DAY 5: Fair Trades

Materials

Copies:	5.1 Fair Trades 5.2 Patterns in Linear Systems 5.3 Solving Linear Systems – Thinking Map Ticket out the Door – Day 5
Supplies:	rulers – 1 per student pattern blocks – 6 green triangles, 3 blue rhombi, 2 red trapezoid and 1 yellow hexagon per pair
Word Wall Words:	no new words today

Objective

Students will trade equivalent pattern blocks to understand the concept of substitution. Students will compare slopes and *y*-intercepts of graphs that meet at one point, are the same line and are parallel to discover the number of solutions for a system linear equations without graphing.

Student Talk Strategy

Report to a Partner for activity 5.1
Think-Pair-Share for intro to activity 5.2 and 5.3

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

25 Minutes – Exploring Substitution Using Pattern Blocks
Pass out activity sheet 5.1. Have the students get into pairs. Direct the students' attention to the opening question, and have them report to a partner about what it means to substitute a player in a soccer game. Elicit other ideas or contexts about what substitution means. Remind the students that today's lesson is working towards

understanding a faster and more efficient way to solve a system of equations, especially for cases when the answer involves decimals, such as the solution for the asteroids. You may even want to ask why some of the intersections were difficult to find during the asteroids activity.

While students are reporting to a partner, pass out the pattern blocks to each pair. Direct the students' eyes to the table with a picture of each block and the corresponding variable assigned to it. Have a volunteer read problem #1 and then give the pairs 3 minutes to solve it. Use random selection to have a student present their solution (you are looking for $y = 2r$. Ask if anyone has a different solution, as it is also correct to write $y = r + r$. Once the class understands, set the timer for 10 minutes and have them complete problems 2-6. Come back together and have students, who you know have correctly written equations, share their work.

Direct the students' attention to part 2. Explain that they will now use their equations for fair trades to solve for values of each letter. Again, give the pairs 3 minutes to complete #1 and have a volunteer share their work. Below is the work you would like to see.

$2y = 24$

$2(3b) = 24$

$6b = 24$

$b = 4$

If the class is struggling, you may need to guide them through by first recording the equation $2y = 24$ and then asking them to recall how many b blocks it takes to make a fair trade with 1 yellow block. Then ask them how they can trade or substitute that for the blocks it takes to make a fair trade with 1 yellow block. Then ask them how they can trade or substitute that for the y and model this.

Set the time for 8 minutes and have pairs complete the rest of the page. Note: it is okay if they don't get the challenge; it is truly a challenge! At the end of the 8 minutes, choose students who did the work correctly to share their work with the class.

End this section by explaining that the trades they made in the equations is what we call "substitution" in solving systems of equations and they will learn more about this method in future days.

20 Minutes: Looking for Patterns when Solving Systems by Graphing
Pass out activity sheet 5.1 and a ruler to each student. While you are passing out the supplies put the following problem the board for students to complete using scratch paper: Convert $2x - 3y = 6$ in to slope-intercept form. Tell students that they are to be finished with the problem by the time you are done passing out the activity sheet and rulers. Ask for a volunteer to present their solution.

Have students move their desk next to a partner and complete questions 1-3. Set a timer for 3 minutes. After 3 minutes, put up the solutions.

Inform students that they will now solve several systems of linear equations by graphing. Remind them that a *solution* must satisfy both equations. Have students work in partners to complete problems 4 through 9. Students must complete their own work. Set a timer for 15 minutes. While students are working, walk around and check for correctness; answer questions about how to verify *no solution* or *infinitely many solutions*; ask questions about why the system has *one solution, no solution* or *infinitely many solutions*. Some of the problems are already graphed for students and they are only required to find the solution by looking at the graph.
The solutions to the problems are: 4) (4, 1); 5) no solution; 6) (2, 1); 7) infinitely many solutions; 8) infinitely many solutions; 9) no solution.

After 15 minutes, bring the class together and read the directions for completing the table. Number four has been completed for the students. The objective for the table is for students to find commonalities in equations based upon the type of solution they arrived at. Give students 8 minutes to fill in the table and answer the three concluding questions, with their partner. After 8 minutes, have pairs compare their results to questions 1 through 3 with another pair. Or, if you feel the class is struggling with the concept, you can answer the questions together as a class. Answer to each of the problems should be similar to:

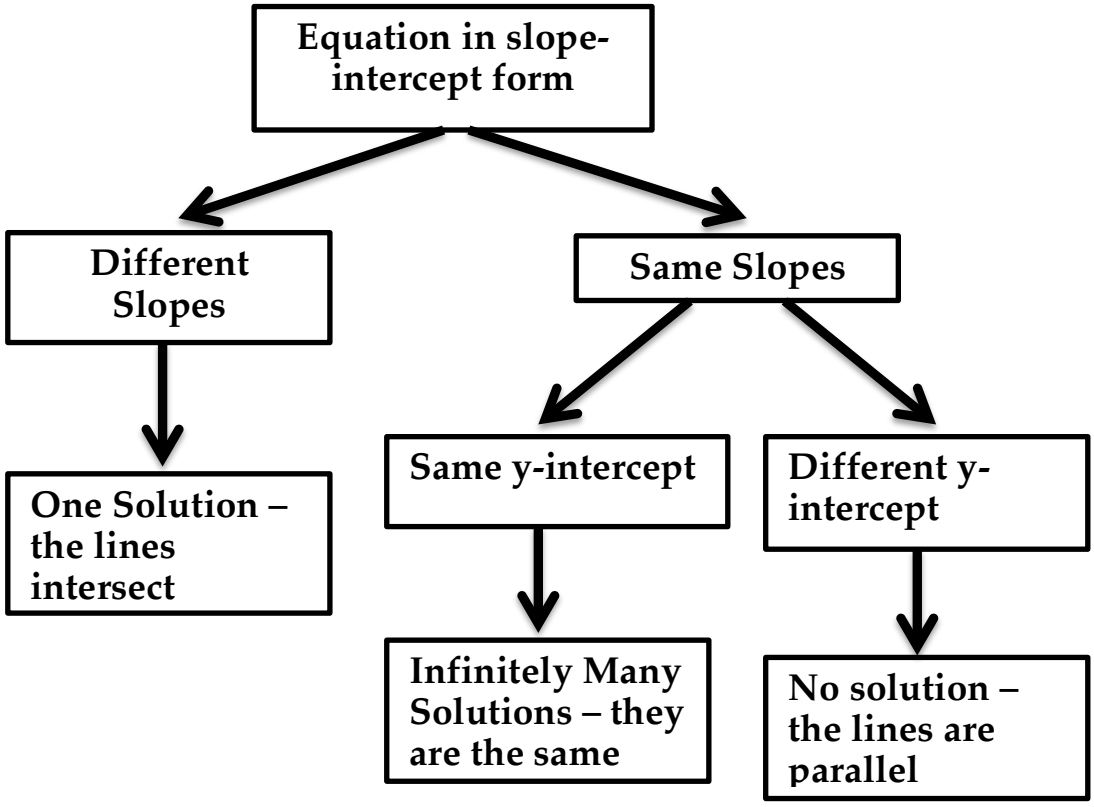
1) Looking at each of the problems that had ***one solution***, what do you notice about the slopes and *y*-intercepts of their equations? *I noticed that when there is one solution, both the slope and y-intercepts are different in the equations.*

2) Looking at each of the problems that had ***no solution***, what do you notice about the slopes and *y*-intercepts of their equations? *I noticed that when there is no solution, the slopes are the same, but the y-intercepts are different in the equations.*

3) Looking at each of the problems that had ***infinitely many solutions***, what do you notice about the slopes and *y*-intercepts of their equations? *I noticed that when there are infinitely many solutions, the slope and y-intercept are the same in* ***both*** *equations.*

10 Minutes: Patterns in Systems of Linear Equations - Thinking Map
Tell students that they will need to keep out page 3 of activity sheet 5.1 to help them complete the next activity. Put students back into pairs and pass out activity sheet 5.2. Have students use think-pair-share the answer to complete the sentence frame. Write this sentence on the board:
"When the slopes are different in the two equations, there will be _____ solution."
Allow students 15 seconds to "think" and 30 seconds to "share" with their partner. Randomly select a pair of students to read through the sentence frame with their answers. Use thumbs up/down to see if the rest of the class agrees. If students disagree, ask them to explain why they disagree, while having them refer to the table they made in activity 5.1 After the class agrees that there is one solution, have them fill in the box underneath "Different Slopes" on worksheet 5.2. (See the thinking map below for suggested language.)

Repeat the process above two more times, by writing up the following sentence frames, one at a time and then discussing as a class: "When the slopes are different and the y-intercepts are the same for both equations, there will be _____ solutions" and "When the slopes are the same but the y-intercepts are different, there will be _____ solution."



Once more, after the organizer is complete, have students think-pair-share as to why this thinking map is valuable when solving systems of equations. Have students "think" for 30-seconds and "share" for 1 minute. Ask for volunteers to share what they and their partner came up with. The value of the thinking map is that it allows us to determine the type of solution before we even begin solving. If we know something will have *no solution* or *infinitely many solutions* then it is not necessary to solve the system. We would only need to *solve* if there is *one solution*.

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).