Summer 2016

UTM Middle School STEM Workshop

**Workshop Facilitator**: Dr. Louis Kolitsch

**Subject/Grade**: Why is the area of a circle given by πr2? (Grade 7)

**Estimated time**: 1 hour

**Standard(s)**: TN Mathematics Standards

Grade 7: **7.G.B.3** Know the formulas for the area and circumference of a circle and use them

 to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

**Objective**: Use pictures and the formula for the area of a parallelogram to explain why the area of a circle is given by πr2.

* I can find the formula for the area of a circle

**Materials and Resources**: Sheet with a large circle, red and blue colored pencils, scissors.

**Motivating Students/Anticipatory SET:**

Relate the area of a circle to the area of a known shape. More generally, the approach here introduces a limiting process that is used in applications such as finding areas, surface areas, or volumes of non-standard shapes.

**Instructional procedures**:

* Give each student the sheet with a large circle, colored pencils, and scissors.
* Have the students cut out the two halves of the circle.
* Have the students use the red colored pencil to color the arc of the circumference in one of the half circles and use the blue colored pencil to color the arc in the other half circle.
* Ask the students “What is the length of each arc you just colored?”.
* Have the students fold and cut each half circle into two equal parts.
* Have the students interweave their four quarter circles like teeth with the red arcs at the top and the blue at the bottom, as shown below.



* Ask the students, “What is the length across the bottom of their shape?”.
* Have the students fold and cut each quarter circle into two equal parts.
* Have the students interweave their eight sectors like teeth with the red arcs at the top and the blue at the bottom.
* Ask the students, “What is the length across the bottom of their shape?”.
* Ask the students, “What shape does the figure resemble?”.
* Have the students fold and cut each of the eight sectors into two equal parts.
* Have the students interweave their sixteen sectors like teeth with the red arcs at the top and the blue at the bottom.
* Ask the students, “What is the length across the bottom of their shape?”.
* Ask the students, “What shape does the figure resemble?”.
* Ask the students, “If the figure were a true parallelogram, how would we calculate its area?”.
* Ask the students, “What dimension of our circle is the approximate height of the parallelogram?”.
* Explain that if we continued to cut our sectors in half and formed our figures by interweaving them like teeth, the figure would become closer and closer to a true parallelogram with height \_\_\_\_\_\_ , base length \_\_\_\_\_\_\_ and area \_\_\_\_\_\_\_ (have the students respond with the values).

**Questioning/Thinking/Problem Solving:**

Formative questions are included in the instructional procedures.

Introductory questions could focus on the process. For example, “does cutting the circle in half change the area or circumference?” or “does rearranging the parts of the circle once it is cut change the area or the circumference?” are good questions to ask at the beginning of the activity.

As you work through the activity, some students may want to include the “cut edges” of the circle (along the diameter or along the various radii you cut) as part of the “circumference” or as part of the “sides” of the “parallelogram” you are building.

* What is the recurring theme in our process to find the area of a circle? Provide supporting details.

**Follow-up Activities/Extensions**:

1. Give students descriptions of a variety of circles and/or semicircles and ask them to use the formula just derived to calculate the area.

2. Give students non-standard shapes that can be partitioned into a portion of a circle and a standard shape (e.g., a cathedral window or an oval track) and ask students to calculate the area.

**Accommodations/Adaptations:**

Provide students a pre-cut set of circle parts to complete the activity.

**Closure:**

Lead a group discussion to write the formula for the area of a circle in symbols and explain what each symbol means.

**Assessment:**

Provide students with different sizes of circles and different pieces of information about the circles (e.g., radius, diameter, or circumference) and ask them to calculate the area of each circle.

**Teacher Reflections:**

To be completed after conducting the lesson.

