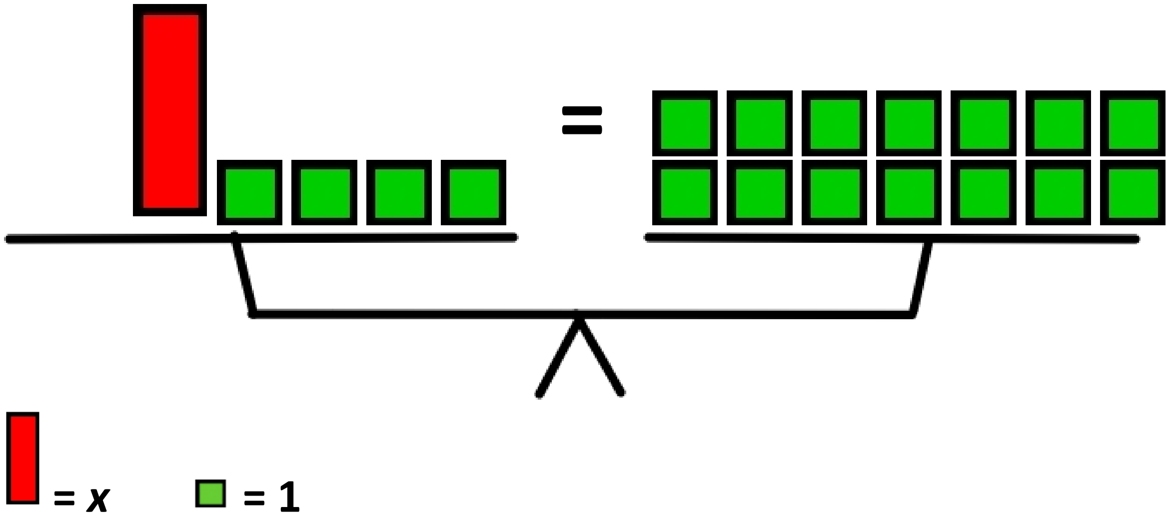
9. Write an equation to represent this balanced equation.

10. How can you determine how many ants are in the ant farm?



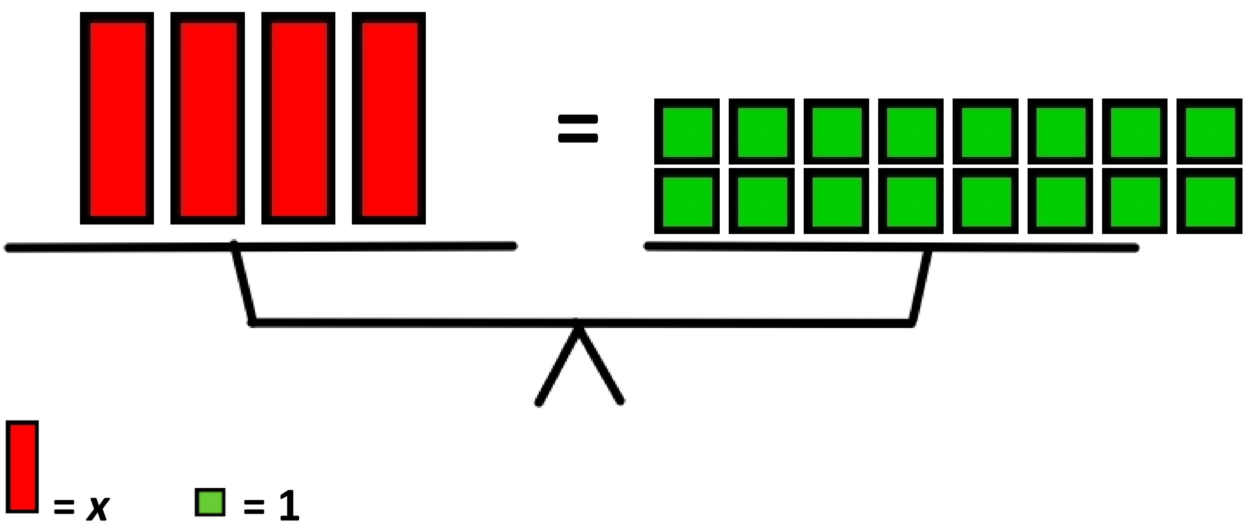
11. Write an equation to represent this balanced equation.

12. How can you determine how many ants are in the ant farms?



13. Write an equation to represent this balanced equation. ___________________________

14. How can you determine the value of the ?

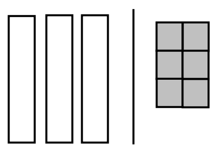


15. Write an equation to represent this balanced equation.

16. How can you determine the value of the ?

Solving Equations Using Algebra Tiles Jigsaw Puzzle

Name ___________________________________ **Date**________________________

Equation	**Tile Model Steps**	**Written Description of Procedure and Properties Used**	**Mathematical Procedure (Algorithm)**
$x + 4 = -8$			
			
		1. One negative x is equal to 5. (Given) 2. Take the opposite of each side of the equation. (_______________) 3. One x is equal to five negative units. (Solution)	
			$\begin{array}{rcr} 3 & = & 2 + x \\ \underline{-2} & & \underline{-2} \\ 1 & = & x \end{array}$