Graphing Inequalities (Scaffolding Task)

Introduction
In this task, students will graph two separate inequalities in two variables and analyze the graph for solutions to each. The students will then graph the two inequalities in two variables on the same coordinate system to show that the solution to both inequalities is the area where the graphs intersect.

Mathematical Goals
- Solve word problems involving inequalities.
- Represent constraints with inequalities.
- Rearrange and graph inequalities.

Essential Questions
- How do I graph a linear inequality in two variables?
- How do I justify a solution to an equation?
- How do I graph a system of linear inequalities in two variables.

Common Core Georgia Performance Standards
MCC9-12.A.REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Standards for Mathematical Practice
1. Make sense of problems and persevere in solving them.
   Students will need to work through problems and find multiple solutions to the problems.
5. Use appropriate tools strategically.
   Students will need to choose the tools to best model these equations based on the tools available.
6. Attend to precision.
   Students will need to be cautious of scale and constraints displayed in their graphs.

Background Knowledge
- Students can graph linear equations.
- Students can graph linear inequalities.

Common Misconceptions
- Students may be confused about the scale of the graphs and how to graph the solution.
- Students may question how to graph the constraints of the problem in terms of the appropriate quadrant.
Materials
- Colored pencils
- Calculator
- Graph Paper
- Ruler

Grouping
- Individual / Partner

Differentiation
Extension:
- Students should show algebraically that the solutions work

Intervention:
- Students should be given graphs of sample inequalities

Formative Assessment Questions
- How do we display linear equations differently from linear inequalities? Why is it necessary to do so?
- When displaying multiple linear equations or inequalities, what additional considerations must we take into account?
Graphing Inequalities – Teacher Notes

1. Graph the inequality \( y > -\frac{1}{2} x + 5 \). What are some solutions to the inequality?

   NOTE: The points shown in the graph are the boundary points but not actually part of the solution set. Students should label points in the shaded region.

2. Graph the inequality \( y < x + 2 \). What are some solutions to the inequality?

   NOTE: The points shown in the graph are the boundary points but not actually part of the solution set. Students should label points in the shaded region.
3. Look at both graphs.

_The main purpose of this exercise is to allow students to discover visually and conceptually where the solutions to the inequalities lie on the graph._

   a. Are there any solutions that work for both inequalities? Give 3 examples.

_There are many solutions that work for both, including: (-2, 7), (4, 4), (7, 3)_

   b. Are there any solutions that work for 1 inequality but not the other? Give 3 examples and show which inequality it works for.

_There are many solutions that work for one inequality but not the other._

4. Graph both inequalities on the same coordinate system, using a different color to shade each.

_Note: Students do not need to label points in this problem. However, IF they do, they should only be labeling points in the region shaded by both graphs._
a. Look at the region that is shaded in both colors. What does this region represent?

_The region shaded in both colors represents the solutions to the system._

b. Look at the regions that are shaded in only 1 color. What do these regions represent?

_The regions shaded in one color represent solutions that work for one inequality, but not the other._

c. Look at the region that is not shaded. What does this region represent?

_The region that is not shaded represents combinations that are not solutions to either inequality._

5. Graph the following system on the same coordinate grid. Use different colors for each.

\[
\begin{align*}
  x + y &\geq 3 \\
  y &\leq -x + 5
\end{align*}
\]

a. Give 3 coordinates that are solutions to the system.

_Answers may vary._
b. Give 3 coordinates that are not solutions to the system.

*Answers may vary.*

c. Is a coordinate on either line a solution?

*Yes, coordinates on the line are solutions to the system.*

d. How would you change the inequality \( x + y \geq 3 \) so that it would shade below the line?

*If you change the \( \geq \) to \( \leq \), the graph will shade below.*

e. How would you change the inequality \( y \leq -x + 5 \) so that it would shade above the line?

*If you change \( \leq \) to \( \geq \), the graph will shade above the line.*

6. Graph the new equations from ‘d’ and ‘e’ above on the same coordinate grid. Use blue for one graph and red for the other.

a. What do the coordinates in blue represent?
Each color represents solutions to one inequality, but not the other.

b. What do the coordinates in red represent?

*See above.*

c. Why do the colors not overlap this time?

*There is no coordinate that is a solution to both inequalities. Therefore, the system has no solution.*

Graph the following on the same coordinate grid and give 3 solutions for each.

7. \(2x + 3y < 6\)
   \(x + 5y > 5\)

*NOTE: The points shown in the graph are the boundary points but not actually part of the solution set. Students should provide three points in the area shaded by both regions.*
8. \[ y \geq \frac{1}{2} x - 1 \]

\[ y \leq -\frac{1}{4} x + 6 \]

*NOTE: Students should provide three points in the area shaded by both region OR on either of the boundary lines.*

9. \[ 3x - 4y > 5 \]

\[ y > \frac{3}{4} x + 1 \]

*NOTE: The points shown in the graph are the boundary points but not actually part of the solution set. There are no solutions to this system of inequalities.*
Scaffolding Task: Graphing Inequalities

Name_________________________________   Date__________________

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• Solve word problems involving inequalities.
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Scaffolding Task: Graphing Inequalities

Name_________________________________   Date__________________

1. Graph the inequality \( y > -\frac{1}{2}x + 5 \). What are some solutions to the inequality?

2. Graph the inequality \( y < x + 2 \). What are some solutions to the inequality?
3. Look at both graphs.
   
   a. Are there any solutions that work for both inequalities? Give 3 examples.
   
   b. Are there any solutions that work for 1 inequality but not the other? Give 3 examples and show which inequality it works for.
   
4. Graph both inequalities on the same coordinate system, using a different color to shade each.
   
   a. Look at the region that is shaded in both colors. What does this region represent?
b. Look at the regions that are shaded in only 1 color. What do these regions represent?

c. Look at the region that is not shaded. What does this region represent?

5. Graph the following system on the same coordinate grid. Use different colors for each.

\[ \begin{align*}
  x + y & \geq 3 \\
  y & \leq -x + 5
\end{align*} \]

a. Give 3 coordinates that are solutions to the system.

b. Give 3 coordinates that are not solutions to the system.

c. Is a coordinate on either line a solution?
d. How would you change the inequality \( x + y \geq 3 \) so that it would shade below the line?

e. How would you change the inequality \( y \leq -x + 5 \) so that it would shade above the line?

6. Graph the new equations from ‘d’ and ‘e’ above on the same coordinate grid. Use blue for one graph and red for the other.

\[
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\end{array}
\]

a. What do the coordinates in blue represent?

b. What do the coordinates in red represent?

c. Why do the colors not overlap this time?
Graph the following on the same coordinate grid and give 3 solutions for each.

7. \[2x + 3y < 6\]
   \[x + 5y > 5\]

8. \[y \geq \frac{1}{2} x - 1\]
   \[y \leq -\frac{1}{4} x + 6\]
9. \(3x - 4y > 5\)

\(y > \frac{3}{4}x + 1\)