3.1 Writing and Graphing Inequalities

Essential Question How can you use an inequality to describe a real-life statement?

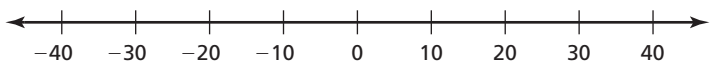
1 ACTIVITY: Writing and Graphing Inequalities

Work with a partner. Write an inequality for the statement. Then sketch the graph of all the numbers that make the inequality true.

a. **Statement:** The temperature t in Minot, North Dakota has never been below $-36°$F.

Inequality:

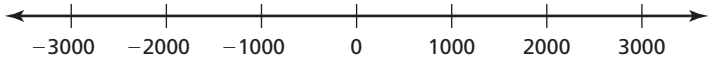
Graph:



b. **Statement:** The elevation e in Wisconsin is at most 1951.5 feet above sea level.

Inequality:

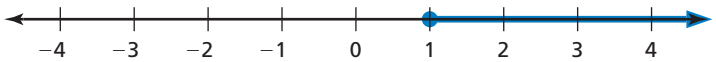
Graph:



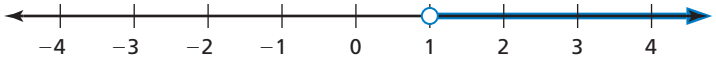
2 ACTIVITY: Writing and Graphing Inequalities

Work with a partner. Write an inequality for the graph. Then, in words, describe all the values of x that make the inequality true.

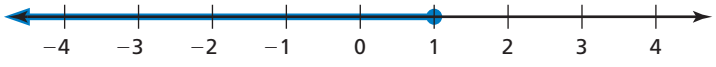
a.



b.



c.



d.

Common Core

Writing Inequalities

In this lesson, you will

- write and graph inequalities.

Learning Standards
A.CED.1
A.CED.3

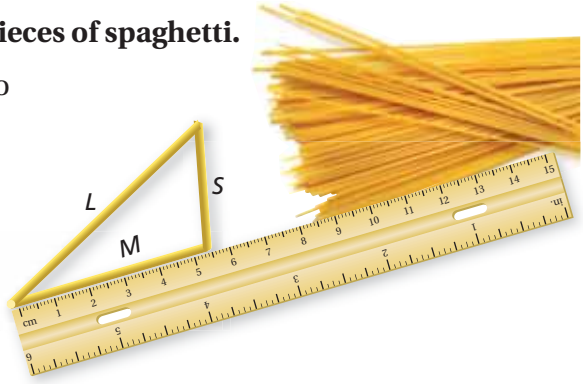
3 ACTIVITY: Triangle Inequality

Math Practice 3

Construct Arguments

How can you use results from this activity to write a rule?

Work with a partner. Use 8 to 10 pieces of spaghetti.



- Break one piece of spaghetti into three parts that can be used to form a triangle.
- Form a triangle and use a centimeter ruler to measure each side. Round the side lengths to the nearest tenth.
- Record the side lengths in a table.

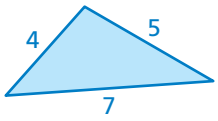
Side Lengths That Form a Triangle			
Small	Medium	Large	$S + M$

- Repeat the process with two other pieces of spaghetti.
- Repeat the experiment by breaking pieces of spaghetti into three pieces that *do not* form a triangle. Record the lengths in a table.

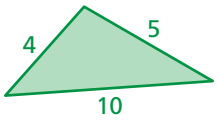
Side Lengths That Do Not Form a Triangle			
Small	Medium	Large	$S + M$

- **INDUCTIVE REASONING** Write a rule that uses an inequality to compare the lengths of three sides of a triangle.
- Use your rule to decide whether the following triangles are possible. Explain.

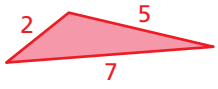
a.



b.



c.



What Is Your Answer?

4. IN YOUR OWN WORDS How can you use an inequality to describe a real-life statement? Give two examples of real-life statements that can be represented by inequalities.

Practice Use what you learned about writing and graphing inequalities to complete Exercises 4 and 5 on page 108.

3.1 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
inequality, *p. 106*
solution of an inequality, *p. 106*
solution set, *p. 106*
graph of an inequality, *p. 107*

An **inequality** is a mathematical sentence that compares expressions. It contains the symbol $<$, $>$, $\leq$, or $\geq$. To write an inequality, look for the following phrases to determine where to place the inequality symbol.

Inequality Symbols				
Symbol	$<$	$>$	$\leq$	$\geq$
Key Phrases	• is less than • is fewer than	• is greater than • is more than	• is less than or equal to • is at most • is no more than	• is greater than or equal to • is at least • is no less than

EXAMPLE 1 Writing an Inequality

A number w minus 3.5 is less than or equal to -2. Write this sentence as an inequality.

A number w minus 3.5 is less than or equal to -2.

$w - 3.5 \quad \leq \quad -2$

∴ An inequality is $w - 3.5 \leq -2$.

On Your Own

Now You're Ready
Exercises 6–9

Write the word sentence as an inequality.

1. A number b is fewer than 30.4.
2. Twice a number k is at least $-\frac{7}{10}$.

A **solution of an inequality** is a value that makes the inequality true. An inequality can have more than one solution. The set of all solutions of an inequality is called the **solution set**.

Value of x	$x + 5 \geq -2$	Is the inequality true?
-6	$-6 + 5 \stackrel{?}{\geq} -2$ $-1 \geq -2$ ✓	yes
-7	$-7 + 5 \stackrel{?}{\geq} -2$ $-2 \geq -2$ ✓	yes
-8	$-8 + 5 \stackrel{?}{\geq} -2$ $-3 \not\geq -2$ ✗	no

Reading
The symbol $\not\geq$ means "is not greater than or equal to."

EXAMPLE 2 Checking Solutions

Tell whether −4 is a solution of each inequality.

a. $x + 8 < -3$

$x + 8 < -3$ Write the inequality.

$-4 + 8 \stackrel{?}{<} -3$ Substitute −4 for x.

$4 \not< -3$ ✗ Simplify.

4 is *not* less than −3.

∴ So, −4 is *not* a solution of the inequality.

b. $-4.5x > -21$

$-4.5x > -21$

$-4.5(-4) \stackrel{?}{>} -21$

$18 > -21$ ✓

18 is greater than −21.

∴ So, −4 is a solution of the inequality.

On Your Own

Now You're Ready
Exercises 11–16

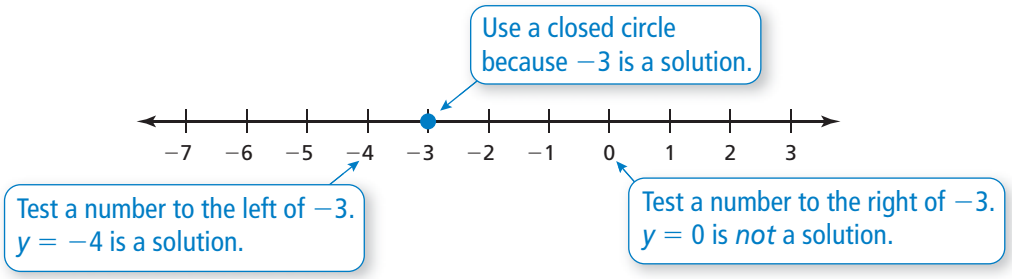
Tell whether −6 is a solution of the inequality.

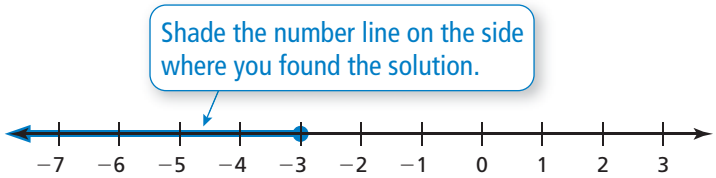
3. $c + 4 < -1$ **4.** $5 - m \leq 10$ **5.** $21 \div x \geq -3.5$

The **graph of an inequality** shows all of the solutions of the inequality on a number line. An open circle ○ is used when a number is *not* a solution. A closed circle ● is used when a number is a solution. An arrow to the left or right shows that the graph continues in that direction.

EXAMPLE 3 Graphing an Inequality

Graph $y \leq -3$.





On Your Own

Now You're Ready
Exercises 17–20

Graph the inequality on a number line.

6. $b > -8$ **7.** $g \leq 1.4$ **8.** $r < -\frac{1}{2}$ **9.** $v \geq \sqrt{36}$

3.1 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **VOCABULARY** Would an open circle or a closed circle be used in the graph of the inequality $k < 250$? Explain.

2. **DIFFERENT WORDS, SAME QUESTION** Which is different? Write "both" inequalities.

   w is greater than or equal to -7.

   w is no less than -7.

   w is no more than -7.

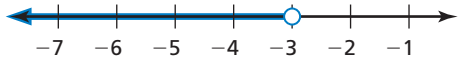
   w is at least -7.

3. **REASONING** Do $x \geq -9$ and $-9 \geq x$ represent the same inequality? Explain.

Practice and Problem Solving

Write an inequality for the graph. Then, in words, describe all the values of x that make the inequality true.

4. 

5. 

Write the word sentence as an inequality.

1 6. A number x is no less than -4.

7. A number y added to 5.2 is less than 23.

8. A number b multiplied by -5 is at most $-\frac{3}{4}$.

9. A number k minus 8.3 is greater than 48.

10. **ERROR ANALYSIS** Describe and correct the error in writing the word sentence as an inequality.

> ✗ Twice a number c is at least $-\frac{4}{9}$.
>
> $2c \leq -\frac{4}{9}$

Tell whether the given value is a solution of the inequality.

2 11. $s + 6 \leq 12;\ s = 4$

12. $15n > -3;\ n = -2$

13. $a - 2.5 \leq 1.6;\ a = 4.1$

14. $-3.3q > -13;\ q = 4.6$

15. $\frac{4}{5}h \geq -4;\ h = -15$

16. $\frac{1}{12} - p < \frac{1}{3};\ p = \frac{1}{6}$

Graph the inequality on a number line.

3 17. $g \geq -6$

18. $q > 1.25$

19. $z < 11\frac{1}{4}$

20. $w \leq -\sqrt{64}$

21. **DRIVING** When you are driving with a learner's license, a licensed driver who is 21 years of age or older must be with you. Write an inequality that represents this situation.

Tell whether the given value is a solution of the inequality.

22. $3p > 5 + p;\ p = 4$

23. $\frac{y}{2} \geq y - 11;\ y = 18$

24. LOGIC Each video game rating is matched with the inequality that represents the suggested ages of players. Your friend is old enough to play "E 10+" games. Is your friend old enough to play "T" games? Explain.

$x \geq 3$ $x \geq 6$ $x \geq 10$ $x \geq 13$ $x \geq 17$

The ESRB rating icons are registered trademarks of the Entertainment Software Association.

25. SCUBA DIVING Three requirements for a scuba diving training course are shown.

a. Write and graph three inequalities that represent the requirements.

b. You can swim 10 lengths of a 25-yard pool. Do you satisfy the swimming requirement of the course? Justify your answer.

26. REPEATED REASONING On an airplane, the maximum sum of the length, width, and height of a carry-on bag is 45 inches. Find three different sets of dimensions that are reasonable for a carry-on bag. Use a diagram to justify your answer.

27. Critical Thinking A number m is less than another number n. The number n is less than or equal to a third number p.

a. Write two inequalities representing these relationships.

b. Describe the relationship between m and p.

c. Can m be equal to p? Explain.

Fair Game Review What you learned in previous grades & lessons

Solve the equation. Check your solution. *(Section 1.1)*

28. $r - 12 = 3$ **29.** $4.2 + p = 2.5$ **30.** $n - 3\pi = 7\pi$

31. MULTIPLE CHOICE Which of the following is the equation of the line in slope-intercept form? *(Section 2.5)*

(A) $y = -2x + 1$ (B) $y = -x - 1$

(C) $y = x + 1$ (D) $y = -x + 1$