EXPLORATIONS ™

Activity 2

Tracing Paper Inequalities

Introduction

A set of two or more linear equations is called a system of equations. A set of two or more linear inequalities is called a system of inequalities. You have most likely learned how to graph systems of linear equations to find their solutions. In this activity, you will use the Inequality Graphing application to graph systems of linear inequalities and find their solutions.
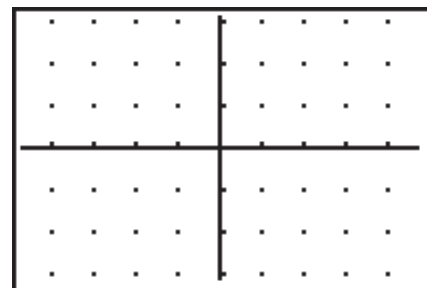
Problem

As you graph systems of linear inequalities, think about how the solution of a system of linear inequalities differs from the solution of a system of linear equations.

Exploration

1. Listen carefully as your teacher gives you an inequality to graph. Write down the inequality. Then graph it in the grid shown.

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2. Use the Inequality Graphing App to verify your graph.

   a. Select **Inequalz** from the **APPS Menu**. Enter your inequality into the **Y=** editor or the **X=** editor. The **X=** editor can be accessed by highlighting **X=** at the top of the **Y=** editor screen and pressing ENTER.

   *Note: Set viewing window to **ZDecimal**.*

   b. Highlight **=** next to **Y1** or **X1** and press ALPHA [F4] for **>** or ALPHA [F2] for **<**.

3. Next, trace your inequality graph onto tracing paper. (Do not forget to trace the axes as well!)

4. Work with your assigned partner and place your traced graphs one on top of the other. Be sure to align the axes. Describe what you see.

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You and your partner have created a system of linear inequalities. How does a system of inequalities differ from a system of linear equations?

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Next, you want to compare the graphs you drew to those made by the Inequality Graphing App.

5. Enter both inequalities into the **Y=** editor. You will need to switch to the **X=** editor by highlighting **X=** and pressing ENTER to enter the *x* inequality. Choose the appropriate inequality symbol by highlighting **=** and pressing ALPHA and the corresponding **F** key.

6. Press GRAPH.

*Note: Set viewing window to **ZDecimal**.*

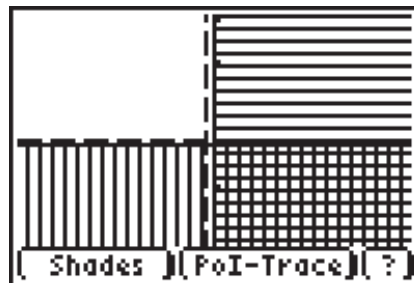What is the difference between the shaded regions of the two original inequalities?

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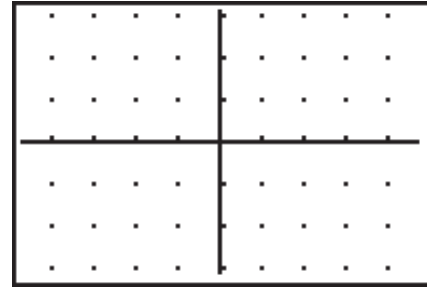How does the Inequality Graphing App show the common region for the system?

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7. Use the Inequality Graphing App to graph the system: $y > 2x - 1$, $y \leq {}^-3x + 2$. Sketch the graph in the grid.

*Hint: Refer to step **5** for help in graphing the system.*

8. Locate the point (-2, 1) on the graph. Is this point part of the solution set for the system of inequalities? Verify algebraically by substituting these coordinates into each inequality of the system.

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The ordered pair (-2, 1) is just one of many points that lie in the common region of this system of inequalities. Select a second point in this common region. Verify algebraically that this second point is also a solution to this system.

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Is the ordered pair (1, 2) part of the solution set for this system? How do you know? Verify your conclusion algebraically.

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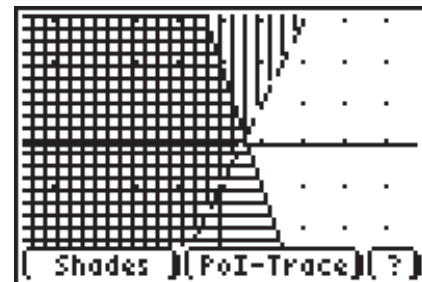**9.** The common region in the graph of a system of linear inequalities is marked by overlapping vertical and horizontal line segments. To better see this region, use **Shades**, the shading feature of the Inequality Graphing App.

*Note: If the **Shades** and **PoI-Trace** options are not on the screen, press* GRAPH

10. Press ⌐ALPHA⌐ [F1] to select **Shades**. Select **Ineq Intersection** and press ⌐ENTER⌐.
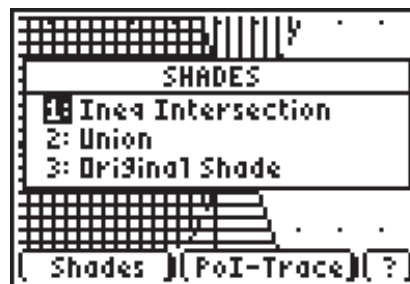
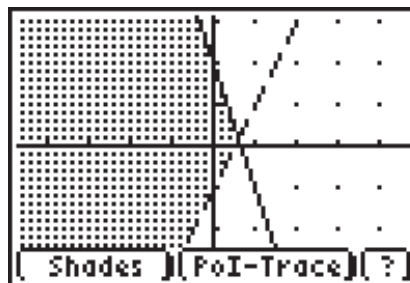**11.** Describe how the graph has changed.

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Now that you have had a chance to graph a system of inequalities, how does the solution of a system of linear inequalities differ from the solution of a system of linear equations?

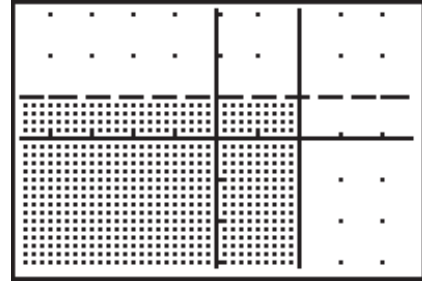# Student Worksheet

Name _____

Date _____

Use the Inequality Graphing application to help you identify which system is represented by each of the following graphs.

1. **A.** $x > 2$

       $y \leq 1$

  B. $x \geq 2$

       $y < 1$

  C. $x < 2$
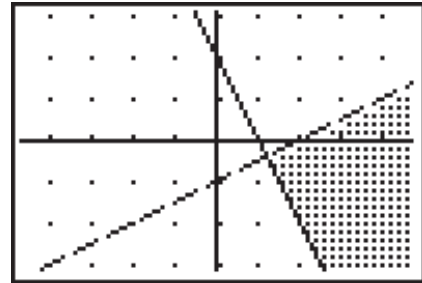
       $y \leq 1$

  D. $x \leq 2$

       $y < 1$

2. **A.** $y > 0.5x - 1$

       $y \leq {}^-2x + 2$

  B. $y \geq 0.5x - 1$

       $y < {}^-2x + 2$

  C. $y \leq 0.5x - 1$

       $y > {}^-2x + 2$

  D. $y < 0.5x - 1$
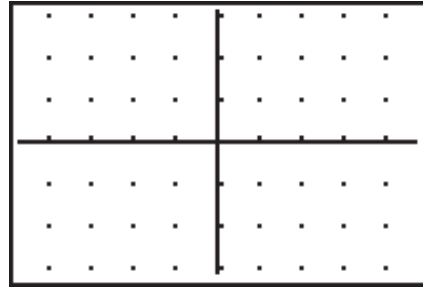
       $y \geq {}^-2x + 2$

Sketch the graphs of the following systems in the grids provided. Then use the Inequality Graphing App to check your graphs. (Use the **ZDecimal** viewing window and **GridOn** format settings.)
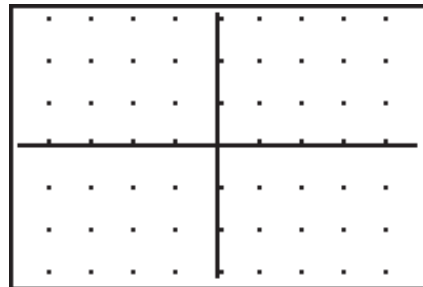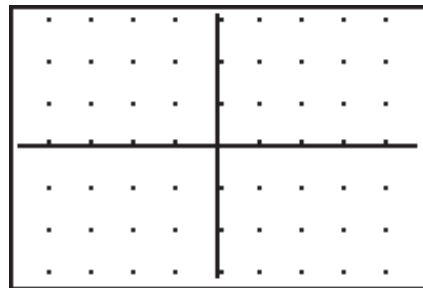
3. $x > {}^-2$

     $y \leq 2.5$
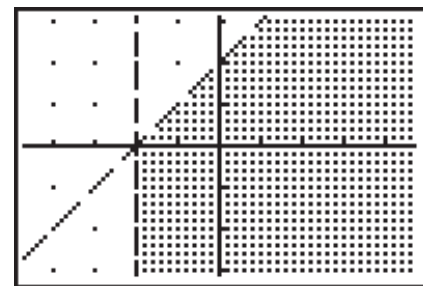
4. $y < 2x - 1$

$y \geq {}^-1.5$

5. $y < 3x - 1$

$y \geq {}^-0.75x + 2$

6. $3x + y < 2$

$^-4x \leq 4$

7. On a recent quiz, students were asked to graph the system $y > x + 2$ and $x \geq {}^-2$.

Germaine provided the graph shown as a solution. Do you agree with his answer? Why or why not?

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Teacher Notes

A c t i v i t y   2

Tracing Paper Inequalities

Prerequisite Skills

- Solving linear inequalities in one and two variables

- Solving a system of linear equations

- Graphing linear inequalities in the Cartesian coordinate plane, including those involving one variable.

Getting Started

Ask students to think about what defines a system of linear equations. Since the objective focuses on graphing systems of linear inequalities, students may need to review graphing linear equations before completing the Exploration.

Management

At the start of the activity, divide the class into two groups. Have Group 1 graph the following: $x > {}^-2$. Group 2 will graph the following: $y \leq 1$. After graphing their inequalities, students will work in pairs to graph a system of inequalities. You may want to assign students to work together or allow them to choose a partner.

Notes about Exploration

In the introduction, students are asked to consider the difference between the solution of a system of linear equations and the solution of a system of linear inequalities. This is an appropriate time for a whole class discussion to ensure students understand the lesson objective.

Monitor student progress as they sketch and shade their graphs. Some students may wish to enhance their graphs by using colored pencils.
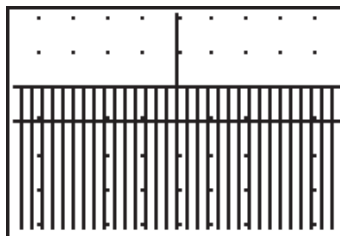
The **Shades** feature of the Inequality Graphing App is introduced to the students in step **9**. Some students might benefit from a teacher-led class demonstration.

Answers to the Exploration Questions

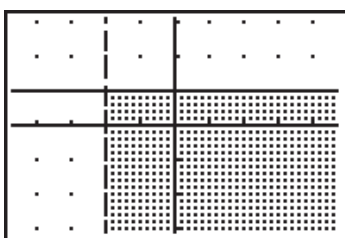1. Student graphs should be similar to these.

$x > {}^-2$ $y \le 1$

4. Student graphs should be similar to this.


$x > {}^-2$ and $y \le 1$

Answers will vary. Students should note the common region of the graphs.

Students should note that a graph of a system of linear equations does not have shaded regions as does a graph of a system of linear inequalities. You might want to prompt students to think about the solution sets for each system as well.

6. Students should notice that directionality of the shaded regions changes from vertical ($x > {}^-2$) to horizontal ($y \le 1$).

The common region has both vertical and horizontal lines.

7. Students' graphs should resemble the one shown.
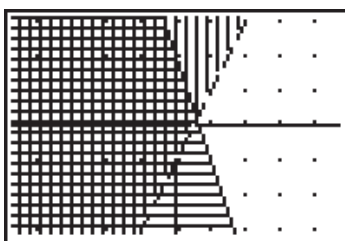
8. Yes, the point ($^-2$, 1) is part of the solution set.

$y > 2x - 1$	$y \le {}^-3x + 2$
$1 > 2({}^-2) - 1$	$1 \le {}^-3({}^-2) + 2$
$1 > {}^-4 - 1$	$1 \le 6 + 2$
$1 > {}^-5$ (True)	$1 \le 8$ (True)

Answers will vary, depending on the chosen point. Students must substitute their *x*- and *y*-coordinates into both inequalities. Students must obtain true statements for both inequalities.

Students should realize that (1, 2) is not part of the solution set. Their explanations may vary, but they should note that (1, 2) does not lie in the common region. Students could also state that evaluating the second inequality for (1, 2) does not produce a true statement.

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$y > 2x - 1$	$y < {}^-3x + 2$
$2 > 2(1) - 1$	$2 < {}^-3(1) + 2$
$2 > 2 - 1$	$2 < {}^-3 + 2$
$2 > 1$ (True)	$2 < {}^-1$ (False)

11. Answers will vary. Students should note that only the intersecting area is shaded. The shading is now a series of dots instead of vertical and horizontal lines.
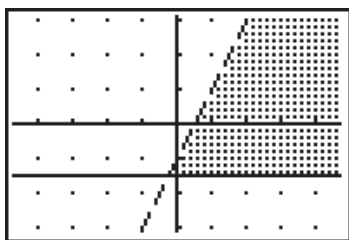
    Answers will vary. Students need to understand that an independent, consistent system of linear equations has only one solution, the point of intersection. By contrast, this system of linear inequalities has a common region. This system of linear inequalities has an infinite number of common points.
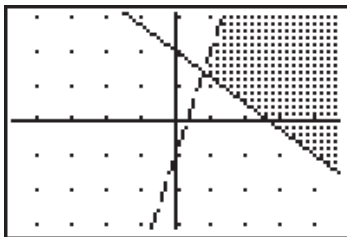
Answers to Student Worksheet
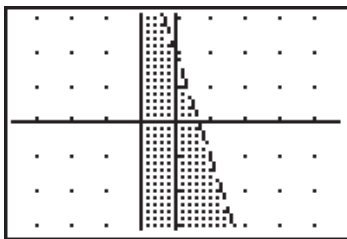
1. **D**

2. **D**

3. $x > {}^-2;\ y \le 2.5$
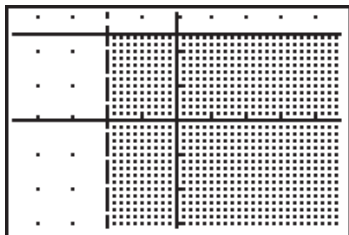
4. $y < 2x - 1;\ y \ge {}^-1.5$

5. $y < 3x - 1$; $y \geq {}^-0.75x + 2$

6. $3x + y < 2$; ${}^-4x \leq 4$

7. Students should realize that the graph is not correct. It contains two mistakes. One mistake involves the shading of $y > x + 2$.

A second mistake involves the use of a dashed line for $x \geq {}^-2$.