

## Linear Inequalities

ID: 8770

Time required  
55 minutes

## Activity Overview

In this activity, students first look at an inequality statement of variable  $x$  and manipulate a slider that changes the value of  $x$ . The given inequality will consequently take on either a true or false characteristic. In Problem 2, students will manipulate a slider that will toggle through the four inequality symbols while also manipulating a value along a number line. The results depict the graphing of a one-variable inequality sentence along the number line with the appropriate shading and inclusion on either an “open” or a “closed” circle around their chosen endpoint.

Students will begin to investigate the means for solving an inequality in Problem 3 by manipulating both sides on an inequality statements and determine whether their resulting graphs are equivalent. In Problem 4, students will experiment with adding, subtracting, multiplying and dividing values to both sides of a known inequality that is always true and discover under what conditions the inequality becomes a false statement.

## Topic: Linear Inequalities

- Graph a simple linear inequality of the form  $x < a$ ,  $x \leq a$ ,  $x > a$ , or  $x \geq a$  on the real line.
- Use addition or subtraction to solve a “one-step” linear inequality in a single variable.
- Use multiplication or division to solve a “one-step” linear inequality in a single variable.

## Teacher Preparation and Notes

This activity is designed for use in an Algebra 1 or Pre-Algebra classroom.

- This activity is intended to be **student-centered** with brief periods of teacher instruction. It is recommended that you introduce each problem by guiding students through an example in a whole-class setting, and then allow them to complete the exercises individually or in small groups with your assistance.
- Prior to beginning the activity, students should have some experience solving simple one-step and multiple-step linear equations.
- Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.
- **To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter “8770” in the keyword search box.**

## Associated Materials

- *LinearInequalities\_Student.doc*
- *LinearInequalities.tns*
- *LinearInequalities\_Soln.tns*

## Suggested Related Activities

To download any activity listed, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter the number in the keyword search box.

- *Simple Inequalities on a Number Line (TI-Nspire technology)* — 11450
- *Multiplying Inequalities by Negative Numbers (TI-Nspire technology)* — 11448

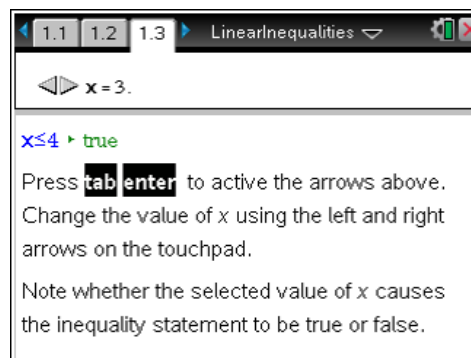
An inequality is a mathematical sentence that shows the relationship between two quantities using these signs:  $>$ ,  $\geq$ ,  $<$ ,  $\leq$ , or  $\neq$ .

Solving inequalities is similar to solving equations, but there are some important differences. One big difference occurs when multiplying or dividing by a negative number. In this activity, students will practice solving linear inequalities and explore these differences using algebraic and graphing techniques.

### Problem 1 – A Simple Inequality

In this problem, students explore values for the inequality  $x \leq 4$  that make it true. The slider is set up to toggle integer values of  $x$  between  $-10$  and  $10$ . If a student continues to press the right arrow while  $x = 10$ , the slider will not change the value until they go back to the left.

**Note:** Emphasizing the use of `tab` `enter` to activate the slider will make things easy for the students to manipulate the value of  $x$  by simply using the left and right arrows on the touchpad.



#### Student Worksheet Solutions

1. Answers may vary. (Any number that is less or equal to 4.)
2. Answers may vary. (Any number that is greater than 4.)
3. The inequality is true. The symbol  $\leq$  also allows the two sides of the inequality to be equal.

### Problem 2 – Graphing a Simple Inequality

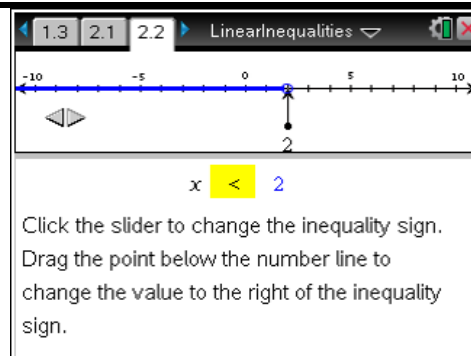
Tell students that there can be many numbers that make an inequality true—often infinitely many! To illustrate this point, you may want to begin by writing a list of solutions to  $x > 2$  on the board. Explain that a common way to represent the solutions of an inequality involves using a number line.

#### TI-Nspire Navigator Opportunity: Screen Capture

See Note 1 at the end of this lesson.

On page 2.2, students can use the slider to toggle through the four types of inequality symbols. By clicking on the number below the number line, they can move the right side value anywhere between  $-10$  and  $10$ .

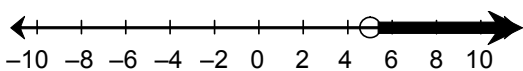
Students should pay particular attention to the open or closed circles around their chosen value on the number line based on the inequality they are investigating.



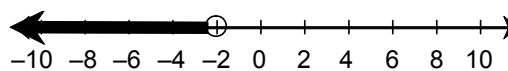
**Student Worksheet Solutions**

4. Sample answer: The graphs are identical except  $x > 2$  has an open circle at  $x = 2$  and  $x \geq 2$  has a closed circle at  $x = 2$ .

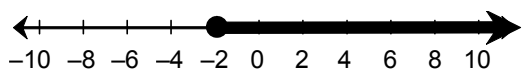
5.  $a > 5$



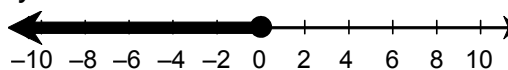
6.  $b < -2$



7.  $z \geq -2$



8.  $y \leq 0$



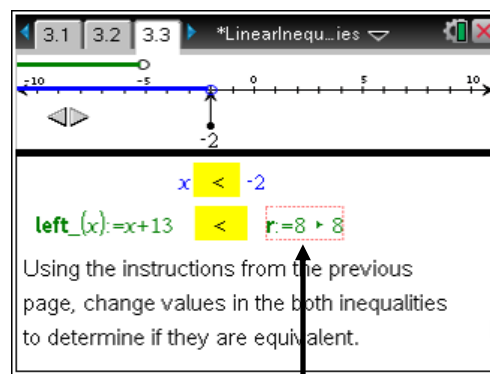
**Problem 3 – Solving Inequalities Using Addition and Subtraction**

In Problem 3, students solve one-step inequalities using addition and subtraction. Then they check their answers by graphing both the original inequality and the simplified form on page 3.3. Demonstrate simplifying an inequality by adding and subtracting from both sides. Connect this process with that of solving a one-step equation.

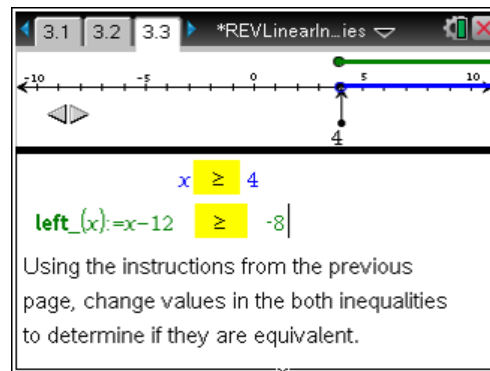
To check their solutions by graphing, students should enter the left and/or right sides of the original (unsimplified) inequality into the math box after `left_(x):=` and the math box on the right side which upon clicking it will display an `r:=` equation with output as shown in the second screen capture to the right.

Students choosing to change the right side value may need to be reminded to only change the “input” and not the “output.” Specific to this example, the input is the 8 after the equals sign.

**Note:** Remind to student to press `enter` after changing either side of the inequality.



input value



In the second screenshot to the right, we see that the original inequality on the bottom,  $x - 12 \geq - 8$  has a solution of  $x \geq 4$  because the shaded number lines are the same.

**Note:** The overall purpose of Problem 3 is to give the students a means to check problems that they have already solved by comparing their obtained solution (the top inequality) to the original problem (the bottom inequality).

**TI-Nspire Navigator Opportunity: Quick Poll**

**See Note 2 at the end of this lesson.**

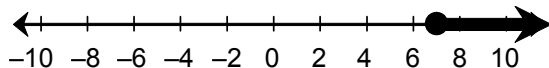
Students should solve the Self Check problem on Page 3.4 before attempting problems 9-14 on the worksheet.

**TI-Nspire Navigator Opportunity: *Screen Capture***

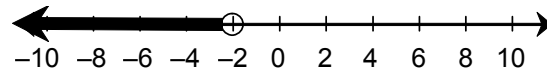
See Note 3 at the end of this lesson.

**Student Worksheet Solutions**

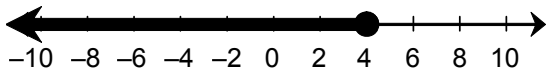
9.  $f \geq 7$



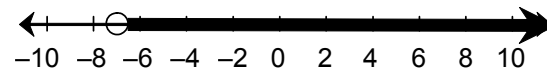
10.  $-2 > g$



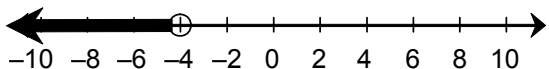
11.  $u \leq 4$



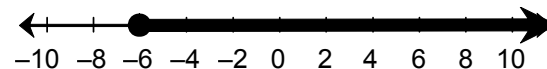
12.  $-7 < v$



13.  $-4 > h$



14.  $-6 \leq t$



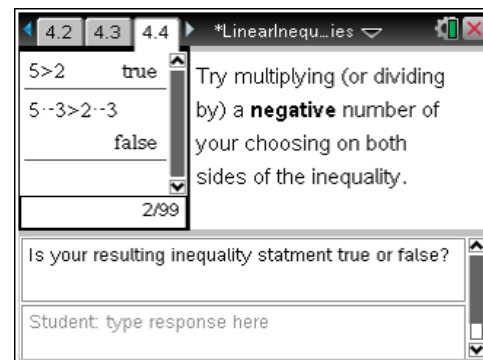
**Problem 4 – Solving Inequalities Using Multiplication and Division**

The Calculator Page activity in Problem 4 walks students through a series of basic operational manipulations of a known true inequality. Students are shown the effects of adding or subtracting, then multiplying or dividing both sides of an inequality by a positive or negative numbers.

Seeing the inequality change from true to false when multiplying or dividing both sides by a negative number could open up class discussion among students.

The teacher could explain various reasons why this occurs such as the reversal of the order that numbers appear on the number line to the left and right of zero.

Note: Emphasized the importance of using the **same value** and **same operation** on both sides of the inequality. Students should not change the inequality symbol to anything other than  $>$ .

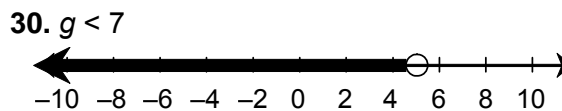
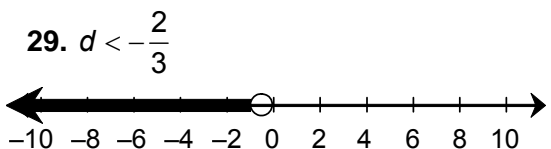
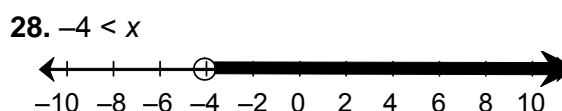
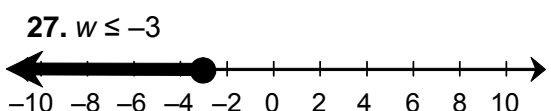
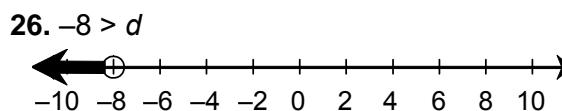
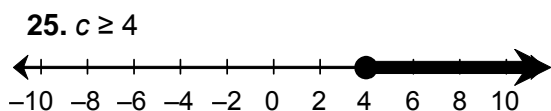


**TI-Nspire Navigator Opportunity: *Quick Poll***

See Note 4 at the end of this lesson.

**Student Worksheet Solutions**

- |   |              |             |
|---|--------------|-------------|
| 15. true                                    | 19. $x < -4$ | 22. $<$     |
| 16. yes; they have the same solutions       | 20. $\leq$   | 23. $\geq$  |
| 17. yes; they have the same solutions       | 21. $>$      | 24. reverse |
| 18. no; they do not have the same solutions |              |             |



**TI-Nspire Navigator Opportunities**

**Note 1**

**Problem 2, Screen Capture**

This would be a good place to do a screen capture to verify students are correctly manipulating the movable point and experimenting with the four various inequality symbols.

**Note 2**

**Problem 3, Quick Poll**

You may choose to use Quick Poll to assess student understanding on Problem 3.4.

**Note 3**

**Problem 3, Screen Capture**

You may want to use screen capture to verify students are manipulating the second inequality correctly and sliding the point rather than changing the contents of the math box of the first inequality. They should use Page 3.3 to check their work for Problems 9-14.

**Note 4**

**Problem 4, Quick Poll**

You may choose to use Quick Poll to assess student understanding on Questions 4.3 and 4.4.