

<h2>Solving Systems of Linear Equations</h2> <h3>Putting it All Together</h3>		Student/Class Goal Students thinking about continuing their academic studies in a post-secondary institution will need to know and be able to do problems on solving systems of equations.
Outcome <i>(lesson objective)</i> Students will determine the best method to use when solving systems of equation as they solve problems using graphing, substitution, and elimination/addition. They will write a system of equations when solving a mathematical situation.		Time Frame 1-2 hours
Standard <i>Use Math to Solve Problems and Communicate</i>		NRS EFL 5-6
COPS Understand, interpret, and work with pictures, numbers, and symbolic information.	Activity Addresses Components of Performance Students are practicing higher level math skills in preparation for post-secondary mathematics courses.	
Apply knowledge of mathematical concepts and procedures to figure out how to answer a question, solve a problem, make a prediction, or carry out a task that has a mathematical dimension.	As part of the classification of systems, students will look for the unknown in equations and determine if the equation is consistent, inconsistent, dependent or independent.	
Define and select data to be used in solving the problem.	Students will analyze solutions for accuracy.	
Determine the degree of precision required by the situation.	Identify variable(s) and write algebraic equations for various situations.	
Solve problem using appropriate quantitative procedures and verify that the results are reasonable.	Students will complete a quiz to determine the best method or strategy to solve systems of equations using graphing, substitution and elimination/addition.	
Communicate results using a variety of mathematical representations, including graphs, chart, tables, and algebraic models.	Turn verbal (written) story into algebraic sentence representing systems of equations, then justify answers to peers.	
Materials Graph paper Scissors, tape or glue <i>Solving Systems of Equations: Which Strategy Works Best? Solution Strategies Part 1 Handout</i> <i>Solving Systems of Equations: Which Strategy Works Best? Solving the System Part 2 Handout</i> <i>Solving Systems of Equations: Which Strategy Works Best? Answer Key Parts 1 & 2</i> <i>Solving Systems of Equations Venn Diagram</i> <i>Writing & Solving Systems of Equations Quiz</i> <i>Writing & Solving Systems of Equations Answer Key</i>		
Learner Prior Knowledge Students should be fluent in solving linear equations, integer operations, and writing algebraic equations for mathematical situations. They should have the ability to convert equations to the slope-intercept form and graph equations. They will have completed earlier lessons on systems of equations, such as <i>Solving Systems of Linear Equations Elimination</i> . Teacher Note Be sure to classify each system as consistent or inconsistent and dependent or independent.		
Instructional Activities Step 1 - Review the three strategies to solve systems of equations (graphing, substitution and elimination). Ask students for reasons why a system of equations might be easier to solve with one strategy rather than another. Step 2 - Distribute the handout, <i>Solving Systems of Equations: Which Strategy Works Best? Solution Strategies Part 1</i> . Following the directions on the handout, students will cut out the systems of equations found on the bottom of the handout. Each slip will then be placed in the solution strategy column which they feel is the best strategy to solve the system. Teacher Note There is no right or wrong answers for this activity. What is important is that students have reasons for their choices. For this activity, the systems could be written on sentence strips with magnets on the back. These strips would be distributed to the students to place on a large Venn diagram drawn on the chalk board. See illustration in the lesson. Discussion would follow each placement. This strategy would allow for systems to be "solved" by multiple techniques.		

Step 3 – Using the handout *Solving Systems of Equations: Which Strategy Works Best? Solving the System Part 2*, students will solve each system using their selected strategy. Work individually or in pairs; then share answers with the class.

Step 4 – Students will take the *Writing & Solving Systems of Equations* Quiz to evaluate the unit on Solving Systems of Linear Equations.

Assessment/Evidence *(based on outcome)*

Teacher observation of students' choices

Completed Venn diagram or chart

Completion of *Writing & Solving Systems of Equations* handout

Teacher Reflection/Lesson Evaluation

This lesson has not yet been field tested.

Next Steps

An excellent way to extend or give students more practice with systems of equations is to follow up with a lesson determining the best cell phone plan to purchase. Here are a couple places to find these lessons online: Cell Phone Plans

http://www.sedl.org/afterschool/lessonplans/index.cgi?show_record=121 or Purchase a Cell Phone with Systems of Equations

<http://www.remc11.k12.mi.us/bstpract/bpIII/066/066.PDF>.

Technology Integration

Venn Diagram Teaching Strategy http://literacy.kent.edu/eureka/strategies/venn_diagrams09.pdf

Virtual Math Lab: Intermediate Algebra http://www.wtamu.edu/academic/anns/mps/math/mathlab/int_algebra/index.htm

Yay Math <http://yaymath.org/video.html>

Purposeful/Transparent

Transitions classes focus on higher level math skills, such as solving systems of equations that will be required for college classes.

Contextual

Students will determine the best method to use when solving systems of equations as they solve problems using graphing, substitution, and elimination/addition.

Building Expertise

Students are given ample practice working in graphing, substitution, and elimination/addition of linear equations and write a system of equations when solving a mathematical situation.

Solving Systems of Equations - Which Strategy Works Best? Solution Strategies Part 1

Directions Cut out the problems found below. Decide which strategy (graphing, substitution, or elimination) is the best to solve each system. Tape or glue the system in the column under the strategy you selected. Be prepared to explain why you selected that strategy to solve the solution, including the characteristics of the system.

Graphing	Substitution	Elimination

Cut the problems below to put on chart above.

¹ $2x - y = 8$ $x + y = 4$	² $2t + 3n = 9$ $5t - 3n = 5$	³ $2x - 5y = 7$ $3x - 2y = -17$
⁴ $5a - b = -9$ $4a + 3b = -11$	⁵ $2r + s = 11$ $r - s = 2$	⁶ $y = 3 - x$ $5x + 3y = -1$
⁷ $7a + 6b = 0$ $15a - 6b = 0$	⁸ $y = 3x - 1$ $y = 2x - 5$	⁹ $2y = 8 - 7x$ $4y = 16 - 14x$
¹⁰ $2w - 3q = 8$ $3w - 7q = 7$		

Solving Systems of Equations - Which Strategy Works Best?
Solving the System Part 2

Directions Solve each system using the strategy you selected in Solution Strategies Part 1 of this activity. Show your work and the solution in each box below.

1 $\begin{aligned} 2x - y &= 8 \\ x + y &= 4 \end{aligned}$	2 $\begin{aligned} 2t + 3n &= 9 \\ 5t - 3n &= 5 \end{aligned}$	3 $\begin{aligned} 2x - 5y &= 7 \\ 3x - 2y &= -17 \end{aligned}$
4 $\begin{aligned} 5a - b &= -9 \\ 4a + 3b &= -11 \end{aligned}$	5 $\begin{aligned} 2r + s &= 11 \\ r - s &= 2 \end{aligned}$	6 $\begin{aligned} y &= 3 - x \\ 5x + 3y &= -1 \end{aligned}$
7 $\begin{aligned} 7a + 6b &= 0 \\ 15a - 6b &= 0 \end{aligned}$	8 $\begin{aligned} y &= 3x - 1 \\ y &= 2x - 5 \end{aligned}$	9 $\begin{aligned} 2y &= 8 - 7x \\ 4y &= 16 - 14x \end{aligned}$
10 $\begin{aligned} 2w - 3q &= 8 \\ 3w - 7q &= 7 \end{aligned}$		

Solving Systems of Equations - Which Strategy Works Best?

ANSWER KEY Parts 1 & 2

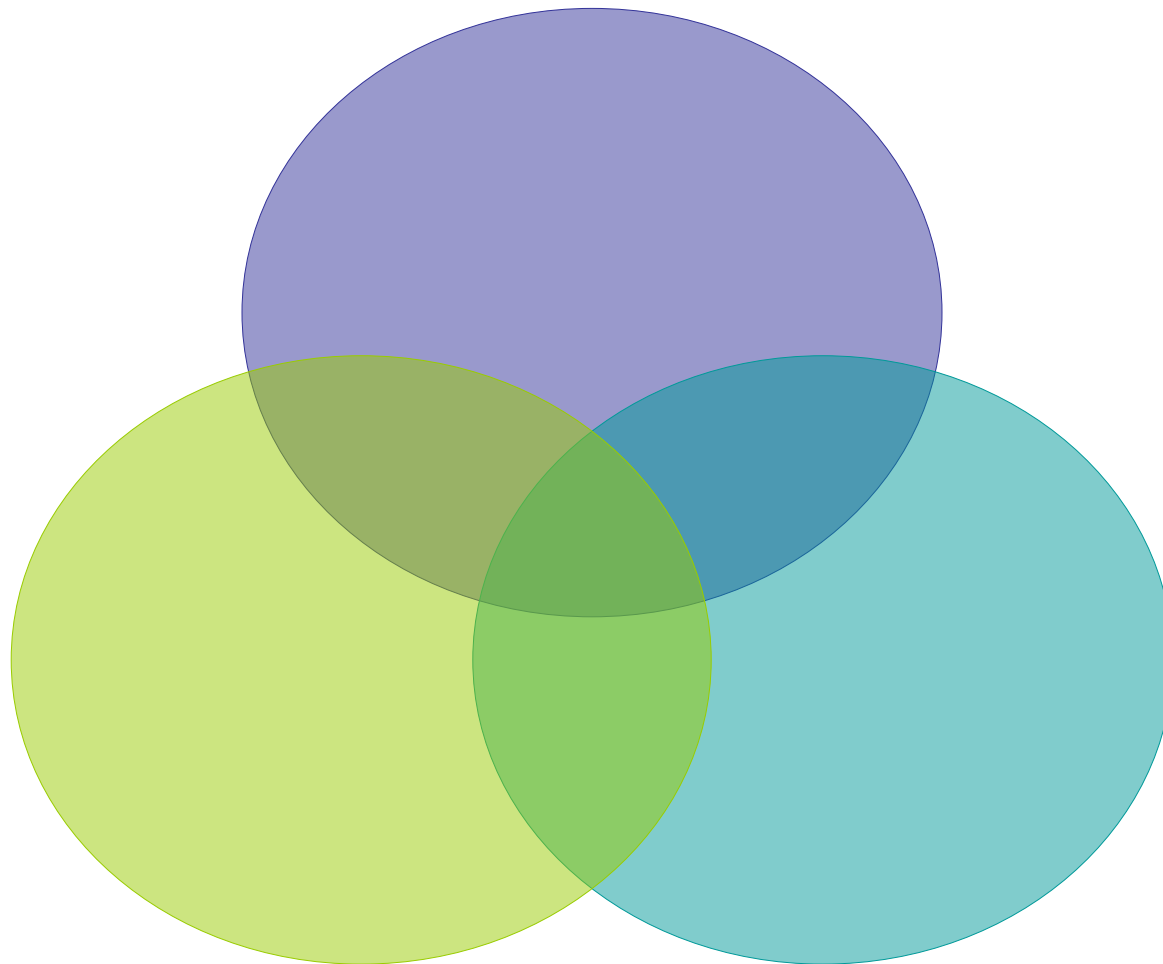
	problem	answers	possible strategy
1	$2x - y = 8$ $x + y = 4$	$x = 4$ $y = 0$	substitution elimination
2	$2t + 3n = 9$ $5t - 3n = 5$	$t = 2$ $n = 5/3$	elimination
3	$2x - 5y = 7$ $3x - 2y = -17$	$y = -5$ $x = -9$	elimination
4	$5a - b = -9$ $4a + 3b = -11$	$a = -2$ $b = -1$	elimination substitution
5	$2r + s = 11$ $r - s = 2$	$r = 4 \frac{1}{3}$ $s = 2 \frac{1}{3}$	elimination substitution
6	$y = 3 - x$ $5x + 3y = -1$	$x = -5$ $y = 8$	substitution
7	$7a + 6b = 0$ $15a - 6b = 0$	$a = 0$ $b = 0$	elimination
8	$y = 3x - 1$ $y = 2x - 5$	$x = -4$ $y = -13$	graphing substitution
9	$2y = 8 - 7x$ $4y = 16 - 14x$	no solution	graphing elimination
10	$2w - 3q = 8$ $3w - 7q = 7$	$q = 2$ $w = 7$	elimination

Solving Systems of Linear Equations Venn Diagram

Graphing

Substitution

Elimination



Writing & Solving Systems of Equations Quiz

Directions Solve each problem. Be sure to:

1. Identify the two variables in each situation
2. Write the system of equations
3. Show your work



Name _____ **Date** _____

1. The Browns scored 13 more points than the Saints. The total of their scores was 47. How many points did each team score?
2. A company produces telephones at the rate of 600 per day. A customer survey indicates that the demand for phones with built in answering machines is twice as great as the demand for phones without the machines. If you are deciding the production quota for the day, how many phones with answering machines would you schedule for production? How many without answering machines would you make?
3. Sarah is the director of the Hoonah marching band. She must order 35 new uniforms for the band. There are usually five more girls than twice the number of boys in the band. How many uniforms of each type should she order for the band?
4. Mary's children decide to run a lemonade stand to earn some extra money. The cost to start the business is \$1.20 and each cup of lemonade costs 6 cents to make. If lemonade sells for 10 cents a cup, how many cups must Mary's children sell to make a profit?
5. At the "Great Hair Barber Shop" Nita and Joe do a total of 95 haircuts each week. If Nita does 16 fewer than twice as many as Joe, how many haircuts does each person do?

6. John has 6 puppies for sale and wants to advertise them in the Cleveland Plain Dealer. To advertise in the paper there is a flat or fixed rate for the first ten words of the ad and a fixed charge for each additional word. The cost of a 17-word ad is \$14.55. The cost for a 21-word ad is \$17.15. What is the flat rate for the first 10 words and the fixed charge for each additional word?

7. You are planning a huge graduation party for your son. You decide to offer both a beef and a chicken meal at the party. The chicken dish costs \$5, and the beef dish cost \$7. There will be 250 people at the party, and the total cost of the food is \$1500. How many chicken meals will there be? How many beef meals will there be?

8. Paula needs to replace the floor in her family room since her cat peed in several places. She wants to put down both vinyl flooring and carpet in the room. The carpet she selected costs \$2 per square foot. The vinyl floor covering costs \$1 per square foot. She has \$500 to spend on materials and must cover an area of 300 square feet. How much carpet and vinyl flooring will she buy to meet her requirements?

9. A salesperson at an electronics store is given a choice of two different compensation plans. Plan A pays him a weekly salary of \$250 plus a commission of \$25 for each stereo sold. Plan B offers no salary but pays \$50 commission on each stereo sold. How many stereos must the salesperson sell to make the same amount of money with both plans? Write a paragraph answering the following questions: When is plan B the better plan? When is plan A the better plan? Which plan would you select and why?

10. ABLE Trucking Company has a job moving 21 tons of sand. The company has 8 drivers in the company and 2 types of trucks. One type of truck can haul 5 tons of sand and the other type of truck can haul 3 tons. Insurance requirements make it necessary for the trucks hauling 5 tons of gravel to have two drivers in the cab during operation. Three ton trucks require only one driver. Using all available drivers, how many trucks of each size will be needed to move the sand in one trip?

Writing & Solving Systems of Equations Quiz

ANSWER KEY

1. The Browns scored 13 more points than the Saints. The total of their scores was 47. How many points did each team score?

→ b = Browns' score; s = Saints' score

$$b + s = 47$$

$$s = 17$$

$$s + 13 = b$$

$$b = 30$$

2. A company produces telephones at the rate of 600 per day. A customer survey indicates that the demand for phones with built in answering machines is twice as great as the demand for phones without the machines. If you are deciding the production quota for the day, how many phones with answering machines would you schedule for production? How many without answering machines would you make?

→ t = regular telephones; a = phones with answering machines

$$t + a = 600$$

$$2t = a$$

$$t = 200$$

$$a = 400$$

3. Sarah is the director of the Hoonah marching band. She must order 35 new uniforms for the band. There are usually five more girls than twice the number of boys in the band. How many uniforms of each type should she order for the band?

→ b = number of boys' uniforms; g = number of girls' uniforms

$$b + g = 35$$

$$2b + 5 = g$$

$$g = 25$$

$$b = 10$$

4. Mary's children decide to run a lemonade stand to earn some extra money. The cost to start the business is \$1.20 and each cup of lemonade costs 6 cents to make. If lemonade sells for 10 cents a cup, how many cups must Mary's children sell to make a profit?

→ a = amount to break even; x = number of cups sold to break even

$$\$1.20 + \$0.06x = a$$

$$\$0.10x = a$$

$$x = 30 \text{ cups}$$

$$a = \$3.00$$

5. At the "Great Hair Barber Shop" Nita and Joe do a total of 95 haircuts each week. If Nita does 16 fewer than twice as many as Joe, how many haircuts does each person do?

→ n = haircuts by Nita; j = haircuts by Joe

$$\begin{array}{ll} n + j = 95 & j = 37 \\ 2j - 16 = n & n = 58 \end{array}$$

6. John has 6 puppies for sale and wants to advertise them in the Cleveland Plain Dealer. To advertise in the paper there is a flat or fixed rate for the first ten words of the ad and a fixed charge for each additional word. The cost of a 17-word ad is \$14.55. The cost for a 21-word ad is \$17.15. What is the flat rate for the first 10 words and the fixed charge for each additional word?

→ x = additional word rate; f = fixed cost of ad

$$\begin{array}{ll} f + (17-10)x = \$14.55 & x = \$.65 \text{ per word} \\ f + (21-10)x = \$17.15 & f = \$10 \end{array}$$

7. You are planning a huge graduation party for your son. You decide to offer both a beef and a chicken meal at the party. The chicken dish costs \$5, and the beef dish cost \$7. There will be 250 people at the party, and the total cost of the food is \$1500. How many chicken meals will there be? How many beef meals will there be?

→ b = number of beef meals; c = number of chicken meals

$$\begin{array}{ll} b + c = 250 & b = 125 \text{ meals} \\ 5c + 7b = 1500 & c = 125 \text{ meals} \end{array}$$

8. Paula needs to replace the floor in her family room since her cat peed in several places. She wants to put down both vinyl flooring and carpet in the room. The carpet she selected costs \$2 per square foot. The vinyl floor covering costs \$1 per square foot. She has \$500 to spend on materials and must cover an area of 300 square feet. How much carpet and vinyl flooring will she buy to meet her requirements?

→ c = amount of carpet flooring; v = amount of vinyl flooring

$$\begin{array}{ll} 2c + 1v = \$500 & v = 100 \text{ sq. ft.} \\ c + v = 300 & c = 200 \text{ sq. ft.} \end{array}$$

9. A salesperson at an electronics store is given a choice of two different compensation plans. Plan A pays him a weekly salary of \$250 plus a commission of \$25 for each stereo sold. Plan B offers no salary but pays \$50 commission on each stereo sold. How many stereos must the salesperson sell to make the same amount of money with both plans? Write a paragraph answering the following questions: When is plan B the better plan? When is plan A the better plan? Which plan would you select and why?

→ x = number of stereos sold; a = amount of money earned

$$\begin{aligned} 250 + 25x &= a \\ 50x &= a \end{aligned}$$

$$\begin{aligned} x &= 10 \text{ stereos} \\ a &= \$500 \end{aligned}$$

10. ABLE Trucking Company has a job moving 21 tons of sand. The company has 8 drivers in the company and 2 types of trucks. One type of truck can haul 5 tons of sand and the other type of truck can haul 3 tons. Insurance requirements make it necessary for the trucks hauling 5 tons of gravel to have two drivers in the cab during operation. Three-ton trucks require only one driver. Using all available drivers, how many trucks of each size will be needed to move the sand in one trip?

→ x = number of 5-ton trucks; y = number of 3-ton trucks

$$\begin{aligned} 5x + 3y &= 21 \\ 2(x) + y &= 8 \end{aligned}$$

$$\begin{aligned} x &= 3 \\ y &= 2 \end{aligned}$$