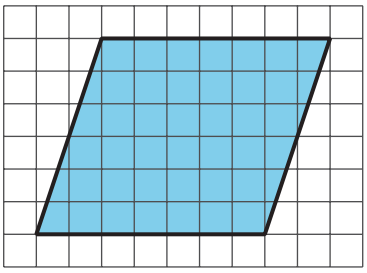
Unit 1, Lesson 5

# Area of Parallelograms

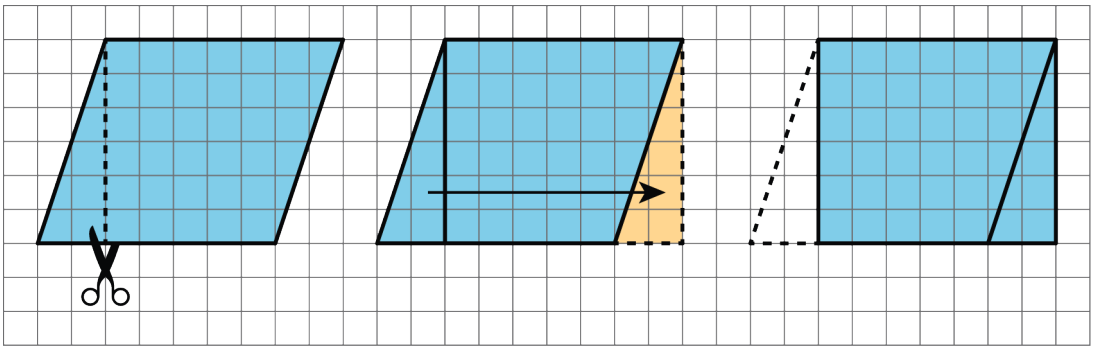
Let's investigate the area of parallelograms some more.

## 5.1 A Parallelogram and Its Rectangles

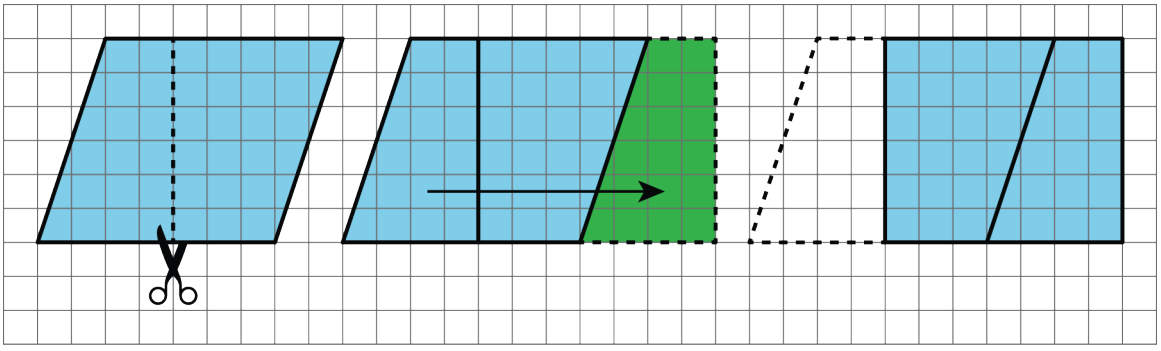
Elena and Tyler were finding the area of this parallelogram:



Here is how Elena did it:



Here is how Tyler did it:

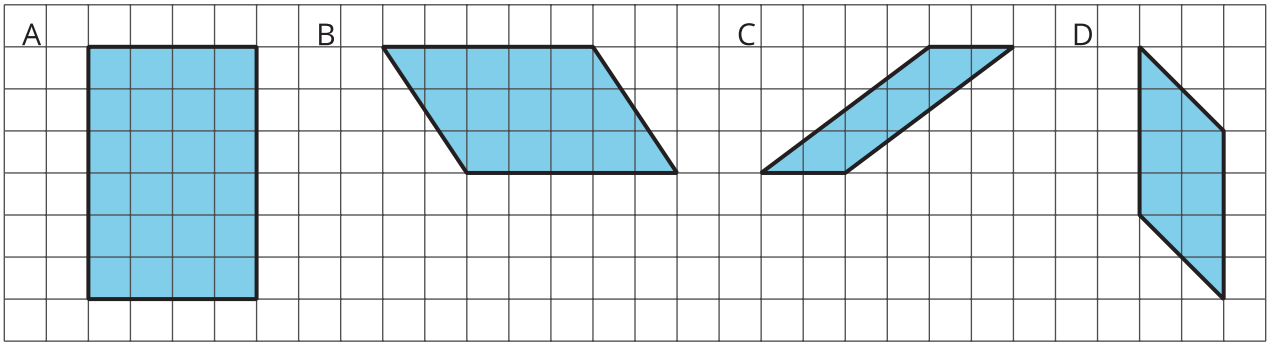


How are the two strategies for finding the area of a parallelogram the same? How they are different?

# 5.2 Finding the Formula for Area of Parallelograms

For each parallelogram:

- Identify a base and a corresponding height, and record their lengths in the table.
- Find the area of the parallelogram and record it in the last column of the table.




| parallelogram | base (units) | height (units) | area (sq units) |
|---|---|---|---|
| **A** | | | |
| **B** | | | |
| **C** | | | |
| **D** | | | |
| **any parallelogram** | $b$ | $h$ | |

In the last row of the table, write an expression for the area of any parallelogram, using $b$ and $h$.

## Are you ready for more?

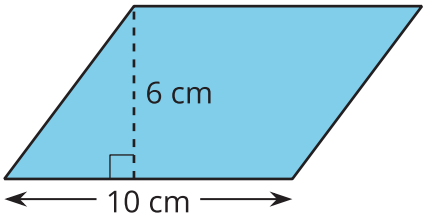
1. What happens to the area of a parallelogram if the height doubles but the base is unchanged? If the height triples? If the height is 100 times the original?

2. What happens to the area if both the base and the height double? Both triple? Both are 100 times their original lengths?

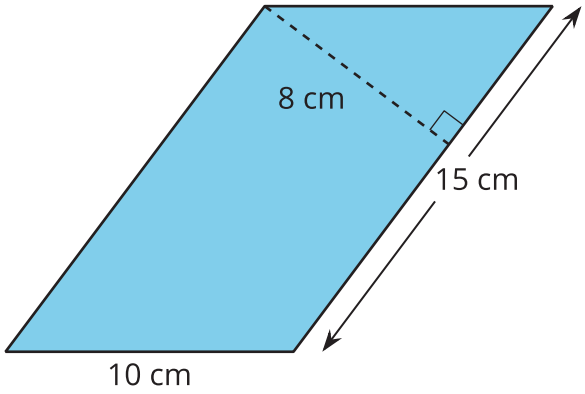
# 5.3 More Areas of Parallelograms

1. Find the area of each parallelogram. Show your reasoning.

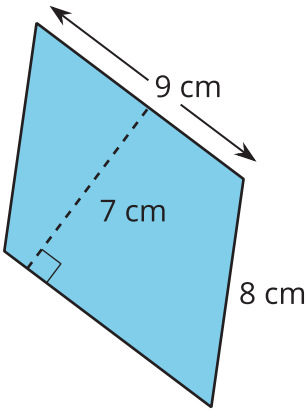
**A**



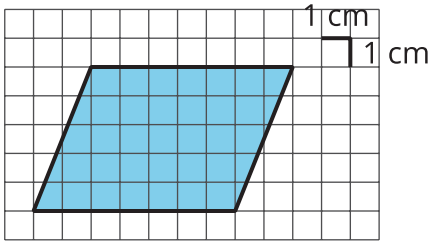

**B**




**C**

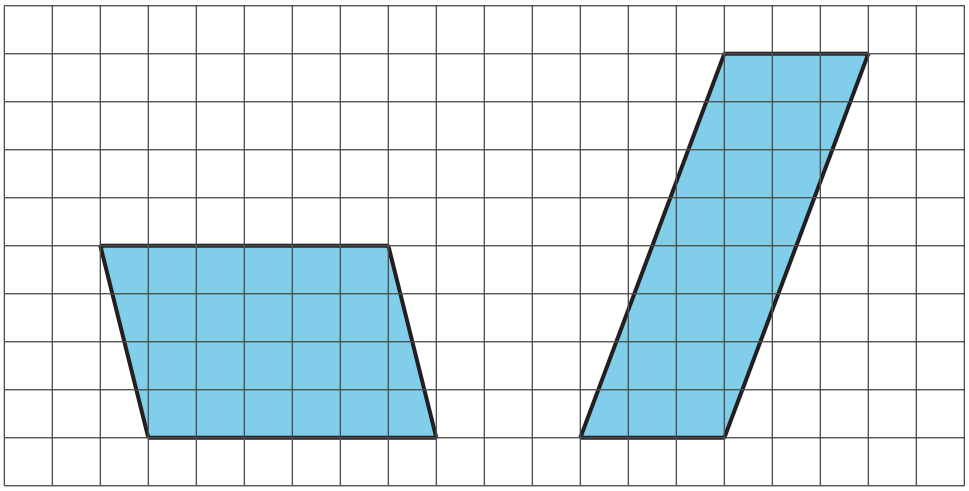



**D**



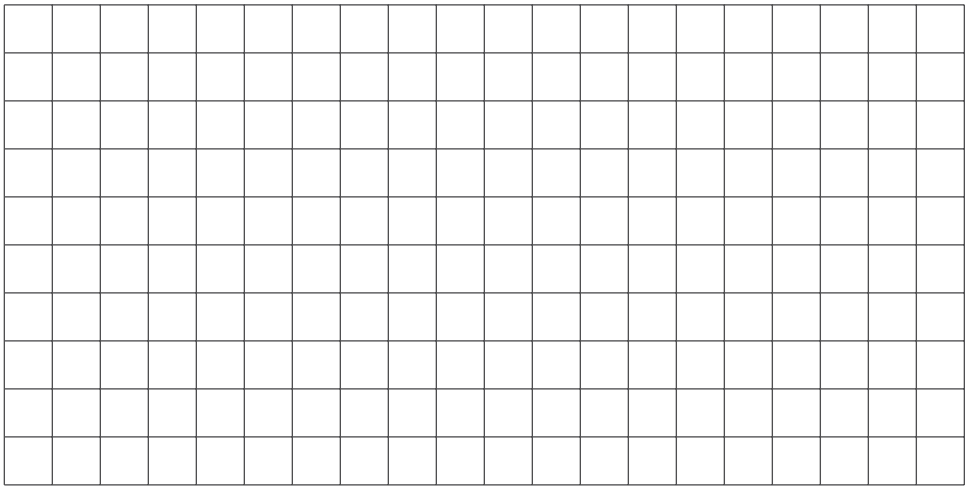

2. In Parallelogram B, what is the corresponding height for the base that is 10 cm long? Explain or show your reasoning.

3. a. Here are two different parallelograms with the same area. Explain why their areas are equal.



b. Two different parallelograms P and Q both have an area of 20 square units. Neither of the parallelograms are rectangles.

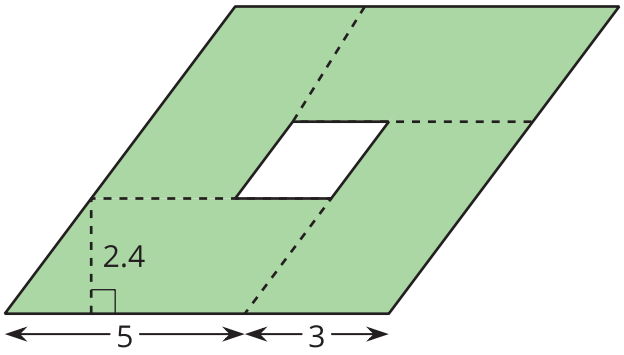
On the grid, draw two parallelograms that could be P and Q. Explain how you know.



## Are you ready for more?

Here is a parallelogram composed of smaller parallelograms. The shaded region is composed of four identical parallelograms. All lengths are in inches.

What is the area of the unshaded parallelogram in the middle? Explain or show your reasoning.




## Lesson 5 Summary

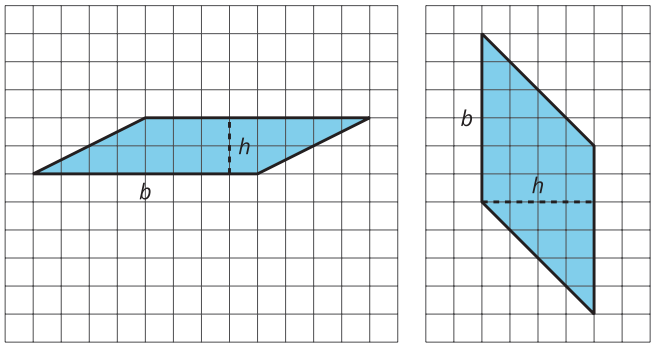
Any pair of a base and a corresponding height can help us find the area of a parallelogram.

- We can choose any side of a parallelogram as the **base**. Both the side selected (the segment) and its length (the measurement) are called the *base*.
- If we draw any perpendicular segment from a point on the base to the opposite side of the parallelogram, that segment will always have the same length. We call that value the **height**. There are infinitely many segments that can represent the height!

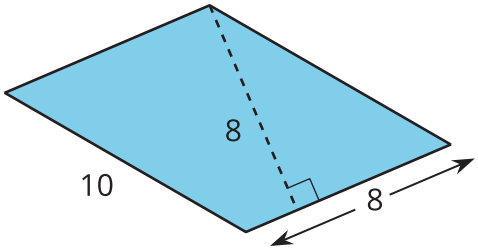
When a parallelogram is drawn on a grid and has *horizontal* sides, we can use a horizontal side as the base.

When it has *vertical* sides, we can use a vertical side as the base.

The grid can help us find (or estimate) the lengths of the base and of the corresponding height.



When a parallelogram is *not* drawn on a grid, we can still find its area if we know a base and a corresponding height.



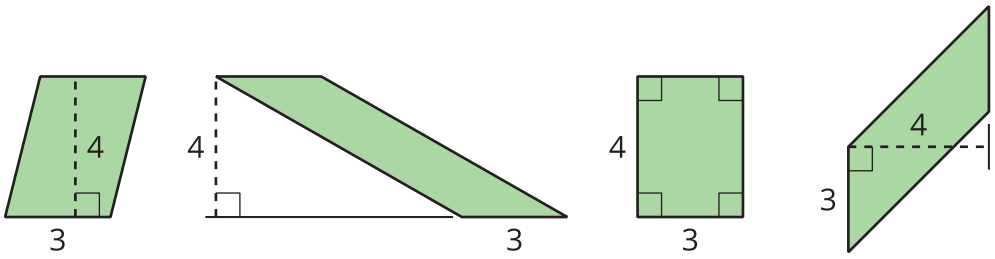

No matter which side is chosen as the base, the area of the parallelogram is the product of that base and its corresponding height.

We often use letters to stand for numbers. If $b$ is a base of a parallelogram (in units), and $h$ is the corresponding height (in units), then the area of the parallelogram (in square units) is the product of these two numbers:

$$b \cdot h$$

Notice that we write the multiplication symbol with a small dot instead of a $\times$ symbol. This is so that we don't get confused about whether $\times$ means multiply, or whether the letter $x$ is standing in for a number.

Parallelograms that have the same base and the same height will have the same area; the product of the base and height will be equal. Here are 4 different parallelograms with the same pair of base-height measurements.





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