

<b>LessonTitle: Polygons and Art</b>	<b>Geo 2.3</b>
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<b>Utah State Core Standards</b> Geometry Standard 3.1, 2.1 Process Standards 1, 2, 4
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<b>Summary</b>
In this lesson, students use Geometer’s Sketchpad to create regular polygons by inscribing them in circles. After they have created the polygons, they connect the vertices and shade areas to create geometric art.

<b>Enduring Understanding</b> Inscribing polygons within circles enables us to draw polygons accurately and in the process understand the relationship of circle measurement and angles in polygons.	<b>Essential Questions</b> How can we draw regular polygons by dividing a circle?
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<b>Skill Focus</b> <ul style="list-style-type: none"><li>• Creating regular polygons inscribed within circles.</li><li>• Observing patterns and relationships between<ol style="list-style-type: none"><li>1) polygons and their diagonals</li><li>2) polygons and their angles</li></ol></li><li>• Using geometry to create art.</li></ul>	<b>Vocabulary Focus</b>
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<b>Assessment</b>
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<b>Materials:</b> Computers with Geometer’s Sketchpad, compass and protractor or circle making tool. Directions sheet (see below), art example sheet (see below)
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<b>Launch</b>
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<b>Explore</b> How can a circle help you construct regular polygons? How do you reproduce the geometric art using polygons inscribed in circles? How can you describe the patterns found in the relationships of 1) polygons and their diagonals and 2) polygons and their angles?
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<b>Summarize</b>
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<b>Apply</b>
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**Directions:** Remember to post the essential questions. Discuss the essential questions during or at the conclusion of the activity.

Follow the directions on the direction sheet below. For doing the work and answering the questions, have students create a separate document on the computer or by hand.

## Pre 2.3

## Polygons and Art

### Instructions

In this activity you will explore creating regular polygons and then use what you learn to create some geometric art. After you complete the assignment and recreate some of the art from the handout, you will create your own art as a final project.

Note: This assignment could be done using Geometer's Sketchpad or by hand using a circle maker tool and angle measuring instrument. In either case create a document with your name and then respond to the questions separately on that document.

- 1) Try constructing an equilateral triangle with a ruler as your only tool? How about a pentagon? What are the problems you must deal with?

How might you approach this task to avoid these problems?  
How could a circle help you?

- 2) Create a circle with about a 1 inch diameter. Figure out how to create a triangle inscribed within the circle. (The triangle points are on the circle circumference.) Show what you did!

Now create a square, a pentagon, a hexagon, and an octagon inside circles. Show all your thinking and your work.

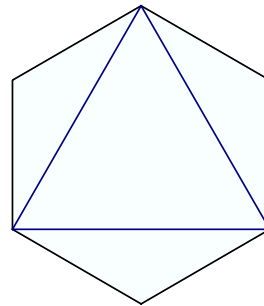
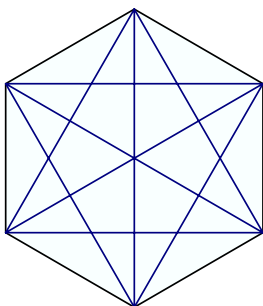
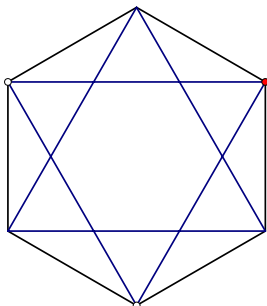
- 3) For this problem you will need to reproduce the square, pentagon, hexagon and octagon. If using Geometer's Sketchpad, copy and paste. Otherwise duplicate what you did for #2 above.

On all of the inscribed shapes, connect every point to every other point (see below). Then 1) find the following shapes. 2) Outline the shapes in a color or color them in, 3) Create a color key with labels for the shapes.

Triangles: 1) equilateral, 2) acute isosceles, 3) right isosceles, 4) obtuse isosceles, and 5) scalene.

Quadrilaterals: 1) parallelogram, 2) isosceles trapezoid, 3) a trapezoid which is not isosceles, 4) kite, 5) rectangle, 6) other quadrilateral

Other Polygons:



- 4) Create a table like below. Examine the pattern of diagonals. What is the pattern? Predict how many diagonals would be in a 12 sided figure.

<u># of sides</u>	<u>diagonals</u>
3	0
4	2
5	

Extra Challenge: Derive a formula for determining the number of diagonals for any given number of points?  $D = \underline{\hspace{2cm}}$

5) Examine the sums of the angles in your polygon constructions.

# of sides	interior angle sums
3	
4	
5	
6	

What do you notice? What is the pattern?

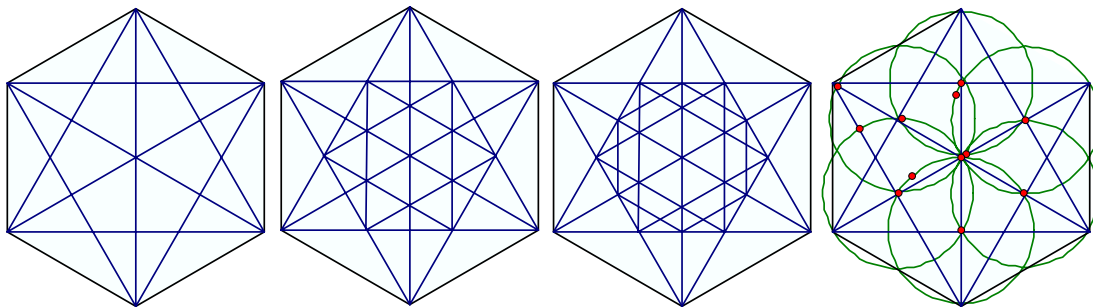
What is your explanation for this pattern?

Predict the sum of the angles for an octagon.

Can you develop a rule for finding the sum of the angles in any polygon?

6) Now have some fun creating some polygon art. Recreate 3 from the art handout.

- 1) Begin by inscribing a hexagons within circles.
- 2) Then connect each point with every other point.
- 3) You may wish to connect inner hexagon points (see example 3 below). Or you may wish to use overlapping circles (see below).
- 4) Erase some lines and/or color in parts to recreate some of the drawings on the example sheet.



7) Create some of your own art using inscribed polygons. You may choose to create a large hexagon project or smaller hexagons. The art can be enhanced using colors or black and white.

8) Try the handshake problem: If there are 10 people in the room and every person in the room shakes hands with every other person, what is the total number of handshakes?

Think about ways to model this problem. Are there any connections to the geometry above?

