

BARTLETT

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Unit 6, Lesson 15: Efficiently Solving Inequalities

Let's solve more complicated inequalities.

2 mins. pair/share discuss
15.1: Lots of Negatives

$$x \leq 4$$

Here is an inequality: $-x \geq -4$.

- Predict what you think the solutions on the number line will look like.
- Select **all** the values that are solutions to $-x \geq -4$:

- a. 3
- b. -3
- c. 4
- d. -4
- e. 4.001
- f. -4.001

- Graph the solutions to the inequality on the number line:



5-10 mins
15.2: Inequalities with Tables

2 mins. DISPLAY TABLE EX.

- Let's investigate the inequality $x - 3 > -2$.

Q1. How are the numbers in the rows related?

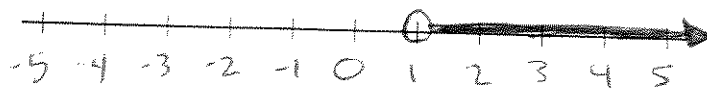
x	-4	-3	-2	-1	0	1	2	3	4
$x - 3$	-7	-6	-5	-4	-3	-2	-1	0	1

Boundary

Q2. Think about the equation $x + z = -2$. What values of x make this true?

Q3. Think about the inequality $x + z > 3$. What values make this true?

- Complete the table.
- For which values of x is it true that $x - 3 = -2$?
 $x = 1$
- For which values of x is it true that $x - 3 > -2$?
 $x > 1$ all values greater
- Graph the solutions to $x - 3 > -2$ on the number line:



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2. Here is an inequality: $2x < 6$.

a. Predict which values of x will make the inequality $2x < 6$ true.

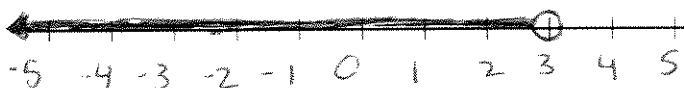
Any value less than 3

b. Complete the table. Does it match your prediction?

Boundary

x	-4	-3	-2	-1	0	1	2	3	4
$2x$	-8	-6	-4	-2	0	2	4	6	8

c. Graph the solutions to $2x < 6$ on the number line:



3. Here is an inequality: $-2x < 6$.

a. Predict which values of x will make the inequality $-2x < 6$ true.

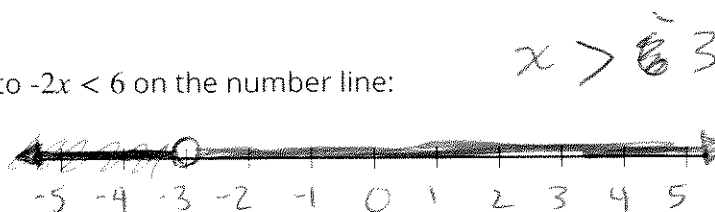
Any value less than -3? Any value greater than -3

b. Complete the table. Does it match your prediction?

Boundary

x	-4	-3	-2	-1	0	1	2	3	4
$-2x$	8	6	4	2	0	-2	-4	-6	-8

c. Graph the solutions to $-2x < 6$ on the number line:



d. How are the solutions to $2x < 6$ different from the solutions to $-2x < 6$?

All values less than 3

All values greater than -3.

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10 mins. 3 mins. work partway class

15.3: Which Side are the Solutions?

1. Let's investigate $-4x + 5 \geq 25$.

a. Solve $-4x + 5 = 25$.

$x \leq -5$

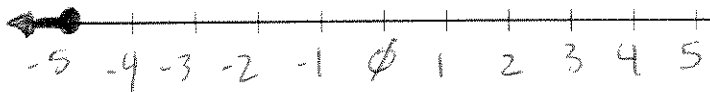
b. Is $-4x + 5 \geq 25$ true when x is 0? What about when x is 7? What about when x is -7 ?

NO

NO

Yes

c. Graph the solutions to $-4x + 5 \geq 25$ on the number line.



$-4x + 5 \geq 25$
 $-5 \quad -5$

$-4x \geq 20$
 $\frac{-4x}{-4} \geq \frac{20}{-4}$

$x \leq -5$

$\frac{14}{3} \cdot \frac{3}{4} =$

$\frac{42}{12} = 3\frac{1}{2}$

2. Let's investigate $\frac{4}{3}x + 3 < \frac{23}{3}$.

a. Solve $\frac{4}{3}x + 3 = \frac{23}{3}$.

$\frac{4}{3}x + 3 < \frac{23}{3}$
 $-\frac{9}{3}$

$\rightarrow \frac{4}{3}x < \frac{14}{3}$
 $\div \frac{4}{3}$

b. Is $\frac{4}{3}x + 3 < \frac{23}{3}$ true when x is 0?

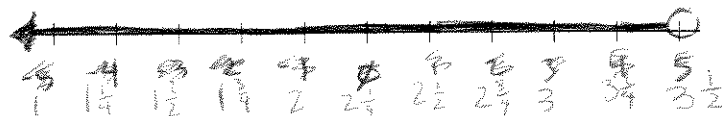
Yes

$\frac{4}{3}x < \frac{20}{3}$
 $\div \frac{4}{3}$

$x < 5$

c. Graph the solutions to $\frac{4}{3}x + 3 < \frac{23}{3}$ on the number line.

$x < 3\frac{1}{2}$ or $\frac{7}{2}$

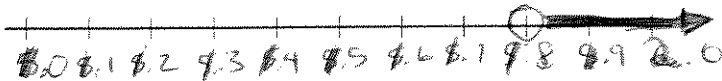


3. Solve the inequality $3(x + 4) > 17.4$ and graph the solutions on the number line.

$\frac{3(x+4)}{3} > \frac{17.4}{3}$

$x + 4 > 5.8$
 $-4 \quad -4$

$x > 1.8$



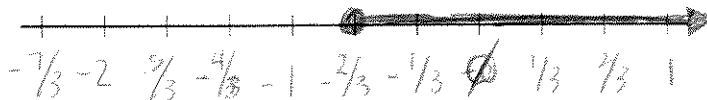
$3 \overline{) 17.4}$
 $\underline{-15}$
 24

4. Solve the inequality $-3(x - \frac{4}{3}) \leq 6$ and graph the solutions on the number line.

$x - \frac{4}{3} \geq -2$

$+\frac{4}{3} \quad +\frac{4}{3}$

$x \geq -\frac{2}{3}$



Unit 6, Lesson 16: Interpreting Inequalities

continue here if finished early

Let's write inequalities.

16.1: Solve Some Inequalities!

For each inequality, find the value or values of x that make it true.

can be more than one

1. $8x + 21 \leq 56$

$-21 \quad -21$

$8x \leq 35$

$x \leq 4\frac{3}{8}$

2. $56 < 7(7 - x)$

$56 < 49 - 7x$
 $-49 \quad -49$

$7 < -7x$

$-1 > x$

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2. The Chemistry Club is experimenting with different mixtures of water with a certain chemical (sodium polyacrylate) to make fake snow.

To make each mixture, the students start with some amount of water, and then add $\frac{1}{7}$ of that amount of the chemical, and then 9 more grams of the chemical. The chemical is expensive, so there can't be more than a certain number of grams of the chemical in any one mixture.

a. $\frac{1}{7}x + 9 \leq 26.25$

b. $9x + \frac{1}{7} \leq 26.25$

c. $26.25x + 9 \leq \frac{1}{7}$

d. $\frac{1}{7}x + 26.25 \leq 9$

$\frac{1}{7}$ of amount of water + 9 grams, ≤ 26.25

3. The Hiking Club is on a hike down a cliff. They begin at an elevation of 12 feet and descend at the rate of 3 feet per minute.

a. $37x - 3 \geq 12$

b. $3x - 37 \geq 12$

c. $12 - 3x \geq -37$

d. $12x - 37 \geq -3$

start @ 12 feet, lose 3 feet per min.

elevation above -37 feet

4. The Science Club is researching boiling points. They learn that at high altitudes, water boils at lower temperatures. At sea level, water boils at 212°F . With each increase of 500 feet in elevation, the boiling point of water is lowered by about 1°F .

a. $212 - \frac{1}{500}e < 195$

b. $\frac{1}{500}e - 195 < 212$

c. $195 - 212e < \frac{1}{500}$

d. $212 - 195e < \frac{1}{500}$

500 ft $\approx 1^\circ\text{F}$
 $\hookrightarrow 1 \text{ ft} \approx \frac{1}{500}^\circ\text{F}$

boiling points 212 decrease
 $\frac{1}{500}$ of a degree for every foot (1 ft)

below 195°

16.3: Club Activities Display

Pass out paper - ask students to work in a relation

Your teacher will assign your group one of the situations from the last task. Create a visual display about your situation. In your display:

- Explain what the variable and each part of the inequality represent
- Write a question that can be answered by the solution to the inequality
- Show how you solved the inequality
- Explain what the solution means in terms of the situation

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Are you ready for more?

Write at least three different inequalities whose solution is $x > -10$. Find one with x on the left side that uses a $<$.

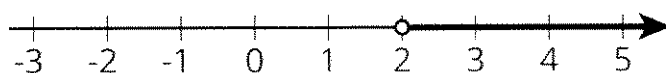
Lesson 15 Summary

Here is an inequality: $3(10 - 2x) < 18$. The solution to this inequality is all the values you could use in place of x to make the inequality true.

In order to solve this, we can first solve the related equation $3(10 - 2x) = 18$ to get the solution $x = 2$. That means 2 is the boundary between values of x that make the inequality true and values that make the inequality false.

To solve the inequality, we can check numbers greater than 2 and less than 2 and see which ones make the inequality true.

Let's check a number that is greater than 2: $x = 5$. Replacing x with 5 in the inequality, we get $3(10 - 2 \cdot 5) < 18$ or just $0 < 18$. This is true, so $x = 5$ is a solution. This means that all values greater than 2 make the inequality true. We can write the solutions as $x > 2$ and also represent the solutions on a number line:



Notice that 2 itself is not a solution because it's the value of x that makes $3(10 - 2x)$ equal to 18, and so it does not make $3(10 - 2x) < 18$ true.

For confirmation that we found the correct solution, we can also test a value that is less than 2. If we test $x = 0$, we get $3(10 - 2 \cdot 0) < 18$ or just $30 < 18$. This is false, so $x = 0$ and all values of x that are less than 2 are not solutions.

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Are you ready for more?

$\{3, 4, 5, 6\}$ is a set of four consecutive integers whose sum is 18.

1. How many sets of three consecutive integers are there whose sum is between 51 and 60? Can you be sure you've found them all? Explain or show your reasoning.
2. How many sets of four consecutive integers are there whose sum is between 59 and 82? Can you be sure you've found them all? Explain or show your reasoning.

Lesson 16 Summary

We can represent and solve many real-world problems with inequalities. Writing the inequalities is very similar to writing equations to represent a situation. The expressions that make up the inequalities are the same as the ones we have seen in earlier lessons for equations. For inequalities, we also have to think about how expressions compare to each other, which one is bigger, and which one is smaller. Can they also be equal?

For example, a school fundraiser has a minimum target of \$500. Faculty have donated \$100 and there are 12 student clubs that are participating with different activities. How much money should each club raise to meet the fundraising goal? If n is the amount of money that each club raises, then the solution to $100 + 12n = 500$ is the minimum amount each club has to raise to meet the goal. It is more realistic, though, to use the inequality $100 + 12n \geq 500$ since the more money we raise, the more successful the fundraiser will be. There are many solutions because there are many different amounts of money the clubs could raise that would get us above our minimum goal of \$500.