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MTH 4040

**Hands-on Activity**

**Where did Pi and Radians Come From?**

**Goals**

The students will understand why the value of pi is 3.14.

The students will understand where the radii values on the unit circle come from.

**Objectives**

Given two different size circles, the students will determine how many times the diameter of the corresponding circle makes up the circumference of that circle to understand where the value pi came from.

Given two different size circles, the students will determine how many times it takes the radius to get to pi in the unit circle to understand where the value pi came from.

Given two different size circles, the students will determine the radii in a unit circle based on the degrees that the radius forms of the corresponding circle.

**Review: The Unit Circle**



**Terms and Skills to Know**

Circumference: The distance around the edge of a circle.

Diameter: a straight line going through the center of the circle connecting two points on the circumference.

Radius: The distance from the center to the circumference of a circle.

Radians: The angle made by taking the radius and wrapping it round the circle.

Circumference Formula: $C=πd$

Converting Degrees to Radians: Radians $=\frac{π}{180}\*$ degrees

**Materials**

* Protractor
* Scissors
* String
* Calculator
* Paperclips
* Sharpie
* Computer & Printer accessibility\*

**Steps for Determining Pi**

1. Construct a Circle Using GeoGebra
2. Open GeoGebra on your computer.
3. Remove any grid lines and/or the axes by right clicking on the screen and unchecking those options.
4. Press on this icon: and select *Circle with Center Through Point* from the drop-down menu to construct a circle.
5. Click anywhere on your blank sheet in GeoGebra and drag across the page to make a circle.
6. Make a line segment from the center point to the point on the circumference of the circle. To do this, press on this icon: and select *Segment* from the drop-down menu. This will be the radius.
7. Repeat steps 4 and 5 to construct another circle that is a different size then the previous circle you just created.
8. Print out your circles.
9. Cut them out.
10. Determining Pi with the Circles Constructed
11. Solve the Circumference formula for pi.
12. Measure a piece of string around the circumference of Circle A using paper clips to keep the string in place.
13. Cut the string.
14. Remove the paper clips.
15. Measure the **diameter** of Circle A using another piece of string and one paper clip at one end of the circle to keep the string in place (use the radius as a guide to measure straight across the circle).
16. Cut the string.
17. Determine how many times the diameter string goes into the circumference string. Use paper clips to hold the diameter string in place next to the circumference string and then mark where it ends with a sharpie.
18. Repeat step 7 until the diameter string has gone along the entire circumference string.
19. Repeat this process for Circle B.
20. If necessary, average the values you got for each circle together to determine a more accurate value for pi.

**Steps for Determining Radians**

1. Starting with Circle B from the previous activity, construct a radius using the string by starting at the center of the circle to the circumference.
2. Cut the string.
3. Start one end of the radius at degree 0 or degree 360 and trace it around the circle until it stops. Use paper clips to hold the radius in place.
4. Mark where the radius stopped on the circle using any utensil.
5. Remove the paper clips and the radius string from Circle B.
6. Measure the angle using your protractor and record it below. Round the angle to the nearest ten’s place, if necessary.
7. Start one end of the radius where you just ended it last and trace it around the circle until it stops. Use paper clips to hold the radius in place.
8. Mark where the radius stopped on the circle using any utensil.
9. Measure the angle using your protractor and record it below. Round the angle to the nearest ten’s place, if necessary.
10. Repeat steps 7-9 until the radius has went around the entire circle.
11. Repeat this process for Circle A.

**Note: Once you get passed 180 degrees, flip the protractor over and add 180 degrees to the degree you measure.**

**Angle Measurements**

 Circle B:

$$∠1:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠2:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠3:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠4:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠5:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠6:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

 Circle A:

$$∠1:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠2:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠3:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠4:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠5:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

$$∠6:\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

**Activity Questions**

What are some possible errors that may have occurred throughout this activity?

What are some ways we can prevent these errors?

Why do you think $∠3$ came out to be pi when determining radians?

Look back at the unit circle. What radii are we missing? Why do you think this is? How do we determine the other radii?

**Extension Activity**

Use a plate as the circle rather than constructing a circle on GeoGebra. Determine pi and determine radians by following the same procedures listed on this worksheet. Is pi still 3.14? Do you get the same radii measurements?

**References**

Angle Conversions. (n.d.). Retrieved April 25, 2017, from http://www.teacherschoice.com.au/maths\_library/angles/angles.htm

Burns, N. (n.d.). Discovering Radians Activity . Retrieved April 25, 2017, from http://mrsnicoleburns.weebly.com/uploads/8/6/7/0/8670276/\_1\_\_discovering\_radians\_act ivity\_\_page\_1\_.pdf

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