

# Changes in Area and Perimeter

You can use technology to determine and describe the resulting changes in the areas and perimeters of regular polygons and circles when one or more dimensions are changed.

## Example 1 Use a Graphing Calculator

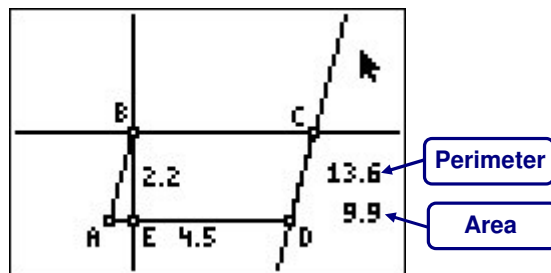
Use Cabri Junior to find the perimeter and area of a parallelogram.

**Step 1** Draw a parallelogram.

- Press **A** and select **Cabri Jr.**
- Select **F2 Segment**, and draw a segment. Then select **F5 Alpha-num**, and label the endpoints of the segment  $A$  and  $B$ . Repeat to draw and label a segment  $AD$ .
- Select **F3 Parallel**, point  $D$ , and segment  $AB$  to draw a line parallel to segment  $AB$  through point  $D$ . Repeat to draw a line parallel to segment  $AD$  through point  $B$ .
- Select **F2 Point, Intersection** to place a point at the intersection of the two lines drawn. Label the point  $C$ .
- Select **F3 Perpendicular** to draw a line through point  $B$  that is perpendicular to segment  $AD$ . Place a point at the intersection of the two lines, and label the point  $E$ .
- Select **F2 Quad**, and draw the parallelogram by selecting points  $A$ ,  $B$ ,  $C$ , and  $D$ .

**Step 2** Find the lengths of the base and height and the measures of the area and perimeter of parallelogram  $ABCD$ .

- Select **F5 Measure, D. & Length**, and click on each endpoint to find the lengths of segments  $AD$  and  $BE$ .
- To find the area, select **F5 Measure, Area**, place the cursor on any segment of the parallelogram, and press **e**.
- To find the perimeter, select **F5 Measure, D. & Length**, place the cursor on any segment, and press **e**.



You can change the figure's dimensions by selecting and dragging one of the vertices.

The Geometer's Sketchpad can also be used to find the perimeter and area of a polygon.

## Example 2 Use Geometer's Sketchpad

Use The Geometer's Sketchpad to find the perimeter and area of a parallelogram.

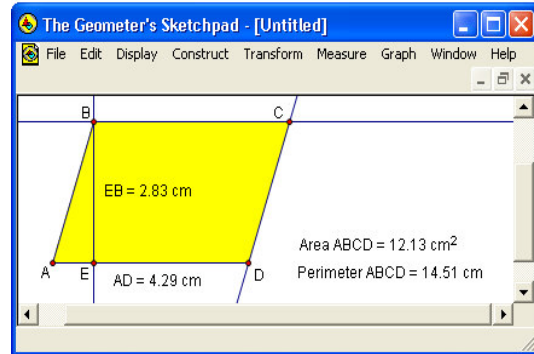
**Step 1** Draw a parallelogram.

- Press the **Segment** tool, and draw a segment. Then select the **Text** tool, and label the endpoints of the segment  $A$  and  $B$ . Repeat to draw and label a segment  $AD$ .
- Construct a line parallel to segment  $AD$  by highlighting point  $D$  and segment  $AD$  and then selecting **Parallel Line** from the **Construct** menu.
- Repeat to draw a line parallel to segment  $AD$  through point  $B$ . Construct a point at the intersection of the two lines by selecting the **Point** tool and clicking on the point of intersection. Label the point  $C$ .
- Highlight point  $B$  and segment  $AD$ , and select **Perpendicular Line** from the **Construct** menu to draw a line through point  $B$  that is perpendicular to segment  $AD$ . Place a point at the intersection of the two lines, and label the point  $E$ .
- Construct the interior of the parallelogram by highlighting points  $A$ ,  $B$ ,  $C$ , and  $D$  and selecting **Quadrilateral Interior** from the **Construct** menu.

## Changes in Area and Perimeter (continued)

**Step 2** Find the lengths of a base and the height, the area, and the perimeter of parallelogram  $ABCD$ .

- Click on each endpoint, and select **Distance** under the **Measure** menu to find the lengths of segments  $AD$  and  $BE$ .
- Highlight the interior of the parallelogram using the **Selection Arrow** tool. To find the perimeter, select **Perimeter** under the **Measure** menu.
- Highlight the interior of the parallelogram using the **Selection Arrow** tool. To find the area, select **Area** under the **Measure** menu.




You can change the figure's dimensions by selecting and dragging one of the vertices.

### Example Use a Spreadsheet

Use a spreadsheet to find the perimeter and area of a parallelogram.

To create a spreadsheet, enter the base of a parallelogram in column B and the height in column C. In cell D2, enter the formula for the perimeter of a parallelogram. Enter the formula for the area in cell E2.

	A	B	C	D	E
1	<b>Parallelogram</b>	$b$	$h$	<b>Perimeter</b>	<b>Area</b>
2		6	4	20	24
3					

You can change the figure's dimensions by entering new values for  $b$  and  $h$  in the next row of the spreadsheet. Then drag the fill handle  down from each formula cell to paste the formulas.

### Exercises

For Exercises 1–8, use one or all of the techniques shown in Examples 1–3 to explore the effects on the area and perimeter of the parallelogram when the lengths of segments  $AD$  and  $BE$  are changed as indicated.

- $AD$  or  $BE$  is twice as long.
- $AD$  or  $BE$  is three times as long.
- $AD$  and  $BE$  are twice as long.
- $AD$  and  $BE$  are three times as long.
- $AD$  or  $BE$  are half as long.
- $AD$  or  $BE$  are a third as long.
- $AD$  and  $BE$  are half as long.
- $AD$  and  $BE$  are a third as long.
- Make a conjecture about the effects on the area and perimeter of a parallelogram when the base *or* height is multiplied by a real number  $x$ . Then make a conjecture as to the effects on the area and perimeter of a parallelogram when the base *and* height are multiplied by a real number  $x$ .
- Suppose you are making a scale model of a room. You want the area of the room on your model to be  $\frac{1}{16}$  the area of the original room. By what factor should you multiply the dimensions of the original room?

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### Answers

1. The area is multiplied by 2, and the perimeter is increased by  $2AD$  or by  $2BE$ .
2. The area is multiplied by 3, and the perimeter is increased by  $4AD$  or by  $4BE$ .
3. The area is multiplied by 4, and the perimeter is multiplied by 2.
4. The area is multiplied by 9, and the perimeter is multiplied by 3.
5. The area is divided by 2, and the perimeter is decreased  $AD$  or by  $BE$ .
6. The area is divided by 3, and the perimeter is decreased  $\frac{4}{3}AD$  or by  $\frac{4}{3}BE$ .
7. The area is divided by 4, and the perimeter is divided by 2.
8. The area is divided by 9, and the perimeter is divided by 3.
9. The area would be multiplied by  $x$ , and the perimeter would increase by  $2x$ ; the area would be multiplied by  $x^2$  and the perimeter would be multiplied by  $x$ .
10.  $\frac{1}{4}$