

Essential Question How can you use addition or subtraction to solve an inequality?

1 ACTIVITY: Writing an Inequality

Work with a partner. Members of the Boy Scouts must be less than 18 years old. In 4 years, your friend will still be eligible to be a scout.

- a. Which of the following represents your friend's situation? What does x represent? Explain your reasoning.



$$x + 4 > 18$$

$$x + 4 < 18$$

$$x + 4 \geq 18$$

$$x + 4 \leq 18$$

- b. Graph the possible ages of your friend on a number line. Explain how you decided what to graph.

2 ACTIVITY: Writing an Inequality

Work with a partner. Supercooling is the process of lowering the temperature of a liquid or a gas below its freezing point without it becoming a solid. Water can be supercooled to 86°F below its normal freezing point (32°F) and still not freeze.

- a. Let x represent the temperature of water. Which inequality represents the temperature at which water can be a liquid or a gas? Explain your reasoning.

$$x - 32 > -86$$

$$x - 32 < -86$$

$$x - 32 \geq -86$$

$$x - 32 \leq -86$$



- b. On a number line, graph the possible temperatures at which water can be a liquid or a gas. Explain how you decided what to graph.

Inequalities

In this lesson, you will

- solve inequalities using addition or subtraction.
- solve real-life problems.

3 ACTIVITY: Solving Inequalities

Math Practice

Interpret Results

What does the solution of the inequality represent?

Work with a partner. Complete the following steps for Activity 1. Then repeat the steps for Activity 2.

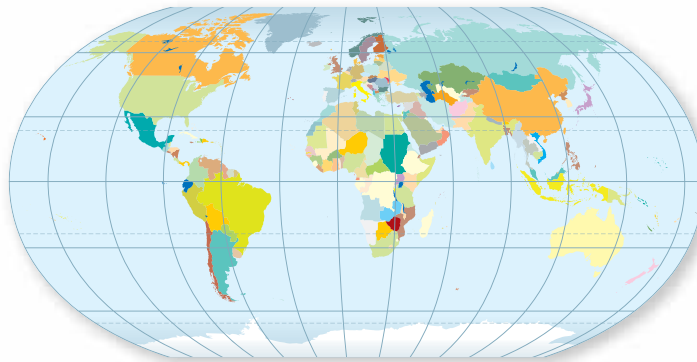
- Use your inequality from part (a). Replace the inequality symbol with an equal sign.
- Solve the equation.
- Replace the equal sign with the original inequality symbol.
- Graph this new inequality.
- Compare the graph with your graph in part (b). What do you notice?

4 ACTIVITY: Temperatures of Continents

Work with a partner. The table shows the lowest recorded temperature on each continent. Write an inequality that represents each statement. Then solve and graph the inequality.

- The temperature at a weather station in Asia is more than 150°F greater than the record low in Asia.
- The temperature at a research station in Antarctica is at least 80°F greater than the record low in Antarctica.

Continent	Lowest Temperature
Africa	-11°F
Antarctica	-129°F
Asia	-90°F
Australia	-9.4°F
Europe	-67°F
North America	-81.4°F
South America	-27°F



What Is Your Answer?

- IN YOUR OWN WORDS** How can you use addition or subtraction to solve an inequality?
- Describe a real-life situation that you can represent with an inequality. Write the inequality. Graph the solution on a number line.

Practice

Use what you learned about solving inequalities to complete Exercises 3–5 on page 134.

Key Ideas

Study Tip

You can solve inequalities in the same way you solve equations. Use inverse operations to get the variable by itself.

Addition Property of Inequality

Words When you add the same number to each side of an inequality, the inequality remains true.

Numbers $-4 < 3$ **Algebra** If $a < b$, then $a + c < b + c$.
 $\quad \quad \quad \underline{+ 2} \quad \underline{+ 2}$ If $a > b$, then $a + c > b + c$.
 $\quad \quad \quad -2 < 5$

Subtraction Property of Inequality

Words When you subtract the same number from each side of an inequality, the inequality remains true.

Numbers $-2 < 2$ **Algebra** If $a < b$, then $a - c < b - c$.
 $\quad \quad \quad \underline{- 3} \quad \underline{- 3}$ If $a > b$, then $a - c > b - c$.
 $\quad \quad \quad -5 < -1$

These properties are also true for \leq and \geq .

EXAMPLE 1 Solving an Inequality Using Addition

Solve $x - 5 < -3$. Graph the solution.

$$x - 5 < -3$$

Write the inequality.

Undo the subtraction.

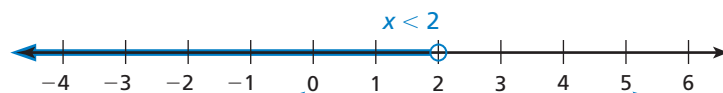
$$\underline{+ 5} \quad \underline{+ 5}$$

Addition Property of Inequality

$$x < 2$$

Simplify.

∴ The solution is $x < 2$.



Check:

$$x = 0: 0 - 5 \stackrel{?}{<} -3$$

$$-5 < -3 \quad \checkmark$$

$$x = 5: 5 - 5 \stackrel{?}{<} -3$$

$$0 \not< -3 \quad \times$$

On Your Own

Solve the inequality. Graph the solution.

1. $y - 6 > -7$

2. $b - 3.8 \leq 1.7$

3. $-\frac{1}{2} > z - \frac{1}{4}$

EXAMPLE 2 Solving an Inequality Using Subtraction

Solve $13 \leq x + 14$. Graph the solution.

$$13 \leq x + 14 \quad \text{Write the inequality.}$$

Undo the addition.

$$\begin{array}{r} -14 \\ \hline -1 \leq x \end{array} \quad \begin{array}{l} \text{Subtraction Property of Inequality} \\ \text{Simplify.} \end{array}$$

∴ The solution is $x \geq -1$.



Reading

The inequality $-1 \leq x$ is the same as $x \geq -1$.

On Your Own

Now You're Ready
Exercises 3–17

Solve the inequality. Graph the solution.

4. $w + 7 \leq 4$

5. $12.5 \geq d + 10$

6. $x + \frac{3}{4} > 1\frac{1}{2}$

EXAMPLE 3 Real-Life Application

A person can be no taller than 6.25 feet to become an astronaut pilot for NASA. Your friend is 5 feet 9 inches tall. Write and solve an inequality that represents how much your friend can grow and still meet the requirement.

Words Current height plus amount your friend can grow is no more than the height limit.

Variable Let h be the possible amounts your friend can grow.

Inequality 5.75 + $h \leq$ 6.25

$$5 \text{ ft } 9 \text{ in.} = 60 + 9 = 69 \text{ in.}$$

$$69 \text{ in.} \times \frac{1 \text{ ft}}{12 \text{ in.}} = 5.75 \text{ ft}$$

$$5.75 + h \leq 6.25 \quad \text{Write the inequality.}$$

$$\begin{array}{r} -5.75 \\ \hline h \leq 0.5 \end{array} \quad \begin{array}{l} \text{Subtraction Property of Inequality} \\ \text{Simplify.} \end{array}$$

∴ So, your friend can grow no more than 0.5 foot, or 6 inches.

On Your Own

7. Your cousin is 5 feet 3 inches tall. Write and solve an inequality that represents how much your cousin can grow and still meet the requirement.



Vocabulary and Concept Check

- REASONING** Is the inequality $c + 3 > 5$ the same as $c > 5 - 3$? Explain.
- WHICH ONE DOESN'T BELONG?** Which inequality does *not* belong with the other three? Explain your reasoning.

$$w + \frac{7}{4} > \frac{3}{4}$$

$$w - \frac{3}{4} > -\frac{7}{4}$$

$$w + \frac{7}{4} < \frac{3}{4}$$


$$\frac{3}{4} < w + \frac{7}{4}$$

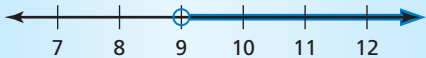
Practice and Problem Solving


Solve the inequality. Graph the solution.

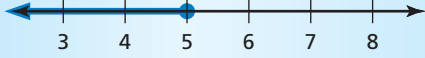
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|---|---|--|------------------------------|--------------------------------------|
| 1 | 2 | 3. $x + 7 \geq 18$ | 4. $a - 2 > 4$ | 5. $3 \leq 7 + g$ |
| | | 6. $8 + k \leq -3$ | 7. $-12 < y - 6$ | 8. $n - 4 < 5$ |
| | | 9. $t - 5 \leq -7$ | 10. $p + \frac{1}{4} \geq 2$ | 11. $\frac{2}{7} > b + \frac{5}{7}$ |
| | | 12. $z - 4.7 \geq -1.6$ | 13. $-9.1 < d - 6.3$ | 14. $\frac{8}{5} > s + \frac{12}{5}$ |
| | | 15. $-\frac{7}{8} \geq m - \frac{13}{8}$ | 16. $r + 0.2 < -0.7$ | 17. $h - 6 \leq -8.4$ |

ERROR ANALYSIS Describe and correct the error in solving the inequality or graphing the solution of the inequality.

18. 
$$\begin{array}{r} x - 7 > -2 \\ +7 \quad +7 \\ \hline x > 9 \end{array}$$



19. 
$$\begin{array}{r} 8 \leq x + 3 \\ -3 \quad -3 \\ \hline 5 \leq x \end{array}$$

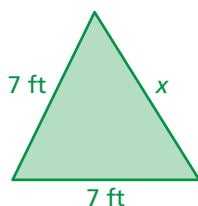


20. **AIRPLANE** A small airplane can hold 44 passengers. Fifteen passengers board the plane.
- Write and solve an inequality that represents the additional number of passengers that can board the plane.
 - Can 30 more passengers board the plane? Explain.

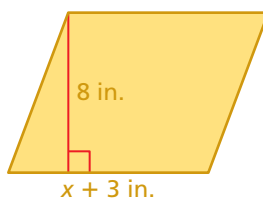


Write and solve an inequality that represents x .

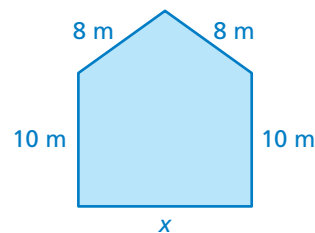
21. The perimeter is less than 28 feet.



22. The base is greater than the height.



23. The perimeter is less than or equal to 51 meters.



24. **REASONING** The solution of $d + s > -3$ is $d > -7$. What is the value of s ?
25. **BIRDFEEDER** The hole for a birdfeeder post is 3 feet deep. The top of the post needs to be at least 5 feet above the ground. Write and solve an inequality that represents the required length of the post.



26. **SHOPPING** You can spend up to \$35 on a shopping trip.
- You want to buy a shirt that costs \$14. Write and solve an inequality that represents the amount of money you will have left if you buy the shirt.
 - You notice that the shirt is on sale for 30% off. How does this change the inequality?
 - Do you have enough money to buy the shirt that is on sale and a pair of pants that costs \$23? Explain.

27. **POWER** A circuit overloads at 2400 watts of electricity. A portable heater that uses 1050 watts of electricity is plugged into the circuit.
- Write and solve an inequality that represents the additional number of watts you can plug in without overloading the circuit.
 - In addition to the portable heater, what two other items in the table can you plug in at the same time without overloading the circuit? Is there more than one possibility? Explain.

Item	Watts
Aquarium	200
Hair dryer	1200
Television	150
Vacuum cleaner	1100

28. **Number Sense** The possible values of x are given by $x + 8 \leq 6$. What is the greatest possible value of $7x$?



Fair Game Review What you learned in previous grades & lessons

Solve the equation. Check your solution. (Section 3.4)

29. $4x = 36$ 30. $\frac{w}{3} = -9$ 31. $-2b = 44$ 32. $60 = \frac{3}{4}h$

33. **MULTIPLE CHOICE** Which fraction is equivalent to -2.4 ? (Section 2.1)

- (A) $-\frac{12}{5}$ (B) $-\frac{51}{25}$ (C) $-\frac{8}{5}$ (D) $-\frac{6}{25}$