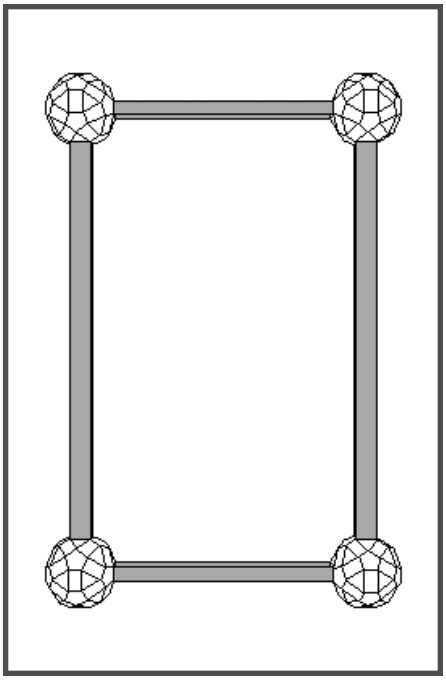
Mathematics Basic Concept

Lesson Objective:
Students will learn the relationship between the rectangle, triangle and pentagon and the numbers 2, 3 and 5, leading to a basic understanding of the relationship between shape and number. This concept is used extensively in Zome System lesson plans.

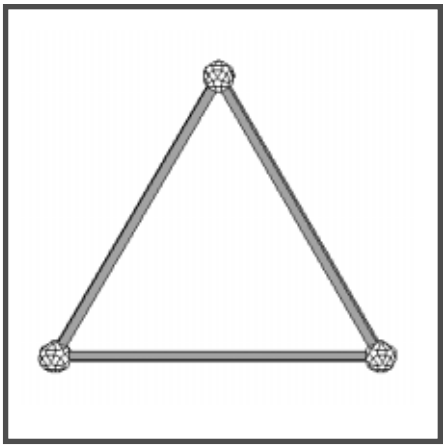


Prerequisite Skills:
Knowledge of basic polygons ("Geometric Shapes," and "Geometry is All Around Us").

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

Materials Needed:
- One Zome System Creator Kit for 25-30 students
- Overhead projector

Procedure:
Divide your class into teams of 4 students each, and distribute the Zome System pieces evenly. Allow the students to explore freely with Zome System for 10-15 minutes. They should discover all they can about the Zome System system, discuss their findings with other team members, and individually write them down in their math journals. Circulate among the teams and help them explore and articulate their discoveries.



After the exploration, lead a class discussion. W*hat did you discover about Zome System? What are the shapes of the holes in the nodes? How can we be sure that a shape is a rectangle as opposed to a square? Which strut fits in which hole?* After a few minutes of discussion the class will agree on the names of the three shapes.

The next challenge for the class is to build the rectangle, triangle and pentagon using Zome System. Each stu-

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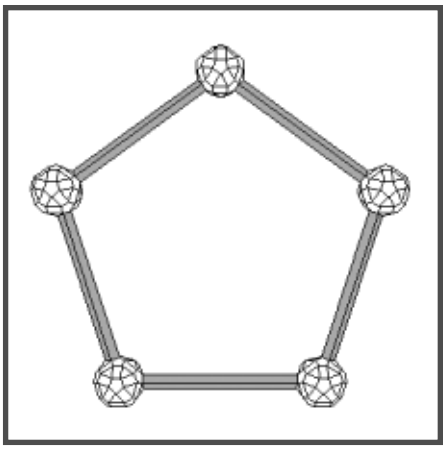
dent needs to build at least one of the 3 shapes: a Golden Rectangle, an equilateral triangle and an equilateral pentagon. Often these 3 shapes can be found embedded in structures built during the initial exploration. If necessary, help students make this connection, since it is generally more difficult to build the shapes in isolation. Students may attempt to build a triangle with the yellow struts or a pentagon with the red struts. This can result in interesting spirals, and students will discover Zome System's implicit rule: when it works, it works perfectly, but structures with struts bent, twisted or under tension are "illegal."

When a student or team completes a shape which they feel is the same as one of the holes in the node, place it on the overhead projector and ask for comments from the class. There will be general agreement if the shape matches; non-matches lead to discussion of squares vs. rectangles, isosceles vs. equilateral triangles, pentagons vs. hexagons, etc. Adjust vocabulary according to the age and experience level of the class; nomenclature is not as important as the concepts.



When all students have one of the 3 basic shapes, ask each to lay the shape flat on the table. Have them find a strut which fits into one of the holes in a node so that it stands perpendicular, or straight up from the table.

Discuss the relationship between the cross-sectional shape of the standing strut and the shape on the table (they are the same!) This feature of Zome System will help students begin discovering the relationship between shape and number. *What number might the rectangle represent? What number is the triangle? What number is the pentagon? How can we find out?* Have students count the number of points (nodes) and the number of lines (struts) in their shapes to formulate an answer. The students will quickly determine that the pentagon and the triangle are the number 5 and 3 respectively (5 identical lines, 5 nodes, 5 angles, 5 lines of symmetry). Many will feel that the rectangle is the number 4, since it has 4 points and 4 lines. In fact, it is more closely related to the number 2, i.e. it has 2 long struts, and 2 short struts, and only 2 lines

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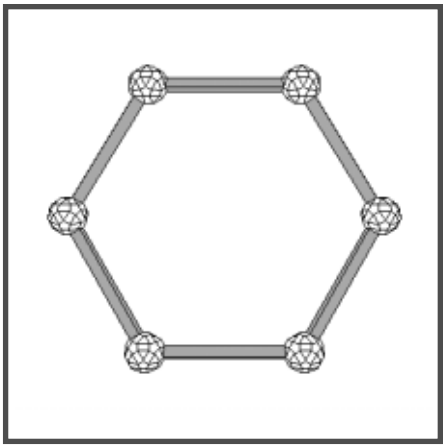
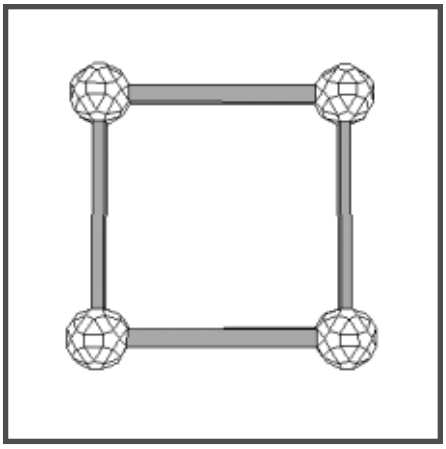
of symmetry. At this point, it is sufficient to offer the square as a "better" number 4 because all its lines are the same lengths, and ask if any other number would work for the rectangle.

Conclude the lesson with a discussion of the use of symbols. *Which symbol or sign better represents the concepts of 2, 3 and 5; i.e. the written number "3" or the triangle?*



Assessment:
Observe students while they work, and review notes in math journals. To meet the standard students must build the three basic polygons and understand how they relate to the numbers 2. 3, and 5.

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



Transfer Possibilities:
Exploration of symmetry concepts and number patterns in nature and the built environment ("What is Reflection Symmetry?" "Multiple Reflection Symmetry," "Rotational Symmetry," and "Fun Fibonacci"). Use of geometry to understand other mathematical concepts ("Odd and Even Numbers," and "Prime Factors").

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