

Solving Systems Algebraically

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LESSON OVERVIEW

Subject(s)	Mathematics
Topic or Unit of Study	Algebra II (Honors) - Systems of Equations
Grade/Level	Grade 10
Objective	Given a system of equations (two equations), students will be able to solve for the variables using substitution or elimination.
Summary	Students will now learn how to solve a system of equations (linear system) algebraically after just learning about how to find the solution(s) of a system of equations graphically. There is only one new definition introduced in this lesson (equivalent systems), but students may need to be reminded/practice the definitions learned when graphing.

IMPLEMENTATION

Learning Context	This is the second section of the new unit/chapter linear systems. Students have just learned about graphing linear systems and the three different types of graphical solutions (one solution - independent, infinitely many solutions - dependent, no solution - inconsistent). Students have also learned the additive property of equality from a previous unit this academic year.
Teaching Strategies	Direct instruction, Whiteboards (active participation)
Time Allotment	1 class periods. 40 Mins. per class.
Sample Student Products	
Author's Comments & Reflections	This lesson is designed as the second part of a block schedule day (90 minute period). Students will learn how to graph systems of equations in the first part of the period before learning how to solve systems of equations algebraically in the last part of the class. This means that the students may need additional time and explanations as they were just introduced to systems of equations earlier in the day.

PROCEDURE

Anticipatory Set	<p><u>Interesting Fact of the Day</u></p> <p>iPhone 6 and iPhone 6 Plus preorders top 4 million in first 24 hours</p> <p>http://www.cnet.com/news/apple-iphone-6-iphone-6-plus-preorders-top-4m-in-first-24-hours/</p> <p><u>Introduction</u></p> <p>We know what linear functions are and have now learned how to graph systems of equations (or a linear system in our case). When a linear system is difficult to solve by graphing, we look for ways to solve the system algebraically.</p>
Modeling	<p>Teacher will model the two different ways of solving a system of equations algebraically (substitution and elimination).</p> <p>Substitution Method Steps (substitute teacher analogy)</p> <ol style="list-style-type: none"> 1. Pick an equation and solve for one of the variables (x or y). <--- first variable 2. Substitute the expression for the variable you just solved for (x or y) into the other equation. Solve for the other variable (y or x). <--- second variable 3. Substitute the value of the second variable (y or x) into either of the original equations. Solve for the first variable (x or y).

Substitution Method Example

Buying the 16GB iPhone 6 Plus at T-Mobile will cost you \$0 down and monthly payments of \$81.24 per month. You can choose to pay the full price of the phone up front at AT&T for \$749.99 and pay \$50 per month. After how many months will the prices be the same (within \$0.32)?

$$\begin{cases} 749.99P + 50m = 1949.99 \\ 0P + 81.24m = 1949.76 \end{cases}$$

Note: T-Mobile monthly cost is broken down into \$31.24 for the phone payment plan and \$50 for unlimited talk and text, 1GB data.

Elimination Concept

9	2		4		6		7	1
			9	3	7			
7				1				5
1	7		8		5		4	6
			1		2			
4	9		7		3		2	8
5				2				7
			6	8	1			
3	1		5		9		8	4

The goal of a sudoku is to enter in all the numbers with exactly one of each number per row, column, and square. Many people try to either enter in all of one number, say 7, to eliminate all 7s so that you don't have to worry about 7s anymore. We can look at 4s now. The same with linear systems. No more x's? Let's focus on the y's.

Elimination Method Steps (home alone analogy)

1. Look at the system of equations and identify which variable has its additive inverse in the other equation. <-- *first variable*
2. Add the two equations in the system together.
3. Solve for the other variable. <--- *second variable*
4. Select one of the original equations.
5. Substitute your second variable into that equation.

6. Solve for the first variable.

Elimination Method Example

Two students, Alice and Walter, look at two different cell phone companies to apply to work at pay off their cell phone debt. Company A gives them a \$9.50 an hour paycheck and a bonus \$30 per cell phone sold (commission). Company B pays its employees \$12.00 an hour, but they only receive a \$15 commission.

The students both apply to each company and they arrange it so that each student can pay off their debt in the same amount time and with the same amount of phones sold. Alice works for company A and needs to pay off \$734 to her parents. Walter is employed by Company B and owes \$744 to the bank. How many hours did the two students work? How many phones did they sell?

Infinite Number of Solutions

$$\begin{cases} 8x - 17y = 52 \\ -8x + 17y = -52 \\ 0 = 0 \end{cases}$$

$$\{(x,y) \mid y = 8x/17 - 52/17\}$$

No Solution

$$\begin{cases} 8x - 17y = 52 \\ -8x + 17y = 0 \\ 0 \neq 52 \end{cases}$$

Guided Practice

Students will answer questions presented by the teacher on their own portable whiteboard. After solving the question, the students will raise their whiteboard and the teacher will state whether the answer is correct or incorrect.

Independent Practice

Students will complete textbook pages 130-131, problems 1, 2, 11, 14, 15, 18, 26, 29, 31, 33, 40

Closure

Exit Ticket/Quick Check (renamed to remove student anxiety):

Directions: Solve the system any way you want algebraically.

$$\begin{cases} 3x + 4y = 32 \\ 5x - 2y = 10 \end{cases}$$

Solution: (4, 5)

Attachments:

1. [exit ticket.pdf](#) Exit ticket printout

Follow-Up

A warm-up will be given the next day. The problem will be the following:

Directions: Solve the system below using any algebraic method (substitution or elimination).

$$\begin{cases} 5x = -y \\ 10x + 4y = 60 \end{cases}$$

Answer: (-6,30)

MATERIALS AND RESOURCES

Instructional Materials

The attached handout for students who will either focus on writing down the equation or needs a handout to follow along.

Attachments:

1. [Sub&Elim Method Steps.docx](#) Printable handout

Resources

- Materials and resources:
Class set of portable whiteboards, whiteboard markers, front whiteboard, document camera, and ...

STANDARDS & ASSESSMENT

Standards

Display: Collapse All Expand All

▼ CA- California Common Core State Standards (2012)

▼ **Subject:** Mathematics

▼ **Grade:** High School

▼ **Content Area:** Algebra

▼ **Domain:**

Reasoning with Equations and Inequalities A-REI

▼ **Area:** Solve systems of equations

Standard:

6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Assessment Plan

Homework is out of 20 points. The teacher will check 5 questions and grade *each* question (worth 4 points). The 5 questions will be from different sections of the assignment to avoid grading 5 questions that are the same problem-type (example: 5 problems asking to plot a linear equation) which may not adequately represent the student's progress towards the lesson's learning goal/standard.

Assessment/Rubrics

Rubrics:

1. [Textbook Homework Rubric](#)