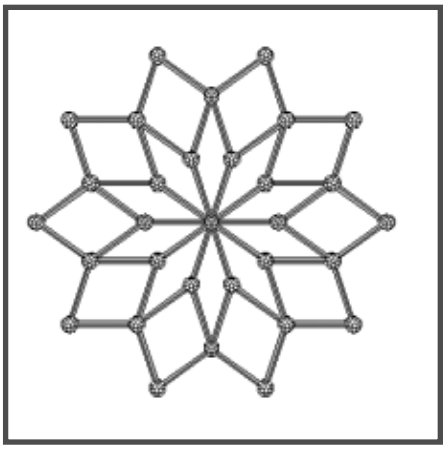
Zome System

*Builds Genius!*

# Plane Patterns

## Mathematics
## Intermediate Concept

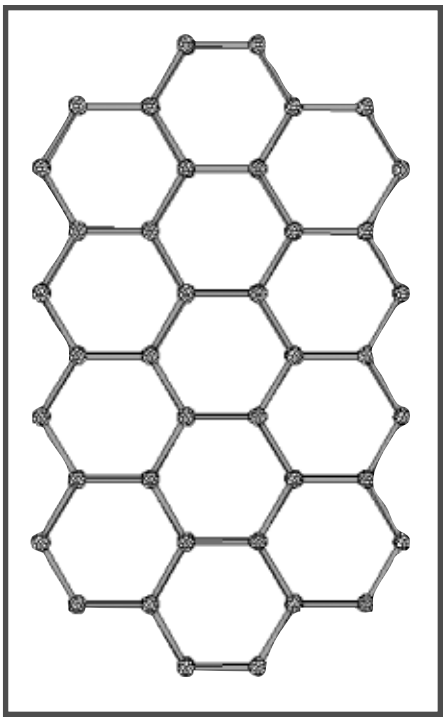
Lesson Objective:
Students will be introduced to 2-fold, 3-fold and 5-fold symmetry embedded in Zome System's blue, yellow and red planes, respectively.



Prerequisite Skills:
Familiarity with Zome System and the concept of planes. Students also need to have experience relating geometric shapes and symmetries to numbers ("Shape and Number," "Similar Triangles," "What is Reflection Symmetry?" "Multiple Reflection Symmetry," "Translational Symmetry in Tilings", and "3-D Triangles").

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

Materials Needed:
- Two Zome System Creator Kits for class of up to 32 students
- Overhead projector



Procedure:
Divide your class into teams of 4 students each and distribute Zome System components evenly among the teams. Challenge each team to build a "flat pattern" using Zome System. Explain that "flat" means all the nodes will touch the surface of the table the team is working around. This is a good opportunity to review the concept of a plane introduced in the "3-D Triangles" exploration. *Will any triangle built in Zome System lie flat on the table? What if another node is added to the triangular structure? Must all four nodes lie flat on the table? How many planes can pass through a triangle represented by a Zome System triangle? How many planes can pass through a line represented by a Zome System strut?*

*How many planes pass through a 3-D triangle?* You may also

wish to discuss the meaning of the word "pattern," using examples from around your classroom: ceiling tiles, wallpaper patterns, graph paper, a group of marbles in the bottom of a bowl, etc.

Allow 10-15 minutes for the initial exploration, during which time you can offer guidance to teams an individual basis. If any teams are having trouble getting started, suggest that they use one of the shapes they built during the "Shape and Number" exploration as a "seed" to start the pattern.

Patterns may be displayed with your overhead projector or hung with push-pins on a wall or chalkboard. Ask the teams if they can find a strut which fits into one of the holes in a node in their pattern so that it stands straight up (perpendicular) from the pattern, just as they did in the "Shape and Number " exploration. *How many different kinds of struts will stick straight up from a pattern* (All of the struts perpendicular to a given pattern will be the same color. In certain patterns, no strut will be perpendicular to the plane)*?* Hold a class discussion of the exploration. *How many different shapes of struts could stick straight up from a pattern? What does it mean means if no strut is perpendicular to the pattern? Are there parts missing from our Zome System kit? Is there a relationship between the pattern and the shape of the strut sticking up from the pattern?*

By the end of the period there will likely be consensus that the patterns perpendicular to the blue strut (in the blue plane) will exhibit symmetries related to the number 2, patterns perpendicular to the yellow strut (in the yellow plane) will exhibit symmetries related to the number 3, and patterns perpendicular to the red strut (in the red plane) will exhibit symmetries related to the number 5. Patterns without a perpendicular strut lie in the "green plane," which is perpendicular to the available green lines/struts which can be purchased separately from the regular Zome System kits. Student should write their conclusions in their math journals.

Assessment:

Review notes in math journals, and take notes of discussions. To meet the standard students must complete a 2-D pattern. They must also determine that all the nodes in the structure are rotated in the same direction, so only one strut can be perpendicular to the pattern. To exceed the standard they must draw the conclusion that the perpendicular strut defines the symmetry number in the pattern.

Standards Addressed:

* Mathematics standards addressing the study of the geometry of one, two, and three dimensions in a variety of situations (NCTM Standard 12).

Transfer Possibilities:

More advanced work on tilings in 2 and 3 dimensions ("Non-Periodic Tilings - I: Kepler's Tilings," "Non-Periodic Tilings - II: Richert-Penrose Tilings," "3-D Triangle Tiles," "Plato's Solids - I," "Plato's Solids - II," and "Bridge Building Unit").