Graphing Systems of Linear Inequalities in Two Variables

Strand: Equations and Inequalities

Topic: Graphing systems of linear inequalities in two variables

Primary SOL: A.EI.2   The student will represent, solve, explain, and interpret the solution to a system of two linear equations, a linear inequality in two variables, or a system of two linear inequalities in two variables.

> d) Create a linear inequality in two variables to represent a contextual situation.

Related SOL: A.EI.2a,c,e,f,g,h,

Materials

- "How much time can I spend on technology?" Activity sheet (attached)
- Graphing calculators/Desmos
- Graph paper (or individual dry-erase boards with the coordinate plane, if desired)
- Colored pencils or markers in different colors
- Highlighter

Vocabulary

increments, inequality, justify, maximum, solution set, system of inequalities

Student/Teacher Actions

1. Introduce systems of inequalities by first reviewing systems of equations. Then, distribute the "How much time can I spend on technology?" Activity sheet, and have students complete it, using graphing calculators/Desmos.
2. Students can use the Desmos graphing calculator to graph linear inequalities in one variable. Teachers and students can learn more about graphing inequalities using Desmos at http://learn.desmos.com/inequalities. Teachers may also wish to have students graph ordered pairs using Desmos to ascertain which fall within the solution set (shaded region).
3. In question 2, students can keep the equation in terms of hours but for question 7 the students will need to convert the hours to minutes to create the system of inequalities.
4. Notice that questions 3 and 8 ask the students to sketch the graph. The goal here is for the student to create a rough sketch of what the graph should look like, rather than a precise rendition of the graph, so the teacher may informally assess whether the student understands the concepts.
5. Notice that Scenario 2 gives the time in hours and minutes. To make this problem easier, it is suggested that students convert 1 hour and 20 minutes into 80 minutes. Encourage student conversation to arrive at this conclusion. Additionally, in Scenario 2, it is assumed that students must spend time on their phones AND playing video games. Students might notice that there are additional options of points (___, 0) available with

zero minutes on the phone. This would yield additional points in the table of (10, 0), (20, 0), ... (80, 0). These points are visible within the shaded region of the graph and could be the subject of class conversation.

6. Notice in question 7, when it asks the students to create the system of inequalities for the problem, a common mistake is that the students will switch the coefficients.

Assessment

- **Questions**
  - How would you write a system of linear inequalities where (2, 4) is a solution and (−3, 2) is not a solution? Justify your answer with a graph.
  - How would you graph this system of linear inequalities?
 $$\begin{cases} y \geq 0 \\ 2x + 3y < 12 \end{cases}$$
  Is (3, 2) a solution to the system? Is (0, 0) a solution to the system? How can you justify the difference in your answers to these questions?

- **Journal/Writing Prompts**
  - Describe a situation when a system of two inequalities would have no solution. Give an example to support your reasoning.
  - Describe a situation where the solution set for a system of inequalities would look like a horizontal strip on the graph. Give an example to support your reasoning.

- **Other**
  - Have students write the system of linear inequalities that defines the solution shown below.
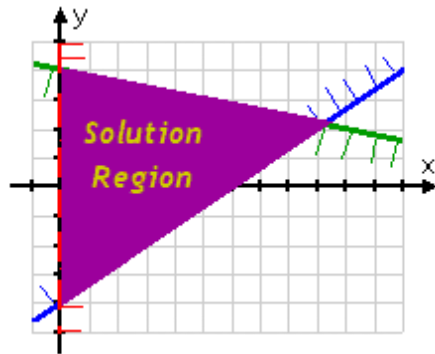
Extensions and Connections (for all students)

- Have students write a system of inequalities that shows the various numbers of hours they could work at each job in the following scenario: "You can work a total of no more than 20 hours per week at your two jobs. Baby-sitting pays $8 per hour, and your job as a cashier pays $10 per hour. You need to earn $120 per week to cover your expenses." Then, have students graph the system of linear inequalities and give two possible ways they could divide their hours between the two jobs to achieve their goal.

Strategies for Differentiation

- Have students use grid paper or individual dry-erase boards with the coordinate plane to help them create more accurate graphs.
- Put painter's tape on the classroom tile floor to represent the x-axis and y-axis of a large coordinate plane. Have students graph on the floor, using different-colored string or yarn for each inequality. Use large sheets of colored paper for the shading. This method is best used with small cooperative learning groups.
- Have students graph a system of two inequalities by graphing each inequality on a separate transparency and then placing one graph on top of the other to see the solution.
- Assign students a partner to work with in graphing and shading solutions of systems of inequalities. For each problem, have student A graph one linear inequality and student B shade the region of that inequality. Then student B will graph the second inequality and student A will shade the region of the solution to that inequality.
- Give students one inequality already graphed for a few problems so that the student is only responsible for graphing one other linear inequality and finding the region of solutions.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

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How much time can I spend on technology?

Name _____   **Date _____**

Scenario 1: On a school night you spend 2 hours of total time on your phone and playing video games. On average, you spend three times as much time playing video games as being on your phone.

1. What are the two variables in this situation? Define your variables.

2. Write a system of *equations* for this problem.

3. Graph this system of equations. It is recommended that you use a graphing calculator to do this. Sketch your graph in the space to the right.

4. Based on the graph created above, how much time do you spend on your phone versus playing video games? Justify your answer.

Scenario 2: Suppose you have basketball practice after school and now have a ***maximum*** of 1 hour and 20 minutes to be on your phone and play video games. On this evening you choose to be on your phone ***at least*** 2 times the amount you are playing video games.

5. What are the two variables in this situation? Define your variables.

6. What is different about this situation? Why does this require inequalities rather than equations? [Hint: What do the words "maximum" and "at least" mean?]

7. Write a system of *inequalities* for this problem.

8. Graph the system of inequalities. It is recommended that you use a graphing calculator to do this. Sketch your graph in the space to the right.

9. How many different combinations of 10-minute increments can you have to fulfill your new criteria? Complete the chart below, showing all the possible combinations.

Phone	Video Games	Total Minutes

10. Notice that this system of inequalities has many solutions. How many different solutions did you find?

11. Using the criteria above, is it possible for you to play video games for 30 minutes? Justify your answer.

12. If you spend 40 minutes on your phone, what are your options for playing video games? Justify your answer.