Monmouth University

School of Education

Department of Curriculum and Instruction

**Unit Plan: Introduction to Linear Equations**

**Teacher Candidate’s Name:** Timothy Behan

**Context:**

This lesson is designed for an 8th grade general education math classroom. The classroom has one student with ADHD and one student with a specific learning disorder (dyscalculia). The development of the lesson has been guided by UDL principles. In the anticipatory set, students are asked if they have ever been on a plane before. The purpose of this is to “optimize relevance, value, and authenticity” in the lesson by relating the virtual field trip to the students’ previous knowledge and experiences (Hall, Meyer, and Rose, 2012, p. 19). The rest of the procedures are also influenced by UDL. In addition to producing a traditional problem set, students also will create a presentation about what they learned through the virtual field trip. This provides the students with multiple means of expression, another UDL principle (Hall, Meyer, and Rose, 2012). In the guided practice portion of the lesson, the teacher will make sure to decode the meaning of the symbols being used, explicitly writing out the meaning of the variables in the equations needed to solve the problem (Hall, Meyer, and Rose, 2012). Lastly, the teacher will provide multiple representations during the guided and independent practice, drawing pictures of scenarios and graphs when applicable, so students are not just seeing equations. Illustrating concepts with different representations gives students a deeper understanding of a problem, since they can make connections between these different representations (Hall, Meyer, and Rose, 2012).

To enhance the lesson, connections have been made to the local community. For instance, as the virtual field trip deals with air traffic control, a link to a live feed from the control tower at Newark Liberty Airport has been provided to give students a feel for what a day in the life of an air traffic controller entails. As mentioned above, the anticipatory set encourages students to share stories about their experiences with airplanes, helping them to make connections between their experiences outside of the classroom and the virtual field trip.

**Unit Title:** Introduction to Linear Equations

**Lesson Title:** The Slope of a Line

**Tentative Date:** 11/14/16

**Duration:** 45 minutes

**Standards (NJCCCS, CCSS, NJPST, and/or CEC):**

**NJCCCS 8.EE.B.5**: Graph proportional relationships, interpreting the unit rate as the slope of the graph. ~~Compare two different proportional relationships represented in different ways. For~~

~~example, compare a distance-time graph to a distance-time equation to determine which of~~

~~two moving objects has greater speed.~~

**NJPST 8.5:** Teachers assist students individually or as a member of a group to access, evaluate, synthesize and use information effectively to accomplish a specific purpose.

1. **Learner Outcomes (goals) & Assessments (include informal and formal):**
2. **Enduring Understanding:** Students will understand the slope is the measure of the steepness of a line.
3. **Essential Questions:** What is the slope of a line?

How can the slope of a line be calculated?

How can the value of the slope be interpreted?

1. **Learner Outcome:** Students will be able to interpret the meaning of the slope of a line and the y-intercept of a line.

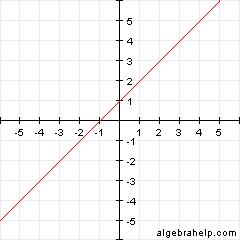
Students will be able to calculate the slope of a given line.

1. **Assessments:**

**Informal:** Students will take part in a discussion of slope based on their previous experiences. After the topic of slope has been introduced, the teacher will listen to students’ answers for the slope of the hill or mountain they have been on and evaluate whether they are able to interpret slope. The students will also turn in a worksheet where they answer questions related to slope. The teacher will provide feedback on these worksheets, leaving feedback to help students identify their weaknesses.

**Formal:** The following questions related to slope will be asked on unit test at the end of the unit:

1. What does the slope of a line represent?
2. What is the slope of the line graphed below? Explain how you found your answer.



1. **Procedures (include anticipatory set, procedure, guided practice, and independent practice):**

**Anticipatory Set:**

This lesson will introduce students to the idea of the slope of a line, a measure of how steep the line is. The lesson will begin with a task where students are asked to recall a time they were on a steep hill or mountain. What number do they think they would use to describe how steep it was? The students will have a few minutes to talk about this with a partner. Then the teacher will ask several students to take a guess and record these on the whiteboard next to the student’s name.

**Guided Practice:**

The teacher will then introduce the notion of slope through examples on graph paper and using Desmos, an online graphing calculator software. In the first example, the teacher will graph on graph paper a line with a slope of three. The teacher will begin by placing one point on the graph, then show how a slope of three means for every one value the line increases in the x direction, the point must go up three places in the y direction. Similarly, with the Desmos example, the teacher will show an example of a line with a slope of ten. The teacher will make sure to mention that this slope value represents a unit rate, meaning that it tells students how much the y value must change for every one change in x. After this introduction, students will be paired and asked to revisit their guesses for how steep the mountain was. Do their numbers make sense based on what they’ve just learned about slope? The inspiration for this activity comes from a lesson titled Understanding Slope: A Key Concept in Algebra, Graphing, and Applied Rates (“Understanding Slope,” 2016). The teacher will lead a discussion where the groups revise their initial guesses based on what they now know about slope. The teacher will make sure the students answers are precise and mention the units of distance. The teacher will record these new values and ask the students to explain their reasoning. After this activity is complete, the teacher will extend the idea of slope to examples where the change in x is not one. The teacher will do this using an example of a line with a slope of 3/2. In this case, the slope can be thought of as the ratio of the rise (change in y values between two points) over the run (change in x values between two points). The teacher will model how to calculate the slope using two points on the line.

**Independent Practice:**

After this activity, students will be given the opportunity to practice what they’ve learned. Students will work together to calculate the slopes of lines given two points on the line. They will also be asked to come up with two points that would create a line of a given slope. The questions which will be asked are:

1. Find the slope of the line passing through (1, 3) and (-2, 2).
2. Find the slope of the line passing through the origin and (20, 7).
3. Give an example of a pair of points on a line with a slope of 3.

This activity will be collected at the end of class to serve as an informal assessment of the lesson.

1. **Accommodations for diverse learners and students with special needs (include suggested adaptive and assistive tech/software/web-supported learning with specific skill areas):**

The student in the class with ADHD will be given access to voice-to-text software to aid his writing (Raskind & Stanberry, 2016). The student often has difficulties putting ideas down on paper, so this modification should allow him to organize his thoughts for his presentation. The student with dyscalculia will be given a calculator that can find distance from the website vcalc to assist with making calculations during the problem solving portion of the lesson. The distance calculator provides an explanation of the meanings of the variables in the equation and helps the student to plug the proper values (“Math tools,” 2016).

1. **Modifications for students with disabilities (none may be needed so just note that in this section with your rationale):**

Since the students in the class will be able to complete the lesson with the help of the accommodations above, no modifications are necessary.

1. **Materials:**

**Student Materials**

* Pencil and paper
* Independent work worksheet
* To enhance learning (these materials will be available on vftbehan.weebly.com for students who need extra practice or wish to reinforce their knowledge of slope):
  + <http://www.mathwarehouse.com/algebra/linear_equation/interactive-slope.php> (a link to an interactive slope visualization)
  + <https://www.khanacademy.org/math/algebra-basics/alg-basics-graphing-lines-and-slope/alg-basics-slope/v/slope-of-a-line> (a Khan academy video that explains slope)

**Teacher Materials**

* Whiteboard and markers
* Smartboard
* Desmos software (linked on vftbehan.weebly.com)

**Unit Title:** Introduction to Linear Equations

**Lesson Title:** Graphing Lines in Slope-Intercept Form

**Tentative Date:** 11/14/16

**Duration:** 45 minutes

**Standards (NJCCCS, CCSS, NJPST, and/or CEC):**

**NJCCCS 8.F.A.3:** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line. ~~Give examples of functions that are not linear. For example, the function A = s2 giving the area of a square as a function of its side length is not linear because its graph contains the points~~

**NJPST 6.12:** Teachers engage in activities to prepare students for and monitor independent and group work that allows for full and varied participation of all individuals.

**NJPST 4.6:** Identify and design instruction appropriate to students’ stage of development, learning styles, strengths and needs;

1. **Learner Outcomes (goals) & Assessments (include informal and formal):**
2. **Enduring Understanding:** Students will understand that a linear equation provides information that can be used to sketch a graph of the line.
3. **Essential Questions:** How can a line be graphed?
4. **Learner Outcome:** Students will be able to graph a linear equation expressed in slope-intercept form.
5. **Assessments: Informal:** During the cooperative learning activity, the teacher will walk from group to group, asking students questions and listening to their responses to gauge their understanding.

**Formal:** Each individual student will turn in a completed worksheet at the end of class which has their responses to the questions asked during the group activity. The teacher will grade these responses.

1. **Procedures (include anticipatory set, procedure, guided practice, and independent practice):**

**Anticipatory Set:**

To review the content from the previous day’s lesson, the teacher will put a graph of the line y = 2/3x on the whiteboard. Students will be asked to find the slope of the line and explain their thinking. After working independently to answer the problem, the teacher will call on one student to come up to the board to answer the problem and describe his or her thought process. This activity will ensure the concept of slope is fresh in students’ minds, which will be crucial for the cooperative learning activity that take up the remainder of the lesson.

**Procedure:**

After this review activity, the teacher will introduce the day’s lesson. The teacher will explain how students will work on a cooperative learning activity where they will discover properties of the equations of lines. The teacher will hand out a worksheet (see page 30 in the appendix for this worksheet) and break the students into predetermined groups of four to complete the activity. Each group is designed to include both advanced and struggling learners. The class’s ELL student will be placed in a group with a student who speaks his native language and English fluently. The diversity of the groups will help foster positive interdependence, since each member of the team will have strength and weaknesses that they bring to the table. Working together, the students will be able to accomplish more than they would individually. The teacher will also hand each individual student a graphing calculator, which they will need to complete the activity. The teacher will explain that students are to work together to complete this activity. The teacher will provide students with direct instruction that this means that students should compare their graphs with their partners and then work through the questions together. Where a difference of opinion arises, students should talk about their reasons for their answers and reach a consensus or, if that is not possible, record their answers on their sheet separately. This also will help with individual accountability, since students are responsible for agreeing with everything they put on their paper.

This activity is based on Learn NC’s Investigating Linear Equations activity (Jarman, 2016). Before beginning the activity, the teacher will make sure to do a brief review of how a graphing calculator can be used to graph equations and how to examine these graphs using the features of the calculator. Students will find these skills helpful as they work on the activity.

In the activity, students are first asked to graph several lines with different constants added to the end of the equation in their graphing calculators and notice the differences between the graphs. The students should notice that the y-intercepts of the graphs correspond to the constant added at the end of the equation. The questions then ask the students apply their new knowledge to write equations for lines with the same slope as the ones they graphed but with a different y-intercept. The students will then complete similar sets of questions using their graphing calculator. The first investigates negating equations, the next varying the slope, and last combining these two changes. While students are working on these exercises together, the teacher will circle the room and monitor, making sure that students are discussing the problems together to facilitate team processing.

The final aspect of the group activity asks questions that have the students combine what they have learned to determine what the m and b correspond to in linear equations of the form y = mx + b. The students will complete this final activity in their group, then hand in the worksheet. To conclude the lesson, the teacher will lead a discussion about linear equations of the form y = mx + b, asking the students to describe what m and b represents and explain how they knew. The teacher will explain that linear equations in the y = mx + b form are in what is called slope intercept form.

1. **Accommodations for diverse learners and students with special needs (include suggested adaptive and assistive tech/software/web-supported learning with specific skill areas):**

The student in the class with ADHD will be given access to voice-to-text software to aid his writing (Raskind & Stanberry, 2016). The student often has difficulties putting ideas down on paper, so this modification should allow him to organize his thoughts for his presentation. The student with dyscalculia will be given a calculator that can find distance from the website vcalc to assist with making calculations during the problem solving portion of the lesson. The distance calculator provides an explanation of the meanings of the variables in the equation and helps the student to plug the proper values (“Math tools,” 2016).

1. **Modifications for students with disabilities (none may be needed so just note that in this section with your rationale):**

Since the students in the class will be able to complete the lesson with the help of the accommodations above, no modifications are necessary.

1. **Materials:**

**Student Materials**

* Cooperative learning worksheet (link available on vftbehan.weebly.com)
* Graphing calculators (TI-83)
* Graph paper

**Teacher Materials**

* Whiteboard
* Link to review website containing video (for this lesson plan and all lessons in this unit review links will be added to vftbehan.webly.com for students to try independently as needed): <http://www.mathwarehouse.com/algebra/linear_equation/slope-intercept-form.php>
* Slope-intercept form applet (for review):

<http://www.mathwarehouse.com/algebra/linear_equation/slope-intercept-applet.php>

**Unit Title:** Introduction to Linear Equations

**Lesson Title:** Point-Slope and Standard Forms of a Line

**Tentative Date:** 11/16/16

**Duration:** 45 minutes

**Standards (NJCCCS, CCSS, NJPST, and/or CEC):**

**NJCCCS 8.F.A:** Define, evaluate, and compare functions.

**NJPST 3.9:** Use strategies to support the learning of students whose first language is not English.

1. **Learner Outcomes (goals) & Assessments (include informal and formal):**
2. **Enduring Understanding**: Students will understand that a line can be represented in an equation in multiple ways.
3. **Essential Questions:** What information do I need to put an equation in point-slope form?

How can I graph lines in point-slope form or standard form?

**Learner Outcome:** Students will be able to interpret lines in point-slope and standard form.

Students will be able to graph lines in point-slope and standard form.

1. **Assessments:**

**Informal assessment:** The teacher will ask students questions to gauge their understanding throughout the lesson. The students will participate in a think-pair-share activity to assess students’ abilities to turn an equation in point-slope form to standard form and to explain their method. The teacher will observe students as they play the game activity at the end of the lesson to gauge their understanding of point-slope form.

**Formal:** During the end of unit test, students will be asked the following questions:

1. Write the equation for the line that passes through (1, 1) and (2,2) in point-slope form, then use this equation to express the line in slope-intercept form.
2. Is this line in standard form? Explain why or why not:

2x + 1/2y = 0

1. **Procedures (include anticipatory set, procedure, guided practice, and independent practice):**

**Anticipatory Set:**

The lesson will begin with a do now to review the topic of slope-intercept form. The teacher will put up two equations representing lines in slope-intercept form and will ask students to work independently to identify the slope and y-intercept of the two equations. They will also be asked to graph each line. After working independently, the teacher will ask for two volunteers to put their work on the board and explain their answers. The teacher will ask follow up questions as necessary.

**Procedure:**

After this activity is complete, the teacher will introduce the idea that equations of lines can be represented in more than one way. The teacher will explain that another way to write the equation of a line is called point-slope form, so called because all that’s needed to write the line in this form is the slope of the line and a point on the line. The teacher will write out the general form of an equation in point-slope form, and explain that, like with slope-intercept form, the m represents the slope of the line. The teacher will explain how and represent the y and x coordinate of a point on the line. After this introduction to the topic, the teacher will present students with a point on a line and its slope and ask the students to write out the equation of the line in point-slope form. The teacher will call on a student to write out the correct equation and explain his or her reasoning. After the correct equation has been written out, the teacher will pose the question “how could be express the same equation in slope-intercept form?” to students and lead a think-pair-share activity where students think about how they would do this, talk with a partner, then share their findings with the whole class. There are a number of ways students could accomplish this (graphically or algebraically) and the teacher will make sure that groups who used different methods have a chance to share their methods.

After this, the teacher will introduce the final form, standard form, where an equation of a line is written as for integers A, B, and C. The teacher will use the example to show how algebra can be used to express an equation of a line in standard form by rearranging the equation to get the variables on one side and the constants on another, then multiplying both sides by any denominators to make sure that the values for A, B, and C are whole numbers, not fractions.

**Independent Work**

After this, the students will participate in a game to solidify their knowledge of forms of a line. The activity, which will be done online with quizlet, asks students to identify the form that an equation of a line is in, to identify a given value in an equation, or to graph a given line. The link to this game can be found here: <https://quizlet.com/167711166/flashcards>.

1. **Accommodations for diverse learners and students with special needs (include suggested adaptive and assistive tech/software/web-supported learning with specific skill areas):**

The student in the class with ADHD will be given access to voice-to-text software to aid his writing (Raskind & Stanberry, 2016). The student often has difficulties putting ideas down on paper, so this modification should allow him to organize his thoughts for his presentation. The student with dyscalculia will be given a calculator that can find distance from the website vcalc to assist with making calculations during the problem solving portion of the lesson. The distance calculator provides an explanation of the meanings of the variables in the equation and helps the student to plug the proper values (“Math tools,” 2016).

1. **Modifications for students with disabilities (none may be needed so just note that in this section with your rationale):**

There are no modifications needed for the students in this class. My rationale for this is that none of the students in the class have disabilities that require a modification of the curriculum. With the assistance of the accommodations, these students will have the supports that they need to fully participate in the lesson.

1. **Materials:**

**Student Materials**

* Graph paper
* Graphing calculator
* Chromebook (to access game)
* Link to game (available on vftbehan.weebly.com)
* Line equation graphic organizer

**Teacher Materials**

* Whiteboard and marker
* (links below are also posted on vftbehan.weebly.com) Point-slope form review website: <https://www.mathsisfun.com/algebra/line-equation-point-slope.html>
* Point-slope review video: <https://www.khanacademy.org/math/algebra-home/alg-linear-eq-func/alg-point-slope/v/idea-behind-point-slope-form>
* Standard form review website: <http://www.virtualnerd.com/algebra-1/linear-equation-analysis/point-slope-standard-form/standard-form-examples/write-linear-equation-standard-form-slope-point>

**Unit Title:** Introduction to Linear Equations

**Lesson Title:** Solving Linear Equations of One Variable

**Tentative Date:** 11/17/16

**Duration:** 45 minutes

**Standards (NJCCCS, CCSS, NJPST, and/or CEC):**

**NJCCCS 8.EE.C.7.a:** Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).

**NJPST 5.4:** Analyze student performance using multiple sources of data, and to modify future plans and instructional techniques that promote desired student learning outcomes.

1. **Learner Outcomes (goals) & Assessments (include informal and formal):**

**Enduring Understanding:** Students will understand that a linear equation can have exactly one solution, no solution, or infinitely many solutions

**Essential Questions**: How can I solve a linear equation of one variable?

What does the solution of a linear equation mean?

When will a linear equation have one solution, no solutions, or infinitely many solutions?

1. **Learner Outcome:**

Students will be able to analyze linear equations of one variable to determine whether they have one solution, infinitely many solutions, or no solution.

1. **Assessments:**

**Informal Assessments:** Students will work independently to determine the number of solution an equation has. During this time, the teacher will observe the students, asking questions and listening to their responses to assess their thinking. Towards the end of class, the teacher will use clicker technology to assess student understanding of the lesson. The students will answer two multiple choice questions on their clickers dealing with identifying the number of solutions a linear equation has.

**Formal Assessment:** On the end of unit test, the following questions will be asked:

1. How many solutions does this equation have? Explain how you know:

2x + x + 3 = 3x

1. How many solutions does this equation have? List the possible solutions:

2(x +3) = 33 - x

1. **Procedures (include anticipatory set, procedure, guided practice, and independent practice):**

**Anticipatory Set:**

The students will be asked to think about the following questions: what value for x makes 2x + 6 = 2x? After thinking about the question for a few minutes the teacher will ask several students for their thinking and how they got their answer. The students should realize that no value of x will solve the equation, since the 2x term appears on both sides, but it is having six added to it on one side. Clearly a number cannot be equal to six more than that same number! The teacher will explain that this will lead into today’s topic, which is how to recognize whether a linear equation has one solution, no solutions, or infinitely many solutions. Students have previously seen how to solve these equations, but they may not have been aware that it was possible for them to have no solution.

**Guided Practice**:

This portion of the lesson is based on a lesson developed by WCCUSD (“Solving Linear Equations,” 2015). The teacher will pass out a series of graphic organizers the students will use to take notes. These materials, also from WCCUSD, are available in the appendix at the end of the unit plan on pages 33 and 34. The teacher will explain that linear equations can have either one solution, no solution, or infinitely many solutions. The linear equations the students have worked with before have all had one solution, which could be found using algebra. But some equations, like the example the students worked with at the beginning of class have no solution. The teacher will explain, with an example from the graphic organizer, that this occurs when algebraic manipulation of the equation leads to something of the form a = b. The teacher will pose the question, “why does it make sense that something of this form would have no solution?” to the students and call on a student to provide an explanation.

After working through this example, the teacher will explain that some linear equations have infinitely many solutions, meaning that any value of x will satisfy the equation. The teacher will ask, “if an equation with no solution simplifies to a = b, what do you think an equation with infinitely many solutions will simplify to?” Then the teacher will call on a student to explain it should be able to simplify to a = a, since the equation should always be true. The teacher will then show how to solve one of these equations from the graphic organizer. After this, students will be given times to try three problems themselves to solve and check. The teacher will call three students up to the board to show their work on these problems.

Now the teacher will break students up into groups to play a game. In this game, students will be asked to take a group of index cards with linear equations on them put them into groups, one for the equations with one solution, one for equations with infinitely many solutions, and one for equations with no solution. The equations can be found in the appendix. The teacher will go from group to group during this time and monitor the groups to assess their learning. When the groups are finished, the teacher will lead a discussion where the teams share their findings. After this is complete, the teacher will ask two questions of the students using a clicker to assess their understanding. The questions are:

1. How many solutions does x + 3 = x – 2 have?
   1. One solution
   2. No solution
   3. Infinitely many solutions
   4. Two solutions
2. How many solutions does 5x + 3 - 2 = 2x + 1 + 3x?
   1. One solution
   2. Three solutions
   3. Infinitely many solutions
   4. No solution

**Accommodations for diverse learners and students with special needs (include suggested adaptive and assistive tech/software/web-supported learning with specific skill areas):**

The student in the class with ADHD will be given access to voice-to-text software to aid his writing (Raskind & Stanberry, 2016). The student often has difficulties putting ideas down on paper, so this modification should allow him to organize his thoughts for his presentation. The student with dyscalculia will be given a calculator that can find distance from the website vcalc to assist with making calculations during the problem solving portion of the lesson. The distance calculator provides an explanation of the meanings of the variables in the equation and helps the student to plug the proper values (“Math tools,” 2016). ELL students will benefit from the graphic organizer note taking guides that will be handed out during the guided practice and independent practice portions of the lessons.

1. **Modifications for students with disabilities (none may be needed so just note that in this section with your rationale):**

There are no modifications needed for the students in this class. My rationale for this is that none of the students in the class have disabilities that require a modification of the curriculum. With the assistance of the accommodations, these students will have the supports that they need to fully participate in the lesson.

1. **Materials:**

**Student Materials**

* Graphic organizers for note taking (link on vftbehan.weebly.com)
* Index cards with equations
* Clickers

**Teacher Materials**

* Whiteboard
* Clicker software
* (links below available at vftbehan.weebly.com) Review website: <http://www.purplemath.com/modules/solvelin.htm>
* Game for review: <http://www.math-play.com/Two-Step-Equations-Game.html>

**Unit Title:** Introduction to Linear Equations

**Lesson Title:** Solving Systems of Equations Using Substitution

**Tentative Date:** 11/18/16

**Duration:** 45 minutes

**Standards (NJCCCS, CCSS, NJPST, and/or CEC):**

**NJCCCS 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.~~

**NJPST 4.6:** Teacher engages in activities to identify and design instruction appropriate to students’ stage of development, learning styles, strengths and needs.

1. **Learner Outcomes (goals) & Assessments (include informal and formal):**
2. **Enduring Understanding:** Students will understand that the solution to a system of equations is the point where the graphs of the equations intersect.
3. **Essential Questions:** How can I solve a system of equations?

What does a solution to a system of linear equations mean graphically and algebraically?

When will a system of linear equations have no solution or infinitely many solutions?

1. **Learner Outcome:** Students will be able to solve systems of linear equations of two variables using the substitution method.

Students will be able to interpret the meaning of the solution of a system of equations graphically and algebraically

1. **Assessments:**

**Informal Assessment:** As students work in small groups to solve systems of equations, the teacher will observe their work and ask questions to prompt students to explain their reasoning. The groups will present answers to questions at the board. Students will also work on a question independently. While the students are working on this, the teacher will observe their work. The teacher will collect this sheet and assess students’ work for accuracy.

**Formal Assessment:** At the end of the unit, the following questions will be asked on the test:

1. Use substitution to solve this system:

2x – 3y = –2

4x + y = 24

1. How many solutions does this system have? Explain your answer.

y = 2x + 3

2y -4x = 6

1. **Procedures (include anticipatory set, procedure, guided practice, and independent practice):**

**Anticipatory Set:**

The teacher will pose the question to the students, “what does it mean for an equation to have a solution?” One student will provide the answer that the solution is the value that makes both sides of the equation equal to each other. Then the teach will ask students, “based on that, what do you think it means for a system of equations (more than one equation) to have a solution?” The teacher will give the students some time to think, then ask several students for their opinion. If no group is able to answer the question, the teacher will explain that a solution to a system of equations is a point that will make both equations true.

**Guided Practice:**

After this question, the teacher explains that we will be investigating systems of equations further during class today. On the smartboard, the teacher will pull up three systems of equations that have been graphed in Desmos. The systems are:

Y=-X

Y=X+ 4

2Y=2X  
Y-X=0

Y=3/2 X +1  
Y=3/2X + 3

This activity has been developed based on a lesson from Cpalms (“Solving Systems,” 2015). The first system is an example of a system with one solution, the second with infinitely many, and the third is an example of parallel lines with no solution. The students will be broken up into small groups to work on this activity. Based on their responses to the questions at the beginning of the class, the groups will be given 10 minutes to try to find a way to solve these three systems. During this time the teacher will circulate from group to group, providing feedback on methods or asking questions to draw out thinking for groups that are having trouble. After this ten-minute period, the teacher will bring the groups back together. Starting with the first group, the students will be asked to explain how they solved the problems. The teacher will let the student discussion guide the class. If not group ends up discovering the substitution method, the teacher will ask the students if they could solve for on expression for one of the variables and if they could think how this might be helpful. This should help lead them towards the method. The students should also notice that the second system will have infinitely many solutions, since both equations represent the same line, and the third system will have no solution. The teacher will ask if the students can think of a rule to tell when a system will have no solution, allowing students to realize that a system of parallel lines will not have a solution, since the lines do not intersect.

**Independent Practice**

After the whole class has discussed using the substitution method for all three problems, the teacher will give the students another problem to work on, this time independently using the substitution method. The problem, again from Cpalms, is the system y=-3x+3 and y=2x-7 (“Solving Systems,” 2015). The teacher will again go from group to group, asking questions to assess student thinking and providing assistance to groups that need it. After the students have completed this example, the teacher will have a volunteer present their work at the front of the board.

**Accommodations for diverse learners and students with special needs (include suggested adaptive and assistive tech/software/web-supported learning with specific skill areas):**

The student in the class with ADHD will be given access to voice-to-text software to aid his writing (Raskind & Stanberry, 2016). The student often has difficulties putting ideas down on paper, so this modification should allow him to organize his thoughts for his presentation. The student with dyscalculia will be given a calculator that can find distance from the website vcalc to assist with making calculations during the problem solving portion of the lesson. The distance calculator provides an explanation of the meanings of the variables in the equation and helps the student to plug the proper values (“Math tools,” 2016).

1. **Modifications for students with disabilities (none may be needed so just note that in this section with your rationale):**

There are no modifications needed for the students in this class. My rationale for this is that none of the students in the class have disabilities that require a modification of the curriculum. With the assistance of the accommodations, these students will have the supports that they need to fully participate in the lesson.

1. **Materials:**

**Student Materials**

* Paper and pencil

**Teacher Materials**

* Desmos (linked at vftbehan.weebly.com)
* Smartboard
* Whiteboard
* (Review links posted to vftbehan.weebly.com) Review video: <https://www.khanacademy.org/math/8th-engage-ny/engage-8th-module-4/8th-module-4-topic-d/v/the-substitution-method>
* Review game: <http://reviewgamezone.com/games3/taxi.php?test_id=10643&title=Substitution%20Method>
* Review website:

<http://www.mathwarehouse.com/algebra/linear_equation/systems-of-equation/index.php>

**Unit Title:** Introduction to Linear Equations

**Lesson Title:** Using Elimination to Solve Systems of Equations

**Tentative Date:** 11/21/16

**Duration:** 45 minutes

**Standards (NJCCCS, CCSS, NJPST, and/or CEC):**

**NJCCCS 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.~~

**NJPST** 5.4 Analyze student performance using multiple sources of data, and to modify future plans and instructional techniques that promote desired student learning outcomes.

**Learner Outcomes (goals) & Assessments (include informal and formal):**

1. **Enduring Understanding:** Students will understand how to use the elimination method to solve systems of linear equations.
2. **Essential Questions:** How can I use elimination to solve systems of linear equations?
3. **Learner Outcome:** Students will be able to solve systems of linear equations of two variables using the elimination method.
4. **Assessments:**

**Informal Assessment:** The teacher will assess student independent work by observing and providing feedback. Students will be chosen to go to the board to explain answers and the teacher will ask questions and listen to student responses to evaluate their understanding. While students are playing the substitution game, the teacher will monitor their game, observing how they use the elimination method and providing feedback.

**Formal Assessment:** The following questions will be asked on the end of unit test:

1. Solve the following system of equations using elimination:

2x – y = 9

3x + 4y = –14

1. **Procedures (include anticipatory set, procedure, guided practice, and independent practice):**

**Anticipatory Set:**

The lesson will begin with a discussion of the topics from last class. Students will be asked to recall what the meaning of the solution of a system of equations is. The teacher will also call on a student to recall the substitution method for solving linear systems of equations.

**Guided Practice**:

After this review, the teacher will introduce a new method for solving linear systems, which is called elimination. The teacher will model the steps of this method, which involves first lining up both equations so that like terms are located under each other. The teacher will write this out on the whiteboard. Then the teacher will explain that students need to find a value to multiply both sides of one equation by so that when the two equations are added together one variable cancels out. The teacher will ask students to provide this value, then perform the operation. The teacher will note that after this has been done, now the equation just has just one variable and can be solved using methods the students should be familiar with. The teacher will ask the students to complete the problem, give them time to work, then ask for a student to come up to the board to complete the problem. After this, the teacher will give the students one more problem to try independently. After this problem has been completed, another student will come to the board to explain his or her solution.

**Independent Practice:**

After this, the students will be split into teams to work on a game that asks them to solve equations using substation. The game can be found at this link: <http://www.mathgames.com/skill/8.54-solve-a-system-of-equations-using-elimination>

For the remainder of the class period, the students will play the game. While this is occurring, the teacher will walk around assessing student progress and answering questions.

1. **Accommodations for diverse learners and students with special needs (include suggested adaptive and assistive tech/software/web-supported learning with specific skill areas):**

The student in the class with ADHD will be given access to voice-to-text software to aid his writing (Raskind & Stanberry, 2016). The student often has difficulties putting ideas down on paper, so this modification should allow him to organize his thoughts for his presentation. The student with dyscalculia will be given a calculator that can find distance from the website vcalc to assist with making calculations during the problem solving portion of the lesson. The distance calculator provides an explanation of the meanings of the variables in the equation and helps the student to plug the proper values (“Math tools,” 2016).

1. **Modifications for students with disabilities (none may be needed so just note that in this section with your rationale):**

There are no modifications needed for the students in this class. My rationale for this is that none of the students in the class have disabilities that require a modification of the curriculum. With the assistance of the accommodations, these students will have the supports that they need to fully participate in the lesson.

1. **Materials:**

**Student Materials**

* Chromebook
* Game: <http://www.mathgames.com/skill/8.54-solve-a-system-of-equations-using-elimination> (this link is posted on vftbehan.weebly.com)

**Teacher Materials**

* Whiteboard and markers
* (review links below available at vftbehan.weebly.com) Review video: <https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-systems-topic/cc-8th-systems-elimination/v/addition-elimination-method-1>
* Review website: <http://www.mathplanet.com/education/algebra-1/systems-of-linear-equations-and-inequalities/the-elimination-method-for-solving-linear-systems>

**Unit Title:** Introduction to Linear Equations

**Lesson Title:** Solving for Distance, Rate, and Time

**Tentative Date:** 11/22/16

**Duration:** 45 minutes

**Standards (NJCCCS, CCSS, NJPST, and/or CEC):**

**NJCCCS 8.F.B.4**: Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship ~~or from~~ ~~two (x, y) values, including reading these from a table or from a graph~~. Interpret the rate of change and initial value of a linear function in terms of the situation it models~~, and in terms~~

~~of its graph or a table of values.~~

**NJPST 7.5:** Apply knowledge of students’ abilities/disabilities, experiences, talents and prior learning, as well as language, culture, economics, family and community values to positively impact student learning;

1. **Learner Outcomes (goals) & Assessments (include informal and formal):**
2. **Enduring Understanding:** Students will understand that the distance an object is travelling can be expressed as the rate the object is travelling at times the time it is travelling for.
3. **Essential Questions:** If I am travelling at a constant rate, how can I find the distance I will travel in a certain time?

How can this equation be used to solve real-world problems?

1. **Learner Outcome:** Students will be able to recognize that the relationship between distance, rate, and time is a linear relationship.

Students will use the D = rt relationship to solve real-world problems involving distance.

1. **Assessments:**

**Informal Assessment:** While students are working to found their average speeds, the teacher will ask questions to gauge their understanding and listen to evaluate student thinking. At the end of class, the teacher will collect these papers to provide further feedback.

**Formal Assessment:** The following questions will be asked on the test at the end of the unit:

1. A racecar travels at a speed of 100 miles per hour for 5 hours. How far does the car travel?
2. A family traveled 500 miles round trip to visit relatives for Thanksgiving. One leg of the trip took 10 hours to complete. What was the family’s average speed?
3. **Procedures (include anticipatory set, procedure, guided practice, and independent practice):**

**Anticipatory Set:**

Students will be introduced to the distance = rate \* time equation through a video from BrainPop, which can be found at this link: [https://www.brainpop.com/science/  
motionsforcesandtime/distancerateandtime/](https://www.brainpop.com/science/motionsforcesandtime/distancerateandtime/).

**Guided Practice:**

After playing the video the teacher will discuss the distance equals rate times time equation with students through examples in a slide show. This slide show, produced by [www.slps.org](http://www.slps.org), will be submitted with this unit plan. The slide show presentation covers word problems that give two quantities and ask students to find the missing third quantity. The teacher will be sure to explain how this equation ties in to physics, since physicists are often interested in studying the movement of object. The slide show also presents the formula for distance, rate, and time using a triangle, an additional representation that may help students to grasp the concept (Hall, Meyer, and Rose, 2012).

**Independent Work:**

After these examples, students will be asked to from their own lives where they have travelled. This could be a vacation or even a daily trip like the walk to school. The teacher will ask students to think about a time they travelled somewhere, how far they went, and how long it took. To find these values, the teacher will allow students to use the chromebooks to look up the data they need. After students have what they need, the teacher will ask students to calculate their average speed during the journey. The teacher will walk around the room, observing students and helping those students who have trouble finding information about the distance they travelled. Once everyone is complete, the group will come back together, and students will be given time to share their experiences and their calculation. At the end of class, the teacher will collect these paper from students as an informal assessment.

1. **Accommodations for diverse learners and students with special needs (include suggested adaptive and assistive tech/software/web-supported learning with specific skill areas):**

The student in the class with ADHD will be given access to voice-to-text software to aid his writing (Raskind & Stanberry, 2016). The student often has difficulties putting ideas down on paper, so this modification should allow him to organize his thoughts for his presentation. The student with dyscalculia will be given a calculator that can find distance from the website vcalc to assist with making calculations during the problem solving portion of the lesson. The distance calculator provides an explanation of the meanings of the variables in the equation and helps the student to plug the proper values (“Math tools,” 2016). In addition to these accommodations, the slide show will be kept up on the board during the independent work, ensuring that struggling students and students who need assistance with academic language can have a reference. The slide show contains the formula, represented both symbolically and visually, aiding students, especially those who struggle with math or who are ELLs, by providing them with multiple means of representing the content.

1. **Modifications for students with disabilities (none may be needed so just note that in this section with your rationale):**

There are no modifications needed for the students in this class. My rationale for this is that none of the students in the class have disabilities that require a modification of the curriculum. With the assistance of the accommodations, these students will have the supports that they need to fully participate in the lesson.

1. **Materials:**

**Student Materials**

* Chromebooks
* Paper and pencil

**Teacher Materials**

* Slide show
* Whiteboard
* BrainPop video (link in procedures and on vftbehan.weebly.com)
* Slide show (created by [www.slps.org](http://www.slps.org) link is posted to vftbehan.weebly.com)
* (Links at vftbehan.weebly.com) Review website: <http://purplemath.com/modules/distance.htm>
* Review video: <https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-rates/v/usain-bolt-s-average-speed>

**Unit Title:** Introduction to Linear Equations

**Lesson Title:** Virtual Field Trip: Introduction to Air Traffic Control

**Tentative Date:** Days 8-10 of unit (10/24/16-10/26/16)

**Duration:** Three 45 minute periods

1. **Standards (NJCCCS, CCSS, NJPST, and/or CEC):**

**NJCCCS 8.SP.A.2**. Know that straight lines are widely used to model relationships between two quantitative variables. ~~For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit (e.g. line of best fit) by judging the closeness of the data points to the line.~~

**NJPST 4.4** Teachers know and understand a variety of instructional approaches and the use of various technologies, to promote thinking and understanding.

**NJPST 2.5** Teachers value and are committed to the belief that all children and adolescents bring talents and strengths to learning

1. **Learner Outcomes (goals) & Assessments (include informal and formal):**
2. **Enduring Understanding:** Students will understand that air traffic controllers direct the flight paths of airplanes using math that includes linear equations.
3. **Essential Questions:** What is an air traffic controller?

What does air traffic control have to do with math?

1. **Learner Outcome:** Students will be able to explain what air traffic controllers do in their careers and how they use linear models.
2. **Assessments:** For this lesson the students will be both formally and informally assessed. The informal assessment will take place while the students are working in groups on the virtual field trip assignment. The teacher will go to each group, asking questions to assess student understanding. The formal assessments are the student’s problem sets, which they will complete in small groups, as well as a presentation that explains what air traffic controllers do and how they use math in their careers. The rubric for this assignment is attached to the end of this lesson plan.
3. **Procedures (include anticipatory set, procedure, guided practice, and independent practice):**

**Day 1:**

**Anticipatory Set (5-10 minutes)**

The teacher will begin the lesson by asking students if they have ever been on an airplane. The students will then briefly be given the opportunity to share their experiences. After this brief discussion, the teacher will pose the question, “how do people ensure that airplanes travel and land safely?” The teacher will ask students for what they think. The purpose of this point of the lesson is to engage students by relating the lesson to students’ lives, based on the UDL suggestion of optimizing relevance (Hall, Meyer, and Rose, 2012).

**Procedure (35-40 minutes)**

After this initial discussion, the teacher will introduce the virtual field trip, which introduces students to air traffic control. The teacher will briefly introduce the profession, tying in the student responses from the anticipatory set. Then the teacher will show a link from the VFT that introduces the basics of the profession. Videos hosted on YouTube such as this one can be an engaging part of a lesson (Everhart, 2009). After viewing this link together, the students will move to the computer to explore the virtual field trip links for themselves under the day one link on the VFT website. The students will be given access to a graphic organizer to write notes about the links of the VFT website. The teacher will go from student to student, asking questions of the students and monitoring progress. When five minutes remain in the period, the teacher will have students log off of the computers. Then he or she will ask students to share some things they learned about air traffic control from the first day of the lesson.

**Day 2:**

**Anticipatory Set (5 minutes)**

The class will begin with a do now, which refreshes students about how to find distance travelled given a rate and time. The teacher will put two of these problems up on the smartboard and give students time to complete them. Then he or she will call the students up to the board to demonstrate the method to the class.

**Guided Practice (15 minutes)**

The teacher will explain that, now that students have become familiar with basics of what an air traffic controller is and what they do, they will be given a chance to try out some problems that an air traffic controller may have to do as part of his or her career. Before students get to work on these problems in their groups, the teacher will present the first two problems. The teacher will draw the situation described in the problem and label the picture with relevant information, then solve the first problem. Then the teacher will read the second problem, giving the students some time to work independently, since allowing students the time to engage in productive struggle with problems is a practice supported by research (NCTM, 2014). After giving students a few minutes to work on the problem, one student will be called to the smartboard to present his or her answer.

**Independent Practice (25 minutes on day 2 and 45 minutes on day 3)**

After completing this problem, the students will work in small groups to complete the problem set portion of the virtual field trip. The teacher will spend time talking to each group of students, answering questions and assessing student understanding. The student with dyscalculia will be given access to a calculator from the website vcalc which has the distance equation programmed into it to aid him with the calculations (“Math tools,” 2016).

The next day, students will begin class by returning to their problem sets to finish up the work. Once they have completed the problem set, one copy from each group will be turned in for a grade. The students will then begin working in their groups on the final project of the virtual field trip, a presentation summarizing what air traffic controllers do and how they use math in their careers. This slide show presentation asks students to take all the information to show that they can explain the basics of air traffic control. This presentation helps students develop their language skills, since they are taking the large amounts of new information they have learned over the course of the virtual field trip and synthesizing it. The project also provides an assessment outside of the traditional unit test or problem set formats in math, allowing students to demonstrate their thinking in ways that may better suit their academic strengths (Surrtamm & Koch, 2014). The student in the class with ADHD, who often has difficulty writing down his thoughts, will be given the option to record his thoughts with the help of speech-to-text software. When there are five minutes left in this class, the teacher will bring the class together and discuss with them what they learned from this virtual field trip and whether or not any students in the class would consider a career as an air traffic controller.

1. **Accommodations for diverse learners and students with special needs (include suggested adaptive and assistive tech/software/web-supported learning with specific skill areas):**

The student in the class with ADHD will be given access to voice-to-text software to aid his writing (Raskind & Stanberry, 2016). The student often has difficulties putting ideas down on paper, so this modification should allow him to organize his thoughts for his presentation. The student with dyscalculia will be given a calculator that can find distance from the website vcalc to assist with making calculations during the problem solving portion of the lesson. The distance calculator provides an explanation of the meanings of the variables in the equation and helps the student to plug the proper values (“Math tools,” 2016). In addition to these accommodations, the students will receive a graphic organizer to aid note taking, a UDL strategy (Hall, Meyer, and Rose, 2012). This graphic organizer has been attached to the end of this lesson plan.

1. **Modifications for students with disabilities (none may be needed so just note that in this section with your rationale):**

There are no modifications needed for the students in this class. My rationale for this is that none of the students in the class have disabilities that require a modification of the curriculum. With the assistance of the accommodations, these students will have the supports that they need to fully participate in the lesson.

1. **Materials:**

**Student Materials**

* Computer
* Vcalc software
* Voice to text software
* Calculators
* Paper and pencils
* Graphic organizer

**Teacher Materials**

* Projector
* Smartboard and markers
* Rubric for presentation
* Materials for VFT are available at vftbehan.weebly.com. Materials for students are on the day 8, 9, and 10 tabs and teacher materials are available under the materials section

For a database containing more lessons about these topics, this website has a number of interesting lesson plans and tasks for math classrooms:

<http://www.wccusd.net/Page/3223>

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**Appendix**

**THE PICTURE TELLS THE *LINEAR* STORY (Handout Created by Misty Jarman)**

\*\* Use your graphing calculator to investigate each family of equations.

\*\* Please sketch each family of equations on a separate sheet of graph paper.

\*\* Answer the questions for each on a separate sheet of paper.

**PART I.**

-- ***Graph the lines y = x, y = x + 6, y = x - 4***

Answer these questions:

1) How are the lines the same?

2) What is different about the lines?

3) Where does each line cross the y-axis?

4) What happens to the graph when a constant is added to y = x ?

5) Write an equation for a line similar to those above but crosses the y-axis at 5.

6) Write an equation for a line similar to those above but crosses the y-axis at -2.

**PART II**.

**-- *Graph the lines y = x and y = -x***

Answer these questions:

1) How are the lines alike?

2) How are the lines different?

**PART III.**

**-- *Graph the lines y = x, y = 2x, y = 5x, y = (1/2)x, y = (1/3)x, and y = (1/4)x***

Answer these questions:

1) Describe the differences in the graphs.

2) Which line appears the steepest?

3) What makes the difference?

**PART IV.**

**-- *Graph the lines y = -x, y = -2x, and y = -4x***

Answer these questions:

1) How are the lines different?

2) Which line appears the steepest?

3) What makes the difference?

**PART V.**

Practice:

1) Where does each of the following cross the y-axis?

y = 2x + 7 \_\_\_\_\_\_\_\_\_\_

y = -x + 11 \_\_\_\_\_\_\_\_\_\_

y = (1/2)x - 8 \_\_\_\_\_\_\_\_\_\_

2) Which line is the steepest and why.

y = x + 8 \_\_\_\_\_\_\_\_\_\_

y = 3x - 4 \_\_\_\_\_\_\_\_\_\_

y = (1/2)x + 3 \_\_\_\_\_\_\_\_\_\_

3) Which line is the steepest and why.

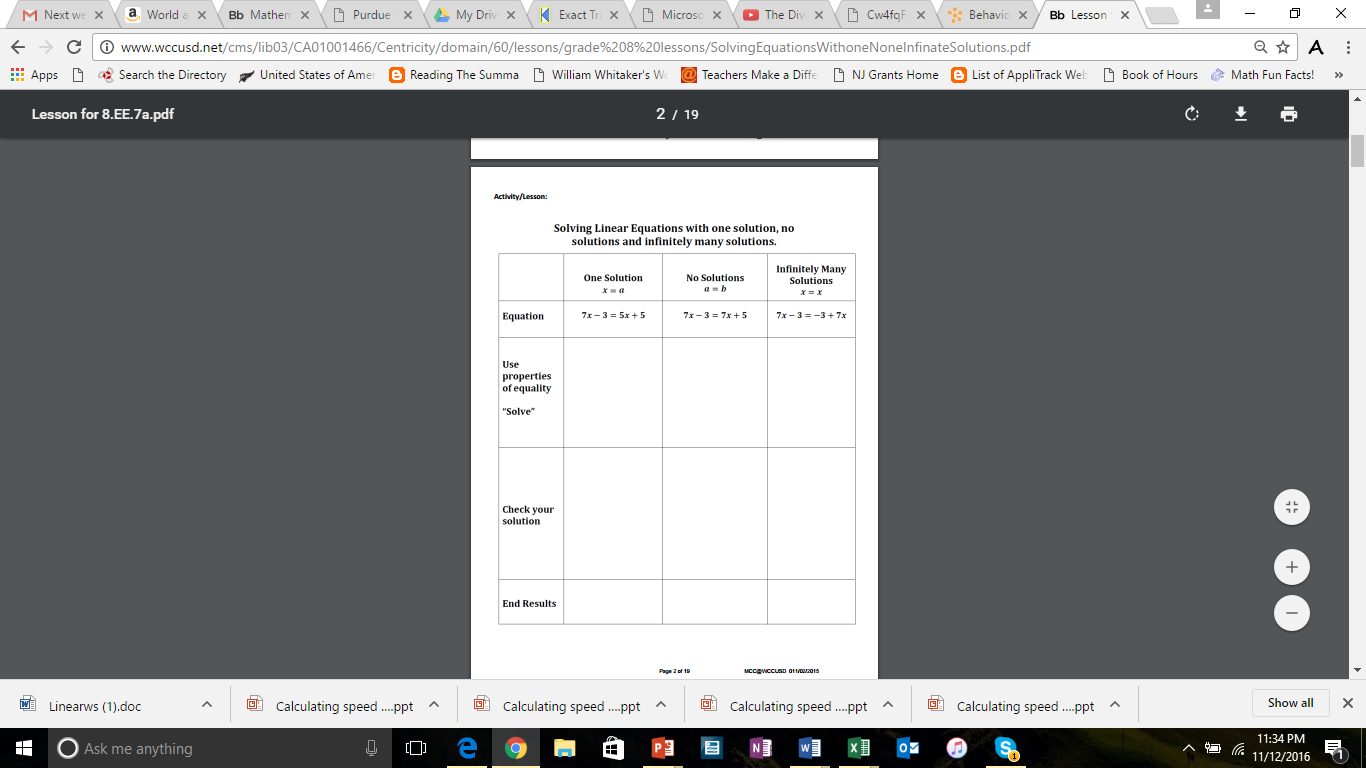
y = -x + 8 \_\_\_\_\_\_\_\_\_\_

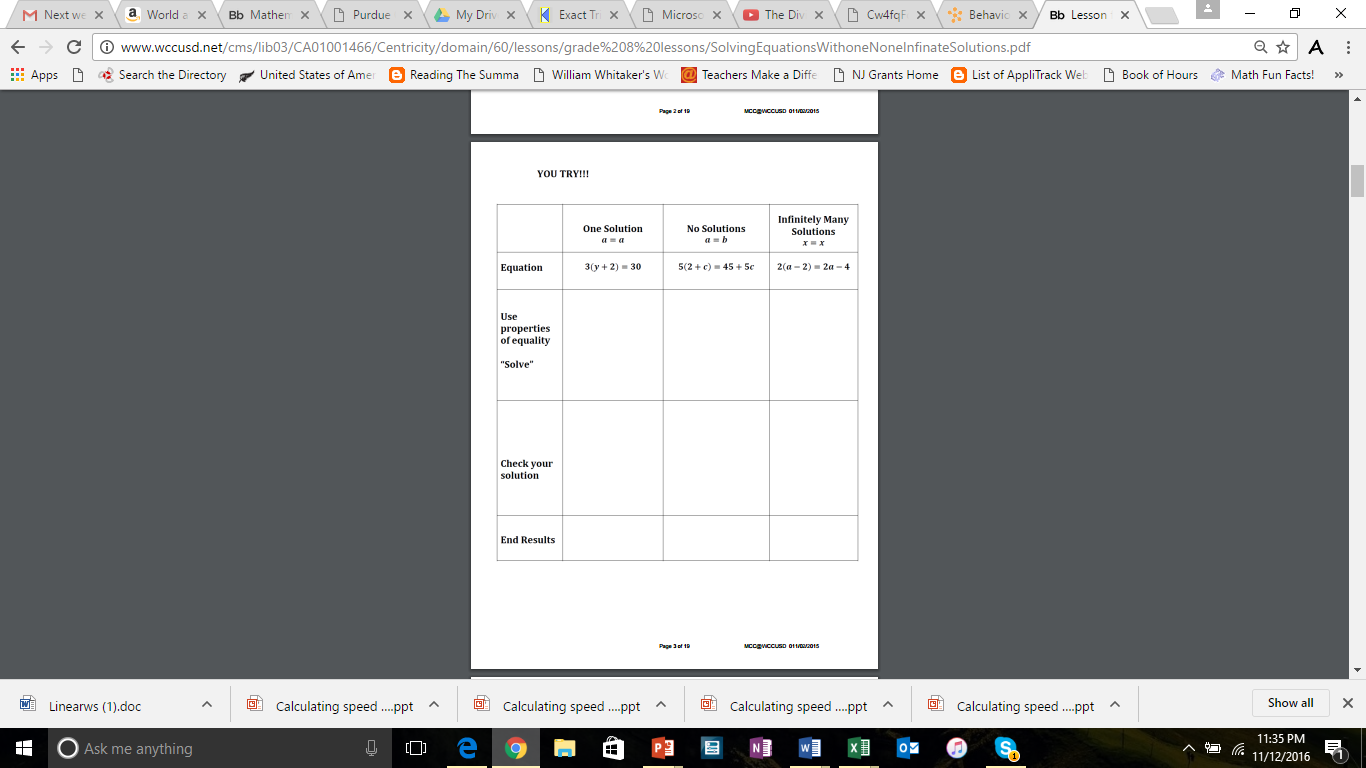
y = -2x + 5 \_\_\_\_\_\_\_\_\_\_

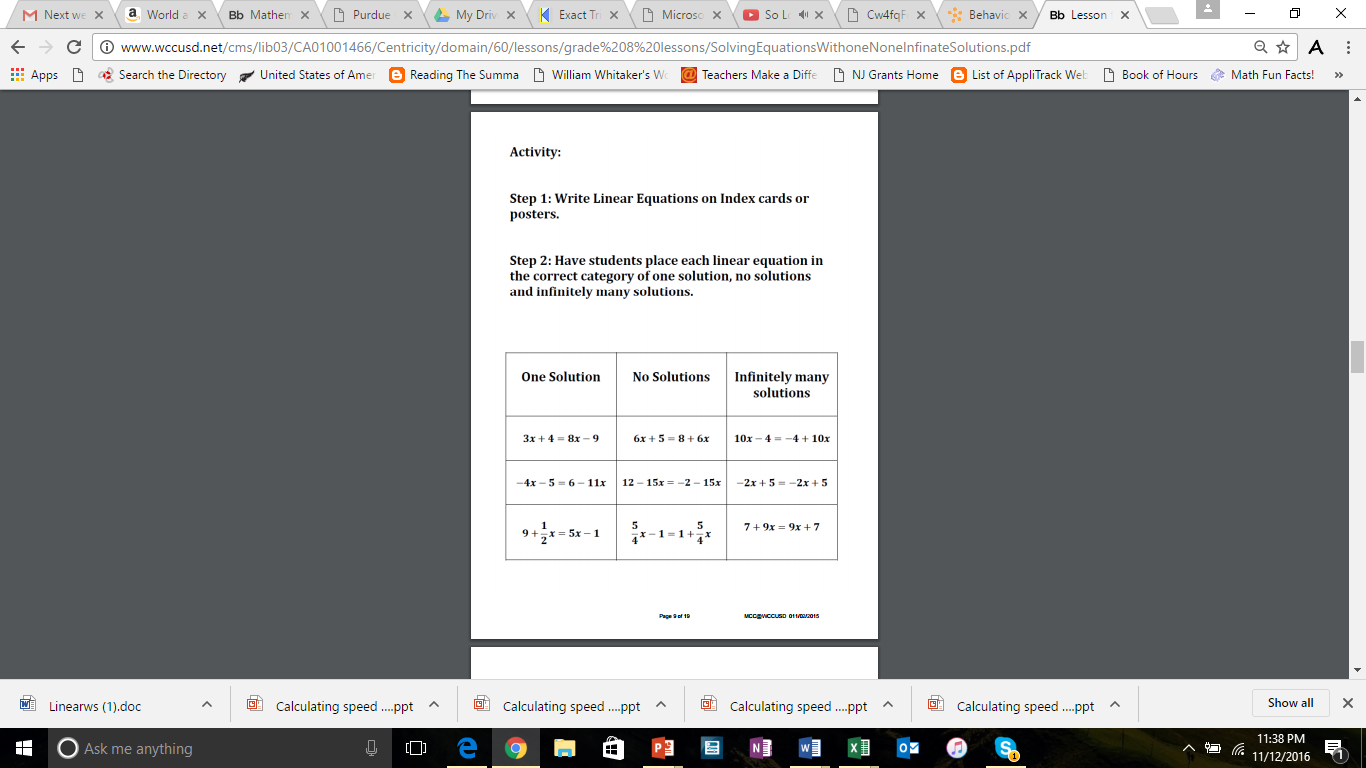
y = -(1/3)x \_\_\_\_\_\_\_\_\_\_

4) If a linear equation can be written in the form y = mx + b, where m and b represent any real values, explain the effect of m on the graph of the equation.

Explain the effect of b on the graph.







|  |  |
| --- | --- |
| *Included in the Unit/Lessons*  **Component** | **Specific Page Number(s) in Unit** |
| Lessons connect to other disciplines | To physics/science pgs 21-28 |
| A lesson database where you could find more lessons about this topic/unit | Link on pg 28 |
| Multimedia software that is learner-centered | Video on pg 22 |
| Spreadsheet or graph that is learner-centered | Students examine graphs on pg 2 |
| Use technology to enhance the *planning* of the unit | Used online resources to plan lesson  Example: pgs 24, 12, 17 |
| Use technology to enhance the *delivery* of instruction | Used slide show: pg 22  Smartboard used throughout, including pg 1 |
| Use of technology to *assess* the learners | Used clickers:  Pg 12 |
| In lessons include list of websites,  virtual reality experience,  pre-existing game,  self-created game to enhance their learning | website: pgs 4-5, 22  virtual reality pg 24-28 (air traffic control simulation)  Pre-existing game: pg 20  Self-created game: pg 10 |
| Individual technology for specific students individual needs | Throughout in each accommodations section, including pg 27 |
| At least 1 lesson plan with cooperative learning (needs to include directions for the students, team assignment and team preparation, creating positive interdependence among students, individual accountability, direct teaching of social skills, and team processing) | Pgs 5-8 |
| Multiple assessments for students to show what they learned | Assessments include unit test (questions scattered throughout in formal assessment sections), presentation pg 25, problem set pg 25, games (pg 20 and pg 10), and collected worksheets (pg 4) |
| Inclusion of the VFT with lessons | Pgs 24-28 |