Lesson: 6.2.5 – Supplement

Solving One-Step Equations

CC Standards

6.EE.7  Solve real-world and mathematical problems by writing and solving equations of the form \( x + p = q \) and \( px = q \) for cases in which \( p, q, \) and \( x \) are all nonnegative rational numbers.

Objective

Students will… solve one-step equations using inverse operations.

Mathematical Practices

#1  Make sense of problems and persevere in solving them
#6  Attend to precision
#7  Look for and make use of structure

Teacher Input

Bellwork:  Review bellwork.
Homework:  Review important problems assigned the previous night.
Introduction:  Explore:  Start with the Cups and Counters activity (see page 2, 3).

Then proceed to the analogy between weight lifting and solving equations.  Script...

1) Today we will learn to solve equations algebraically.

2) Before we get started I wanted to show you a picture that I think will help you understand one of the new concepts that we will learn later on in the lesson.  I have a picture of a Weightlifter.  (Display picture)

3) Notice in the picture that on each side of the barbell, there are the same number of weights.  Harry Pitts the weightlifter is lifting 4 weights on each side.  Point out that there are two red weights and two yellow on each side.

4) Can anyone take a guess as to what would happen if the weightlifter tried to lift the barbell and there was 1 weight on one side and 3 weights on the other?  Possible student response:  It may throw the weightlifter off-balance and he would not be able to lift it.  If he does that too often and is able to lift it, one arm muscle may end up bigger than the other.

5) So, is it fair to say that if you add a weight to one side of the barbell, then you must add one to the other side to balance it off?  Student response:  Yes

6) What if Harry takes off a weight on one side of the barbell, what should he do to the other side to keep the balance?  Response:  Take off the same amount of weight on the other side.

7) Remembering this concept will help us solve equations.

8) As you are reviewing the steps to solving equations with the students, have them remember the weights and keeping the balance.

9) The story behind Harry Pitts:  He is an unknown Olympic weightlifter.  Since I did not know the weightlifter’s name, my students at Horn Lake Middle School decided to name him Harry for obvious reasons.  My sister began to use the image in her class at Southaven Middle and explained that HLMS students gave him his name “Harry”.  They got a big chuckle; then decided that they should give him a last name.

So, thanks to HLMS and SMS students, our weightlifter became known as Harry Pitts.

Lesson:  There is NO PowerPoint.  Review the vocabulary on page 4, and then teach via the student notes.

Practice

Classwork:  Page 7, 8
Homework:  Page 9

Closure

See closure questions on page 10.  Suggested appropriate responses on page 18 of this document.
Lesson 6.2.5 – Solving One-Step Equations

CUPS and COUNTERS

In each picture, the cup is holding an unknown number of counters, \( x \). If there is more than one cup, every cup is holding the same number of counters.

Each picture shows an equation. This picture shows \( x + 5 = 7 \). To make the two sides equal, there must be 2 counters in the cup. This means \( x = 2 \).

Work with other students to write an equation for each picture. Then find the number of counters in each cup. You can use the cups and counters at the station to help you.

1. \( \text{Equation: } \quad \text{Solution: } \)

2. \( \text{Equation: } \quad \text{Solution: } \)

3. \( \text{Equation: } \quad \text{Solution: } \)

4. \( \text{Equation: } \quad \text{Solution: } \)
Meet Harry Pitts the Weightlifter!
Vocabulary

Variable - It is a letter that stands for an unknown number.

\[ x \]

Numerical Expression - A mathematical expression built from numbers and operations.

\[ 15 + 7 \]

Algebraic Expression - A mathematical expression built from numbers, variables, and operations.

\[ x + 3 \quad \text{or} \quad 2x \]

Equation - It is a sentence that states that two mathematical expressions are equal.

\[ x + 1 = 12 \]

\[ 5x = 105 \]
Lesson 6.2.5 – Solving One-Step Equations

Section 1: New Vocabulary

**Equation** - It is a sentence that states that two mathematical expressions are equal.
Examples: \( x + 1 = 12 \)  \( 5x = 105 \)

**Inverse operations** - You solve equations using inverse operations. Inverse operations are operations that undo each other... they are opposite.

The inverse operation of **addition** is \( \underline{\text{_________}} \).
The inverse operation of **subtraction** is \( \underline{\text{_________}} \).
The inverse operation of **multiplication** is \( \underline{\text{_________}} \).
The inverse operation of **division** is \( \underline{\text{_________}} \).

Section 2: Solving Equations

When asked to solve an equation, you are being asked to find the exact value of the variable in the equation.

**Our MISSION:** Is to get the variable **alone** on one side of the equal sign!

**Key Concepts to Remember:** Whatever you do to one side of an equation, you **must** do the same to the other side! This keeps the balance!

**Example 1:** \( x + 7 = 10 \)

\[
\begin{align*}
\text{STEP 1:} & \quad \text{Find the variable.} \\
& \quad \text{What number must you remove in order to get the variable alone?}
\end{align*}
\]

\[
\begin{align*}
\text{STEP 2:} & \quad \text{Use inverse operations to cancel out the number.}
\end{align*}
\]

\[
\begin{align*}
\text{STEP 3:} & \quad \text{Do the same operation to the other side of the equal sign.}
\end{align*}
\]

\[
\begin{align*}
\text{STEP 4:} & \quad \text{Use substitution to check your answer.}
\end{align*}
\]

Check: \( x + 7 = 10 \)
\[
\begin{align*}
 & \quad 3 + 7 = 10 \\
 & \quad 10 = 10 \checkmark
\end{align*}
\]

\[
\begin{align*}
x & = 3
\end{align*}
\]

**Example 2:** \( w - 24 = 119 \)

\[
\begin{align*}
\text{STEP 1:} & \quad \text{Find the variable.} \\
& \quad \text{What number must you add to get the variable alone?}
\end{align*}
\]

\[
\begin{align*}
\text{STEP 2:} & \quad \text{Add the number to both sides of the equation.}
\end{align*}
\]

\[
\begin{align*}
\text{STEP 3:} & \quad \text{Simplify and check your answer.}
\end{align*}
\]

Check: \( w - 24 = 119 \)
\[
\begin{align*}
 & \quad 143 - 24 = 119 \\
 & \quad 119 = 119 \checkmark
\end{align*}
\]

\[
\begin{align*}
w & = 143
\end{align*}
\]
Lesson 6.2.5 – Solving One-Step Equations

**Example 3:**

\[ 5x = 15 \]

**Check:**

\[ 5x = 15 \]

\[ 5(3) = 15 \]

\[ x = 3 \]

**Example 4:**

\[ x = \frac{8}{6} \]

**Check:**

\[ x = \frac{8}{6} \]

\[ x(6) = 8 \]

\[ x = 48 \]

Solve each equation. Please show where you use inverse operations. Check your answer.

**Teacher Guided Practice**

\[ x + 165 = 512 \]

**You Try!!**

\[ x + 73 = 100 \]

\[ p - 47 = 57 \]

\[ p - 15 = 48 \]

\[ 3b = 24 \]

\[ 4b = 32 \]

\[ w = \frac{13}{9} \]

\[ w = \frac{4}{16} \]
Directions: Solve each equation. Please show where you use inverse operations. Check your answer.

### Addition and Subtraction

<table>
<thead>
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<tr>
<td>$y - 3 = 4$</td>
<td>$y + 5 = 5$</td>
</tr>
<tr>
<td>$s + 8 = 9$</td>
<td>$s - 7 = 0$</td>
</tr>
<tr>
<td>$n - 6 = 3$</td>
<td>$n + 9 = 11$</td>
</tr>
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</table>

Try these challenging ones.

- $p + \frac{3}{5} = 2$
- $y - 0.6 = 9.3$
### Multiplication and Division

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Try these challenging ones.

- $\frac{4}{5}w = 2$
- $7a = 0.21$
- $\frac{g}{3} = \frac{2}{5}$
Directions: Solve each equation. Please show where you use inverse operations. Check your answer.

1. $b + 8 = 9$
2. $s + 3 = 5$
3. $4 + q = 11$

4. $6p = 36$
5. $3z = 27$
6. $12r = 48$

7. $\frac{y}{4} = 8$
8. $\frac{b}{18} = 2$
9. $\frac{r}{7} = 10$

10. $h - 33 = 13$
11. $p - 1 = 44$
12. $36 + k = 3$
CLOSURE

Prompts/Questions

1. What are some different tools, objects, or drawings that you can use to help you solve equations?
2. What does the equal sign tell you in an equation?
3. How do you solve an equation using inverse operations?
4. How can you check your solution to an equation?
Answer Keys
CUPS and COUNTERS
Activity

In this activity, students use cups and counters to model simple one-step equations. In the given pictures, each cup is holding an unknown number of counters. Students use this idea to write the equation that is modeled by each picture. Then they use actual cups and counters, as well as logical reasoning, to help them find the unknown number of counters in each cup. This is equivalent to solving the corresponding equation.

**Answers:**
1. $x + 2 = 9, \ x = 7$;
2. $6 = x + 1, \ x = 5$;
3. $2x = 10, \ x = 5$;
4. $3x = 12, \ x = 4$

**Materials List/Set Up**

3 paper cups; 12 counters or other small objects, such as pennies or beans
Lesson 6.2.5 – Solving One-Step Equations

Section 1: New Vocabulary

**Equation** - It is a sentence that states that two mathematical expressions are equal.
Examples: \( x + 1 = 12 \) \( 5x = 105 \)

**Inverse operations** - You solve equations using inverse operations. Inverse operations are operations that undo each other... they are opposite.

The inverse operation of **addition** is _____.
The inverse operation of **subtraction** is _____.
The inverse operation of **multiplication** is _____.
The inverse operation of **division** is _____.

Section 2: Solving Equations

When asked to solve an equation, you are being asked to find the exact value of the variable in the equation.

⚠️ **Our MISSION:** Is to get the variable **alone** on one side of the equal sign!

📝 **Key Concepts to Remember:** Whatever you do to one side of an equation, you **must** do the same to the other side! This keeps the balance!

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**Example 1:** \( x + 7 = 10 \)

\[
\begin{align*}
-7 & \quad -7 \\
\hline \\
 x & = 3
\end{align*}
\]

Check: \( x + 7 = 10 \)

\[
\begin{align*}
3 + 7 & = 10 \\
10 & = 10 \checkmark
\end{align*}
\]

**Example 2:** \( w - 24 = 119 \)

\[
\begin{align*}
+24 & \quad +24 \\
\hline \\
w & = 143
\end{align*}
\]

Check: \( w - 24 = 119 \)

\[
\begin{align*}
143 - 24 & = 119 \\
119 & = 119 \checkmark
\end{align*}
\]
Lesson 6.2.5 – Solving One-Step Equations

**Example 3:** \(5x = 15\)

Check: \(5x = 15\)

\[\begin{align*}
5x &= 15 \\
5 &= 5 \\
x &= 3
\end{align*}\]

Check: \(5(3) = 15\)

\[15 = 15\]

**Example 4:** \(x = 8\)

Check: \(x = 8\)

\[\begin{align*}
x &= 8 \\
6 &= 6 \\
\frac{x}{6} &= \frac{8}{6} \\
x &= 48
\end{align*}\]

Check: \(48 = 8\)

\[8 = 8\]

Solve each equation. Please show where you use inverse operations. Check your answer.

**Teacher Guided Practice**

\[
\begin{align*}
x + 165 &= 512 \\ x &= 347
\end{align*}
\]

\[
\begin{align*}
347 + 165 &= 512 \\ 512 &= 512
\end{align*}\]

\[
\begin{align*}
p - 47 &= 57 \\ p &= 104
\end{align*}
\]

\[
\begin{align*}
104 - 47 &= 57 \\ 57 &= 57
\end{align*}\]

\[
\begin{align*}
3b &= 24 \\ b &= 8
\end{align*}\]

\[
\begin{align*}
3(8) &= 24 \\ 24 &= 24
\end{align*}\]

\[
\begin{align*}
w &= 13 \\ w &= 117
\end{align*}\]

\[
\begin{align*}
\frac{w}{9} &= 13 \\ \frac{117}{9} &= 13
\end{align*}\]

\[
\begin{align*}
\frac{w}{16} &= 4 \\ \frac{64}{16} &= 4
\end{align*}\]

\[
\begin{align*}
\frac{64}{16} &= 4 \\ 4 &= 4
\end{align*}\]

**You Try!!**

\[
\begin{align*}
x + 73 &= 100 \\ x &= 27
\end{align*}\]

\[
\begin{align*}
27 + 73 &= 100 \\ 100 &= 100
\end{align*}\]

\[
\begin{align*}
p - 15 &= 48 \\ p &= 63
\end{align*}\]

\[
\begin{align*}
63 - 15 &= 48 \\ 48 &= 48
\end{align*}\]

\[
\begin{align*}
4b &= 32 \\ b &= 8
\end{align*}\]

\[
\begin{align*}
4(8) &= 32 \\ 32 &= 32
\end{align*}\]

\[
\begin{align*}
\frac{w}{16} &= 4 \\ w &= 64
\end{align*}\]
Directions: Solve each equation. Please show where you use inverse operations. Check your answer.

### Addition and Subtraction

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<td>$s - 7 = 0$</td>
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<td>$n + 9 = 11$</td>
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Try these challenging ones.

- $p + \frac{3}{5} = 2$  
  \[ p = \frac{7}{5} \text{ or } 1\frac{2}{5} \]
- $y - 0.6 = 9.3$  
  \[ y = 9.9 \]
## Lesson 6.2.5 – Solving One-Step Equations

### Multiplication and Division

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Try these challenging ones.

\[
\frac{4}{5}w = 2 \quad 7a = 0.21 \quad \frac{g}{3} = \frac{2}{5}
\]

\[
w = \frac{5}{2} \text{ or } 2\frac{1}{2} \quad a = 0.03 \quad g = \frac{6}{5} \text{ or } 1\frac{1}{5}
\]
Lesson 6.2.5 – Solving One-Step Equations

Homework

Directions: Solve each equation. Please show where you use inverse operations. Check your answer.

1. \( b + 8 = 9 \)
\[ -8 \quad -8 \]
\[ b = 1 \]

2. \( s + 3 = 5 \)
\[ -3 \quad -3 \]
\[ s = 2 \]

3. \( 4 + q = 11 \)
\[ -4 \quad -4 \]
\[ q = 7 \]

4. \( 6p = 36 \)
\[ \frac{6}{6} \]
\[ p = 6 \]

5. \( 3z = 27 \)
\[ \frac{3}{3} \]
\[ z = 9 \]

6. \( 12r = 48 \)
\[ \frac{12}{12} \]
\[ r = 4 \]

7. \( 4 \times \frac{y}{4} = 8 \cdot 4 \)
\[ y = 32 \]

8. \( \frac{18}{18} \times b = 2 \cdot 18 \)
\[ b = 36 \]

9. \( 7 \times \frac{r}{7} = 10 \cdot 7 \)
\[ r = 70 \]

10. \( h - 33 = 13 \)
\[ +33 \quad +33 \]
\[ h = 46 \]

11. \( p - 1 = 44 \)
\[ +1 \quad +1 \]
\[ p = 45 \]

12. \( 36 + k = 3 \)
\[ -36 \quad -36 \]
\[ k = -33 \]
Lesson 6.2.5 – Solving One-Step Equations

CLOSURE

Discussion Guide
To support students in reflecting on the activities, and to gather formative information about student learning, use the following prompts to facilitate a class discussion to “debrief” the station activities.

Prompts/Questions
1. What are some different tools, objects, or drawings that you can use to help you solve equations?
2. What does the equal sign tell you in an equation?
3. How do you solve an equation using inverse operations?
4. How can you check your solution to an equation?

Think, Pair, Share
Have students jot down their own responses to questions, discuss their responses with a partner, and then discuss as a whole class.

Suggested Appropriate Responses
1. algebra tiles, cups and counters, drawings of balance scales, etc.
2. It tells you that the quantities on either side of the equation are the same.
3. Isolate the variable by applying inverse operations to both sides of the equation.
4. Substitute the value for the variable in the equation and simplify. If the solution is correct, the two sides of the equation should be equal.

Possible Misunderstandings/Mistakes
- Using an incorrect operation to solve an equation (e.g., solving $x + 3 = 12$ by adding 3 to both sides)
- Attempting to solve an equation such as $x + 4 = 9$ by subtracting $x$ from both sides
- Applying an operation that does not isolate the variable (e.g., solving $9 = 3x$ by dividing both sides by 9)