DAY 8: Henry's Dilemma

Materials

Copies:	8.1 Henry's Dilemma 8.2 Henry's Dilemma - Graph Ticket out the Door – Day 8
Supplies:	rulers – 1 per student Calculators – 1 per group
Word Wall Words:	no new words today

Objective

Students will work together to graph and compare the rates of three different phone plans and use that information to determine when the costs will be the same for each plan. Students will solve the different systems of linear equations posed in the phone problem by using substitution.

Academic Language Use

Linear Equation – An equation that makes a straight line when graphed, and is often written in the form $y = mx + b$.
Solution to a Linear Equation – A solution to a linear equation $y = mx + b$ is an ordered pair (c, d) with the property that when you substitute c for x and d for y in the equation, the equation is satisfied, or is *true.*
System of Equations – A system of equations involves the relationship between two or more equations and can be used to model a number of real-world situations.
Solution to a System of Linear Equations - A *solution* to a system of linear equations is the point(s) of intersection of the lines or the value of the variables that satisfy the equations. The number of *solutions* can vary from one, to none, to infinitely many solutions.

Activity Notes

55 Minutes: Solving a System of Linear Equations by Graphing and Substitution
Have students move their desks and get in to groups of three. (Pre-assigned groups would be best, so that there is one 'stronger' student per group if possible.) Pass out activity sheets 8.1 and 8.2, one ruler per student and one calculator per group. While passing out the worksheets and rulers, prompt a class discussion about how many texts students think they send in a day? In a month?

Task 1 (10 minutes)
Ask for a volunteer to read through the problem and another to read through the three different phone plans. Instruct students that they will have 10 minutes, with their group, to complete the three tables. They may choose to divide the work amongst themselves in any way they would like. For example, they may all work together on one table at a time, or they can divide up the work and each complete a table and share it

with the rest of their group. Set a timer for 10 minutes and walk around to check for understanding about what is happening in each phone plan and checking for accuracy.

At the end of 10 minutes, or when most groups have completed the tables, have one group (who you know has the correct answers) present their completed tables and equations. Ask the class if there are any groups that have anything different and clear up any misunderstandings.

Task 2 (15 minutes)
Have groups take out 8.2, the graph for Henry's Dilemma. Randomly ask students to answer the following questions while you are plotting the first few points with them:

a) What values do the numbers on the x-axis represent?
b) Why do you think the values are written in increments of 10 and not 1? (Is it reasonable that you would only make 1 or 2 texts a month? (For some students this may be true, but a phone company would not offer a plan with that few texts.))
c) What values do the numbers on the y-axis represent?
d) Why do you think the values are written in increments of 5 and not 1 or 0.10 (the slope of Plan A)?
e) Why do you think we are only using the first quadrant of the coordinate plane? (Why do we not need to include negative numbers on our graph?)
f) To graph the first point for table one, what would that point be? (What is the value of x, or the number of texts? How much would the bill be for that month if there were no texts made?)
g) What would the second point for Plan A be? How many texts could be made, and how much would be owed?

If you feel the class is ready for a deeper conversation, you can have a class discussion as to why the equation for Plan A is $y = 0.10x + 15$, but we are not using the slope of 0.10 to graph the line (rise over run).

Inform students that they will now have 10-minutes to graph the lines for each of the three plans. You may want to check for understanding by asking them how many different lines they will have on their graph. Let them know that after they graph each line, they should label the line with the name of the plan. Set a timer for 10 minutes. Walk around and monitor students, checking their graphs for accuracy. Students may struggle with how to graph Plan C, as it is a horizontal line at graphs for accuracy. Students may struggle with how to graph Plan C, as it is a horizontal line at $y = 30$. If the majority of the class is struggling, stop them and have them graph the first few points in the table with you. Continue having students graph until time is up, or most groups are finished. Randomly select one group to present their graphs and ask the class if everyone agrees, or if a group has something different. It is important that the graphs be accurate, as the point of intersection for each system will be incorrect.

Task 3 (10 minutes)
After discussing each line, have a student read through number 1 on page 2. Have groups discuss for 30-seconds about where Plan A and Plan B intersect on their graph. Randomly select groups to report their answer and ask them to explain how they determined their answer. Use thumbs up/down to determine if the class agrees. Now ask groups to discuss for 30-seconds what they think the coordinate means in terms of

the number of texts Henry can make and how much it will cost him per month. Randomly select groups to report out, as you record their statements at the front. Come to an agreement as a class about which statement best represents the answer to the question. Give groups 30 more seconds to discuss what the point of intersection means about Plan A and Plan B. Again, randomly select groups to report out while you are recording their statements. Come to an agreement as a class about which statement best represents the answer to the question. Have students write the two statements down under question 1.

Tell students that they will have 4 minutes to complete questions 2 and 3, while you walk around and answer questions and check for understanding. Set a timer for 4 minutes. After 4 minutes, select groups to read their answers to questions 2 and 3.

Task 4 (10 minutes)
Pose the following question to students: "Is making a graph and finding the point of intersection the easiest way to solve Henry's problem, or is there another method that would have been easier to use?" Students can volunteer responses. Have students recall that they have learned a second method to solve a system of linear equations, which is the substitution method. Have students write the three equations from page 1 on the given lines. Ask them to look at number 4, which has been started for them. Have students continue number 4 with their group. Let students know they will have two minutes to solve for x and y. Walk around to check for understanding, asking questions such as: "What does the x represent?"; "Are you finished if you have only solved for x?"; "What does y represent?" After 2 minutes bring the class together and have a discussion about what they discovered. (The solution is the same as the point of intersection on the graph.)

Allow students 5 minutes to complete numbers 5 and 6. Set a timer and walk around to check for understanding and accuracy. Ask similar questions to those posed when working on number 4. At the end of 5 minutes, have two groups report out what they found the solutions to be.

For the remaining time, have students answer questions 7 and 8 on their own. Allow students 2-3 minutes to write. After a few minutes, ask students to volunteer to read their answer to question 8. Take a poll about how many students prefer to graph, and how many students prefer substitution. Let students know that part of the beauty of mathematics is that there are usually several ways to go about solving a problem and what appeals to one student may not to another, and that is okay.

If you still have a few minutes remaining, have a class discussion about which phone plan would be better if someone sent 50 texts per month? 100 texts per month? 200 texts per month?

5 Minutes: Ticket out the Door
Pass out the Ticket out the Door and collect it as soon as each student finishes (so that you can discuss mistakes with students as they turn it in).