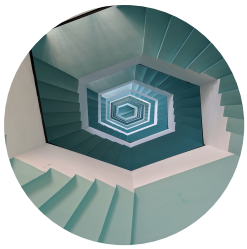

Designing Your Area

Area and Perimeter of Regular Polygons

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Grade Level	9th – 10th Grade	**Time Frame**	70-90 minutes
Subject	Mathematics	**Duration**	2 periods
Course	Geometry		

Essential Question

How do you find the area of any regular polygon?

Summary

In this lesson, students will use their existing knowledge to find the area and perimeter of triangles, rectangles, and trapezoids to discover how to find the area of a regular polygon and apply their knowledge to real-world scenarios.

Snapshot

Engage

Students recall what they know about finding the area and perimeter of composite figures.

Explore

Students explore the relationship between the area of a triangle and the area of a regular polygon.

Explain

Students complete guided notes with the class and formalize their understanding of the formula for the area of a regular polygon and learn the definition of *apothem*.

Extend

Students apply what they have learned to find the area of each surface of a pool to give a cost estimate for ordering tile.

Evaluate

Students determine the quantity of materials needed to build and paint a frame for an octagonal mirror.

Standards

Oklahoma Academic Standards Mathematics (Geometry)

G.2D.1.7: Apply the properties of polygons, and use them to represent and apply mathematical models involving perimeter and area (e.g., triangles, special quadrilaterals, regular polygons up to 12 sides, composite figures).

Attachments

- Composite Figures—Designing Your Area - Spanish.docx
- Composite Figures—Designing Your Area - Spanish.pdf
- Composite Figures—Designing Your Area.docx
- Composite Figures—Designing Your Area.pdf
- DIY Mirror—Designing Your Area - Spanish.docx
- DIY Mirror—Designing Your Area - Spanish.pdf
- DIY Mirror—Designing Your Area.docx
- DIY Mirror—Designing Your Area.pdf
- Exploring Patterns—Designing Your Area - Spanish.docx
- Exploring Patterns—Designing Your Area - Spanish.pdf
- Exploring Patterns—Designing Your Area.docx
- Exploring Patterns—Designing Your Area.pdf
- Guided Notes—Designing Your Area - Spanish.docx
- Guided Notes—Designing Your Area - Spanish.pdf
- Guided Notes—Designing Your Area.docx
- Guided Notes—Designing Your Area.pdf
- Lesson Slides—Designing Your Area.pptx
- Polygon Pool Party—Designing Your Area - Spanish.docx
- Polygon Pool Party—Designing Your Area - Spanish.pdf
- Polygon Pool Party—Designing Your Area.docx
- Polygon Pool Party—Designing Your Area.pdf

Materials

- Lesson Slides (attached)
- Composite Figures handout (attached; one per pair; printed front only)
- Exploring Patterns handout (attached; one per pair; printed front only)
- Guided Notes handout (attached; one per student; printed front only)
- Polygon Pool Party handout (attached; one per pair; printed front/back)
- DIY Mirror handout (attached; one per student; printed front only)
- Pencil
- Scientific calculators
- Student devices with Internet access

20 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. **Slide 3** displays the lesson's essential question. **Slide 4** identifies the lesson's learning objectives. Review each of these with your class to the extent you feel necessary.

Instruct students to find a partner or assign students partners. Pass out scientific calculators to each student. Go to **slide 5**. Give each pair a copy of the **Composite Figures** handout. Here students are asked to find the area and perimeter of each composite figure. Once students have completed the handout, use a modified Think-Pair-Share strategy and have students find another pair of students to discuss their results and thought process.

Teacher's Note: Guiding the Activity

Be sure not to immediately tell a student how to find the area of a figure. Ask students what shapes they see that they know how to find the area of, as there are multiple ways of finding the answer. Students will each see different arrangements of shapes, so it is important that each student divides the figure into known shapes. For example, a student may not see a trapezoid but instead see a rectangle and triangle – both are valid ways of finding the area.

All of the triangles are Pythagorean triples, so minimal calculations, if any, are needed to determine each hypotenuse length. Calculators are used as a time-saver. There are many calculations throughout the lesson, but the calculations are not the focus of the lesson.

As you show the slides for students to check their work, remind students that these are just one example of how to find each area and perimeter. Encourage students to share their differing strategies, or ask volunteers to share the thought process that they heard about in their discussions, and found interesting.

Show **slides 6–9**, giving students time to check their work on each composite figure. Ask volunteers to share different methods of finding the area and/or perimeter of each figure, as time allows.

20 minutes

Explore

Display **slide 10** and pass out the **Exploring Patterns** handout to each pair of students. Provide students with the link to the GeoGebra activity: https://www.geogebra.org/m/x4tsbeuz. Have students work with their partner to complete the handout. Here, students explore the relationships between the area of one triangle, the number of sides of a polygon, and the area of a regular polygon. During this exploration, students should record the area of one triangle and number of sides of each polygon in the GeoGebra activity. On the handout, students are asked to use those two given details to determine the area of each regular polygon. The GeoGebra activity demonstrates how each *n*-gon is made up of *n* congruent triangles, starting with an octagon down to a triangle.

Teacher's Note: Purpose

The purpose here is for students to have more of an intuitive sense of the formula for the area of a regular polygon rather than trying to memorize a meaningless formula. On the last row of the handout, students are asked to use words and/or variables to write an equation to find the area of any regular polygon. This is where students try out finding a pattern and start thinking about a formula. The formula is defined during the Explain portion of the lesson.

10 minutes

Explain

Display **slide 11**. Give each student a copy of the **Guided Notes** handout. Complete the handout as a class. Have students add this to their math notebook if that is a classroom norm.

Teacher's Note: Guiding the Activity

Using example 1, have students share how they think that they would find the area based on their observations from the GeoGebra activity:

- divide the hexagon into six congruent triangles;
- find the area of one triangle using the base of 8 and height of 4 square roots of 3;
- multiply the area of one triangle, 16 square roots of 3, by 6, since there are 6 congruent triangles;
- find that the total area of the regular hexagon is 96 square roots of 3.

Guide students through the formal definitions of apothem, side length, and number of sides as well as the formulas for area and perimeter of a regular polygon. It is likely that *apothem* is the only new vocabulary word for students.

Consider asking students if they think these formulas would work for irregular polygons or for all polygons? Why or why not?

Use example 2 as a time to practice using this newly learned formula:

- identify and write down what is known: a = 2, s = 2.9, and n = 5;
- use the formula, $A = (\frac{1}{2}) \cdot a \cdot n \cdot s$, to find that the area is 14.5.

30 minutes

Extend

Teacher's Note: Preparation

Decide whether you want the Polygon Pool Party handout to be guided practice or independent practice. The sample responses to the handout are on hidden slides, so if you would like the class to check their work as they go, unhide slides 13 – 17.

Now it is time for students to apply what they have learned; display **slide 12**. Give each pair of students the **Polygon Pool Party** handout. Instruct students to work with their partner to find the area of each surface of the pool and record their results on the back side of the handout. Here students are asked to find the square footage of each surface of the pool to determine the cost of tiling the pool. Students are also asked to find the area of the concrete patio surrounding the pool.

Optional Slides

Unhide and display **slides 13-17** so students can check their answers for each side of the pool. Ask for volunteers to explain their work.

10 minutes

Evaluate

Use the Exit Ticket strategy to individually assess what students have learned from the lesson. Go to **slide 18** and give each student the **DIY Mirror** handout. Students are asked to find the area and perimeter of the frame of a regular octagonal mirror.

After students have submitted their work, unhide and show **slides 19** and **20**. Give students time to reflect on their thinking. Use student responses to see what misconceptions still exist.

Alternative Pacing

This could also be done as bell work the following day. Consider giving the DIY Mirror handout as homework, then starting the next day with a 3–5 minute review using slides 19 and 20.

Teacher's Note: Differentiation

For students who are needing an additional challenge, remove the detail about the length of the sides of the frame: “and you want the side lengths of the frame to each be 24.5 inches.” Removing this detail requires students to set up proportions for similar triangles to find that side length. Consider your curriculum sequencing if making this change.

Resources

- Image source: Mithul Varshan. (October 1, 2019). Empty Gray and White Concrete Spiral Stairs [Photograph]. Pexels. https://www.pexels.com/photo/empty-gray-and-white-concrete-spiral-stairs-3023211/
- K20 Center. (n.d.). Bell Ringers and Exit tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Think-Pair-Share. Strategies. https://learn.k20center.ou.edu/strategy/139
- K20 Center. (n.d.). GeoGebra. Tech Tools. https://learn.k20center.ou.edu/tech-tool/2352