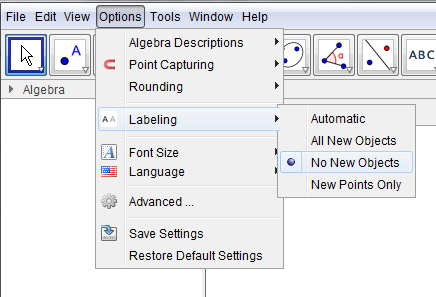
William O’Brien

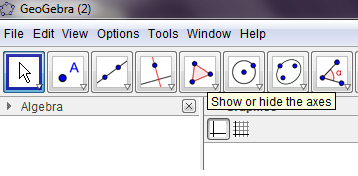
**Geogebra Lesson:** Polygons and Pi

**Grades:** 9-12

1. Open the **Geogebra** **Program** on your computers.
2. Start by going to **Options** then **Labeling** then **No New Objects** on your navigation bar.



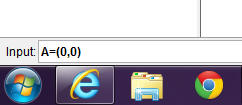
1. Then under the **Graphics tab** select the grid that says **“Show or Hide Axis”**



1. Create your center and radius for your circle by plugging into the **Input Bar** the following points as shown below:

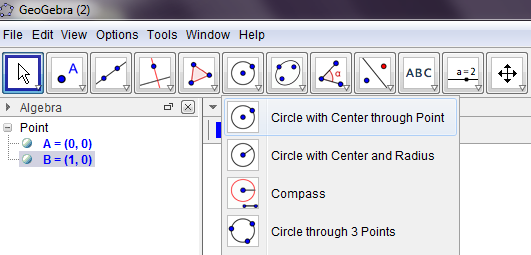
**A=(0,0) then click ENTER**

**B=(1,0) then click ENTER**

****

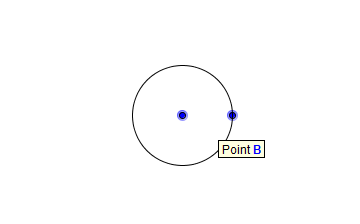
**\*\*Note: When you create your first parenthesis for point A it will appear as this. --> A=()**

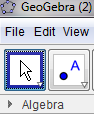
1. Label first point, **Point A**, by double clicking on the point, select **Object Properties,** then click **Show Label** box. Repeat this process for **Point B.**
2. Now, create a circle by clicking the down arrow on the **circle button** as shown below, selecting **Circle with Center through Point.**

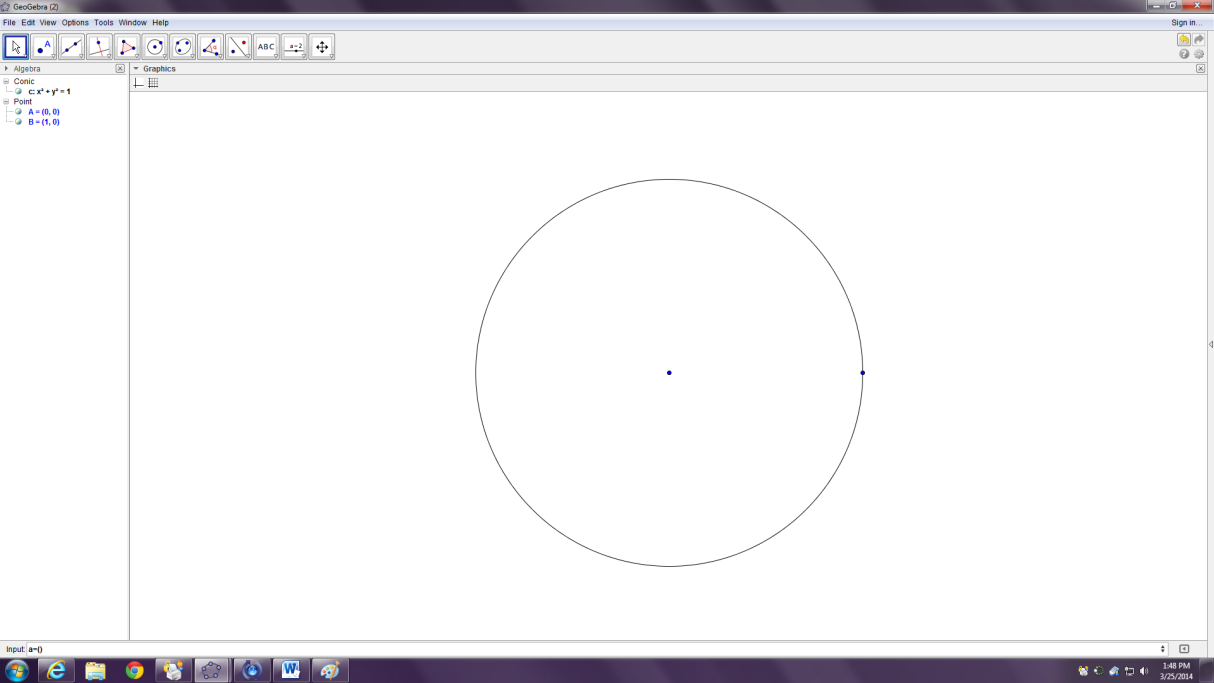


1. Start by dragging your cursor to your first point **(A),** clicking on it, then dragging the cursor to the second point **(B)** and clicking on that point, forming your circle.

**\*\*Note: Your circle will start forming when you click on your first point A.**



1. **Click on the  (Move Button),** then **click** on the white area outside of your circle. Use **Ctrl+Shift+(+ or -) to Zoom In and Out** on your circle figure. **Use** the directional arrows **<- and ->** to center your circle in the middle of your screen as shown below:



1. Now, create a slider by selecting the **slider button** shown below:

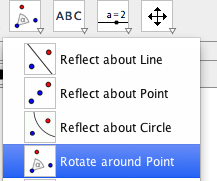


Click anywhere in the **white area** and a **slider** window will open.

* Choose **Integer.**
* In the **Name bar** write the letter **n**
* Change the **Min: 1** and **Max: 50**
* **Then Press Apply**

Drag your slider to a visible white area on your screen.

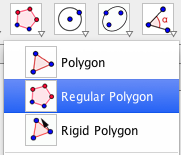
1. Now, we are going to Rotate **Point B.** Click the down arrow on the **Rotate/Reflect Button** located to the left of the **ABC** button. Select **Rotate around Point** as shown below:



Then Click on **Point B** then on **Point A** and a **third point, Point B’,** will form on your circle.

Click on the **Move Button** from **Step #8** and move your value of **n** on your **slider** until you can see **Point B’** separate from **Point B** on your circle.

1. Click the down arrow on the **Polygon Button** located to the left of the **Circle** button. Select **Regular Polygon** as shown below:

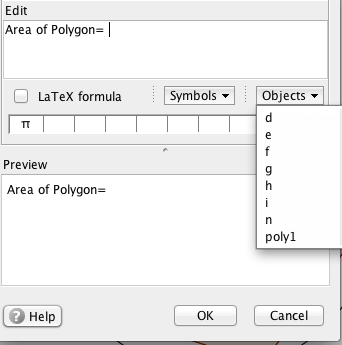


A cursor will appear, then click on **Point B** then click on **Point B’** and a window will appear. When the window appears input **“n”** in the **points bar** and press **OK.**

1. Click on the move button, and then drag the slider from left to right and notice that with **n amount of points/vertices** a regular polygon is made with that many number of points/vertices. Make a regular polygon with **at least** **n = 3 points/vertices.**
2. Click on the **ABC Button** located to the left of the **slider button,** and a cursor will appear. Click on a white area outside of your new **Regular Polygon and Circle objects.**



In the **Edit box** type in **Area of a Polygon=** then select the **Objects button** and scroll down and choose **poly1.** Then press **OK.**



1. Go to **Options** then **Rounding** then **5 Decimal Places.** Then change the **n value** on the slider and try to pick up on how the **Area of the Polygon** changes as we look at the questions on the following page.

**Questions for Discovering Relationships Geogebra Activity:**

1. List some of the patterns you notice when you change the slider **(n-values)**??

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What changes do you see occur as the **n-values** increase to create a pentaconagon, 50 points/vertices?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What would be the area of the circle figure in our worksheet if we know that the radius is equal to 1?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What can we notice about the Area of the Polygon we created in this Geogebra Worksheet?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. How is the Area of the Polygon and the Area of the Circle related? What would you think the Area of the Polygon would be if the slider went up to 100? 500? 2000?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. How many vertices or points does our polygon need to have in order for it to have the same area as the circle?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Sources for Geogebra Activity:**

YouTube Video: Polygons and Pi (Week 2, Part 9)

Link: <https://www.youtube.com/watch?v=V6Gl1dx8V2U>

**Conclusion:**

I would teach this topic of inscribing a regular polygon with a circle during a inscribing lesson in a Geometry classroom in 9-12th grade classroom. Students would use Geogebra and the technology provided to discover the relationship between the Area of a Circle with radius=1 and the inscribed Area of a Polygon. Discovering the relationship of Pi being the circumference divided by the diameter would be a lesson that can be demonstrated afterwards with this circle on this Geogebra program through the use of sliders as well.