1 Polygons

In math, a polygon is commonly defined as being a plane figure with at least three straight sides and angles. Basically, all of the geometric figures you are familiar with, such as a triangle, square, pentagon, etc. are all polygons. However, today we are going to teach you about a polygon that defies these laws.

2 Reuleaux Polygons

Reuleaux polygons are polygons, like the ones that were mentioned above, that are plane figures, but none of their sides are straight. Instead, all of the sides are replaced with the curves, similar to those from a circle. In fact, all reuleaux polygons are drawn utilizing intersecting circles centered at each vertice. If the polygon is created correctly, it should look like a combination between a certain regular polygon and a circle. Shown below is a reuleaux triangle, the polygon we will be focusing on mostly in today's session.

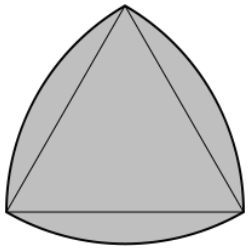

Figure 1: example

3 Perimeter

Now we're going to figure out how to obtain the perimeter of a reuleaux triangle. The perimeter of a reuleaux triangle is made up of sections of the circumference of a circle. Note that the circumference of a circle is $2\pi r$ and that the inner triangle is an equilateral triangle.

1. How many degrees are in each interior angle of the inner triangle?
2. If each side of the inner triangle is 6cm, what is the perimeter of the reuleaux triangle?
3. How much longer is the perimeter of the reuleaux polygon compared to the inner triangle? (use $\pi = 3.1416$ as an approximation
4. What would be the perimeter of a reuleaux pentagon in which all the sides were 15cm? (Hint: Each internal angle has a measure of 108 degrees.)

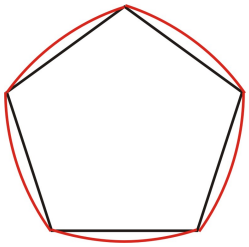

Figure 2: Reuleaux Pentagon

4 Area

The area of a reuleaux triangle is a little tricky to compute, as it is difficult to calculate the area of the curves along the inner triangles edge. However, a good approach is to look at the polygon as a bunch of sectors of a circle.

1. If the base of the inner triangle is 3cm, what is the area of the triangle (Hint: The area of an equilateral triangle is $s * \sqrt{3}/2$, where s is any side)
2. What is the area of the entire reuleaux polygon?

5 Real Life

Because of their unique shapes, reuleaux polygons are used in many modern-day products because of their useful characteristics that set them apart from ordinary polygons. First off, unlike a circle, a reuleaux polygon does not rotate around a single point. Due to this nature, they can be rotated inside a square. It is because of this characteristic that they are used in the Henry Watt square drill bit. Also, many pencils are beginning to be manufactured in the shape of a reuleaux triangle. Even guitar picks used by musicians around the world take the shape of a reuleaux triangle.

1. What advantages would a pencil shaped like a reuleaux triangle have?
2. Can you think of any other items that have a shape similar to a reuleaux polygon?
3. What other objects could benifit from modifying their shape in some way to resemble a reuleaux polygon?