Name: Key Date:________ Hour:_____ **Chapter 2: Transformations**

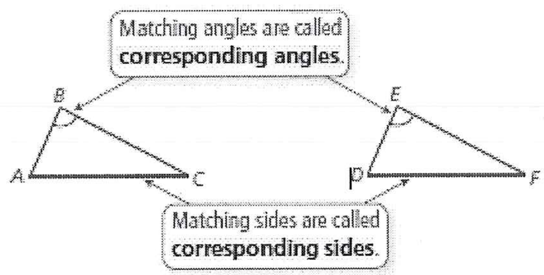
2.1 Congruent Figures

Standards	Learning Objectives (I can…)
8.G.2	• Name corresponding angles and corresponding sides of congruent figures. • Identify congruent figures.

Key Idea

Congruent Figures

Figures that have the same size and the same shape are called **congruent figures**. The triangles below are congruent.



Example 1: Naming Corresponding Parts

The figures are congruent. Name the corresponding angles and the corresponding sides.

Corresponding Angles

$\angle A$ and $\angle W$

$\angle B$ and $\angle X$

$\angle C$ and $\angle Y$

$\angle D$ and $\angle Z$

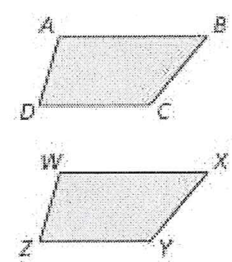
Corresponding Sides

$\overline{AB}$ and $\overline{WX}$

$\overline{BC}$ and $\overline{XY}$

$\overline{CD}$ and $\overline{YZ}$

$\overline{DC}$ and $\overline{ZW}$



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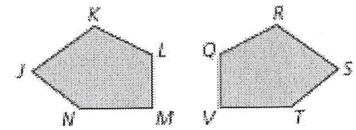
On Your Own: **The figures are congruent. Name the corresponding angles and the corresponding sides.**



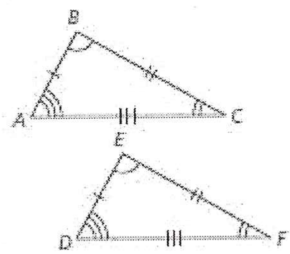
Corresponding Angles	Corresponding Sides
$\angle L$ and $\angle Q$	$\overline{LM}$ and $\overline{QV}$
$\angle M$ and $\angle V$	$\overline{MN}$ and $\overline{VT}$
$\angle N$ and $\angle T$	$\overline{NJ}$ and $\overline{TS}$
$\angle J$ and $\angle S$	$\overline{JK}$ and $\overline{SR}$
$\angle K$ and $\angle R$	$\overline{KL}$ and $\overline{RQ}$

Key Idea

Identifying Congruent Figures

Two figures are congruent when corresponding __angles__ and corresponding __sides__ are congruent.

Triangle __ABC__ is congruent to Triangle __DEF__.

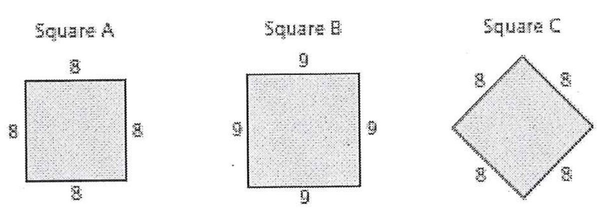


$\triangle ABC \cong \triangle DEF$

$\cong$ means congruent to

Example 2: Identifying Congruent Figures

Which square is congruent to Square A?



Each square has 4 right angles. So, corresponding angles are congruent.

Square A and Square B

Each side length of Square A is 8 and each side length of Square B is 9. So, corresponding sides are not congruent.

Square A and Square C

Square A has side length of 8 and Square C has side length of 8. Square A $\cong$ Square C

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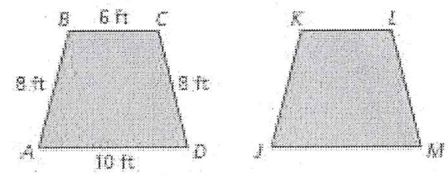
Example 3: Using Congruent Figures

Trapezoids *ABCD* and *JKLM* are congruent.



a. What is the length of side *JM*?

Side JM corresponds to side AD.

So the length of side JM is 10 ft.

b. What is the perimeter of *JKLM*?

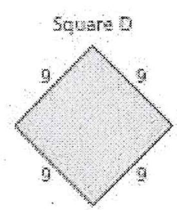
The perimeter of ABCD is 10 + 8 + 6 + 8 = 32 ft. Because the trapezoids are congruent, their corresponding sides are congruent.

So the perimeter of JKLM is 32 ft.

On Your Own:

1. Which square in Example 2 is congruent to Square D?

Square B because the side lengths are equal.



2. In Example 3, which angle of *JKLM* corresponds to *C* ? What is the length of side *KJ* ?

$\angle L$ and $KJ = 8$ ft

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2.2 Translations

Standards	Learning Objectives (I can...)
8.G.1 8.G.2 8.G.3	• Identify translations • Translate figures in the coordinate plane

Key Idea

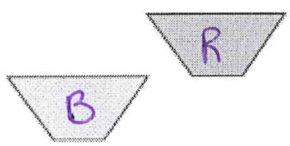
A transformation changes a figure into another figure. The new figure is called the image.

A translation is a transformation in which a figure slides but does not turn. Every point of the figure moves the same distance and in the same direction.

Example 1: Identifying a Translation

Tell whether the blue figure is a translation of the red figure.

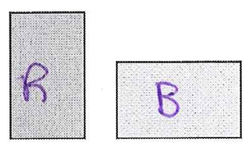
a)



The ~~red~~ red figure slides from the blue figure.

So, the blue figure is a translation of the red figure.

b)



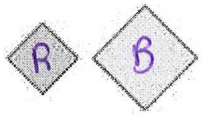
The red figure turns from the blue figre.

So, the blue figure is not a translation of the red figure.

On Your Own:

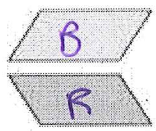
Tell whether the blue figure is a translation of the red figure. Explain.

1.



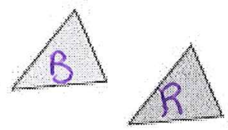
No, the blue figure is larger than the red figure.

2.



No, the red figure flips to form the blue figure.

3.



Yes, the red figure slides up and to the left to form the blue figure.

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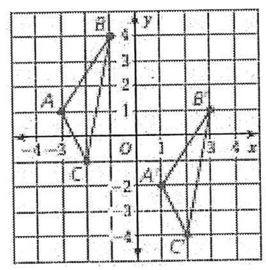
Key Idea

Translations in the Coordinate Plane

To ___translate___ a figure a units horizontally and b units vertically in a coordinate plane, ___add___ a to the x-coordinates and b to the y-coordinates of the vertices. Positive values of a and b represent translations ___up___ and ___right___. Negative values of a and b represent translations ___down___ and ___left___.

Algebra: $(x, y) \rightarrow (x + a,\ y + b)$



$\triangle ABC \cong \triangle A'B'C'$

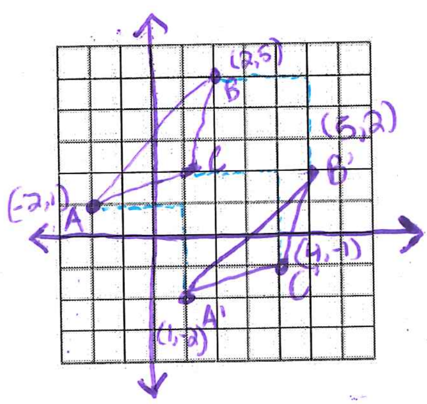
In a translation, the original figure and its image are congruent.

Example 2: Translating a Figure in the Coordinate Plane

Translate the red triangle 3 units right and 3 units down. What are the coordinates of the image?

Red triangle

A(-2,1) B(2,5) C(1,2)

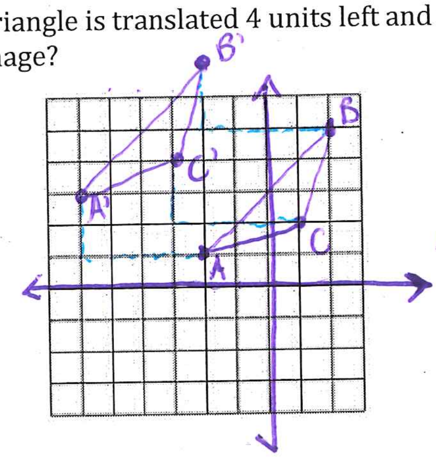


New triangle

A'(1,-2) B'(5,2) C'(4,-1)

On Your Own:

4. **WHAT IF?** The red triangle is translated 4 units left and 2 units up. What are the coordinates of the image?



New Triangle

A'(-6,3) B'(-2,7) C'(-3,4)

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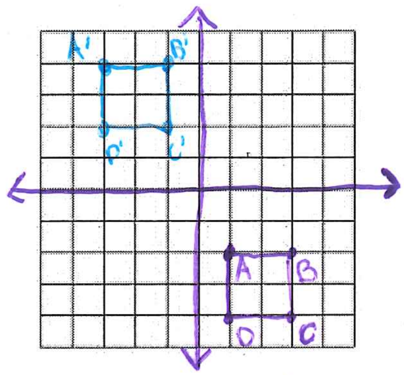
Example 3: Translating a Figure Using Coordinates

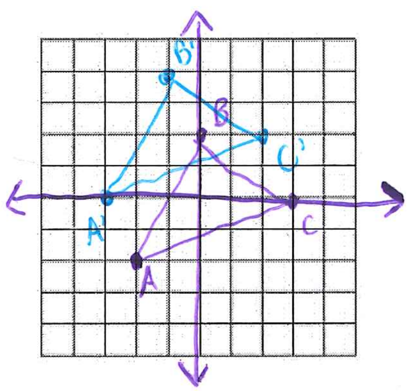
The vertices of a square are $A(1, -2)$, $B(3, -2)$, $C(3, -4)$, and $D(1, -4)$. Draw the figure and its image after a translation 4 units left and 6 units up.



Vertices of ABCD	(x −4 , y +6)	Vertices of A'B'C'D'
A(1,-2)	(1-4 , -2+6)	A' (-3,4)
B(3,-2)	(3-4 , -2+6)	B' (-1,4)
C(3,-4)	(3-4 , -4+6)	C' (-1,2)
D(1,-4)	(1-4 , -4+6)	D' (-3,2)

On Your Own:

5. The vertices of a triangle are $A(-2, -2)$, $B(0, 2)$, and $C(3, 0)$. Draw the figure and its image after a translation 1 unit left and 2 units up.



Vertices of ABC	(x-1 , y+2)	Vertices A'B'C'
A(-2,-2)	(-2-1 , -2+2)	A'(-3,0)
B(0,2)	(0-1 , 2+2)	B'(-1,4)
C(3,0)	(3-1 , 0+2)	C'(2,2)

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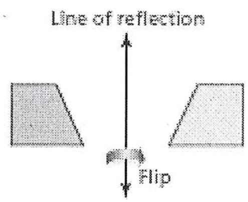
2.3 Reflections

Standards	Learning Objectives (I can…)
8.G.1 8.G.2 8.G.3	• Identify reflections. • Reflect figures in the x-axis or the y-axis of the coordinate plane.

Key Idea

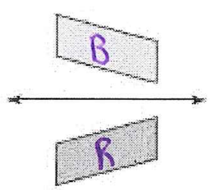
A reflection, or flip, is a transformation in which a figure is reflected in a line called the line of reflection. A reflection creates a mirror image of the original figure.



Example 1: Identifying a Reflection

Tell whether the blue figure is a reflection of the red figure.

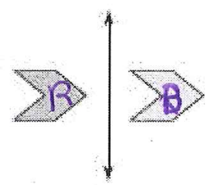
a.



The red figure can be flipped to form the blue figure.

So, the blue figure is a reflection of the red figure.

b.



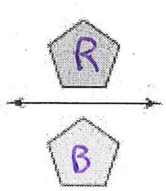
If the red figure were flipped it would point to the left.

So, the blue figure is not a reflection of the red figure.

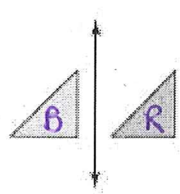
On Your Own:

Tell whether the blue figure is a reflection of the red figure. Explain.

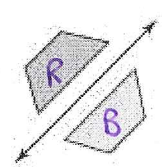
1.



2.



3.



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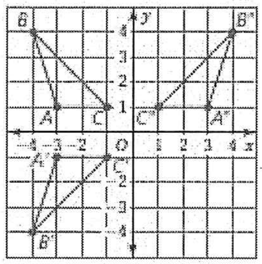
Key Idea

To reflect a figure in the *x*-axis, take the __opposite__ of the *y*-coordinate.

To reflect a figure in the *y*-axis, take the __opposite__ of the *x*-coordinate.

Algebra: To reflect a figure in the *x*-axis: $(x, y) \rightarrow (x, -y)$

To reflect a figure in the *y*-axis: $(x, y) \rightarrow (-x, y)$

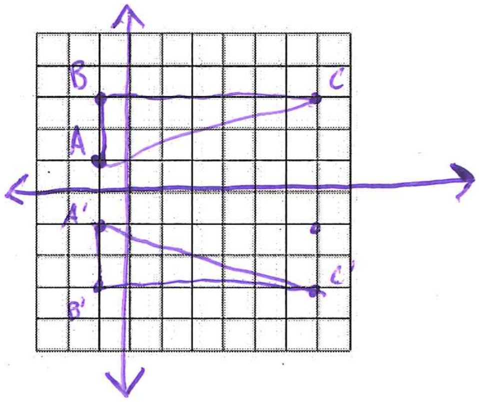


In a reflection, the original figure and its image are __congruent__.

Example 2: Reflecting a Figure in the x-axis

The vertices of a triangle are *A*(−1, 1), *B*(−1, 3), and *C*(6, 3). Draw the figure and its reflection in the *x*-axis. What are the coordinates of the image?

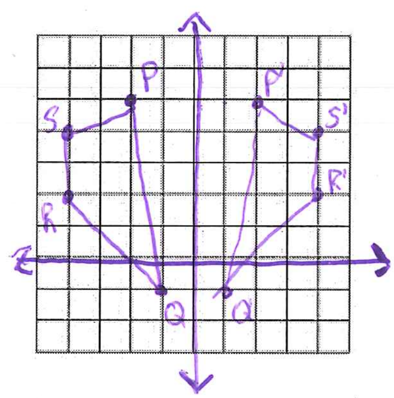
Vertices of ABC	(x , -y)	Vertices of A'B'C'
A(-1,1)	(-1 , -1)	A' (-1,-1)
B (-1,3)	(-1 , -3)	B' (-1,-3)
C (6,3)	(6 , -3)	C' (6,-3)



Example 3: Reflecting a Figure in the y-axis

The vertices of a quadrilateral are *P*(−2, 5), *Q*(−1, −1), *R*(−4, 2), and *S*(−4, 4). Draw the figure and its reflection in the *y*-axis.

Vertices of PQRS	(-x , y)	Vertices of P'Q'R'S'
P (-2,5)	(-(-2), 5)	P' (2,5)
Q (-1,-1)	(-(-1), -1)	Q' (1,-1)
R (-4,2)	(-(-4), 2)	R' (4,2)
S (-4,4)	(-(-4), 4)	S' (4,4)

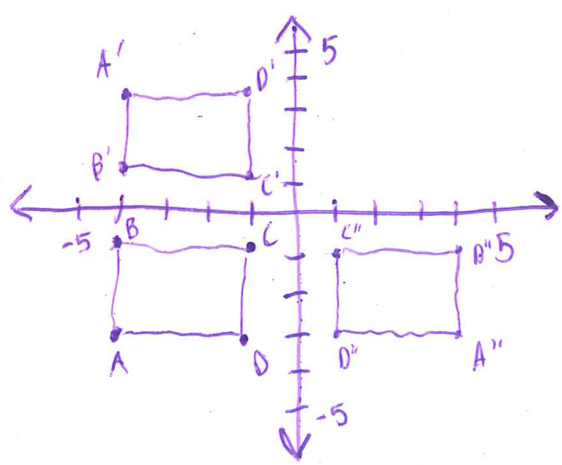


On Your Own:

4. The vertices of a rectangle are $A(-4, -3)$, $B(-4, -1)$, $C(-1, -1)$, and $D(-1, -3)$.
   a. Draw the figure and its reflection in the *x*-axis.
   b. Draw the figure and its reflection in the *y*-axis.
   c. Are the images in parts (a) and (b) congruent? Explain.

X-axis

Vertices of ABCD	(x, -y)	A'B'C'D'
A (-4,-3)	(-4, -(-3))	A'(-4,3)
B (-4,-1)	(-4, -(-1))	B'(-4,1)
C (-1,-1)	(-1, -(-1))	C'(-1,1)
D (-1,-3)	(-1, -(-3))	D'(-1,3)



y-axis

Vertices of ABCD	(-x, y)	A"B"C"D"
A (-4,-3)	(-(-4), -3)	A"(4,-3)
B (-4,-1)	(-(-4), -1)	B"(4,-1)
C (-1,-1)	(-(-1), -1)	C"(1,-1)
D (-1,-3)	(-(-1), -3)	D"(1,-3)

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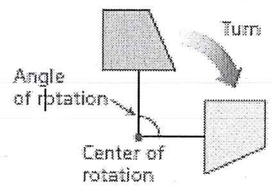
2.4 Rotations

Standards	Learning Objectives (I can...)
8.G.1 8.G.2 8.G.3	• Identify rotations. • Rotate figures in the coordinate plane. • Use more than one transformation to find images of figures.

Key Idea

Rotations

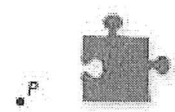
A rotation, or turn, is a transformation in which a figure is rotated about a point called the center of rotation. The number of degrees a figure rotates is the angle of rotation.

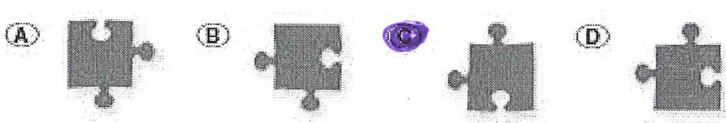


In a rotation, the original figure and its image are Congruent.

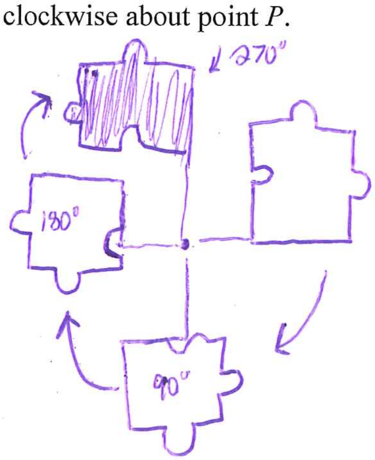
Example 1: Identifying a Rotation

You must rotate the puzzle piece 270°clockwise about point *P* to fit it into a puzzle. Which piece fits in the puzzle as shown?





Rotate the puzzle piece 270° clockwise about point *P*.



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On Your Own:

1. Which piece is a 90° counterclockwise rotation about point *P*?

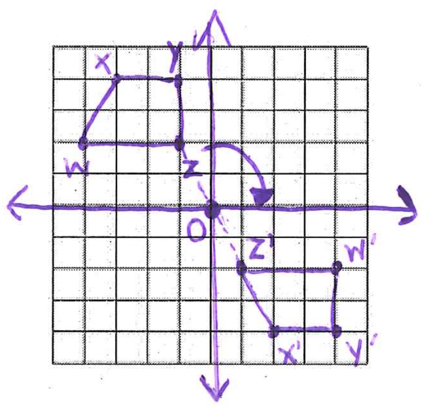
Piece C, It is the same spot as 270° Counterclockwise

2. Is Choice D a rotation of the original puzzle piece? If not, what kind of transformation does the image show?

No, choice D would be a reflection of the orignal piece.

Example 2: Rotating a Figure

The vertices of a trapezoid are *W*(−4, 2), *X*(−3, 4), *Y*(−1, 4), and *Z*(−1, 2). Rotate the trapezoid 180° about the origin. What are the coordinates of the image?



Plot Z' so that segment OZ and segment OZ' are congruent to form a 180° anglse.

* A 180° clockwise rotation and a 180° counterclockwise rotation have the same image.

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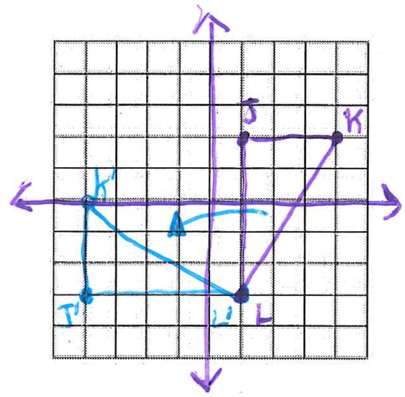
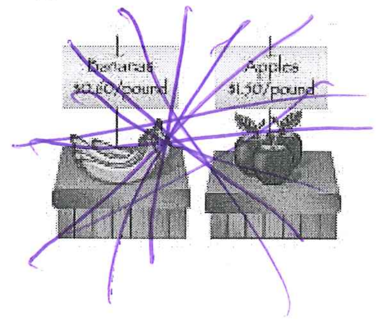
Example 3: Rotating a Figure

The vertices of a triangle are *J*(1, 2), *K*(4, 2), and *L*(1, −3). Rotate the triangle 90° counterclockwise about vertex *L*. What are the coordinates of the image?





Plot K' so that segment KL and segment K'L' are congruent and for a 90° angle.

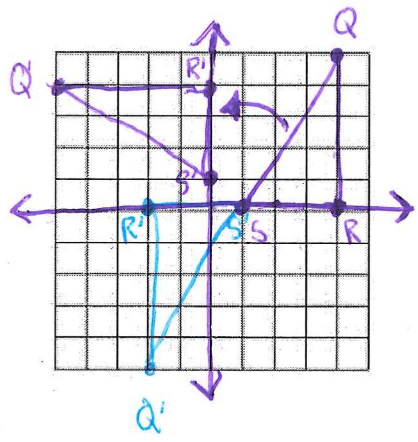
On Your Own:

3. A triangle has vertices *Q*(4, 5), *R*(4, 0), and *S*(1, 0).

a) Rotate the triangle 90° counterclockwise about the origin.

b) Rotate the triangle 180° about vertex *S*.

c) Are the images in parts (a) and (b) congruent? Explain. Yes, rotating figures still keeps them congruent.



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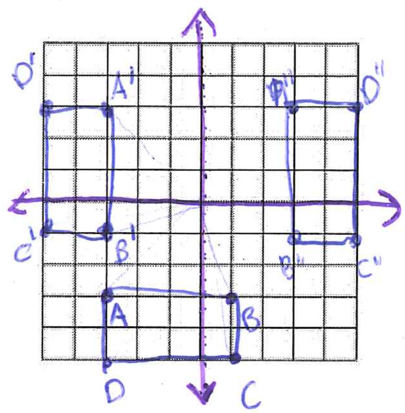
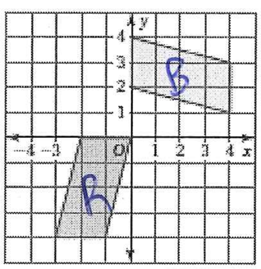
Example 4: Using More than One Transformation

The vertices of a rectangle are $A(-3,-3)$, $B(1,-3)$, $C(1,-5)$, and $D(-3,-5)$. Rotate the rectangle 90° clockwise about the origin, and then reflect it in the y-axis. What are the coordinates of the image?



Example 5: Describing a Sequence of Transformations

The red figure is congruent to the blue figure. Describe a sequence of transformations in which the blue figure is the image of the red figure.



You can turn the red figure 90° counter clockwise follwed by a translation 4 units up.

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2.6 Perimeters and Areas of Similar Figures

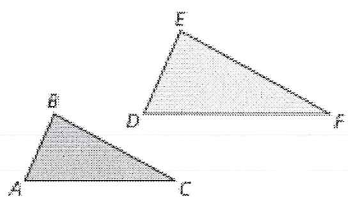
Standards	Learning Objectives (I can…)
8.G.4	• Understand the relationship between perimeters and similar figures. • Understand the relationship between areas and similar figures.

Key Idea

Perimeters of Similar Figures

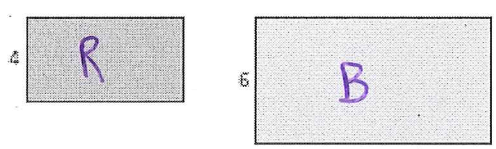
When two figures are similar, the ratio of their perimeters is equal to the ratio of their corresponding side lengths.

$$\frac{\text{Perimeter of } \triangle ABC}{\text{Perimeter of } \triangle DEF} = \frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF}$$



Example 1: Finding Ratios of Perimeters

Find the ratio (red to blue) of the perimeters of the similar rectangles.



The ratio of the perimeters is $\frac{2}{3}$.

$$\frac{\text{Peremeter of red rectangle}}{\text{Perimeter of blue rectangle}} = \frac{4}{6} = \frac{2}{3}$$

On Your Own:

1. The height of Figure A is 9 feet. The height of a similar Figure B is 15 feet. What is the ratio of the perimeter of A to the perimeter of B ?

$$\frac{9}{15} = \frac{3}{5}$$

The ratio of the perimeters is $\frac{3}{5}$.

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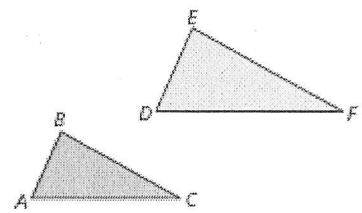
Key Idea

Areas of Similar Figures

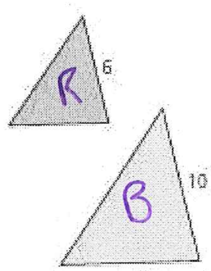
When two figures are similar, the ratio of their ___areas___ is equal to the *square* of the ratio of their ___corresponding___ side lengths.

$$\frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle DEF} = \left(\frac{AB}{DE}\right)^2 = \left(\frac{BC}{EF}\right)^2 = \left(\frac{AC}{DF}\right)^2$$



Example 2: Finding Ratios of Areas

Find the ratio (red to blue) of the areas of the similar triangles.



$$\frac{\text{Area of red triangle}}{\text{Area of blue triangle}} = \left(\frac{6}{10}\right)^2 = \left(\frac{3}{5}\right)^2 = \frac{9}{25}$$

The ratio of the areas is $\frac{9}{25}$.

On Your Own:

2. The base of Triangle P is 8 meters. The base of a similar Triangle Q is 7 meters. What is the ratio of the area of P to the area of Q?

$$\left(\frac{8}{7}\right)^2 = \frac{8^2}{7^2} = \frac{64}{49}$$

The ratio of the areas is $\frac{64}{49}$.

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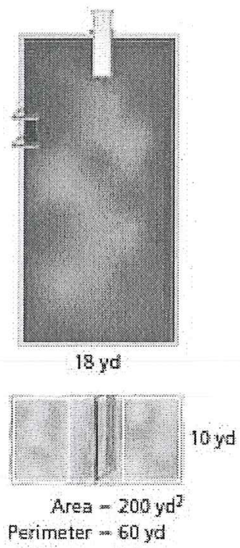
Example 3: Using Proportions to Find Perimeters and Areas

A swimming pool is similar in shape to a volleyball court. Find the perimeter *P* and the area *A* of the pool.

The rectangular pool and the court are similar. So, use the ratio of corresponding side lengths to write and solve proportions to find the perimeter and the area of the pool.



Perimeter

$$\frac{\text{Perimeter of court}}{\text{perimeter of pool}} = \frac{\text{Width of court}}{\text{width of pool}}$$

$$\frac{60}{P} = \frac{10}{18}$$

$$1080 = 10P$$

$$108 = P$$

108 yds

Area

$$\frac{\text{Area of court}}{\text{Area of pool}} = \left(\frac{\text{Width of court}}{\text{Width of pool}}\right)^2$$

$$\frac{200}{A} = \left(\frac{10}{18}\right)^2$$

$$\frac{200}{A} = \frac{100}{324}$$

$$64,800 = 100A$$

$$648 = A$$

648 yds^2

On Your Own:

3. **WHAT IF?** The width of the pool is 16 yards. Find the perimeter *P* and the area *A* of the pool.

$$\frac{60}{P} = \frac{10}{16}$$

$$10P = 960$$

$$P = 96$$

96 yds

$$\frac{60}{A} = \left(\frac{10}{16}\right)^2$$

$$\frac{60}{A} = \frac{100}{256}$$

$$10A = 15,360$$

$$A = 1,536$$

1536 yds^2

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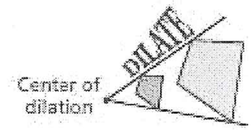
2.7 Dilations

Standards	**Learning Objectives (I can...)**
8.G.3 8.G.4	• Identify dilations. • Dilate figures in the coordinate plane. • Use more than one transformation to find images of figures.

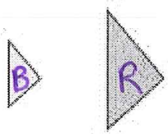
A dilation is a transformation in which a figure is made larger or smaller with respect to a point called the center of dilation.



Example 1: Identifying a Dilation

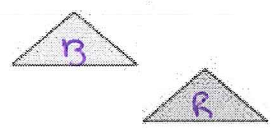
Tell whether the blue figure is a dilation of the red figure.

a.



The blue figure is a dilation of the red figure. because the blue figure become smaller.

b.

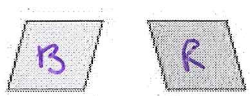


The figures have the same shape and size. So, the blue figure is not a dilation of the red figure.

On Your Own:

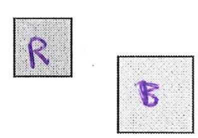
Tell whether the blue figure is a dilation of the red figure. Explain.

1.



The figures have the same size and the same shape. So, the blue figure is not a dilation of the red figure.

2.



The blue figure is a dilation of the red figure because the blue figure became larger.

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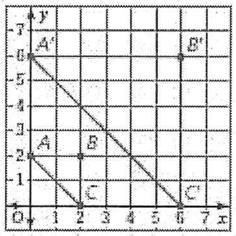
In a dilation, the original figure and its image are __similar__. The ratio of the side lengths of the image to the corresponding side lengths of the original figure is the __scale factor__ of the dilation.

Key Idea

Dilations in the Coordinate Plane

To dilate a figure with respect to the origin, multiply the coordinates of each vertex by the scale factor *k*.

Algebra: $(x, y) \rightarrow (kx, ky)$



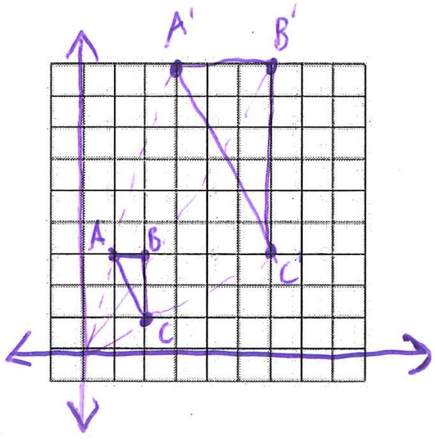
When $k > 1$, the dilation is an __enlargement__.

When $k > 0$ and $k < 1$, the dilation is a __reduction__.

Example 2: Dilating a Figure

Draw the image of Triangle *ABC* after a dilation with a scale factor of 3. Identify the type of dilation.

Vertices of ABC	(3x , 3y)	Vertices of A'B'C'
A (1, 3)	(3·1 , 3·3)	A' (3, 9)
B (2, 3)	(3·2 , 3·3)	B' (6, 9)
C (2, 1)	(3·2 , 3·1)	C' (6, 3)



The dilation is an enlargement.

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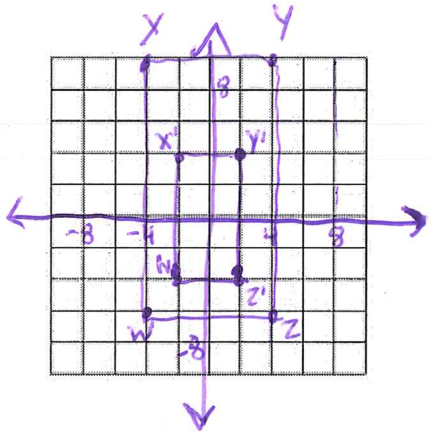
Example 3: Dilating a Figure

Draw the image of Rectangle *WXYZ* after a dilation with a scale factor of 0.5. Identify the type of dilation.

Vertices of WXYZ	(0.5x , 0.5y)	Vertices of W'X'Y'Z'
W (-4, -6)	(0.5·(-4), 0.5·(-6))	W' (-2, -3)
X (-4, 8)	(0.5·(-4), 0.5·8)	X' (-2, 4)
Y (4, 8)	(0.5·4, 0.5·8)	Y' (2, 4)
Z (4, -6)	(0.5·4, 0.5·(-6))	Z' (2, -3)



The dilation is a reduction.

On Your Own:

3. **WHAT IF?** Triangle *ABC* in Example 2 is dilated by a scale factor of 2. What are the coordinates of the image?

A'(2,6) B'(4,6) C'(4,2)