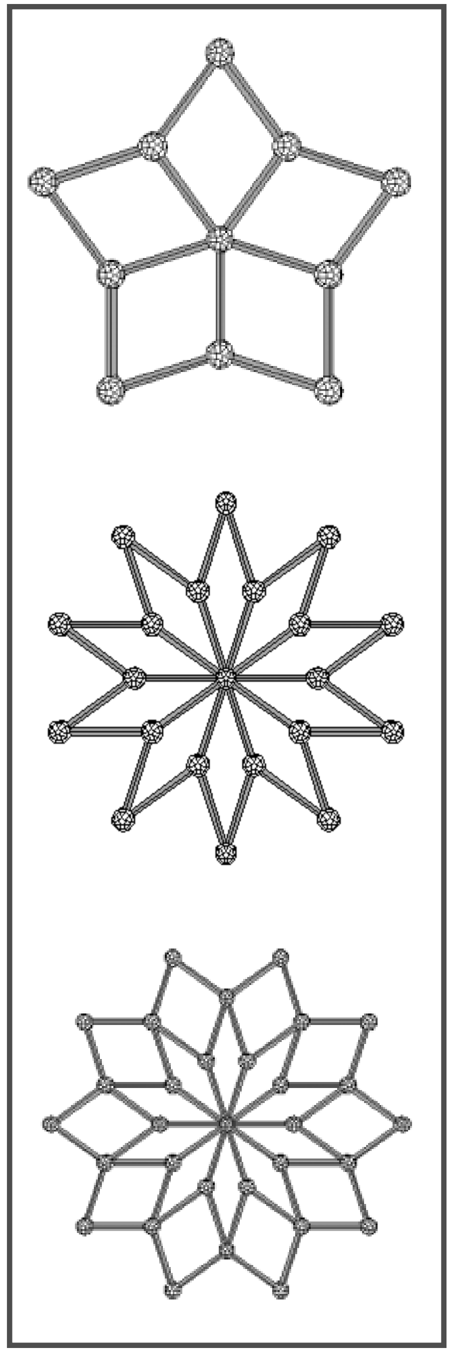
Zome System

Builds Genius!

Richert-Penrose Tilings

Mathematics
Intermediate Concept



Lesson Objective:
Students will discover Richert-Penrose tiles which can tile the plane non-periodically, without translational symmetry.

Prerequisite Skills:
Some previous work with tessellation ("Trying Tessellation," "What are Quadrilaterals" "Tiling with Quadrilaterals," and "Plane Patterns"). Basic understanding of symmetry concepts ("What is Reflection Symmetry?" "Multiple Reflection Symmetry," "Rotational Symmetry." and "Translational Symmetries in Tilings"). Knowledge of non-periodic tilings ("Kepler's Tilings").

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

Materials Needed:
• Two Zome System Creator Kits for 25-30 students

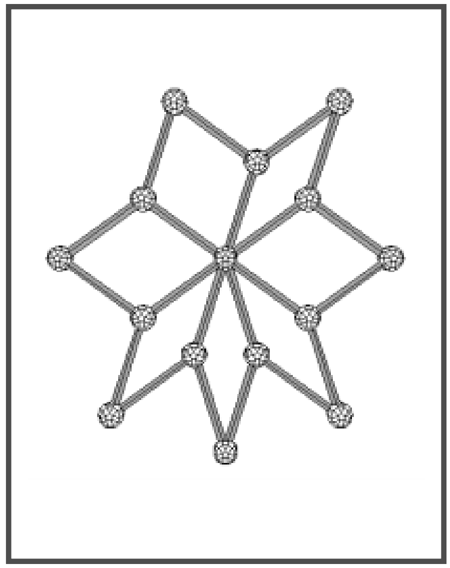
Procedure:
Divide the class into teams of 3-4 students, and distribute the Zome System pieces evenly. Each team should start by making a flat starburst of 5 blue struts of one length. This will form a starfish with arms 72° apart. *Can we make these V shapes into diamonds? How can we continue building outward in this manner? What would the pattern look like? Can we continue farther? What shapes do we have? Are they identical? What are the angles on each? What kind of symmetry does this pattern have? Is there a way to determine the angles without measuring?*

Next, have each team begin by filling in all ten holes on the equator of a node with the pentagon shape on top. *Can all of the Vs be made into diamonds? Can this be continued?*

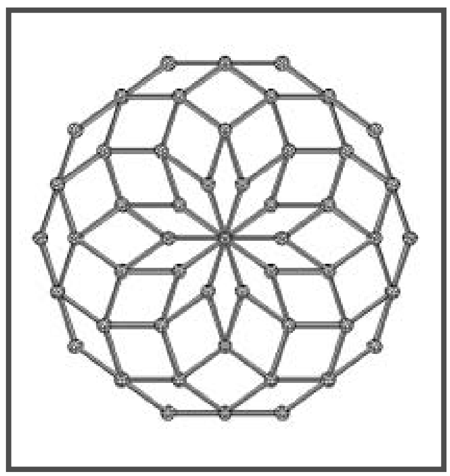
How far? How many shapes were needed? What kind of symmetry does this pattern have? Does this pattern have more than one kind of vertex? How many? How many distinctly different vertices can be created with these two diamonds. i.e. how many combinations of skinny and fat diamonds exist around a central node?

A typical random vertex is shown in the figure. *Can a tiling be made with no symmetry at all, completely random?* Conclude by exploring how many can be identified with the remaining time.

The properties of the tilings in this lesson were discovered independently by the American artist Clark Richert and by the British mathematician Roger Penrose in the late 1960s and early 1970s.



Assessment:
Study the tilings produced by the teams and review definitions in math journals. To meet the standard students must determine how many ways the skinny and fat diamond can combine around a central node. To exceed the standard they must be able to state whether a Richert-Penrose tiling is always non-periodic, or if it can be made periodic.



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 tilings in 3 dimensions (“3-D Triangles,” “3-D Triangle Tiles,” “Plato’s Solids - I,” and Plato’s Solids - II”).