

Unit 7: Simultaneous Equations

Cluster: Analyze and solve pairs of simultaneous linear equations.

Nevada Academic Content Standard

What does this standard mean that a student will know and be able to do? (adapted from North Carolina 8th Grade Standards, *Unpacked Content*)

8.EE.C.8a

Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

8.EE.C.8b

Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.

8.EE.C.8c

Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through and second pair.

8.EE.8 Systems of linear equations can also have one solution, infinitely many solutions or no solutions. Students will discover these cases as they graph systems of linear equations and solve them algebraically.

Students graph a system of two linear equations, recognizing that the ordered pair for the point of intersection is the x -value that will generate the given y -value for both equations. Students recognize that graphed lines with one point of intersection (different slopes) will have one solution, parallel lines (same slope, different y -intercepts) have no solutions, and lines that are the same (same slope, same y -intercept) will have infinitely many solutions.

By making connections between algebraic and graphical solutions and the context of the system of linear equations, students are able to make sense of their solutions. Students need opportunities to work with equations and context that include whole number and/or decimals/fractions. Students define variables and create a system of linear equations in two variables.

Example 1:

1. Plant A and Plant B are on different watering schedules. This affects their rate of growth. Compare the growth of the two plants to determine when their heights will be the same.

Solution:

Let W = number of weeks

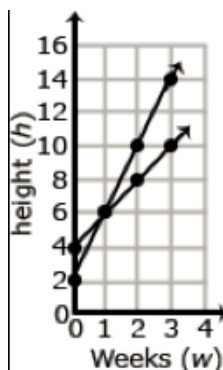
Let H = height of the plant after W weeks

Plant A		
W	H	
0	4	(0, 4)
1	6	(1, 6)
2	8	(2, 8)
3	10	(3, 10)

Plant B		
W	H	
0	2	(0, 2)
1	6	(1, 6)
2	10	(2, 10)
3	14	(3, 14)

2. Based on the coordinates from the table, graph lines to represent each plant.

Solution:



3. Write an equation that represents the growth rate of Plant A and Plant B.

Solution: Plant A: $H = 2W + 4$

Plant B: $H = 4W + 2$

4. At which week will the plants have the same height?

Solution:

$$2W + 4 = 4W + 2 \quad \text{Set height of Plant A equal to height of Plant B}$$

$$2W - 2W + 4 = 4W - 2W + 2 \quad \text{Solve for } W$$

$$4 = 2W + 2$$

$$4 - 2 = 2W + 2 - 2$$

$$\frac{2}{2} = \frac{2W}{2}$$

$$1 = W$$

After one week, the height of Plant A and Plant B are both 6 inches.

Check: $2(1) + 4 = 4(1) + 2$

$$2 + 4 = 4 + 2$$

$$6 = 6$$

Given two equations in slope-intercept form (Example 1) or one equation in standard form and one equation in slope-intercept form, students use substitution to solve the system.

Example 2:

Solve: Victor is half as old as Maria. The sum of their ages is 54. How old is Victor?

Solution: Let v = Victor's age

$$v + m = 54$$

Let m = Maria's age

$$v = \frac{1}{2}m$$

Substitute $\frac{1}{2}m$ for v in the first equation

$$\frac{1}{2}m + m = 54$$

$$\frac{3}{2}m = 54$$

$$m = 36$$

If Maria is 36, then substitute 36 into $v + m = 54$ to find Victor's age of 18.

Note: Students are not expected to change linear equations written in standard form to slope-intercept form or solve systems using elimination. For many real world contexts, equations may be written in standard form. Students are not expected to change the standard form to slope-intercept form. However, students may generate ordered pairs recognizing that the values of the ordered pairs would be solutions for the equation. For example, in the equation above, students could make a list of the possible ages of Victor and Maria that would add to 54. The graph of these ordered pairs would be a line with all the possible ages for Victor and Maria.

Victor	Maria
20	34
10	44
50	4
29	25

Approximate Time Frame: 2 - 3 weeks

Terms:

- ✓ system of linear equations
- ✓ simultaneous equations
- ✓ linear equation
- ✓ parallel
- ✓ coincident
- ✓ substitution
- ✓ elimination

Resources

- MGH – McGraw Hill, Glencoe Math (2015)
- ML – McDougal Littell, Pre-Algebra Book; Larson, 2005
- EX – Explorations in Core Math (Holt McDougal)
- MA – Massachusetts Model Curriculum Units—you will have to sign-up for 30 day permission
- NY – Engage New York
- IL – Illinois Model Math Curriculum
- MAP – Math Assessment Project (MARS)

	<i>Suggested Topics for Lessons</i>	<i>Suggested Resources</i>
<p>8.EE.C.8a 8.EE.C.8b</p>	<p>Solve systems of linear equations by graphing</p> <p>Classifying systems of linear equations as intersecting, coincident, or parallel</p> <p>SBAC Evidence:</p> <ul style="list-style-type: none"> ➤ The student estimates solutions by graphing systems of two linear equations in two variables. ➤ The student recognizes when a system of two linear equations in two variables has one solution, no solution, or infinitely many solutions. 	<ul style="list-style-type: none"> ➤ MGH 3-7 Inquiry Lab: <i>Graphing Technology – Systems of Equations</i> (pg 231) ➤ MGH 3-7 <i>Solve Systems of Equations by Graphing</i> (page 233) ➤ ML 8.8 <i>Systems of Linear Equations</i> (page 431) ➤ EX 8-6 <i>Solving Systems of Equations by Graphing</i> (page 321) ➤ EX 8-3 <i>Using Slopes and Intercepts</i> (page 305) ➤ Math Station Activities: (page 56) <i>Solve Systems by Graphing</i> ➤ MA Lesson 3: <i>Strategies for Solving Simultaneous Equations (Graphing)</i> ➤ NY Module 4 Lesson 24: <i>Introduction to Simultaneous Equations</i> ➤ NY Module 4 Lesson 25: <i>Geometric Interpretation of the Solutions of a Linear System</i> ➤ NY Module 4 Lesson 26: <i>Characterization of Parallel Lines</i> ➤ NY Module 4 Lesson 27: <i>Nature of Solutions of a System of Linear Equations</i> ➤ Learn Zillion Video Lesson: <i>Solve systems of equations that have no solution</i> ➤ Learn Zillion Video Lesson: <i>Solve systems of equations with infinite solutions</i> ➤ Learn Zillion Lesson Set: <i>Understand why solutions correspond to points of intersection</i> ➤ Learn Zillion Lesson Set: <i>Solving linear systems using models</i> ➤ Learn Zillion Lesson Plan: <i>Find the solution to a system of linear equations by looking at their graphs</i> ➤ Learn Zillion Lesson Plan: <i>Determine if a system of two linear equations with two variables has one solution by graphing</i> ➤ Learn Zillion Lesson Plan: <i>Determine if a system of two linear equations in two variables has no solution by graphing</i> ➤ Learn Zillion Lesson Plan: <i>Determine if a system of two linear equations in two variables has infinitely many solutions...</i> ➤ Learn Zillion Lesson Plan: <i>Predict the number of solutions for a system of two linear equations in two variables by inspection</i>
<p>8.EE.C.8b</p>	<p>Solve systems of linear equations by substitution</p> <p>SBAC Evidence:</p> <ul style="list-style-type: none"> ➤ The student solves a system of two linear equations in two 	<ul style="list-style-type: none"> ➤ MGH 3-8 <i>Solve Systems of Equations by Graphing</i> (page 243) ➤ EX 7-4 <i>Systems of Equations</i> (page 277) ➤ MA Lesson 4: <i>Strategies for Solving Simultaneous Equations (Substitution)</i> ➤ Learn Zillion Video Lesson: <i>Solve systems of equations using substitution</i> ➤ Learn Zillion Lesson Plan: <i>Solve a system of equations in slope-intercept form by using substitution</i> ➤ Learn Zillion Lesson Plan: <i>Solve a system of equations in different forms using substitution</i>

	variables algebraically.	➤ MAP: <i>Classifying Solutions to Systems of Equations</i>
8.EE.C.8c	<p>Analyze and solve problems leading to two linear equations in two variables in multiple representations</p> <p>SBAC Evidence:</p> <ul style="list-style-type: none"> ➤ The student solves real-world and mathematical problems leading to two linear equations in two variables. 	<ul style="list-style-type: none"> ➤ MGH 3-8 Inquiry Lab: <i>Analyze Systems of Equations</i> (pg 251) ➤ EX 8-6 <i>Solving Systems of Equations by Graphing</i> (page 323,327-330) ➤ EX 7-4 <i>Systems of Equations</i> (page 279, 282-288) ➤ NY Module 4 Lesson 29: <i>Word Problems</i> ➤ NC Lessons for Learning (page 23): <i>Cookie Calorie Conundrum</i> ➤ Dan Meyer Three Acts: <i>Playing Catch Up</i> ➤ Tap into Teen Minds Three Acts: <i>Thick Stacks</i> ➤ Illustrative Math Task: <i>8EE Summer Swimming</i> ➤ Illustrative Math Task: <i>8EE Quinoa Pasta 1</i> ➤ MAP: <i>Solving Real-Life Problems: Baseball Jerseys</i> ➤ MAP: <i>Task—Buying Chips and Candy</i>