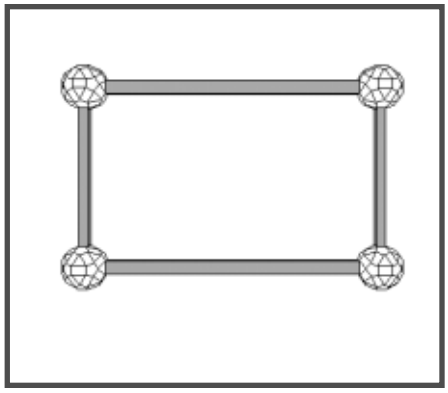
Zome System

Builds Genius!

Even and Odd Numbers

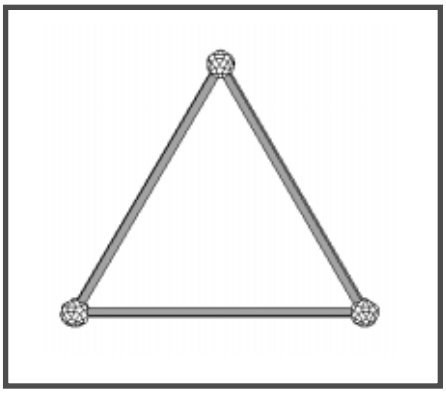
Mathematics
Basic Concept

Lesson Objective:
Students will learn the concept of even and odd numbers in relation to the rotational symmetry of 2-dimensional polygons. The concept of geometric projection will be introduced.



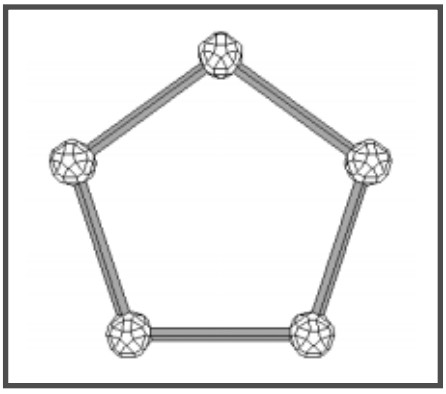
Time Needed:
One class period of 45-60 minutes.

Materials Needed:
- One or two Zome System Creator Kits for 30 students
- Overhead projector or blackboard



Procedure:
Divide your class into teams of 3 students each, and distribute the Zome System components evenly among the teams. Initiate a short discussion about the components. *Which shapes are the holes in the node? Are all the struts the same lengths? How do the 3 types of struts differ from each other?* Students will point out that the red and yellow struts are "twisted" while blue struts are "straight". *Why do you think this is so?*

Ask the teams to build the cross-sectional shapes of the struts based on their experience in the "Shape and Number" exploration. Team members should build the three shapes, Golden Rectangle, equilateral triangle, and regular pentagon. Encourage students to use shorter struts as they later will trace them in their math journals.



The next challenge is to find the center of those shapes using Zome System parts. The question may arise whether the central node must lie flat on the table with the other nodes. This is possible with the rectangle but not with the triangle or pentagon. When a student builds a possible solution, the teacher can place it on the overhead projector and ask if this solves the problem of find-

ing the center of the shape. *"How does the shadow 'project' the node to the center of the shape?"* Ask your students to lay their shapes flat on the table. Can they find a strut which they can insert in the central node so that it sticks straight up from the shape? As shown in "Shapes and Numbers," the cross-sectional shape of the central strut is the same as the shape on the table.

How would we go about finding the central point on a blank sheet of paper? The rectangle model and use of a ruler should help students find a simple solution. Now ask them to choose one of the 2 lines on the paper and call it the "center line," and place the model over the center point so that one of the "spokes" lines up with the center line. The teams should mark one of the struts with a piece of tape. Also ask them to trace the model onto the page. *How many sides of the rectangle are on one side of the center line?* They should record the number in their journals.

Challenge the teams to find a way to turn the shape half-way around while keeping the center node over the point in the center of the page, and then trace the result. Use a clock analogy to illustrate: at the top of the hour, the big hand points to 12; half-way around it points to 6. Students can write 12 at one end of the center line and 6 at the other and call the strut with the tape the "big hand." The teams should then repeat this process for the other two shapes on separate pages in their journals, and write down their observations.

Allow about 10 minutes at the end of the period to discuss their observations. Your students will have discovered that when turned half way around, the rectangle (number 2) lines up with itself while the triangle (number 3) and the pentagon (number 5) make "stars." The rectangle has 2 struts on one side of the center line while the triangle has 1.5 and the pentagon has 2.5. Students should conclude that odd numbered struts are twisted while the even numbered strut is straight.

An excellent extension challenge is to build a copy of the Zome System node. This larger model makes it easy to see how the triangular and pentagonal holes on opposite sides of the node are rotated relative to each other. The odd number struts need the twist so the nodes in a structure remain in the same orientation.

Assessment:

Review written work and drawings in math journals. Question students individually and in groups to ensure that they understand how the different shapes react to the 180° rotation. To meet the standard, students must complete the drawings of the rotated polygons. To exceed the standard they must conclude that odd numbered struts are twisted while the even numbered strut is straight.

Standards Addressed:

* Mathematics standards addressing number sense and numeration (NCTM Standard 6).
* Mathematics standards addressing geometry and spatial sense (NCTM Standard 9).

Transfer Possibilities:

Some students may discover that if you switch the central strut to the other side of the shape, you get a cool "spinner." This is a good introduction to the Spinners lesson plan, and may be used as a follow-up.