[**Lesson Title:** Special Systems of Linear Equations

Unit Title: Systems of Linear Equations

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Subject, Grade Level, and Date: Excel Algebra- 2/18/16

Placement of Lesson in Sequence

This lesson is the second lesson in the Systems of Linear Equations unit. The students were just introduced to systems of equations where the lines intersect, what they are, what they represent, what their solution represents, and how to solve them using graphs and tables. In this lesson sequence we will be focusing mainly on systems of equations that have one solution and what the various ways to solve them are. In the previous lesson, students learned to solve solving systems of equations by graphing and creating a table. In this lesson, we will focus on the various types of systems of linear equations and how you can tell if they have a solution by looking the lines produced through graphing. Students will discover that if the lines are parallel there are no solutions, if the lines are the same there are an infinite number of solutions, and if the lines are intersecting they have one solution.

Central Focus and Essential Questions

This lesson is a continuation on the introduction to systems of linear equations. At the beginning of class for the warm up, I will have 5 students volunteer to come up to the front of the class and walk. The first 2 students will be asked to stand at opposite ends of the classroom and walk towards each other, the next two will walk in the same direction at the same pace with one student a few feet in front of the other, and the 5th student will be asked to just walk while the class imagines that they are giving someone a piggy back ride. This exercise will be used as a segue into introducing the three types of systems of linear equations. During the lecture, I will model for the students how to determine what type of system of linear equations you are working with and thus how many solutions it has by manipulating the equations so that they end up in slope-intercept form. Students will be asked to assist me as I work towards the solution by telling me what my next step will be and what the outcome will be. This will give the students the opportunity to refresh their algebra skills. Students will then be given a worksheet that asks them to classify 5 systems of linear equations.

Content Standards

CCSS.MATH.CONTENT.8.EE.C.8- Analyze and solve pairs of simultaneous linear equations.

CCSS.MATH.CONTENT.8.EE.C.8.B- 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*.

Learning Outcomes	Assessment
Students will be able to: • classify systems of linear equations algebraically	The formative assessment for this lesson will be students telling me what my next step and what the outcome will be as I manipulate the equations of the example systems of equations on the overhead during the lecture. The students will also identify the slopes and y-intercepts of the equations and using that

	information combined with the definitions they've received to classify what type of system it is. Based on the answers I get from the students, I will be able to tell how many of them understand the classification process and are good to move on or if I need to do more example problems. The students will also be assessed based on performance on the worksheet and personal communications as they complete the worksheet. The performance assessment questions assess if the student can correctly classify the given systems of equations algebraically. The personal communication assessment will assess the students' use of vocabulary. The summative assessment for this lesson will be students' exit tasks.

Learning Targets	Student Voice
▪ I can determine whether systems of equations are consistent or inconsistent. ▪ I can determine whether systems of equations are dependent or independent. ▪ I can identify how many solutions a system of linear equations has.	Students will have to justify how the answers on their worksheet are correct by showing and explaining that based on the slopes and y-intercepts they can determine if the lines are intersecting, parallel, or coinciding.

Prior Content Knowledge and Pre-Assessment

Students have experience with systems of equations. They know how to solve for the solution by graphing the system or creating tables and comparing. Students should be able to take a given equation and put it into slope intercept form. Nevertheless, some students still have not fully mastered this skill. The students do not usually ask for help if they get stuck on a problem, rather they get up from their desk and walk around the classroom or talk to their neighbors. For this reason, I tried to come up with an easy to follow procedure for determining what type of system of linear equations you are working with by looking at the slopes and y-intercepts that I will model during the lecture portion of the lesson.

Vocabulary Academic Language Demands		
Vocabulary & Symbols	**Language Function**	**Precision, Syntax & Discourse**
• systems of linear equations • intersecting lines • parallel lines	• Students will be able to justify if the system of equations has one solution, no solution, or infinite	**Mathematical Precision:** Students must correctly identify the type of system of linear equations they have

• coinciding lines • slope intercept form • consistent • inconsistent • independent • dependent	solutions. • Students will be able to explain each step of their solutions for determining the slopes and y-intercepts of the lines and justify how based off of that information they know their answer is correct.	been presented with as well as justify their answer through the steps discussed in the lecture portion of the lesson. Students must also be able to explain how they know their solution is correct by graphing the system if asked to do so. **Syntax:** Students must have both equations in slope intercept form before they identify the type of system. Students must also show their intermediate steps when they are manipulating the given equations in order to get them into slope intercept form. **Discourse:** The problems will be posed on the worksheet and solved individually. The students will have to use the correct terminology in their person communications with me as they complete the worksheet. The students will also have to use the correct terminology when explaining to me what the next step is as I work through the example problems in front of the class during the lecture.

Language Target	Language Support	Assessment of Language Target
Using the correct terms and vocabulary, I can share how I identified the type of system of linear equation I had by finding and comparing the slopes and y-intercepts of both equations. I can also explain how I knew solutions the system of linear equations has based on what type of lines I would get if I graphed it.	Model and Explain how to classify systems of linear equations using the correct terms. Discuss how we will be using previous terms such as slope, y-intercept, and slope intercept form in our steps as we manipulate the equations in the given systems of linear equations.	Part of the formative assessment is the personal communications of their process for manipulating the equations in the given systems of equations and how they classified such systems using the language of the lesson.

Lesson Rationale (Connection to previous instruction and Objective Standards)

In the previous lesson, students were introduced to systems of equations and how to solve a system of equations through graphing and through using tables. In the lesson, students will discover how you can tell if the systems have one solution, no solutions, or an infinite number of solutions and the corresponding terms.

Differentiation, Cultural Responsiveness and/or Accommodation for Individual

To accommodate for the diverse levels of mathematical abilities, the students will work individually on the worksheet as the teacher walks around the classroom to provide help when needed.

Materials – Instructional and Technological Needs (attach worksheets used)

Special Systems of Linear Equations

Objectives:
- Determine whether systems of equations are consistent or inconsistent.
- Determine whether systems of equations are dependent or independent.

When you graph a systems of linear equations there are three possible outcomes:

- _____ lines
- _____ lines
- _____ lines

Important Definitions:

If a system of equations has at **least one solution**, it is _____.
If a system of equations has **no solutions**, it is _____.
If a system of equations has **only one solution**, it is _____.
If all of the solutions of a system of equations are the same (meaning there are **infinite solutions**), the system is _____.

Applying the Definitions:

Intersecting lines mean the system is _____.
Parallel lines mean the system is _____.
Coinciding lines mean the system is _____.

Determining what type of system of linear equations you have:

Example 1

$y = 3x - 10$
$y = -2x + 5$

Example 2

$4x + 3y = 0$
$6y + 8x = 0$

Example 3

$3y - 6x = 10$
$y = 2x - 3$

Activity

State whether each system is

a. Consistent and independent
b. Consistent and dependent
c. Inconsistent

1) $y = 3x - 1$
$y = x + 3$

2) $3x + y = 2$
$-5y = -3x - 28$

3) $3y - x = 1$
$3y = x + 21$

4) $x = 2y - 6$
$-3x + 6y = 18$

5) $2x + y = 6$
$y = -2x + 1$

Exit Task

1) Fill in the blanks:

In this system, the graphs intersect and there is/are _____ solution(s).
In this system, the graphs are parallel and there is/are _____ solution(s).
In this system, the graphs coincide and there is/are _____ solution(s).

2) Sketch examples of the following:

A consistent and independent system.
A consistent and dependent system.
An inconsistent system.

Name: Answer Key
EXCEL Algebra

Special Systems of Linear Equations

Objectives:
- Determine whether systems of equations are consistent or inconsistent.
- Determine whether systems of equations are dependent or independent.

When you graph a systems of linear equations there are three possible outcomes:

- intersecting lines
- parallel lines
- coinciding lines

Important Definitions:

If a system of equations has at **least one solution**, it is consistent.

If a system of equations has **no solutions**, it is inconsistent.

If a system of equations has **only one solution**, it is independent.

If all of the solutions of a system of equations are the same (meaning there are **infinite solutions**), the system is dependent.

Applying the Definitions:

Intersecting lines mean the system is consistent and independent.

Parallel lines mean the system is inconsistent.

Coinciding lines mean the system is consistent and dependent.

Name:
EXCEL Algebra

Answer Key

Determining what type of system of linear equations you have:

Example 1

$y = 3x - 10$ Slope = 3 ; y-int = -10
$y = -2x + 5$ Slope = -2 ; y-int = 5

These lines have different slopes so they intersect.

Therefore the system is consistent and independent.

Example 2

$4x + 3y = 0$
$6y + 8x = 0$

$4x + 3y = 0$
$-4x \quad -4x$
$\frac{3y}{3} = \frac{-4x + 0}{3}$
$y = -\frac{4}{3}x + 0$

$6y + 8x = 0$
$-8x \quad -8x$
$\frac{6y}{6} = \frac{-8x + 0}{6}$
$y = -\frac{8}{6}x + 0$
$y = -\frac{4}{3}x + 0$

Slope = $-\frac{4}{3}$; y-int = 0
Slope = $-\frac{4}{3}$; y-int = 0

These are the same line because they have the same slope and y-intercept.

Therefore the system is consistent and dependent.

Example 3

$3y - 6x = 10$
$y = 2x - 3$

$3y - 6x = 10$
$+6x \quad +6x$
$\frac{3y}{3} = \frac{6x + 10}{3}$
$y = \frac{6}{3}x + \frac{10}{3}$
$y = 2x + \frac{10}{3}$

Slope = 2 ; y-int = $\frac{10}{3}$
slope = 2 ; y-int = -3

These lines have the same slope but different y-intercepts so they are parallel.

Therefore the system is inconsistent.

Name:
EXCEL Algebra

Answer key

Activity

State whether each system is

a. Consistent and independent
b. Consistent and dependent
c. Inconsistent

(a) 1) $y = 3x - 1$
$y = x + 3$

slope = 3; y-int = -1
slope = 1; y-int = 3

different slopes
intersecting lines

(a) 2) $3x + y = 2$
$-5y = -3x - 28$

$3x + y = 2$
$-3x \quad -3x$
$y = -3x + 2$

$\frac{-5y}{-5} = \frac{-3x - 28}{-5}$
$y = \frac{3}{5}x + \frac{28}{5}$

slope = -3; y-int = 2
slope = $\frac{3}{5}$; y-int = $\frac{28}{5}$
different slopes
intersecting lines

(c) 3) $3y - x = 1$
$3y = x + 21$

$3y - x = 1$
$+x \quad +x$
$\frac{3y}{3} = \frac{x+1}{3}$
$y = \frac{1}{3}x + \frac{1}{3}$

$\frac{3y}{3} = \frac{x+21}{3}$
$y = \frac{1}{3}x + 7$

slope = $\frac{1}{3}$; y-int = $\frac{1}{3}$
slope = $\frac{1}{3}$; y-int = 7
same slopes, different y-ints.
parallel lines

(b) 4) $x = 2y - 6$
$-3x + 6y = 18$

$x = 2y - 6$
$+6 \quad +6$
$\frac{x+6}{2} = \frac{2y}{2}$
$\frac{1}{2}x + 3 = y$

$-3x + 6y = 18$
$+3x \quad +3x$
$\frac{6y}{6} = \frac{3x+18}{6}$
$y = \frac{1}{2}x + 3$

slope = $\frac{1}{2}$; y-int = 3
slope = $\frac{1}{2}$; y-int = 3
same slopes, same y-ints.
coinciding lines.

(c) 5) $2x + y = 6$
$y = -2x + 1$

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

slope = -2; y-int = 6
slope = -2; y-int = 1
same slopes, different y-ints
parallel lines

Name: Answer Key
EXCEL Algebra

Exit Task

1) Fill in the blanks:

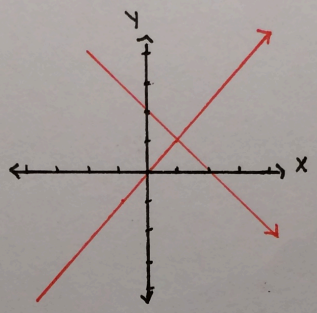
In this system, the graphs intersect and there is/are one solution(s).

In this system, the graphs are parallel and there is/are no solution(s).

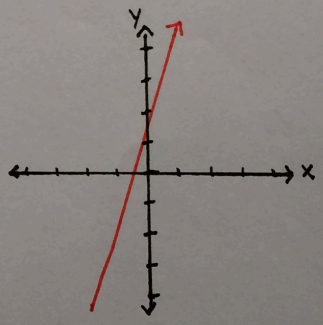
In this system, the graphs coincide and there is/are infinite solution(s).

2) Sketch examples of the following:

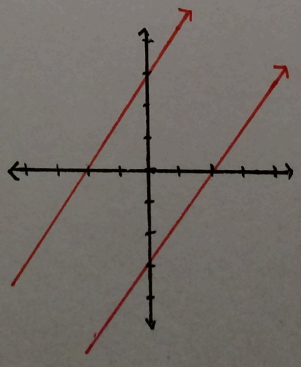
* A consistent and independent system



* A consistent and dependent system



* An inconsistent system



*Sketches should look similar to these shown.

Measure achievement of learning targets

Scoring Rubrics for Worksheet:

Performance Assessment:

Guided Notes Rubric (6 possible participation points)

Introduction: worth 1 participation point	
+1 point	All blanks are filled in with correct answers
+0 points	Wrote nothing
Definition Section: worth 2 participation points	
+2 point	All blanks are filled in with correct answers
+1 point	Most blanks are filled in with correct answers
+0 points	Wrote nothing
Example 1: worth 1 participation points	
+1 point	Example done correctly
+0 points	Wrote nothing
Example 2: worth 1 participation point	
+1 point	Example done correctly
+0 points	Wrote nothing
Example 3: worth 1 participation point	
+1 point	Example done correctly
+0 points	Wrote nothing

Activity Rubric (15 possible points)

Problem 1-5: worth 3 points each	
+2 point	Both equations are in slope intercept form
+1 point	Correctly identified the type of system
-½ point	Did not show work
-½ point	Computational errors

Exit Task Rubric (6 possible points)

Problem 1: worth 3 points	
3 points	Answered all 3 parts correctly
2 points	Answered 2 parts correctly
1 point	Answered 1 part correctly
0 points	Did not attempt or no correct answers
Problem 2: worth 3 points	
3 points	Answered all 3 parts correctly
2 points	Answered 2 parts correctly
1 point	Answered 1 part correctly
0 points	Did not attempt or no correct answers

Communication Assessment:

Above Target	Student is able to explain and justify their solutions to the problems and able use the correct language.
Hit Target	Student is able to explain and justify their solutions to the problems. However their use of language does not quite meet the language target. For example, they at first misidentify the type of system the

	given system of linear equations is but correct themselves without prompting.
Below Target	Student is unable to explain and justify their solutions to the problems and unable to use the correct language with or without prompting.

Teaching & Instructional Activities			
Time	**Teacher Activity**	**Student Activity**	**Purpose**
Before	• Teacher asks for 5 volunteers.	• 2 students will be asked to stand at opposite ends of the classroom and walk towards each other, • The next 2 students will walk in the same direction at the same pace with one student a few feet in front of the other. • The 5th student will be asked to just walk while the class imagines that they are giving someone a piggy back ride.	• This will be used as a segue into introducing the three types of systems of linear equations. The teacher will draw comparisons between intersecting line with the 2 students who crossed paths, parallel lines with the two students who walked in the same direction at the same pace just a few feet apart, and coinciding lines with the students giving someone a piggyback ride.
Lecture	• Teacher will start going through the guided notes section of the packet where they will first introduce the three different types of systems of linear equations and the corresponding vocabulary used to identify the 3 types of systems. • Next the teacher will model how to determine what type of system it is by putting the two equations in to slope intercept form and	• Students will take notes by filling in the blanks appropriately and copying and following along as the teacher models how to identify the type of system.	• To give students the definitions of new vocabulary and how to apply it. • To give students examples to call back upon as they complete the worksheet portion of the packet.

	then comparing the slopes and y-intercepts.		
Activity	• Teacher hands out worksheet. • Teacher walks around the room and monitors student progress and asks leading questions when needed. • Teacher assesses students' use of language as they walk around the classroom observing the students. • Example question: How could you determine if you answer for question 1 is correct?	• Students start working on the worksheet individually or in small groups. • Example Answer: I could graph the system of linear equations and show that the lines intercept.	• To give students the opportunity to practice working with and manipulating different forms of linear equations as well as identifying what type of system the given system of linear equations is algebraically.
Exit Task	• Teacher hands out worksheet.	• Students complete the exit task individually.	• To give the teacher an idea of which students understood or are on their way to understanding the lesson and which students need more time. It also can be used to identify common misconceptions.