

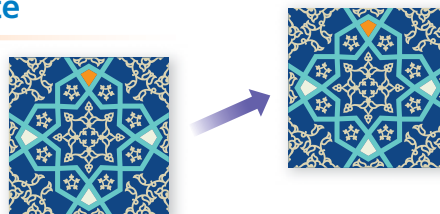
2.2 Translations

Essential Question How can you arrange tiles to make a tessellation?

The Meaning of a Word ● Translate

When you **translate** a tile, you slide it from one place to another.

When tiles cover a floor with no empty spaces, the collection of tiles is called a *tessellation*.



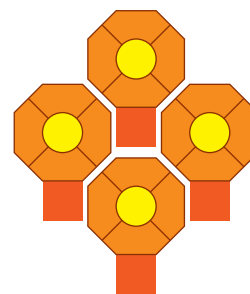
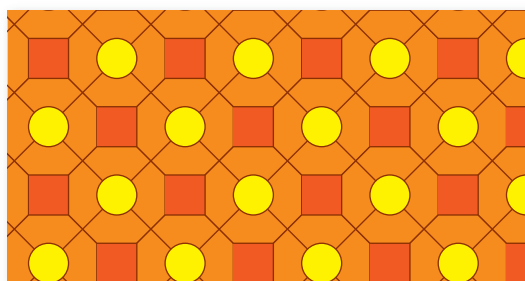
1 ACTIVITY: Describing Tessellations

Work with a partner. Can you make the tessellation by translating single tiles that are all of the same shape and design? If so, show how.

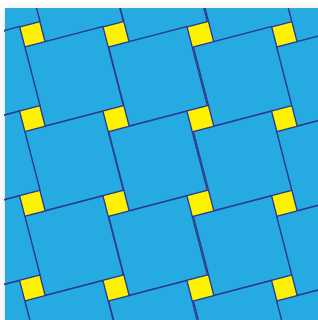
a. Sample:

Tile Pattern

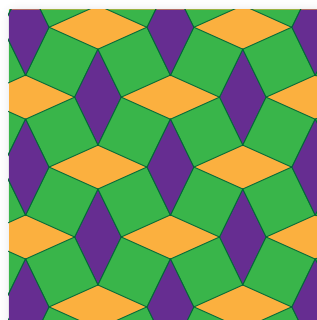
Single Tiles



b.



c.



Geometry

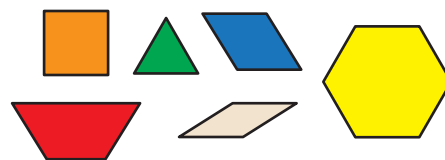
In this lesson, you will

- identify translations.
- translate figures in the coordinate plane.

2 ACTIVITY: Tessellations and Basic Shapes

Work with a partner.

- Which pattern blocks can you use to make a tessellation? For each one that works, draw the tessellation.
- Can you make the tessellation by translating? Or do you have to rotate or flip the pattern blocks?



3 ACTIVITY: Designing Tessellations

Work with a partner. Design your own tessellation. Use one of the basic shapes from Activity 2.

Sample:



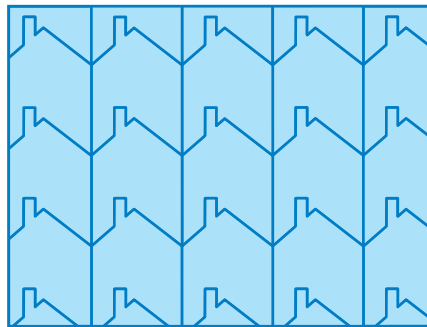
Step 1: Start with a square.



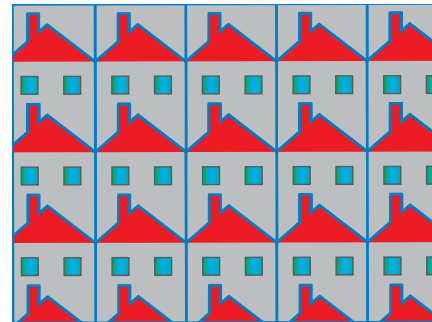
Step 2: Cut a design out of one side.



Step 3: Tape it to the other side to make your pattern.



Step 4: Translate the pattern to make your tessellation.



Step 5: Color the tessellation.

4 ACTIVITY: Translating in the Coordinate Plane

Work with a partner.

Math Practice

Justify Conclusions

What information do you need to conclude that two figures are congruent?

- Draw a rectangle in a coordinate plane. Find the dimensions of the rectangle.
- Move each vertex 3 units right and 4 units up. Draw the new figure. List the vertices.
- Compare the dimensions and the angle measures of the new figure to those of the original rectangle.
- Are the opposite sides of the new figure still parallel? Explain.
- Can you conclude that the two figures are congruent? Explain.
- Compare your results with those of other students in your class. Do you think the results are true for any type of figure?

What Is Your Answer?

- IN YOUR OWN WORDS** How can you arrange tiles to make a tessellation? Give an example.
- PRECISION** Explain why any parallelogram can be translated to make a tessellation.

Practice

Use what you learned about translations to complete Exercises 4–6 on page 52.

Key Vocabulary

transformation,
p. 50
image, p. 50
translation, p. 50

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

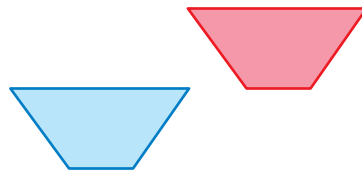
A **translation** is a transformation in which a figure *slides* but does not turn. Every point of the figure moves the same distance and in the same direction.



EXAMPLE 1 Identifying a Translation

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

a.



The red figure *slides* to form the blue figure.

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

b.



The red figure *turns* to form the blue figure.

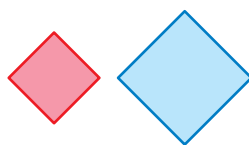
❖ So, the blue figure is *not* a translation of the red figure.

On Your Own

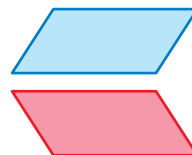
Now You're Ready
Exercises 4–9

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

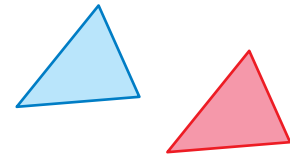
1.



2.



3.



Key Idea

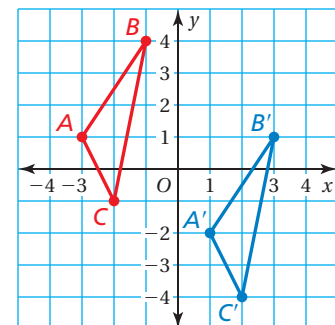
Translations in the Coordinate Plane

Words 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 $(x, y) \rightarrow (x + a, y + b)$

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



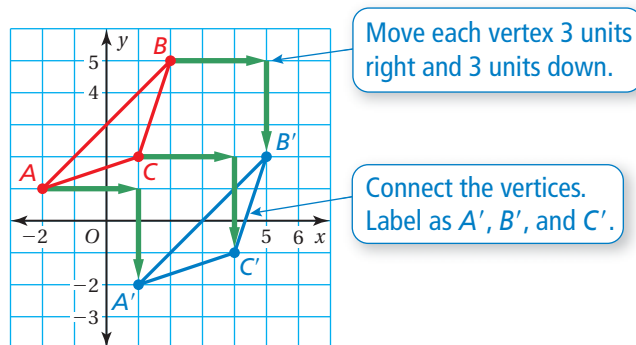
Reading

A' is read "A prime."
Use *prime* symbols when naming an image.

$A \rightarrow A'$
 $B \rightarrow B'$
 $C \rightarrow C'$

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?



∴ The coordinates of the image are $A'(1, -2)$, $B'(5, 2)$, and $C'(4, -1)$.

On Your Own

Now You're Ready
Exercises 10 and 11

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

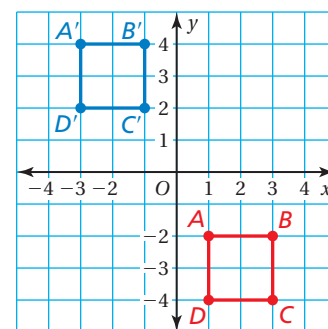
EXAMPLE 3 Translating a Figure Using Coordinates

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.

Add -4 to each x -coordinate. So, subtract 4 from each x -coordinate.

Add 6 to each y -coordinate.

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



∴ The figure and its image are shown at the above right.

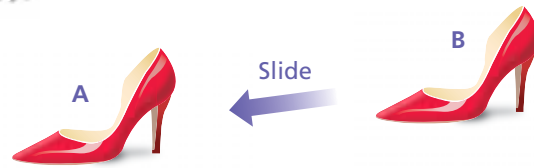
On Your Own

Now You're Ready
Exercises 12–15

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.

Vocabulary and Concept Check

- VOCABULARY** Which figure is the image?
- VOCABULARY** How do you translate a figure in a coordinate plane?
- WRITING** Can you translate the letters in the word TOKYO to form the word KYOTO? Explain.

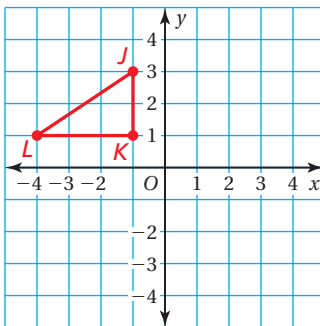


Practice and Problem Solving

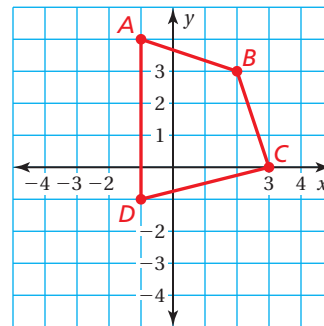
Tell whether the blue figure is a translation of the red figure.

- Two right triangles: one blue, one red.
 - Two trapezoids: one red, one blue.
 - Two lightning bolts: one red, one blue.
 - Two crosses: one red, one blue.
 - Two hexagons: one red, one blue.
 - Two squares: one red, one blue.

- Translate the triangle 4 units right and 3 units down. What are the coordinates of the image?



- Translate the figure 2 units left and 4 units down. What are the coordinates of the image?



The vertices of a triangle are $L(0, 1)$, $M(1, -2)$, and $N(-2, 1)$. Draw the figure and its image after the translation.

- 1 unit left and 6 units up
 - 5 units right
 - $(x + 2, y + 3)$
 - $(x - 3, y - 4)$
- ICONS** You can click and drag an icon on a computer screen. Is this an example of a translation? Explain.

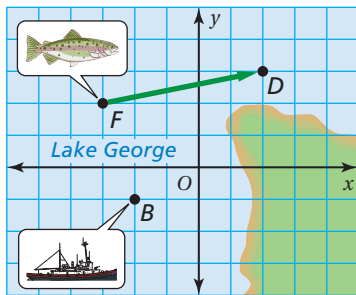
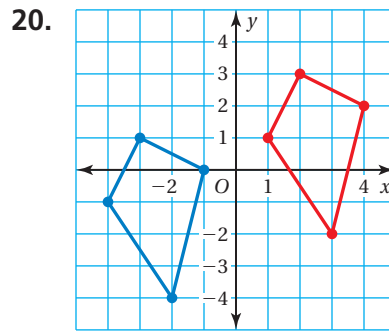
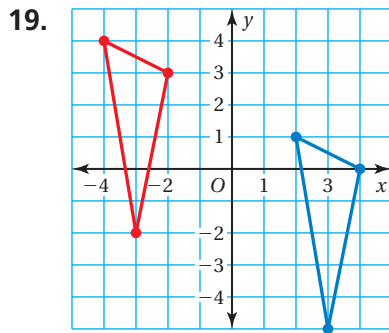


Describe the translation of the point to its image.

17. $(3, -2) \rightarrow (1, 0)$

18. $(-8, -4) \rightarrow (-3, 5)$

Describe the translation from the red figure to the blue figure.



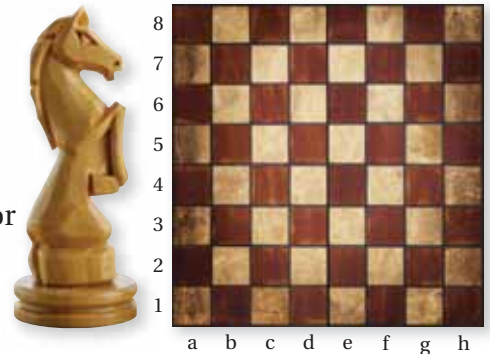
21. **FISHING** A school of fish translates from point F to point D .

- Describe the translation of the school of fish.
- Can the fishing boat make the same translation? Explain.
- Describe a translation the fishing boat could make to get to point D .

22. **REASONING** The vertices of a triangle are $A(0, -3)$, $B(2, -1)$, and $C(3, -3)$. You translate the triangle 5 units right and 2 units down. Then you translate the image 3 units left and 8 units down. Is the original triangle congruent to the final image? If so, give two ways to show that they are congruent.

23. **Problem Solving** In chess, a knight can move only in an L-shaped pattern:
- two vertical squares, then one horizontal square;
 - two horizontal squares, then one vertical square;
 - one vertical square, then two horizontal squares; or
 - one horizontal square, then two vertical squares.

Write a series of translations to move the knight from g8 to g5.



Fair Game Review what you learned in previous grades & lessons

Tell whether you can fold the figure in half so that one side matches the other.

(Skills Review Handbook)



28. **MULTIPLE CHOICE** You put \$550 in an account that earns 4.4% simple interest per year. How much interest do you earn in 6 months? (Skills Review Handbook)

(A) \$1.21

(B) \$12.10

(C) \$121.00

(D) \$145.20