

### Mathematics Intermediate Concept

#### Lesson Objective:

Students will analyze the symmetries of quadrilateral tilings. They will discover how various types of symmetries, used alone or in combination, can generate the same pattern more than one way.

#### 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”).

#### Time Needed:

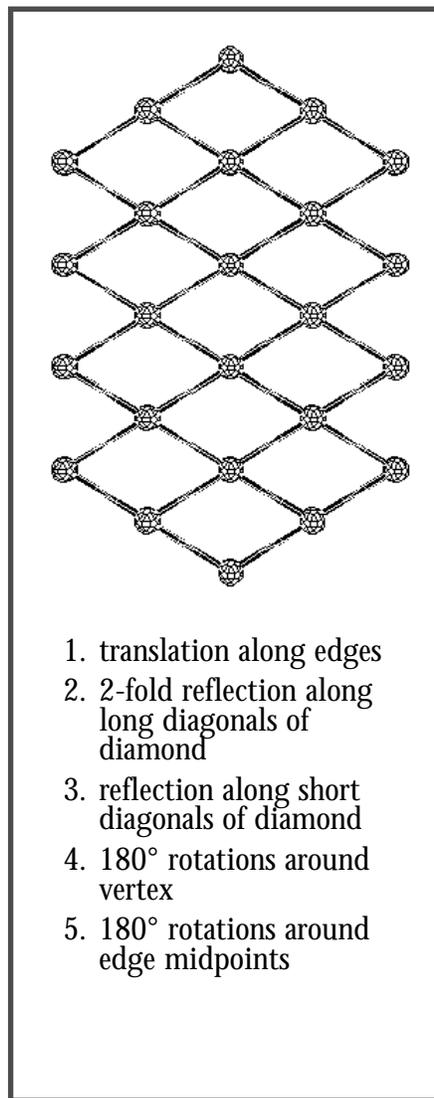
One class period of 45-60 minutes.

#### Materials Needed:

- Two Zome System Creator Kits for a class of 25-30 students
- Tilings from “Tilings with Quadrilaterals?” lesson

#### Procedure:

Review with the students the basic types of **symmetry**; **translation**, **reflection**, and **rotation**. Regroup students into their teams from the “Tilings with Quadrilateral” lesson, and return their tilings, or trade among teams. Challenge the students to determine in their groups how many different ways they can generate the tiling, identically to the original, using the various forms of symmetry they have learned. *Can the patterns be generated with a combination of symmetries? How many forms of symmetry can be used?* Allow 10-15 minutes for the teams to discuss their solutions and possibilities. Ask each team to explain their



# Symmetries in Quadrilateral Tilings

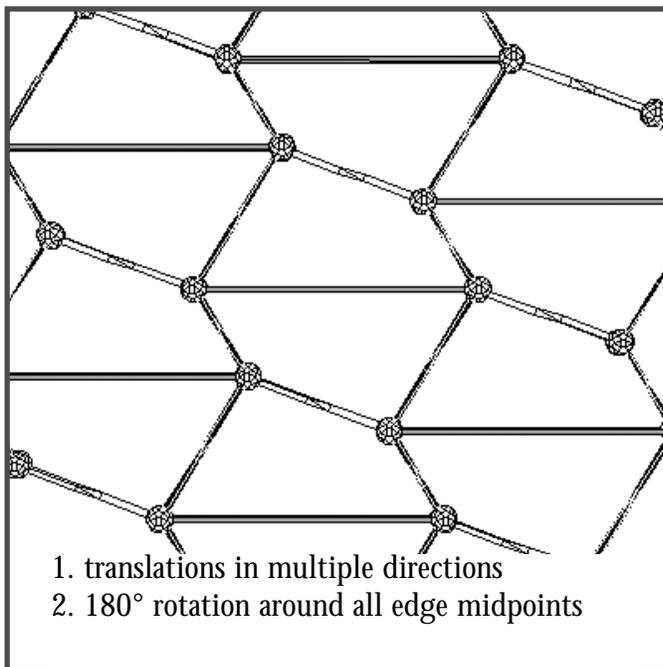
solutions to the rest of the class, using an individual tile to demonstrate how each form of symmetry can translate the tile to anywhere in the overall pattern. List the different types of symmetry on the board as they are discussed. Examples of various types of quadrilaterals are shown here along with an analysis of their respective symmetries.

## 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 two and three dimensions ("Non-Periodic Tilings-I: Kepler's Tilings," "Non-Periodic Tilings-II: Richert-Penrose Tilings," "3-D Triangles," "3-D Triangle Tiles," "Plato's Solids - I," and "Plato's Solids - II").



# Zome System

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