Name: **Mr. Huntley**   Date:_____ Hour:_____ **Chapter 1:**
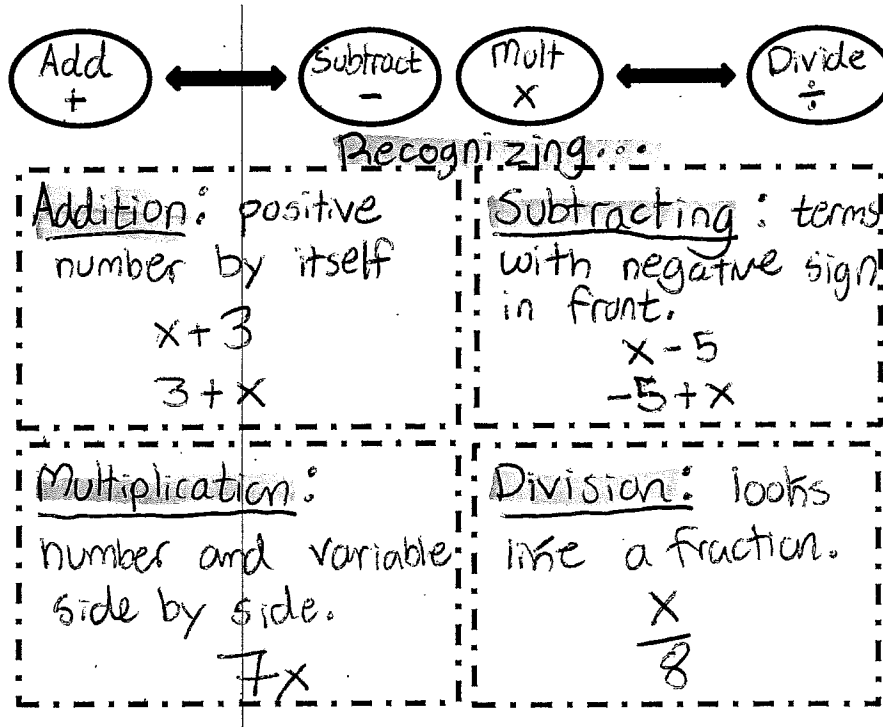**Solving Linear Equations**

1.1 Solving Simple Equations

Standards	Learning Objectives (I can...)
8.EE.7a 8.EE.7b	• Solve simple equations using addition, subtraction, multiplication, or division.

Add + ⟷ Subtract − Mult × ⟷ Divide ÷

Recognizing...

Addition: positive number by itself
$$x + 3$$
$$3 + x$$

Subtracting: terms with negative sign in front.
$$x - 5$$
$$-5 + x$$

Multiplication: number and variable side by side.
$$7x$$

Division: looks like a fraction.
$$\frac{x}{8}$$

Example 1: Solving Equations Using Addition or Subtraction

a. Solve $x - 7 = -6$

$$\frac{+7 \mid +7}{x = 1}$$

Check:
$$1 - 7 = -6$$
$$-6 = -6 \checkmark$$

b. Solve $y + 3.4 = 0.5$

$$\frac{-3.4 \mid -3.4}{y = -2.9}$$

Check: $-2.9 + 3.4 = 0.5$
$$0.5 = 0.5 \checkmark$$

c. Solve $h + 2\pi = 3\pi$

$$\frac{-2\pi \mid -2\pi}{h = \pi}$$

Check: $\pi + 2\pi = 3\pi$
$$3\pi = 3\pi \checkmark$$

On Your Own: Solve the equation and check the solution.

1. $b + 2 = -5$

$$\frac{-2 \mid -2}{b = -7}$$

2. $g - 1.7 = -0.9$

$$\frac{+1.7 \mid +1.7}{g = 0.8}$$

3. $-3 = k + 3$

$$\frac{-3 \mid -3}{-6 = k}$$

4. $r - \pi = \pi$

$$\frac{+\pi \mid +\pi}{r = 2\pi}$$

5. $t - \frac{1}{4} = -\frac{3}{4}$

$$\frac{+\frac{1}{4} \quad +\frac{1}{4}}{t = \frac{2}{4} = \frac{1}{2}}$$

6. $5.6 + z = -8$

$$\frac{-5.6 \mid -5.6}{z = -13.6}$$

Example 2: Solving Equations Using Multiplication or Division

a. **Solve** $\frac{3}{4}n = -2$

$$\frac{x \cdot \frac{4}{3} \mid x \cdot \frac{4}{3}}{n = \frac{8}{3}}$$

$$\frac{-4 \rightarrow}{3 \rightarrow} \cdot \frac{-2}{1} = \frac{8}{3}$$

b. **Solve** $\pi x = 3\pi$

$$\frac{\div \pi \mid \div \pi}{x = 3}$$

On Your Own: Solve the equation and check the solution.

7. $\frac{y}{4} = -7$

$\times 4 \mid \times 4$

$y = -28$

8. $6y = \pi x$

$6 = x$

9. $0.09w = 1.8$

$\frac{}{0.09} \quad \frac{}{0.09}$

$w = 20$

Example 3: Solving an Equation

What value of k makes the equation $k + 4 \div 0.2 = 5$ true?

Ⓐ −15   Ⓑ −5   Ⓒ −3   Ⓓ 1.5

$k + 4 \div 0.2 = 5$

$k + 20 = 5$

$-20 \mid -20$

$k = -15$

Example 4: Real-Life Application

The *melting point* of a solid is the temperature at which the solid becomes a liquid. The melting point of bromine is $\frac{1}{30}$ of the melting point of nitrogen. Write and solve an equation to find the melting point of nitrogen.

Words: The melting point of bromine is $\frac{1}{30}$ of melting point of nitrogen.

Variable: nitrogen = n

Equation:

$$-7 = \frac{1}{30}n$$

$$x\frac{30}{1} \qquad x\frac{30}{1}$$

$$\boxed{-210 = n}$$
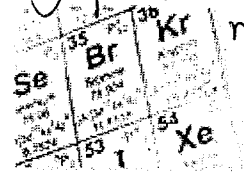
$$\frac{30}{1} \times \frac{-7}{1} = \frac{-210}{1}$$

$$\begin{array}{r} 30 \\ \times -7 \\ \hline -210 \end{array}$$

The melting point of bromine is $-7°C$.

On Your Own:

10. Solve $p - 8 \div \frac{1}{2} = -3$

$$p - 16 = -3$$
$$+16 \quad +16$$
$$\boxed{p = 13}$$

11. Solve $q + |-10| = 2$

$$q + 10 = 2$$
$$-10 \quad -10$$
$$\boxed{q = -8}$$

12. The melting point of mercury is about $\frac{1}{4}$ of the melting point of krypton. The melting point of mercury is -39 °C. Write and solve an equation to find the melting point of krypton.

Variable: Krypton = K

$$-39 = \frac{1}{4}K$$

$$x\frac{4}{1} \qquad x\frac{4}{1}$$

$$\boxed{-156 = K}$$

$$\begin{array}{r} 3 \\ -39 \\ \times \ 4 \\ \hline -156 \end{array}$$

1.2 Solving Multi-Step Equations

Standards	Learning Objectives (I can...)
8.EE.7a	• Use inverse operations to solve multi-step equations
8.EE.7b	• Use the Distributive Property to solve multi-step equations

	If "no" move on to the next step. If "yes" open that flap and follow the directions	
No	**Grouping Symbols** ( ) { } [ ]	Yes
No	**Like Terms** $8x - 2x + 3 = 4x - 5 + 6$	Yes
No	**Variables on Both Sides** $7x + 3 = 5x$	Yes
	Numbers on Both Sides $9x - 4 = 3$	Yes

Example 1: Solving a Two-Step Equation

The height (in feet) of a tree after x years is $1.5x + 15$. After how many years is the tree 24 feet tall?

$$1.5x + 15 = 24$$
$$-15 \quad -15$$
$$1.5x = 9$$
$$\frac{1.5x}{1.5} = \frac{9}{1.5}$$
$$x = 6$$

Example 2: Combing Like Terms to Solve an Equation

Solve $8x - 6x - 25 = -35$.

$$2x - 25 = -35$$
$$ +25 \mid +25$$
$$\overline{}$$
$$\frac{2x}{2} = \frac{-10}{2}$$
$$\boxed{x = -5}$$

On Your Own:

1. $-3z + 1 = 7$
$$ -1 \mid -1$$
$$\overline{}$$
$$\frac{-3z}{-3} = \frac{6}{-3}$$
$$\boxed{z = -2}$$

2. $\frac{1}{2}x - 9 = -25$
$$\phantom{\frac{1}{2}x} +9 \mid +9$$
$$\overline{}$$
$$\frac{1}{2}x = -16$$
$$\times \frac{2}{1} \mid \times \frac{2}{1}$$
$$\boxed{x = -32}$$

3. $-4n - 8n + 17 = 23$

$$-12n + 17 = 23$$
$$ -17 \quad -17$$
$$\overline{}$$
$$\frac{-12n}{-12} = \frac{6}{-12}$$
$$\boxed{n = -\frac{1}{2}}$$

Example 3: Using the Distributive Property to Solve an Equation

Solve $2(1 - 5x) + 4 = -8$.

$$2 - 10x + 4 = -8$$
$$6 - 10x = -8$$
$$-10x = -14$$
$$\frac{-10x}{-10} = \frac{-14}{-10}$$
$$\boxed{x = \frac{14}{10} = \frac{7}{5}}$$

Example 4: Real-Life Application

Use the table to find the number of miles x you need to run on Friday so that the mean number of miles run per day is 1.5.

Write an equation using the definition of mean.

Day	Miles
Monday	2
Tuesday	0
Wednesday	1.5
Thursday	0
Friday	x

$$\frac{2+0+1.5+0+x}{5} = 1.5$$

$\times 5 \qquad \times 5$

$$3.5 + x = 7.5$$
$$-3.5 \qquad -3.5$$

$$\boxed{x = 4}$$

On Your Own:

4. $-3(x+2) + 5x = -9$

$-3x + -6 + 5x = -9$

$2x + -6 = -9$
$\quad +6 \quad +6$

$2x = -3$

$\boxed{x = \frac{-3}{2}}$

5. $5 + 1.5(2d - 1) = 0.5$

$5 + 3d - 1.5 = 0.5$

$3.5 + 3d = 0.5$
$-3.5 \qquad -3.5$

$$\frac{3d}{3} = \frac{-3}{3}$$

$$\boxed{d = -1}$$

6. You scored 88, 92, and 87 on three tests. Write and solve an equation to find the score you need on the fourth test so that your mean test score is 90.

$\begin{array}{r} 88 \\ 92 \\ +87 \\ \hline 267 \end{array}$

$$\frac{88 + 92 + 87 + x}{4} = 90$$

$\times 4 \qquad \times 4$

$\begin{array}{r} 360 \\ -267 \\ \hline 93 \end{array}$

$$267 + x = 360$$
$$-267 \qquad -267$$

$$\boxed{x = 93}$$

1.3 Solving Equations with Variables on Both Sides

Standards	Learning Objectives (I can...)
8.EE.7a 8.EE.7b	• Solve equations with variables on both sides. • Determine whether equations have no solution or infinitely many solutions
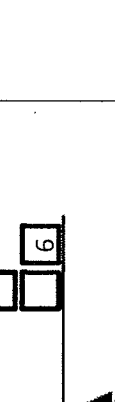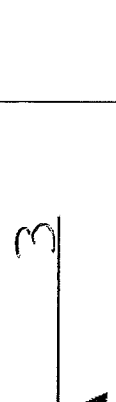
Learning Object (I can...)

- Solve equations with variables on both sides.
- Determine whether equations have no solution or infinitely many solutions

One Solution
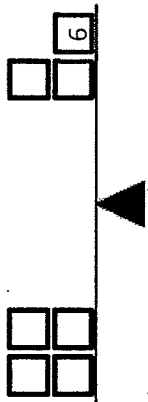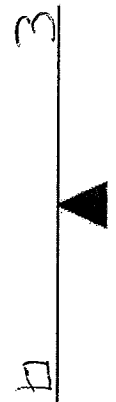
○ Only one number works

$$4x \neq 2x + 6$$
$$-2x \quad -2x$$
$$\frac{2x}{2} = \frac{6}{2}$$
$$x = 3$$

✳ $x = 3$ is the only possible answer to balance

$$\square \quad 3$$

No Solution

○ no possible number that can work

$$x + 3 \neq x + 5$$
$$-x \quad -x$$
$$3 \neq 5$$

✳ All variables are eliminated.

✳ No Solution, the scale does not balance.

$$3 \quad 5$$

Infinite Solutions

○ All numbers work

$$x + 4 \neq x + 4$$
$$-x \quad -x$$
$$4 = 4$$

✳ All variables are eliminated.

✳ Infinite Solutions, any number for the variable will work.

$$4 \quad 4$$

Example 1: Solving an Equation with Variables on Both Sides

Solve $15 - 2x = -7x$. Check your solution.

$$+2x \quad | \quad +2x$$

$$\frac{15}{-5} = \frac{-5x}{-5}$$

$$\boxed{-3 = x}$$

Example 2: Solving Equations with Variables on Both Sides

a. Solve $3(5x + 2) = 15x$.

$$15x + 6 = 15x$$
$$-15x \qquad -15x$$

$$6 \neq 0$$

$$\boxed{\text{No Solution}}$$

b. Solve $-2(4y + 1) = -8y - 2$.

$$-8y - 2 = -8y - 2$$

$$-8y = -8y$$

$$\boxed{\text{Infinite Solutions}}$$

On Your Own: Solve the equation. Check your solution, *if possible*.

1. $-3x = 2x + 19$

$$-2x \quad | \quad -2x$$

$$-5x = 19$$

$$\boxed{x = \frac{19}{-5}}$$

2. $4(1 - p) = -4p + 4$

$$4 - 4p = -4p + 4$$
$$+4p \qquad +4p$$

$$4 = 4 \qquad \boxed{\text{Infinite Solutions}}$$

3. $6m - m = \frac{5}{6}(6m - 10)$

$-x\frac{6}{1} = \frac{30}{6} = 5$

$$5m = 5m - \frac{25}{3}$$
$$-5m \quad -5m$$

$$0 \neq -\frac{25}{3}$$

$x\frac{-10}{1} = \frac{-50}{6} = \frac{-25}{3}$

$$\boxed{\text{No Solution}}$$

4. $10k + 7 = -3 - 10k$

$$+10k \qquad +10k$$

$$20k + 7 = -3$$
$$-7 \quad -7$$

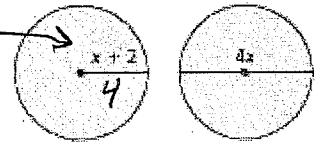$$\frac{20k}{20} = \frac{-10}{20} \qquad \boxed{k = \frac{-10}{20} = \frac{-1}{2}}$$

Example 3: Writing and Solving an Equation

$A = \pi r^2$

The circles are identical. What is the area of each circle?

Ⓐ 2   Ⓑ 4   ● 16π   Ⓓ 64π

$x + 2 = 2x$
$-x \quad\quad -x$
_____
$\boxed{2} = \boxed{x}$

$2 + 2 = 4$

$A = \pi\, 4^2$

$A = \pi 16$

$\boxed{A = 16\pi}$

Example 4: Real-Life Application

A boat travels *x* miles per hour upstream on the Mississippi River. On the return trip, the boat travels 2 miles per hour faster. How far does the boat travel upstream?

30 miles

The speed of the boat on the return trip is (*x* + 2) miles per hour.
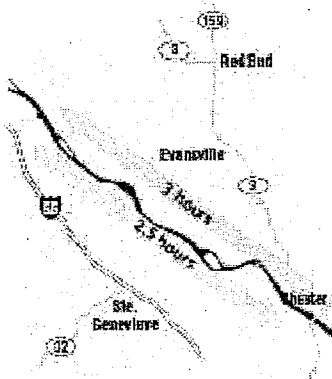
upstream = return

$3(10) = 30$

$3x = 2.5(x + 2)$

$3x = 2.5x + 5$
$-2.5x \quad\quad -2.5x$
_____
$0.5x = 5$

$\frac{1}{2}x = 5$

$\times \frac{2}{1} \quad\quad \times \frac{2}{1}$

$x = 10$

On Your Own:

5. **WHAT IF?** In Example 3, the diameter of the purple circle is 3x. What is the area of each circle?

$$X + 2 = \text{○○} \, 1.5x$$

$$2 = 0.5x$$

$$4 = x$$

$$A = \pi \, 6^2$$

$$A = \pi \, 36$$

$$\boxed{A = 36\pi}$$

6. A boat travels x miles per hour from one island to another island in 2.5 hours. The boat travels 5 miles per hour faster on the return trip of 2 hours. What is the distance between the islands?

$$2.5x = 2(x + 5)$$

$$2.5x = 2x + 10$$

$$0.5x = 10$$

$$x = 20$$

$$2.5(20) = 50$$

$$\boxed{50 \text{ miles}}$$

1.4 Rewriting Equations and Formulas

Standards	Learning Objectives (I can...)
8.EE.7	• Rewrite equations to solve one variable in terms of the other variable(s).

An equation that has two or more variables is called a ___literal equation___. To rewrite a literal equation, solve for ___one___ variable in terms of the other variable(s).

Example 1: Rewriting an Equation

Solve the equation $2y + 5x = 6$ for y.

$$-5x \quad -5x$$

$$\frac{2y}{2} = \frac{6}{2} - \frac{5x}{2}$$

$$y = 3 - \frac{5}{2}x$$

On Your Own:

Solve the equation for y.

1. $5y - x = 10$

$$+x \quad +x$$

$$\frac{5y}{5} = \frac{10}{5} + \frac{x}{5}$$

$$y = 2 + \frac{x}{5}$$

2. $4x - 4y = 1$

$$-4x \qquad -4x$$

$$\frac{-4y}{-4} = \frac{1}{-4} - \frac{4x}{-4}$$

$$y = -\frac{1}{4} + 1x$$

3. $12 = 6x + 3y$

~~Create Your Own Example:~~

$$12 = 6x + 3y$$

$$-6x \quad -6x$$

$$\frac{12 - 6x}{3} = \frac{3y}{3}$$

$$4 - 2x = y$$

Example 2: Rewriting a Formula

The formula for the surface area S of a cone is $\pi r^2 + \pi r l$. Solve the formula for the slant height l.

$$S = \pi r^2 + \pi r l$$

$$\underline{-\pi r^2 \quad -\pi r^2}$$

$$\frac{S - \pi r^2}{\pi r} = \frac{\pi r l}{\pi r}$$
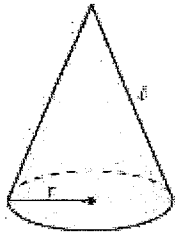
$$\frac{S - \pi r^2}{\pi r} = l$$

On Your Own:

Solve the formula for the **bold** variable.

4. Area of rectangle: $A = bh$

$$\frac{A}{h} = \frac{bh}{h}$$

$$\frac{A}{h} = b$$

5. Simple interest: $I = Prt$

$$\frac{I}{rt} = \frac{Prt}{rt}$$

$$\frac{I}{rt} = P$$

6. Surface area of cylinder: $S = 2\pi r^2 + 2\pi r h$

$$-2\pi r^2 \quad -2\pi r^2$$

$$\frac{S - 2\pi r^2}{2\pi r} = \frac{2\pi r h}{2\pi r}$$

$$\frac{S - 2\pi r^2}{2\pi r} = h$$

Key Idea

Temperature Conversion

A formula for converting from degrees Fahrenheit F to degrees Celsius C is

$$C = \frac{5}{9}(F - 32)$$

Example 3: Rewriting the Temperature Formula

Solve the temperature formula for F.

$$C = \frac{5}{9}(F - 32)$$
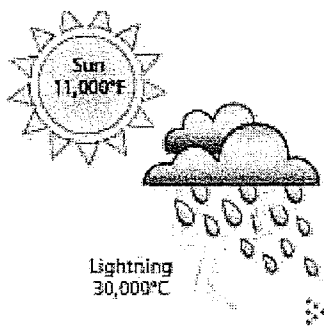
$$\times \frac{9}{5} \qquad \times \frac{9}{5}$$

$$\frac{9}{5}C = F - 32$$

$$\frac{9}{5}C = F - 32$$
$$+32 \qquad +32$$

$$\boxed{\frac{9}{5}C + 32 = F}$$

Example 4: Real-Life Application

Which has the greater temperature?

Convert celsius temp. of lightning to fahrenheit.

$$F = \frac{9}{5}C + 32$$

$$F = \frac{9}{5}(30,000) + 32$$

$$F = 54,032$$

Sun 11,000°F

Lightning 30,000°C

Lightning is hotter

On Your Own:

7. Room temperature is considered to be 70°F. Suppose the temperature is 23°C. Is this greater than or less than room temperature?

$$F = \frac{9}{5}(23) + 32$$

$$F = 73.4$$

Greater than room temp