Exploring Inequalities

Part 1: Creating Equivalent Inequalities

You have learned in previous mathematics classes that there are ways to manipulate equations but keep them true. When this happens, since the two equations have the same solution, they are called equivalent equations. For example, the statement $4 + 9 = 6 + 7$ is true, because $4 + 9$ and $6 + 7$ are both equal to 13. If you add -3 to both sides, the resulting statement is $4 + 9 + (-3) = 6 + 7 + (-3)$, which is also true.

1. The first thing we will explore is to see whether similar properties hold true for inequalities. Start with the inequality $5 > 4$, which is true. For this inequality, perform each of these tasks in the table below and then examine whether the resulting statements are true. You will use both positive and negative numbers.
   a. Add the same number to both sides of the inequality.
   b. Subtract the same number from both sides of the inequality.
   c. Multiply both sides of the inequality by the same number.
   d. Divide both sides of the inequality by the same number.

For example, if you multiply both sides of the inequality $5 > 4$ by 2, the statement becomes $5 \cdot 2 > 4 \cdot 2$, which is also true.

NOTE: There are times when these operations WILL NOT create equivalent inequalities. Your task is to find and show when the operations WILL or WILL NOT create equivalent inequalities.

	A positive number	A negative number
Add		
Subtract		
Multiply		
Divide		

2. Now, do the same process as number 1 with a different true inequality. Inequality: _______________

	A positive number	A negative number
Add		
Subtract		
Multiply		
Divide		

3. Under what general conditions will these operations work? When will they not work?

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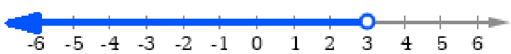
Part 2: Graphing One Variable Inequalities

To graph an inequality in a single variable, we can shade the solution (the part that makes the statement true) on a number line. If an inequality uses the < (less than) or > (greater than) symbol, it is called a **strict** inequality. If an inequality uses the $\leq$ (less than or equal to) or $\geq$ (greater than or equal to) symbol, it is called a **nonstrict** inequality.

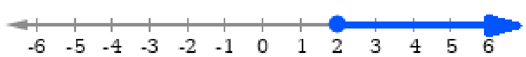
Here is an example of the graph of a strict inequality.



$x < 3$

The open circle at 3 means that the solution does not include 3 and therefore is not included in the graph.

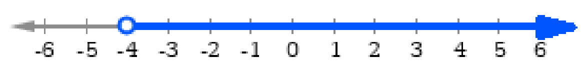
If you wish to graph the non-strict inequality that does include the endpoint as a part of the solution, the endpoint is a closed (filled in) circle.



$x \geq 2$

The closed circle at 2 means that the solution includes 2 and therefore is included in the graph.

4. Draw the graph of the inequality $x > -1$.
5. Draw the graph of the inequality $x \leq 0$.
6. What inequality goes with this graph?



7. How would you use inequalities to describe this graph?