6th Grade Math

Unit 11: One-variable inequalities
6.9A, 6.9B, 6.9C, 6.10A, 6.10B

Inequalities help us understand relationships, solve problems, make decisions, and model real-world scenarios. They foster critical thinking and are used in mathematics, economics, science, and engineering.

- Determine whether values are solutions to inequalities
- Graph one-variable inequalities
- Solve one-step inequalities
- Translate word problems into inequalities

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<th>TEKS standards</th>
<th>Common misconceptions</th>
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<td><strong>6.9A</strong>: Write one-variable, one-step equations and inequalities to represent constraints or conditions within problems</td>
<td>Confusing the inequality symbols</td>
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<td><strong>6.9B</strong>: Represent solutions for one-variable, one-step equations and inequalities on number lines</td>
<td>Forgetting to flip</td>
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<td><strong>6.9C</strong>: Write corresponding real-world problems given one-variable, one-step equations or inequalities</td>
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<td><strong>6.10A</strong>: Model and solve one-variable,</td>
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How to help: Show some examples, like in the first video for Lesson 2, for why we need to flip the symbol. Reiterate that to keep the statement true, the inequality must flip. Give lots of practice!

“Inequalities have one solution” | Some students might think that inequalities are like equations and have one solution. Inequalities generally have many solutions (sometimes infinitely many!).

How to help: Use an inequality like $x > -2$ to show that there are many possible solutions by plugging in a variety of numbers that both satisfy and do not satisfy it. For example, -1, 0, 1.2, 5, 30.95, 87, and 1468 are all possible solutions for $x > -2$ while -3, -5.9, -28, and -34582 are not solutions to $x > -2$. In word problems, discuss a variety of possible answers for the specific situation.

Confusing open and closed dots on a number line | When we graph inequalities on a number line, we show whether the value in the inequality is included in the set or not by the type of dot we use on the graph. An open dot (○) means that the point is not included in the solution set while a closed dot (●) is included in the solution set.

How to help: Do examples together and make sure students get lots of practice. Explain that an open dot cannot equal the number (that’s why it’s open) and a closed dot is solid, so it can equal the number.

“Inequalities are not applicable to real situations” | It can be difficult at times to relate math in classrooms with mathematical thinking that is used outside of classrooms. We talk about inequalities all the time, like “I need at least 10 minutes to finish this project,” $t \geq 10$ and “it’s less than one mile to the store,” $d < 1$.

How to help: In addition to working on the word problems in this unit, give students examples of how they might use inequality language every day. Have them pay attention to inequality language outside of class time to see what they notice and share with the class. Once they start paying attention, they’ll hear inequalities everywhere!
Unit resources

- For Lesson 1, it may be helpful to use this [Number line template](#) when graphing inequalities.
- For the videos in this unit, use the [Learning summary video notetaking guide](#).
- For the articles in this unit, use the [Article notetaking guide](#).
- For the exercises in this unit, use the [Blank workspace template](#).
- To record key terms and information, use the [Vocabulary and notation notetaker](#).

Lesson overview

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<th>Lesson</th>
<th>Objective</th>
<th>Teaching tips</th>
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| **Lesson 1: Intro to inequalities with variables** | Students will be able to determine whether a number is a solution to an inequality. Students will be able to graph inequalities on a number line. Students will be able to write an inequality to represent a word problem situation. | - **Warm up activity:** To refresh inequalities, give students pairs of numbers and ask them to fill in the correct symbol (<, >, =).  
  
  $5 \ ? \ 9 \rightarrow 5 \ < \ 9$  
  
  Students worked with inequalities back in Unit 3, and they may need a reminder here.  
  
  - Students will begin their work with inequalities by substituting values for the variable and simplifying to determine if the statement is true. Do a few examples together and remind students of the order of operations.  
  
  - Graphing inequalities on a number line requires students to determine if the dot is open or closed and then which side to shade. See "Best practices" for more. Use this [Number line template](#) so students can make their own graphs. Students may need guidance in the fourth exercise for how to use the buttons to make the points open/closed and then shade.  
  
  - As students work on word problems, document the language that goes along with the inequality symbols on a word wall or poster. For example, “over” means “greater than” and “no more than” means “less than or equal to.” Students will need to read the problems carefully to interpret which symbol to use. |
Lesson 2: One-step inequalities

TEKS standard: 6.9C, 6.10A

Students will be able to solve one-step inequalities.
Students will be able to write a one-step inequality that represents a word problem situation.

- Students will use what they learned in the previous unit (Unit 10), solving equations, and apply those same skills here, to inequalities. The same rules apply (use in inverse operation to isolate a variable, keep it balanced by doing the same thing to both sides). There is only one difference: when both sides of the inequality are multiplied or divided by a negative number, the symbol will flip. See “Best practices for more.

\[
\begin{align*}
-2x &< 6 \\
\frac{y}{-5} &\geq 4 \\
\frac{-2x}{-2} &< \frac{6}{-2} \\
-5 \cdot \frac{y}{-5} &\geq 4 \cdot -5 \\
x &> -3 \\
y &\leq -20
\end{align*}
\]

- In the exercises, students may need help figuring out how to include a symbol in the answer box. Click on the operation symbols icon in the answer box and then click the middle icon on the top, with symbols. That will open a menu with all of the inequality symbols they can choose from. If they are using greater than or less than (not equal to), they can use the keys on their keyboard (above the period and comma).

- As students complete word problems, encourage them to read slowly and carefully. Drawing pictures may help to visualize what is happening.

- The article provides an overview of solving one-step inequalities and includes extra practice problems.
Best practices

Graphing inequalities
Students have used a number line to plot points before, and graphing inequalities uses those same skills, plus more! Once students locate the point on the number line, they will need to determine if the dot is open (not equal to) or closed (can equal to). Then, they will need to either reason it out or plug in points to determine which side of the point to shade.

Graph \( x \geq -3 \).

First, we need to locate -3 on the number line and determine if the point should be open or closed. Since the \( \geq \) symbol is used, it can be equal, so it is a solid dot.

Then, we need to determine which side of the point includes the solution set and will get “shaded.” We can reason it out, “\( x \) is greater than or equal to -3, so I will shade where the numbers are greater than -3.” Another method is to plug in a number that is not -3 to see if that gives a true statement. If it does then shade that side and if it doesn’t shade the other side.

<table>
<thead>
<tr>
<th>( x )</th>
<th>Inequality</th>
<th>True?</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( 0 \geq -3 )</td>
<td>Yes! Shade the side that includes 0.</td>
</tr>
<tr>
<td>-5</td>
<td>( -5 \geq -3 )</td>
<td>No! Do not shade the side that includes -5.</td>
</tr>
</tbody>
</table>

Graph \( x < 1 \).

First, we need to locate 1 on the number line. Since the \( < \) symbol is used, it cannot be equal, so it will be an open dot.

Then, we need to determine which side of the point induces the solution set and will get “shaded.” We can reason it out “\( x \) is less than 1, so I will shade where the numbers are less than 1.” Another method is to plug in a number that is not 1 to see if that gives a true statement. If it does then shade that side and if it doesn’t shade the other side.

<table>
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<tr>
<th>( x )</th>
<th>Inequality</th>
<th>True?</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>( 6 &lt; 1 )</td>
<td>No! Do not shade the side that includes 6.</td>
</tr>
<tr>
<td>0</td>
<td>( 0 &lt; 1 )</td>
<td>Yes! Shade the side that includes 0.</td>
</tr>
</tbody>
</table>
why we flip the sign

When solving inequalities, we flip the sign when both sides of the inequality are multiplied or divided by a negative number. Let’s look at why we do this.

Here is one way to think about it:

\[
-2x < 10 \\
-2x < 10 \\
-2 < \frac{10}{-2} \\
x < -5 \\
3 \not< -5 \\
x > -5
\]

If I plug in \( x = 3 \), I get \(-6 < 10\), which is true.

Now, let’s divide both sides by -2 to isolate \( x \).

We knew that \( x = 3 \) was true in the initial inequality, so it should also make a true statement here.

BUT, it isn’t true! We need to *flip* the sign to make it true.

Here is another way to think about it, as a proof:

Given \( a > b \)

\[
\begin{align*}
0 &> b - a \\
-b &> -a
\end{align*}
\]

Subtract \( a \) from both sides. Subtract \( b \) from both sides.

Thus, if \( a > b \), then \(- a < -b \).

Here is a visual/logical way to think about it:

1. “Greater than” means “to the right of” on the number line.
2. Multiplying or dividing by a negative number flips numbers around 0. For example, \( 3 \times (-1) = -3 \).
3. Thus, “right of” becomes “left of,” or “less than”.

**CLASSROOM ACTIVITY**

**Writing stories**

Have students write their own inequality word problems. They can put their problem on a poster with an illustration and then trade with a classmate to solve and graph it. Have students give examples of solutions and non-solutions to the inequality word problem and explain why they do or do not make sense in the problem situation. Extra challenge: Have students write one-step inequality word problems.

**GENERAL CLASSROOM IMPLEMENTATION RESOURCES:**

- **Weekly Khan Academy quick planning guide**: Use this template to plan your week using Khan Academy.
- **Using Khan Academy in the classroom**: Learn teaching techniques and strategies to support your students and save time with Khan Academy.
- **Differentiation strategies for the classroom**: Discover strategies to support the learning of all students.