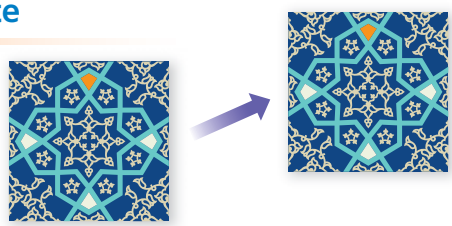
2.2 Translations

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*.

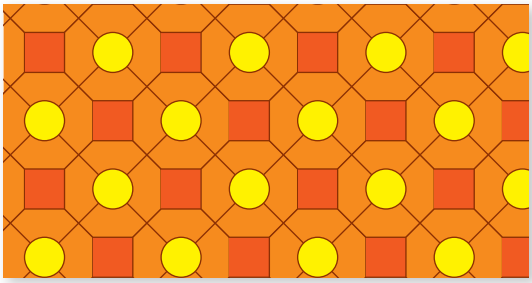


1 ACTIVITY: Describing Tessellations

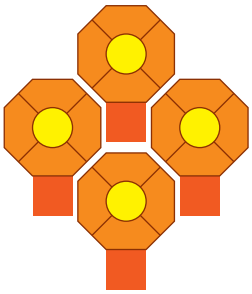
Work with a partner. Can you make the tessellation by translating single tiles that are all of the same shape and design? If so, show how.

a. Sample:

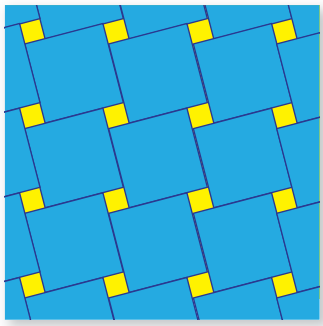
Tile Pattern



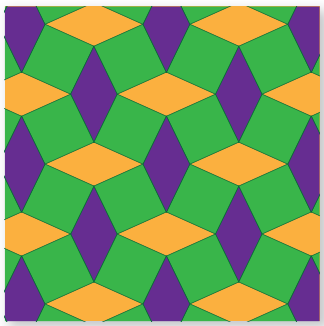
Single Tiles



b.

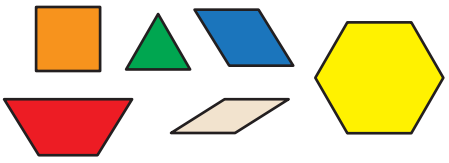


c.



2 ACTIVITY: Tessellations and Basic Shapes

Work with a partner.



a. Which pattern blocks can you use to make a tessellation? For each one that works, draw the tessellation.

b. Can you make the tessellation by translating? Or do you have to rotate or flip the pattern blocks?

COMMON CORE

Geometry

In this lesson, you will

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

Learning Standards
8.G.1
8.G.2
8.G.3

3 ACTIVITY: Designing Tessellations

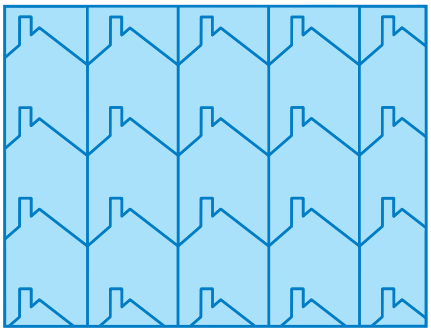
Work with a partner. Design your own tessellation. Use one of the basic shapes from Activity 2.

Sample:

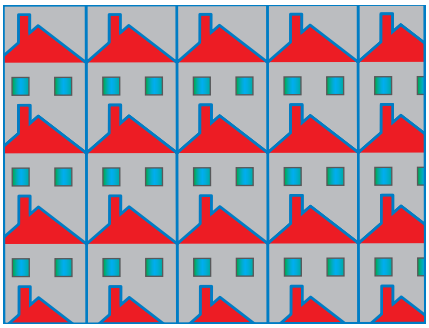
Step 1: Start with a square.

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 3

Justify Conclusions

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

a. Draw a rectangle in a coordinate plane. Find the dimensions of the rectangle.

b. Move each vertex 3 units right and 4 units up. Draw the new figure. List the vertices.

c. Compare the dimensions and the angle measures of the new figure to those of the original rectangle.

d. Are the opposite sides of the new figure still parallel? Explain.

e. Can you conclude that the two figures are congruent? Explain.

f. 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?

5. **IN YOUR OWN WORDS** How can you arrange tiles to make a tessellation? Give an example.

6. **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.

2.2 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
transformation, *p. 50*
image, *p. 50*
translation, *p. 50*

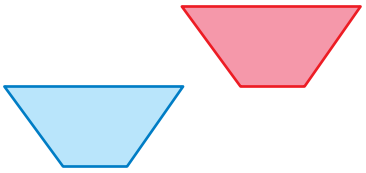
A **transformation** changes a figure into another figure. The new figure is called the **image**.

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.

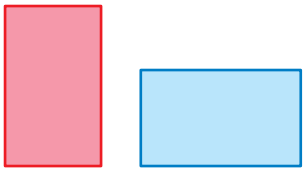
a.



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.

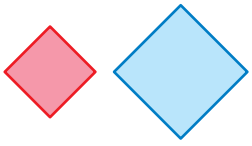
So, the blue figure is *not* a translation of the red figure.

On Your Own

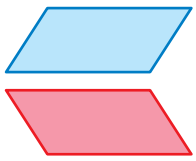
Now You're Ready
Exercises 4–9

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

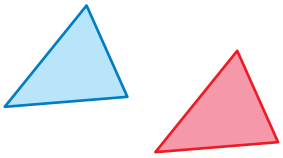
1.



2.



3.

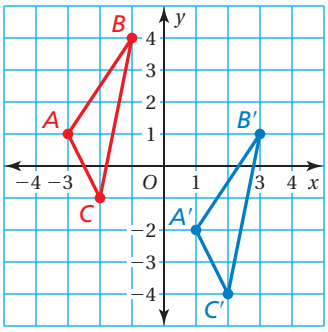


Key Idea

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

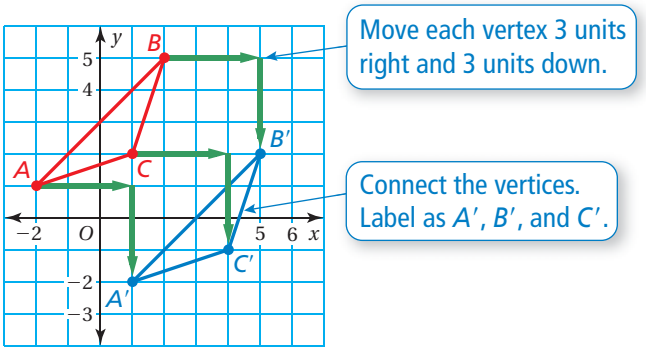
A' is read "A prime." Use *prime* symbols when naming an image.

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

Multi-Language Glossary at BigIdeasMath.com

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?

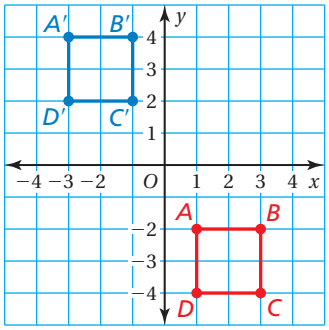
EXAMPLE 3 Translating a Figure Using Coordinates

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

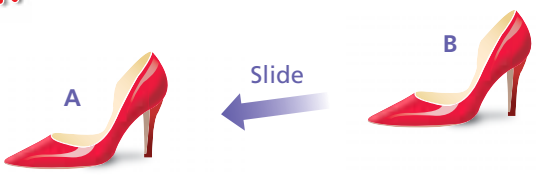
5. The vertices of a triangle are $A(-2, -2)$, $B(0, 2)$, and $C(3, 0)$. Draw the figure and its image after a translation 1 unit left and 2 units up.

2.2 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **VOCABULARY** Which figure is the image?



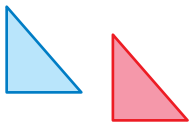
2. **VOCABULARY** How do you translate a figure in a coordinate plane?

3. **WRITING** Can you translate the letters in the word TOKYO to form the word KYOTO? Explain.

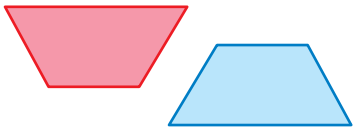
Practice and Problem Solving

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

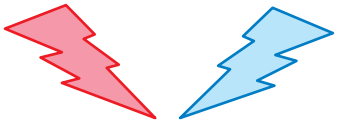
1 4.



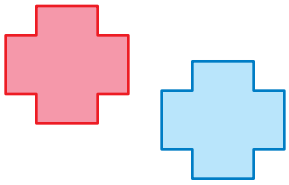
5.



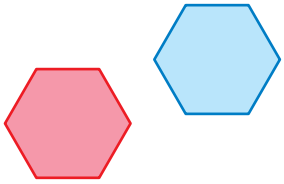
6.



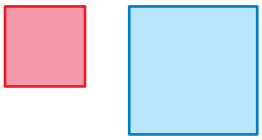
7.



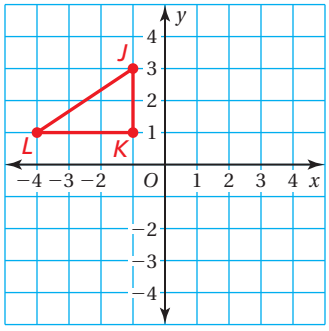
8.



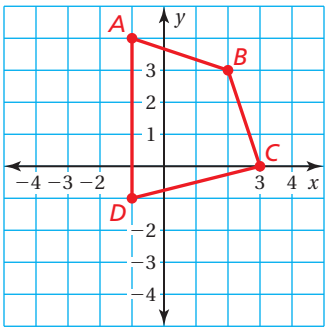
9.



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



11. 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.

3 **12.** 1 unit left and 6 units up

13. 5 units right

14. $(x + 2, y + 3)$

15. $(x - 3, y - 4)$

16. **ICONS** You can click and drag an icon on a computer screen. Is this an example of a translation? Explain.

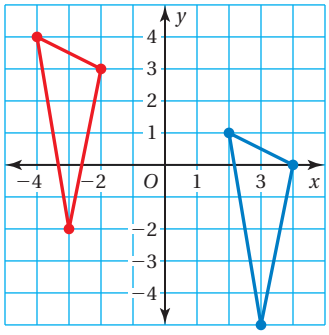
Describe the translation of the point to its image.

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

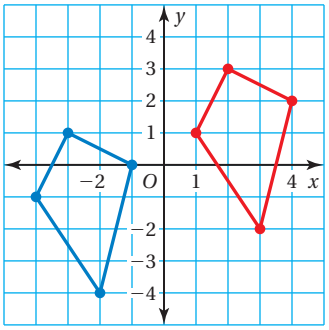
18. $(-8, -4) \rightarrow (-3, 5)$

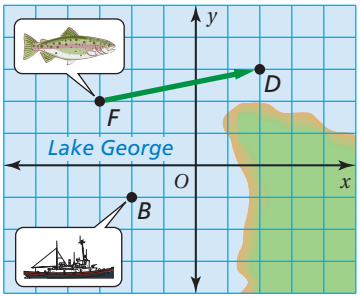
Describe the translation from the red figure to the blue figure.

19.



20.





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

a. Describe the translation of the school of fish.

b. Can the fishing boat make the same translation? Explain.

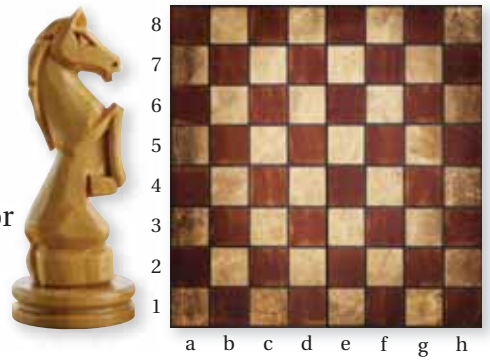
c. Describe a translation the fishing boat could make to get to point D.

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)*

24.

25.

26.

27.

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