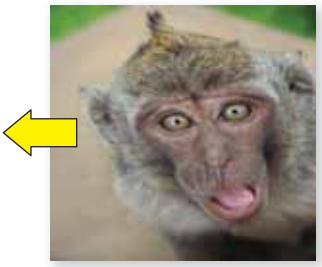
# 2.5 Similar Figures

**Essential Question** How can you use proportions to help make decisions in art, design, and magazine layouts?

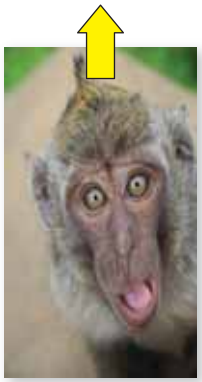
Original photograph

In a computer art program, when you click and drag on a side of a photograph, you distort it.

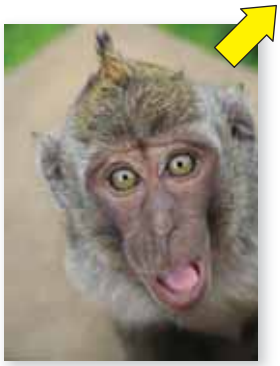
But when you click and drag on a corner of the photograph, the dimensions remain proportional to the original.



Distorted



Distorted

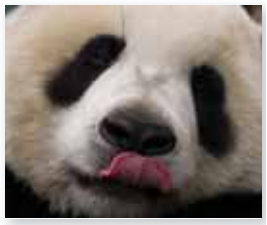


Proportional

## 1 ACTIVITY: Reducing Photographs

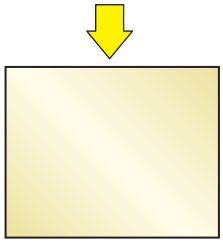
**Work with a partner. You are trying to reduce the photograph to the indicated size for a nature magazine. Can you reduce the photograph to the indicated size without distorting or cropping? Explain your reasoning.**

**a.**



5 in.

6 in.



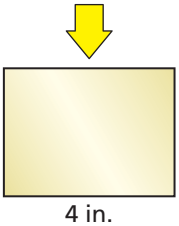
4 in.

5 in.

**b.**

6 in.

8 in.



3 in.

4 in.

**Common Core**

**Geometry**

In this lesson, you will

- name corresponding angles and corresponding sides of similar figures.
- identify similar figures.
- find unknown measures of similar figures.

Preparing for Standard 8.G.4

## 2 ACTIVITY: Creating Designs

**Work with a partner.**

**Math Practice 4**

**Analyze Relationships**

How can you use mathematics to determine whether the dimensions are proportional?

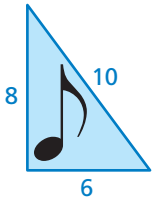
**a.** Tell whether the dimensions of the new designs are proportional to the dimensions of the original design. Explain your reasoning.

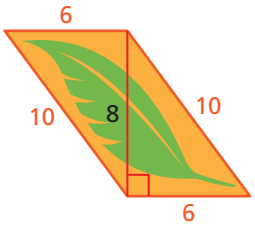
**Original**


**Design 1**


**Design 2**


**b.** Draw two designs whose dimensions are proportional to the given design. Make one bigger and one smaller. Label the sides of the designs with their lengths.

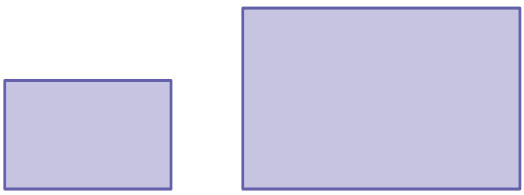




## What Is Your Answer?

**3. IN YOUR OWN WORDS** How can you use proportions to help make decisions in art, design, and magazine layouts? Give two examples.

**4. a.** Use a computer art program to draw two rectangles whose dimensions are proportional to each other.




**"I love this statue. It seems similar to a big statue I saw in New York."**

**b.** Print the two rectangles on the same piece of paper.

**c.** Use a centimeter ruler to measure the length and the width of each rectangle.

**d.** Find the following ratios. What can you conclude?

$$\frac{\text{Length of larger}}{\text{Length of smaller}} \qquad \frac{\text{Width of larger}}{\text{Width of smaller}}$$

**Practice** Use what you learned about similar figures to complete Exercises 4 and 5 on page 74.

# 2.5 Lesson

Check It Out
Lesson Tutorials
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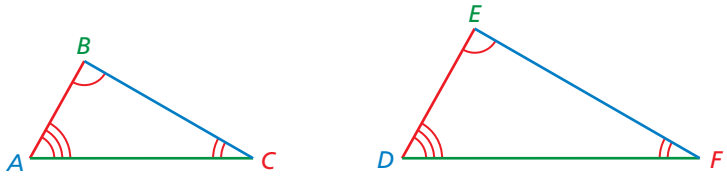
**Key Vocabulary**
similar figures, *p. 72*

## Key Idea

### Similar Figures

Figures that have the same shape but not necessarily the same size are called **similar figures**.




Triangle $ABC$ is similar to Triangle $DEF$.

**Words** Two figures are similar when

- corresponding side lengths are proportional and
- corresponding angles are congruent.

**Symbols**

| *Side Lengths* | *Angles* | *Figures* |
|---|---|---|
| $\frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF}$ | $\angle A \cong \angle D$<br>$\angle B \cong \angle E$<br>$\angle C \cong \angle F$ | $\triangle ABC \sim \triangle DEF$ |

**Reading**

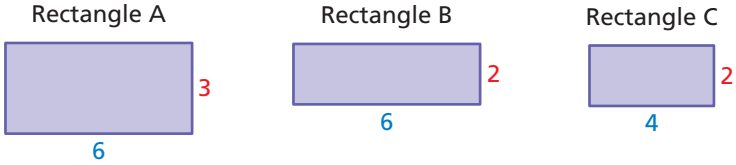
The symbol $\sim$ means *is similar to*.

**Common Error**

When writing a similarity statement, make sure to list the vertices of the figures in the correct order.

## EXAMPLE 1 Identifying Similar Figures

**Which rectangle is similar to Rectangle A?**




Each figure is a rectangle. So, corresponding angles are congruent. Check to see if corresponding side lengths are proportional.

***Rectangle A and Rectangle B***

$\frac{\text{Length of A}}{\text{Length of B}} = \frac{6}{6} = 1$ $\quad$ $\frac{\text{Width of A}}{\text{Width of B}} = \frac{3}{2}$ $\quad$ Not proportional

***Rectangle A and Rectangle C***

$\frac{\text{Length of A}}{\text{Length of C}} = \frac{6}{4} = \frac{3}{2}$ $\quad$ $\frac{\text{Width of A}}{\text{Width of C}} = \frac{3}{2}$ $\quad$ Proportional

∴ So, Rectangle C is similar to Rectangle A.

## On Your Own

Now You're Ready
Exercises 4–7

1. Rectangle D is 3 units long and 1 unit wide. Which rectangle is similar to Rectangle D?



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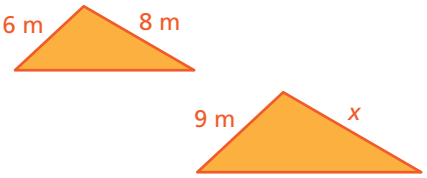
## EXAMPLE 2 Finding an Unknown Measure in Similar Figures

**The triangles are similar. Find $x$.**




Because the triangles are similar, corresponding side lengths are proportional. So, write and solve a proportion to find $x$.

$\frac{6}{9} = \frac{8}{x}$ Write a proportion.

$6x = 72$ Cross Products Property

$x = 12$ Divide each side by 6.

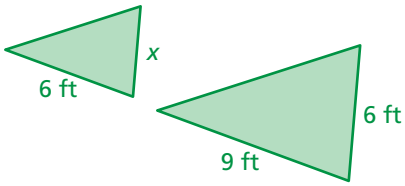
So, $x$ is 12 meters.

### On Your Own

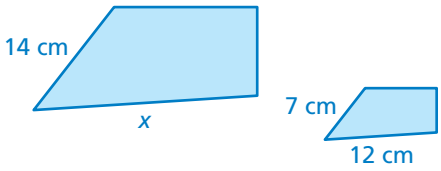
Now You're Ready
Exercises 8–11

**The figures are similar. Find $x$.**

**2.**

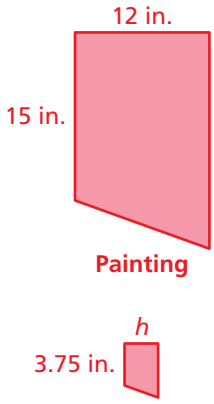



**3.**




## EXAMPLE 3 Real-Life Application

**An artist draws a replica of a painting that is on the Berlin Wall. The painting includes a red trapezoid. The shorter base of the similar trapezoid in the replica is 3.75 inches. What is the height $h$ of the trapezoid in the replica?**




Because the trapezoids are similar, corresponding side lengths are proportional. So, write and solve a proportion to find $h$.

$\frac{3.75}{15} = \frac{h}{12}$ Write a proportion.

$12 \cdot \frac{3.75}{15} = 12 \cdot \frac{h}{12}$ Multiplication Property of Equality

$3 = h$ Simplify.

So, the height of the trapezoid in the replica is 3 inches.

### On Your Own

4. **WHAT IF?** The longer base in the replica is 4.5 inches. What is the length of the longer base in the painting?

# 2.5 Exercises

Check It Out
Help with Homework
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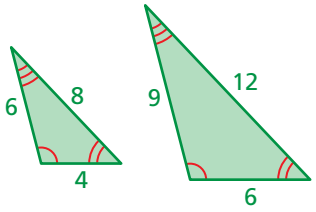
## Vocabulary and Concept Check

1. **VOCABULARY** How are corresponding angles of two similar figures related?
2. **VOCABULARY** How are corresponding side lengths of two similar figures related?
3. **CRITICAL THINKING** Are two figures that have the same size and shape similar? Explain.

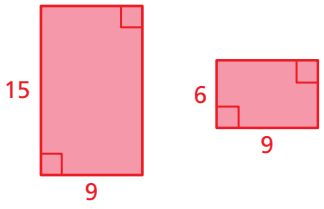
## Practice and Problem Solving

**Tell whether the two figures are similar. Explain your reasoning.**

1 4.




5.



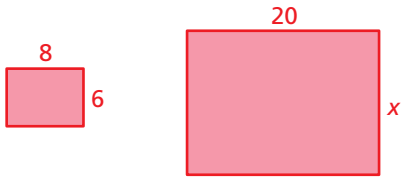

**In a coordinate plane, draw the figures with the given vertices. Which figures are similar? Explain your reasoning.**

6. Rectangle A: (0, 0), (4, 0), (4, 2), (0, 2)
   Rectangle B: (0, 0), (−6, 0), (−6, 3), (0, 3)
   Rectangle C: (0, 0), (4, 0), (4, 2), (0, 2)

7. Figure A: (−4, 2), (−2, 2), (−2, 0), (−4, 0)
   Figure B: (1, 4), (4, 4), (4, 1), (1, 1)
   Figure C: (2, −1), (5, −1), (5, −3), (2, −3)

**The figures are similar. Find *x*.**

2 8.

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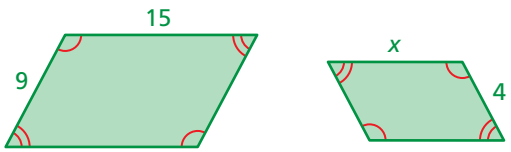


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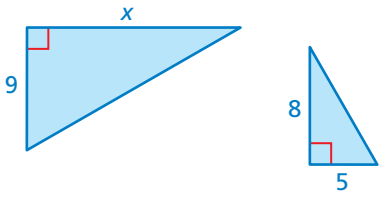
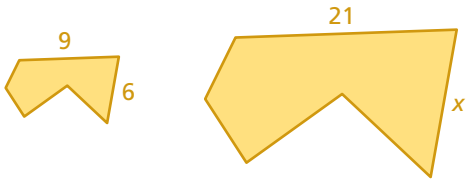
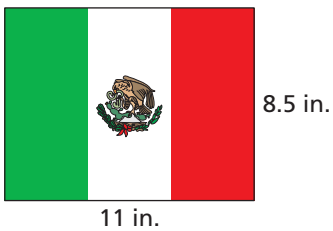



11.




12. **MEXICO** A Mexican flag is 63 inches long and 36 inches wide. Is the drawing at the right similar to the Mexican flag?




13. **DESKS** A student's rectangular desk is 30 inches long and 18 inches wide. The teacher's desk is similar to the student's desk and has a length of 50 inches. What is the width of the teacher's desk?

**14.** **LOGIC** Are the following figures *always*, *sometimes*, or *never* similar? Explain.

**a.** two triangles

**b.** two squares

**c.** two rectangles

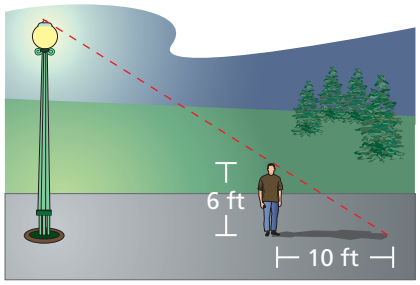
**d.** a square and a triangle

**15.** **CRITICAL THINKING** Can you draw two quadrilaterals each having two 130° angles and two 50° angles that are *not* similar? Justify your answer.

**16.** **SIGN** All the angle measures in the sign are 90°.

**a.** You increase each side length by 20%. Is the new sign similar to the original?

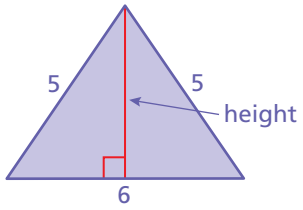
**b.** You increase each side length by 6 inches. Is the new sign similar to the original?


**17.** **STREETLIGHT** A person standing 20 feet from a streetlight casts a shadow as shown. How many times taller is the streetlight than the person? Assume the triangles are similar.

**18.** **REASONING** Is an object similar to a scale drawing of the object? Explain.

**19.** **GEOMETRY** Use a ruler to draw two different isosceles triangles similar to the one shown. Measure the heights of each triangle to the nearest centimeter.




**a.** Is the ratio of the corresponding heights proportional to the ratio of the corresponding side lengths?

**b.** Do you think this is true for all similar triangles? Explain.

**20.** Critical Thinking Given $\triangle ABC \sim \triangle DEF$ and $\triangle DEF \sim \triangle JKL$, is $\triangle ABC \sim \triangle JKL$? Give an example or a non-example.

## Fair Game Review What you learned in previous grades & lessons

**Simplify.** *(Skills Review Handbook)*

**21.** $\left(\frac{4}{9}\right)^2$ **22.** $\left(\frac{3}{8}\right)^2$ **23.** $\left(\frac{7}{4}\right)^2$ **24.** $\left(\frac{6.5}{2}\right)^2$

**25.** **MULTIPLE CHOICE** You solve the equation $S = \ell w + 2wh$ for $w$. Which equation is correct? *(Section 1.4)*

(A) $w = \frac{S - \ell}{2h}$ (B) $w = \frac{S - 2h}{\ell}$ (C) $w = \frac{S}{\ell + 2h}$ (D) $w = S - \ell - 2h$