Two polygons are **similar** if they have the same shape but not necessarily the same size. The symbol \( \sim \) is used to indicate that two polygons are similar. **Congruent polygons** are similar polygons that have the same shape and the same size.

### Similar Polygons

<table>
<thead>
<tr>
<th>( \triangle LMN \sim \triangle PQR )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( L )</td>
</tr>
<tr>
<td>( 4 \text{ m} )</td>
</tr>
<tr>
<td>( M )</td>
</tr>
<tr>
<td>( 3 \text{ m} )</td>
</tr>
<tr>
<td>( N )</td>
</tr>
<tr>
<td>( 5 \text{ m} )</td>
</tr>
<tr>
<td>( P )</td>
</tr>
<tr>
<td>( 8 \text{ m} )</td>
</tr>
<tr>
<td>( Q )</td>
</tr>
<tr>
<td>( 6 \text{ m} )</td>
</tr>
<tr>
<td>( R )</td>
</tr>
<tr>
<td>( 10 \text{ m} )</td>
</tr>
</tbody>
</table>

**Angles**  Corresponding angles are congruent:
\[ \angle L \cong \angle P, \angle M \cong \angle Q, \text{ and } \angle N \cong \angle R \]

**Sides**  Ratios of lengths of corresponding sides are equal:
\[ \frac{LM}{PQ} = \frac{MN}{QR} = \frac{LN}{PR} \]

### Congruent Polygons

<table>
<thead>
<tr>
<th>( \triangle ABC \cong \triangle DEF )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A )</td>
</tr>
<tr>
<td>( B )</td>
</tr>
<tr>
<td>( C )</td>
</tr>
<tr>
<td>( D )</td>
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<td>( E )</td>
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<td>( F )</td>
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<td>( a )</td>
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<td>( b )</td>
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<td>( c )</td>
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<tr>
<td>( d )</td>
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<tr>
<td>( e )</td>
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<tr>
<td>( f )</td>
</tr>
</tbody>
</table>

**Angles**  Corresponding angles are congruent:
\[ \angle A \cong \angle D, \angle B \cong \angle E, \text{ and } \angle C \cong \angle F \]

**Sides**  Corresponding sides are congruent:
\[ AB \cong DE, AC \cong DF, \text{ and } BC \cong EF \]

### Example 1

**Finding Measures of Congruent Polygons**

Given that \( \triangle RST \cong \triangle XYZ \), name the corresponding sides and corresponding angles. Then find \( XY \).

**Corresponding sides:** \( RS \) and \( XY \), \( RT \) and \( XZ \), \( ST \) and \( YZ \)

**Corresponding angles:** \( \angle R \) and \( \angle X \), \( \angle S \) and \( \angle Y \), \( \angle T \) and \( \angle Z \)

Because \( XY \) and \( RS \) are corresponding sides, they are equal in length.

\[ XY = RS = 6 \text{ inches} \]
Use the fact that $ABCD \cong EFGH$.

1. Name the corresponding sides and corresponding angles.
2. Find the unknown angle measures.

**Example 2** Finding the Ratio of Lengths

Given that $\triangle ABC \sim \triangle DEF$, find the ratio of the lengths of the corresponding sides of $\triangle ABC$ to $\triangle DEF$.

Write a ratio for each pair of corresponding sides. Then substitute the lengths of the sides and simplify each ratio.

\[
\frac{AB}{DE} = \frac{16}{12} = \frac{4}{3}, \quad \frac{BC}{EF} = \frac{20}{15} = \frac{4}{3}, \quad \frac{AC}{DF} = \frac{28}{21} = \frac{4}{3}
\]

**Answer** The ratio of the lengths of the corresponding sides is $\frac{4}{3}$.

**Example 3** Checking for Similarity

**Painting** A rectangular painting has a length of 48 inches and a width of 36 inches. A rectangular print of the painting has a length of 32 inches and a width of 24 inches. Are the original and the print similar figures?

**Solution**

Because both figures are rectangles, all angles are right angles, so corresponding angles are congruent. To determine whether the figures are similar, see if the ratios of the lengths of the corresponding sides are equal.

\[
\frac{\text{Length of original}}{\text{Length of print}} = \frac{\text{Width of original}}{\text{Width of print}}
\]

\[
\frac{48}{32} = \frac{36}{24}
\]

\[
\frac{3}{2} = \frac{3}{2}
\]

**Answer** The corresponding angles are congruent and the ratios of the lengths of the corresponding sides are equal, so the figures are similar.
Exercises
More Practice, p. 714

Getting Ready to Practice

1. **Vocabulary** Copy and complete: Two polygons that have the same shape but not necessarily the same size are _?_ polygons.

**Sails** Use the diagram of the two sailboat sails and the fact that \(\triangle ABC \sim \triangle DEF\).

2. Name the corresponding sides and the corresponding angles.
3. Find the ratio of the lengths of the corresponding sides of \(\triangle ABC\) to \(\triangle DEF\).

Practice and Problem Solving

Name the corresponding sides and the corresponding angles of the congruent polygons. Then find the unknown measures.

4. \(KLMN \cong QRST\)

5. \(\triangle FGH \cong \triangle JKL\)

Tell whether the two polygons are similar. If they are similar, find the ratio of the lengths of the corresponding sides of figure A to figure B.

6.

7.

8.

9.
10. **Photo Sticker** A standard photograph is a rectangle with a length of 6 inches and a width of 4 inches. You have a camera that makes photo stickers. Each sticker is a rectangle with a length of 1.4 inches and a width of 0.9 inch. Are the photograph and sticker similar figures? Explain your reasoning.

**Critical Thinking** Tell whether the statement is true or false. If it is false, give an example to show why.

11. Two rectangles are congruent if they have the same perimeter.

12. Two squares are congruent if they have the same perimeter.

13. **Critical Thinking** Draw a rectangle similar to rectangle $DEFG$ shown. Then draw a rectangle congruent to $DEFG$. Explain why each rectangle is similar or congruent to $DEFG$.

14. **Athletic Fields** An NCAA football field has a width of 160 feet and a length of 360 feet. An NCAA soccer field can vary from 195 feet to 240 feet in width and from 330 feet to 360 feet in length. Can NCAA football and soccer fields ever be similar rectangles? Explain.

15. **Challenge** Two rectangles are similar. The ratio of the lengths of their corresponding sides is $1:2$. Find the ratio of the perimeters of the two rectangles. Then find the ratio of the areas. Explain your answers.

**Mixed Review**

16. Use equivalent ratios to solve the proportion $\frac{15}{18} = \frac{x}{6}$. (*Lesson 8.4*)

17. Find the perimeter of a regular quadrilateral with a side length of 16 meters. (*Lesson 10.4*)

**Basic Skills** Test the number for divisibility by 2, 3, 5, 6, 9, and 10.

18. 136
19. 942
20. 1675
21. 2458

**Test-Taking Practice**

22. **Multiple Choice** If $\triangle ABC \cong \triangle DEF$ and both triangles are scalene, which of the following is not true?

A. $\overline{AC} \cong \overline{DF}$
B. $\overline{AB} \cong \overline{EF}$
C. $\angle B \cong \angle E$
D. $\angle C \cong \angle F$

23. **Short Response** Rectangle $JKLM$ has a length of 30 feet and a width of 9 feet. Rectangle $NPQR$ has a length of 50 feet and a width of 15 feet. Tell whether the two rectangles are similar. Explain your reasoning.