



## ZOME TOOL at The Tulsa Girls' Math Circle

April 5, 2016

TULSA GIRLS'  
MATH CIRCLE

Zometools consist of balls and struts. The struts come in three colors: blue, yellow and red. Each color of strut comes in three lengths: short, medium, long. We use subscripts to indicate size. Thus  $b_1$  is a short blue and  $r_3$  is a long red.

### Getting familiar with ZomeTools

1. Take a zomeball and put in on the table so that it is resting on a pentagonal hole. It will also have a pentagonal hole facing straight up, since each hole is opposite another hole of the same shape. Think of the bottom and top pentagonal holes as south and north poles. Stick ten blue struts (any size) into the ten rectangular holes along the equator. They will all be horizontal, defining a flat "starburst" of ten equally spaced rays. QUESTION: With a pentagonal hole at the pole, what is the angle between consecutive equatorial struts?
2. Put a triangular hole at the pole, and make a starburst along the new equator. QUESTION: With a triangular hole at the pole, what is the angle between consecutive equatorial struts?
3. Now put a rectangular hole at the pole, and make a blue starburst along the new equator. QUESTION: With a rectangular hole at the pole, what is the angle between consecutive equatorial struts?
4. Maybe you'd like to make a table to record your results. Describe the pattern in the relationship between the number of rays in each starburst and the shape of the hole at the pole.
5. Using the angles you found in the above questions, you should be able to make regular  $n$ -gons for five different values of  $n$ . What are the values of  $n$ ?
6. Add to your chart relating the shape of the hole at the zomeball pole with the corresponding  $n$ .



7. A three-dimensional analog to the polygon is a prism. A *right prism* is shaped something like a drum, but with an  $n$ -gon (instead of a circle) for top and bottom and rectangles around the sides. Make a regular pentagon for a base (use any size of blue struts). Then place a red strut (any size, but all five the same) into the north pole of each of the five zomeballs. Top each red strut off with another zomeball, and connect them to make a second regular pentagon. Your pentagonal prism is a three-dimensional solid bounded by two pentagons and five rectangles. Count the number of edges (E), faces (F), and vertices (V). Does the Euler Characteristic hold?
8. Make a prism using a triangle, a square, a hexagon, and a decagon as base. Make one set per table. Count the edges (E), faces (F), and vertices (V). Record in your notebook.
9. For an  $n$ -gonal prism, write formulas that involve  $n$ : for the number of vertices, the number of edges and for the number of faces.