# Finding the Area of Regular Polygons

## *Activity 3*

Not all prisms have rectangular bases. Some have bases that are triangular. Others, such as the octagonal prisms shown in Figure 7, have bases that are regular polygons.

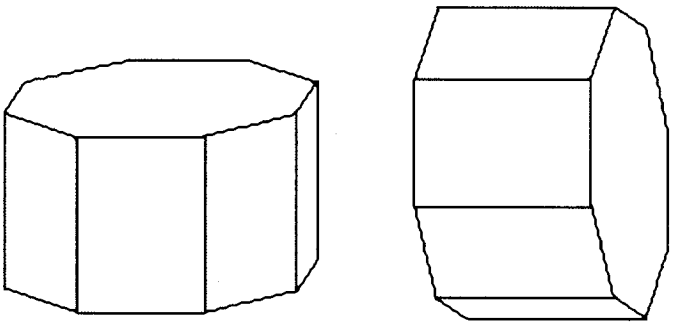

**Figure 7: Octagonal prisms**

In this activity, you use your knowledge of the area of triangles and squares to develop a method for finding the area of regular polygons with five or more sides.

## Exploration

**a.** Use a geometry utility to construct a regular pentagon by completing the following steps.

1. Construct a circle. Place five points on the circle. Use segments to connect the center of the circle to each of the five points. Each angle formed by two adjacent radii is a **central angle**.
2. Drag the points on the circle until the measures of all the central angles are equal.
3. Connect the points on the circle to form a regular pentagon.

**b.** Create a table with headings like those in Table **2** below.

**Table 2: Triangles in regular polygons**

| Polygon | No. of Triangles | Apothem ($a$) | Length of Side ($s$) | Area of Polygon |
|---|---|---|---|---|
| pentagon | 5 | | | |
| heptagon | | | | |
| decagon | | | | |
| $n$-gon | | | | |

**c.** Measure the perpendicular distance from the center of the polygon to one side. This distance is the length of the **apothem**. In Figure **7**, for example, $\overline{AG}$ is the apothem. Record this measure in the appropriate column in Table **2**.

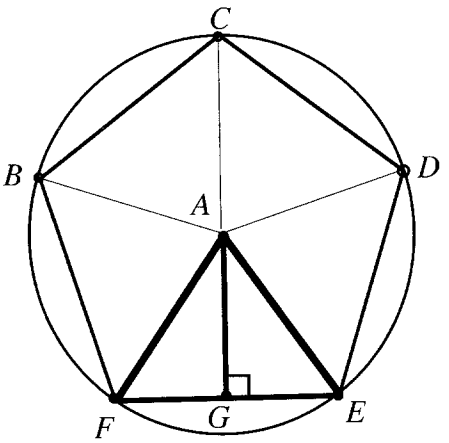


**Figure 7: Constructing a regular pentagon**

**d.** Measure the length of one side of the polygon. Record this length in the appropriate column of Table **2**.

**e.** **1.** Your construction of a polygon contains congruent triangles. Create a formula using the length of the apothem to find the area of one of these triangles.

**2.** Use the area of one congruent triangle to find the total area of the polygon. Record this area in the appropriate column of Table **2**.

**f.** Use the geometry utility to find the area of the polygon. Compare this value to the one you determined in Part **e**.

**g.** Repeat Parts **a–f** for a regular heptagon and a regular decagon.

**h.** Create a formula for finding the area of a regular $n$-gon. Enter it in the appropriate cell of Table **2**.

## Discussion

**a.** As the number of sides of a polygon increases, what happens to the shape of the polygon?

**b.** How does the measure of the central angle of a polygon affect the shape of the polygon?

**c.** How do the areas of the polygons found using your formula compare to the areas of the same polygons found using the geometry utility?

**d.** The area of a regular polygon with $n$ sides, apothem $a$, and side length $s$ can be described by the following equation:

$$\text{Area} = \left(\frac{1}{2}as\right)n$$

Is this equation equivalent to the formula you developed in Part **h** of the exploration? Explain your response.