How Do You Solve a System of Equations by Substitution?
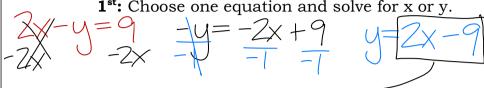
$$3x + 2y = 10$$
$$2x - y = 9$$

1ˢᵗ: Choose one equation and solve for x or y.

$$2x - y = 9$$
$$-2x \qquad -2x$$
$$-y = -2x + 9$$
$$\frac{-y}{-1} = \frac{-2x}{-1} + \frac{9}{-1}$$
$$y = 2x - 9$$

2ⁿᵈ: Substitute the expression from that equation into the other equation and solve.

$$3x + 2y = 10$$
$$3x + 2(2x - 9) = 10$$
$$3x + 4x - 18 = 10$$
$$7x - 18 = 10$$
$$+18 \quad +18$$

$$\frac{7x}{7} = \frac{28}{7}$$
$$x = 4$$

3ʳᵈ: Substitute the value found in step 2 back into the equation solved step one.

$$2x - y = 9$$
$$2(4) - y = 9$$
$$8 - y = 9$$
$$-8 \qquad -8$$

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

4ᵗʰ: Write the solution as an ordered pair.

$$(4, -1)$$

Solve the following systems using substitution.

1. $y = 4x - 9$
$y = x - 3$

$4x - 9 = x - 3$

$y = 2 - 3$
$y = -1$

$(2, -1)$

$4x = x + 6$
$-x \quad -x$

$3x = 6$
$\frac{3x}{3} = \frac{6}{3}$

$x = 2$

2. $4x + 7y = -6$
$x + 6y = -10$

$-6y \quad -6y$

$x = -6y - 10$

$4(-6y - 10) + 7y = -6$

$-24y - 40 + 7y = -6$

$-17y - 40 = -6$
$+40 \quad +40$

$-17y = 34$
$\frac{-17y}{-17} = \frac{34}{-17}$

$y = -2$

$(2, -2)$

$x + 6(-2) = -10$

$x - 12 = -10$
$+12 \quad +12$

$x = 2$

3. $4x + 2y = 10$
$x - y = 13$

$+y \quad +y$

$x = 13 + y$

$4(13 + y) + 2y = 10$

$52 + 4y + 2y = 10$

$52 + 6y = 10$
$-52 \quad -52$

$6y = -42$
$\frac{6y}{6} = \frac{-42}{6}$

$y = -7$

$(6, -7)$

$x - 7 = 13$
$+7 \quad +7$

$x = 6$

4. $y = 4x - 11$
$4x - y = 11$

$4x - (4x - 11) = 11$

$4x - 4x + 11 = 11$

$11 = 11$

$4 = 12$
No Solution

infinitely many solutions

5. Word problem

Mrs. Flips sold 300 cookies for her bake sale. She sold two types of cookies: large chocolate chip and small peanut butter cookies. She charged $1 for the chocolate chip and 50-cents for the peanut butter cookies and collected $270 total. How many of each type did she sell?

$x = $ choco chip cookies
$y = $ peanut butter cookies

$x + y = 300 \rightarrow x + y = 300$
$\qquad\qquad\qquad -y \quad -y$

$1x + 0.50y = 270$

$x = -y + 300$

$1(-y + 300) + 0.50y = 270$

$-y + 300 + 0.50y = 270$

$-0.50y + 300 = 270$
$\quad\quad -300 \quad -300$

$-0.50y = -30$
$\frac{-0.50y}{-0.50} = \frac{-30}{-0.50}$

$y = 60$ peanut butter cookies

$x + 60 = 300$
$\quad -60 \quad -60$

$x = 240$ choco chip cookies

6. Word problem

Paco's Tacos sold 280 food items from its mobile unit. Only tacos ($2 each) and burritos ($3 each) were available. It took in $660 in sales. How many tacos and how many burritos did it sell?

$x = $ tacos
$y = $ burritos

$x + y = 280 \rightarrow x + y = 280$
$\qquad\qquad\qquad -y \quad -y$

$2x + 3y = 660$

$x = -y + 280$

$2(-y + 280) + 3y = 660$

$-2y + 560 + 3y = 660$

$y + 560 = 660$
$\quad -560 \quad -560$

$X = 180$ tacos
$y = 100$ burritos

$x + 100 = 280$
$\quad -100 \quad -100$

$x = 180$

Try me

$$2x + 3y = 16$$
$$-7x - y = 20$$