**Lesson Title: Modeling with Cars**

**Unit Title: Linear Models**

**Teacher Candidate: Liz**

**Subject, Grade Level, and Date: Excel Algebra, Freshman, and 10/22/14**

**Placement of Lesson in Sequence**

This is an Excel Algebra class during the beginning of the year. We have just reviewed creating linear equations to model real-world situations. And the solution to a system of a linear equation is the intersection of two lines. This modeling activity will use ActivBoard Touch students’ knowledge of linear equations to find the intersection of lines that represents where two friends meet on their drive to the movie theater.

**Central Focus and Essential Questions**

The problem, “Sam and Sally are driving separate cars and racing to make it in time to the movie theater before tickets run out for the midnight premiere. Sam is on the freeway and starts driving at 60 mph, but has to slow down and after 2 hours is only driving 20 mph. Sally on the other hand had to take street roads which was only 30 mph, but got to increase her speed 5 miles every hour. Theoretically, if Sam is slowing down at a constant rate and Sally is speeding up at a constant rate in the same direction, at what speed and hour would they meet each other?” Will be used as the real-world situation to compare linear equations and find the solution to intersecting lines. ActivBoard will be used by the instructor to create a visual model of the movie theater problem. After students have helped create a car model as a whole class, they will use the data from the model to discuss solutions to the movie theater problem in groups of 6 students or less. Finally student will be asked to come to the ActivBoard with their group and draw a more detailed model that shows the exact point at which the cars will meet. Student will need to remember how to develop equations for each car and the mathematical procedures of finding where two lines intersect. The students will also need to justify their mathematical procedures and solutions with correct vocabulary.

**CCSS-Math (Standards)**

**8.E 5** Understand the connections between proportional relationships, lines, and linear equations.

**8.EE 8c** Solve real-world and mathematical problems leading to two linear equations in two variables.

**MP 1** Make sense of problems and persevere in solving them.

**MP 4** Model with mathematics.

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| **Learning Outcomes** | **Assessment** |
| Students will identify variables given and variables needed to solve the problem.  Students will identify and explain algebraic relationships needed to model the car problem using ActivBoard Touch.  Students will use the data from the ActivBoard Touch model of the car problem to give and justify a solution to the car problem.  Students will use their knowledge of the slope and y-intercept to graphically represent a given problem and find the intersection that represents where the cars meet. | The teacher will use formative assessment by walking from group to group to assure students understand the problem by correctly identifying the given variables and by accurately modeling the scenario on their worksheet.  Peer assessment between groups will be used to compare the equations each member of the group is coming up with. Also peers can assess each other regarding the mathematical procedures to find where two lines intersect.  The teacher will go from group to group to assure students are using the data from the ActivBoard model to write a correct solution and justification.  At the end of class the teacher ask all groups to present their solution and support it with algebraic and graphic methods. Other groups will be asked to comment and make connections to their own solutions and process on deriving the solution.  Summative assessment will be the teacher’s assessment of the worksheet they turn in at the end of class. |

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| **Learning Targets** | **Student Voice** |
| I will answer all prompts on the worksheet to:   1. Solve the movie theater problem; 2. Assist in creating the class and group model on the ActivBoard Touch 3. Algebraically find the point of intersect that accurately corresponds to the model.   I will be able to verbally justify our group’s solution and algebraic procedures with correct vocabulary. | The teacher will use the worksheet to communicate the learning target by asking the student to explaining how they will use the worksheet to assist them to movie theater problem through the modeling process. |

**Prior Content Knowledge and Pre-Assessment**

Students have been working with graphing linear functions and identifying relationships to develop equations. Previously students have also had practice solving for y so that they can put equations into standard form. The previous lesson students were given direct instruction about how you can find the intersection of two points by setting the equations equal to each other.

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| **Academic Language Demands** | | |
| **Vocabulary & Symbols** | **Language Functions** | **Precision, Syntax & Discourse** |
| * Identify which variables correspond to slope, y-intercept, and coordinate points in the movie theater problem * Identify independent and dependent variables * Identify what are reasonable variables for x and y axis | * Students will be able to discuss how to extract information from the given scenario and develop two equations that accurately represent the information given. They will also discuss the ways to solve for the solution either graphically or algebraically. | **Mathematical Precision:**  **Syntax:**   * Identify the slope and y-intercept * Identify the coordinate in the ActivBoard Touch model that represents where the cars meet.   **Discourse:**  Discuss how to create equations of the two cars and an ActivBoard Touch model that can compare the two cars initial speed and rate of change to observe where they will meet. |

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| **Language Target** | **Language Support** | **Assessment of Language Target** |
| I will be able to identify or find the slope and y-intercept based on the information given and then relate the scenario of cars meeting to intersection of two linear equations on a graph. | Introduction whole group, review vocabulary related to linear equations and processes of finding the intersection of lines.  Small groups identify variables of the cars’ speed and relate them to slope and y-intercept and report out to whole group for purpose of creating an ActiBoard Touch Model. Teacher will create the ActiveBoard Touch model for visual representation and repeat back student responses from small groups with correct syntax for writing and speaking about linear equations. Finally students will discuss in small groups and present to the class their findings on the ActivBoard Touch. They will graph the equations, write the algebraic procedures in finding the solution, and demonstrate how it corresponds to the intersection on the graph. | Formatively the teacher will give feedback by correctly modeling the verbal and written syntax for the linear equation models.  For summative assessment the teacher will use a rubric to assess the students’ models on ActivBoard Touch. The teacher will analyze the information students put on the ActivBoard Touch. Teacher will evaluate their verbal explanation about the equation of the lines, the graphical representation of the line, and the algebraic solution to the problem found through mathematical procedures.  The students will also write down their groups finding on their worksheet and turn it in for the teacher to evaluate individual work and correct syntax. |

**Lesson Rationale (Connection to previous instruction and Objective Standards)**

This lesson helps students learn how to create a math model to solve a problem. Using the variables given, students can use their previous knowledge of linear relationships, slope, and y-intercepts to graphically represent the information. ActivBoard Touch will be introduced as a whole class activity to guide the students in how to use this technology to model algebraic situations. Students will also be able to use the ActivBoard Touch to compare and contrast their algebraic and graphic solutions. In the future students will be allowed to model the scenario on the ActivBoard Touch without the teacher giving students a reference point or direct instructions. They will be able to explore different scenarios and see how changing the slope or intercepts will alert their equations.

**Differentiation, Cultural Responsiveness and/or Accommodation for Individual Differences**

Students with visual and kinesthetic learning styles will be supported through the use of ActivBoard Touch for modeling. ActivBoard Touch will help students visualize the scenario and find the slope by touching the screen to find rise over run. Students who struggle with math procedures or identifying variable will also be supported by their peers because they are working in groups.

**Materials – Instructional and Technological Needs (attach worksheets used)**

Classroom ActivBoard Touch that is accessible for whole class discussion and group presentation. If students are struggling during group work they will be allowed to come to the ActivBoard and experiment with different variables to help them get a better understanding of the mathematical concepts. The worksheet Driving to the Movies has the scenario and learning objectives for students and teacher to use as reference.

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| **Teaching & Instructional Activities** | | | |
| **Time** | **Teacher Activity** | **Student Activity** | **Purpose** |
| 5 mins. | Hand out worksheet and instruct students to read the worksheet, while I take attendance. | Students will read the worksheet and learning objectives. They will be ready to discuss how the scenario relates to the learning target and identify what concepts they are dealing with. | Make sure all students understand the scenarios and understand what is expected of them regarding the learning targets. |
| 15 mins. | Break into groups of 6. Teacher will remind the students of how to find the intersection of two points. Instruct students to share the variables they identified and collectively develop an equation for each car. Possible discussion questions: Discussion Questions:  -What do we know and what do we need to know?  -How will we graphically represent this information?  -What type of slope does Sam’s car produce?  -What type of slope does Sally’s car produce?  -What will our axis look like?  -Is there more than one way to solve this problem?  -How do you find the intersection of two points? | Students should list known and unknown variables. Students need to decide what type of relationship is occurring. Students will need to collaborate and decide which variables should correspond to the x axis and which variables correspond to the y axis. They need to extract crucial information out of the word problem such as the y-intercept will be 60 for the Sam and 30 for Sally. Students will also need to find the rate at which Sam is slowing down by plotting the two instances given [(0, 60) and (2, 20)]. One person from each group will report to the whole class needed facts and assumptions to solve the problem. | Students will work in groups to use peer assessment and peer collaboration. Students will use peers and the teacher to clarify mathematical procedures and ensure they correctly identified the variables. |
| 10 mins. | There were will be a class discussion about the equations the groups came up with. The teacher will first call on groups to identify the variables. Then the teachers will call on students to report their findings using correct vocabulary and syntax to justify their slopes and y-intercepts. Once the whole class agrees the teacher will use those equations and model the scenario on the ActivBorad Touch to give students a visually representation and help student picture where the lines will intersect. | Students will be ready to share information from group discussions on their worksheets. Students will be ready to respond to information from the discussion to suggest a model for Sally and Sam’s car. Students will draw a graph of the ActivBoard Touch model on their worksheets. | Students will respond and use information from others groups to guide the whole class modeling of the two cars.  The Teacher will use the student responses to give feedback on correct vocabulary. The teacher will also ensure all groups have set up the problem correctly to make finding the intersection easier. |
| 5 min. | Teacher will ask students to collaborate with their peers and algebraically solve for the solution. Then the teacher will ask the class to prepare to report out to class concluding their data. | Students will be performing mathematical procedures to find intersection and discuss the responsibilities of each person for the mini presentation. | Students will use their knowledge of linear equations, points of intersection, and ActiBoard Touch model to solve the problem. |
| 15 mins. | The teacher will call up groups one at time for the mini presentation of about 2 to 3 minutes each. The teacher will evaluate students’ mathematical understanding of the learning targets and analyze students’ justification. The teacher will help students identify common misconceptions and guide students to correct their mistakes. At the end the teacher will collect the worksheets. | Each group with take turns coming up to the front of class and graphing what they got on ActivBoard Touch. The axis will already be displayed. One person will have to label the axis. Another person will plot the y-intercepts. A third person will have to graph the lines. A fourth person could draw rise over run to represent the slope of each line. A fifth person in the group can explain the mathematical procedures of finding the intersection of the two lines. A sixth person could explain how their algebraic solution matches the model. This way each student can use their touch senses and contribute in explaining how their group solved for the solution. | Students will verbally justify their solution using correct vocabulary. The teacher will evaluate the students’ mathematically understanding of the learning targets. The students will also write their group solutions and equations on the worksheet for the teacher to evaluate their syntax. |

Rubric:

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| Criteria | Met or Not Met |
| Accurately form an equation for Sam’s Car |  |
| Accurately form an equation for Sallys’s Car |  |
| Accurately model the scenario |  |
| Find the correct intersection(solution) |  |
| Justify solution and mathematical procedures with correct vocabulary and syntax |  |