Name: _____
Block: ____

Modified Exploration Guide: Linear Programming

(This guide is a modified from the Exploration Guide: Linear Programming – Activity A found at http://www.explorelearning.com .)

In linear programming, the function that you are trying to find the maximum or minimum value of is called the **objective function**. It is displayed in the top-left corner of the Gizmo. To modify the objective function, select the button to its left, and adjust the *a*, *b*, and *c* sliders at the bottom of the Gizmo.

Turn on the first three constraints in the Gizmo. Notice that each constraint is written as a linear inequality. Together, these constraints form a system of linear inequalities. The shaded area on the graph represents the set of points that satisfies this system. It is called the **feasible region**.

1. Find the coordinates of a point within the feasible region. On paper, substitute its coordinates into each of the constraints. Does the point satisfy each of the constraints?

2. Do you expect all of the points in the feasible region to satisfy each of the constraints? Why or why not?

3. Find the coordinates of a point outside the feasible region. On paper, substitute its coordinates into each of the constraints. Does the point satisfy all of the constraints?

4. Do you expect any point outside the feasible region to satisfy all of the constraints? Why or why not?

Form a feasible region using the following 3 constraints: $x + y \leq 4$, $\_x + y \leq 4$, and $y \geq 0$. (To change a constraint, click on the button immediately to its left and then use the sliders at the bottom of the Gizmo to change the *a*, *b* and *c* terms.)

5. What shape does this system of inequalities form?

6. A feasible region that has finite area is called a *bounded* feasible region. If it is has infinite area, it is called an *unbounded* feasible region. Is the current feasible region bounded or unbounded?

7. Set the objective function to $f(x, y) = 2x + y$. Use your mouse to find the maximum value of this function within the feasible region. Where does the maximum occur?

8. Use your mouse to find the minimum value of this function within the feasible region. Where does the minimum occur?

9. Click on the DATA tab. The table lists the coordinates of each of the vertices in the feasible region as well as the value of the objective function at each vertex. If an objective function $f(x, y)$ has a maximum value, where must it occur in the feasible region? Is the same true for a minimum?

Set the objective function to $f(x, y) = 2x + y$. Turn on only two constraints and set them to $x + y \leq 4$ and $\_x + y \leq 4$.

10. Is the feasible region bounded or unbounded?

11. Would it be possible to find a maximum value for the objective function in this feasible region? What about a minimum value?

A local jeweler makes earrings and bracelets. In one hour, he can make 3 rings or 2 bracelets. To model the number of items the jeweler can make in a given time period, set the objective function in the Gizmo to $f(x, y) = 3x + 2y$. In this function, x is the number of hours the jeweler spends making rings, and y is the number of hours spent making bracelets.

12. On paper, calculate how many total items the jeweler will make if he spends 4 hours making rings and 4 hours making bracelets. Check your answer by placing the mouse pointer at (4, 4).

13. Suppose the jeweler wants to spend at least 3 hours making rings and at least 3 hours making bracelets. How would you model these two constraints in the Gizmo? Enter these first two constraints in the Gizmo.

14. The jeweler's third constraint is that he wants to work no more than 8 total hours. How would you model this constraint in the Gizmo. Enter this constraint in the Gizmo.

15. What is the maximum number of items the jeweler can make in 8 hours?

16. If the jeweler wants to make the maximum number of items, how many hours must he spend making rings, and how many hours must he spend making bracelets?