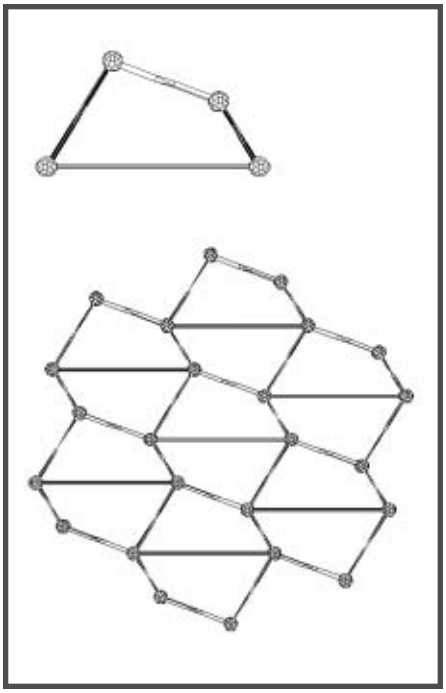
Zome System

Builds Genius!

Tilings with Quadrilaterals

Mathematics / Art
Basic Concept

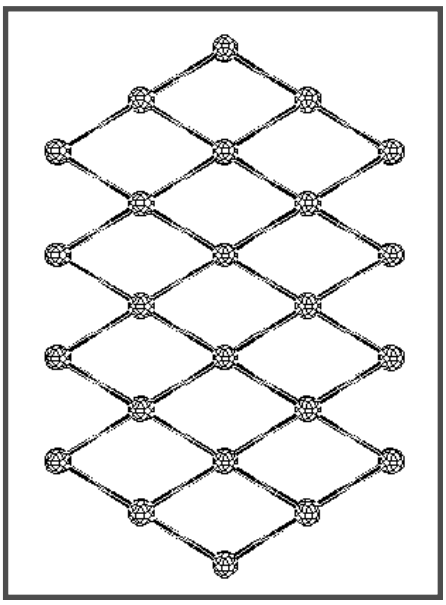


Lesson Objective:
Students will understand how any quadrilateral can periodically tile a plane out to infinity (indefinitely) without gaps. Students should try to determine how this is possible using a proof based on angles.

Prerequisite Skills:
Knowledge of basic polygons (”2-D Polygons,” “What are Quadrilaterals”).

Time Needed:
One or two class periods of 45-60 minutes

Materials Needed:
- Two Zome System Creator kits for 25-30 students
- One sheet of construction paper per team of 3-4 students
- One pair of scissors per team



Procedure:
Start with a brief discussion on the concept of tiling. *Where do we find tilings?Why is it used? Are there any artistic applications of tilings? Can we find examples of tiling in everyday life?* Review the various quadrilaterals the students defined in the “What are Quadrilaterals?” lesson. *What were the eight variations of quadrilaterals? Can any of the quadrilaterals be used to tile a plane? Which four sided shapes can tile and which can not? Are there four sided shapes that can tile more than one way?*

Divide the students into work teams and distribute the Zome System elements. Let each team choose one or two examples of the eight types of quadrilaterals. The challenge for each team is to determine whether their shape will tile or not, by building a tiling in Zome System. The

students should be allowed to build their tiling as large as they can in a 20 minute period. During this time, circulate and assist the students as necessary. *Does the shape need to be inverted or flipped over?*

After the tilings are built, ask the students what they found. *Were there any four sided shapes that would not create a tiling? How can we show that any four sided figure will tile?* One way to experimentally show this is to fold a sheet of paper several times so that it becomes several sheets thick. Cut from this stack a random quadrilateral. This will produce several quadrilaterals from four cuts. Playing with the tiles, the students will quickly see how any quadrilateral will tile. This can also show how all four angles of any quadrilateral will always add up to 360°.

The tilings can be saved for the "Symmetries in Quadrilateral Tilings" lesson.

Assessment:

Observe and listen to students as they build their structures. Review notes in math journals. To meet the standard students must create a tiling of quadrilaterals in one plane without gaps. To exceed the standard they must write a definition that relates the tiling properties of quadrilaterals to their combined angles of 360°.

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 work with tilings ("Symmetries in Quadrilateral Tilings," and "Non-Periodic Tilings-II: Richert-Penrose Tilings").