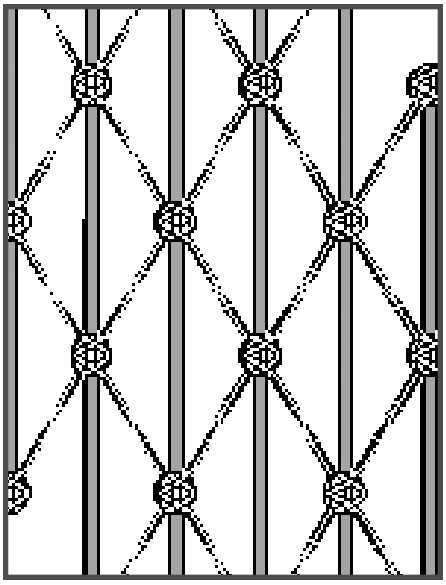
Zome System

Builds Genius!

Triangle Tiles - II

Mathematics / Art
Intermediate Concept

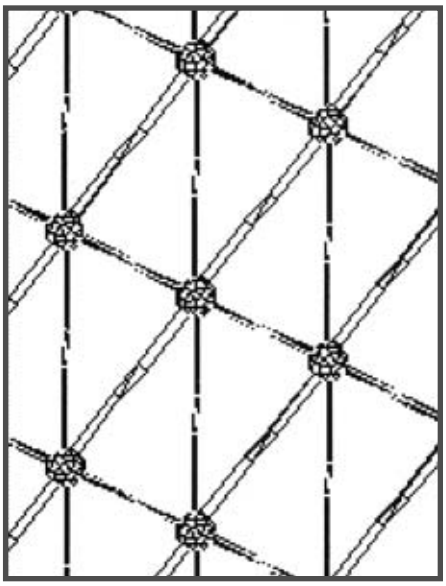


Lesson Objective:
Students will learn the concept of 2-dimensional translational symmetry by manipulating a flat grid structure in relation to a full-sized image, produced using sunlight.

Prerequisite Skills:
Familiarity with tessellations/tilings ("Trying Tessellation," "Plane Patterns," and "Triangle Tiles 1"). Previous work on symmetry concepts ("What is Reflection Symmetry?," "Multiple Reflection Symmetry," and "Rotational Symmetry")

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

Materials Needed:
- Two Zome System Creator Kits for class of 25-30 students
- One 9"x12" sheet of blueprint paper per team of 3 students (see "Resources" section)
- One piece of 12"x 15" cardboard per team, to cast shadows upon
- One cardboard box per team, large enough to fit over Zome System model and sheet of blueprint paper
- Household ammonia solution
- One 9x12 plastic tub or cake pan (not aluminum)
- Masking tape



Procedure:
Prepare the supplies needed by following the instructions in the "Resources" document. The required ammonia solution can be harmful, the "Caution" and "First Aid" notices should be taken very seriously. Cut the large sheets of blueprint paper into 9"x12" sections.

Since students will be working with a photosensitive material, the work area should be set up in an area out of

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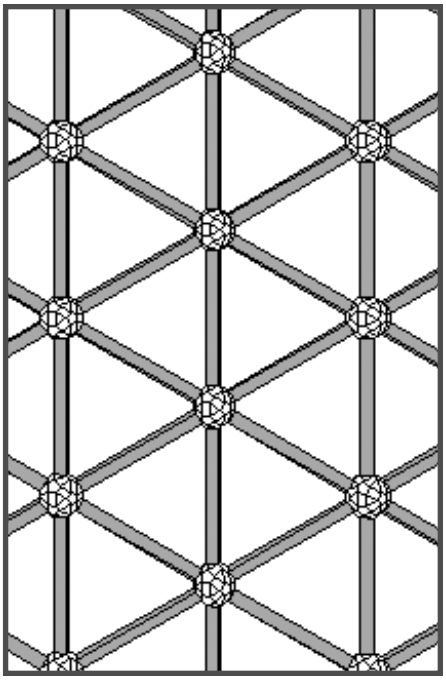
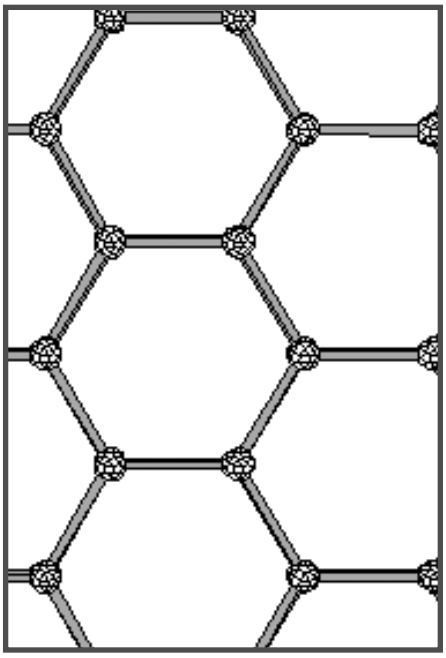
direct sunlight. The paper will be exposed by direct sunlight in a few seconds, fluorescent light in less than an hour, incandescent light will take several hours.

The first task for your students will use the triangular flat grid structures they built in the "Triangle Tiles 1" class, is to make a full size "photo" of their finished pattern. Distribute the grids and a sheet of blueprint paper to each team. The teams should mount blueprint paper on cardboard, and attach their grids on top. The assemblies should be brought outdoors and placed on a flat, level surface when the sun is relatively high in the sky. Place weights on the corners of the paper to keep it from blowing away. While the "photos" are being exposed, discuss what is happening. *Why does the sun need to be high in the sky? Why does the paper & model assembly need to be flat and level? What is happening to the paper while we wait?* When the time is up, the teams should bring their assemblies back inside. Lay the paper flat on the table and the model flat on the paper so it lines up exactly with its image.



The second task for the teams is to find out how many directions they can move their model from its central position so that it lines up with its image again. Ask teams to discuss their findings and write their conclusions in their math journals. Follow up with a class discussion of the exploration. *How many directions can you move the pattern so that it lines up with it's image again? Why? Did one team find more directions than another? Why, or why not? Do the patterns line up with their images if you move them by just one triangle? Two triangles? Three triangles? More? Can these kinds of patterns go on forever?*



A motif that can be shifted and repeated has translational symmetry. The resulting pattern is periodic, in that it is created by infinite repetition of the same motif. Ask students to identify examples of translational symmetry from the classroom or elsewhere (bricks, ceiling tiles, border decorations in books, parking meters in a row, soldiers standing in formation, etc.)

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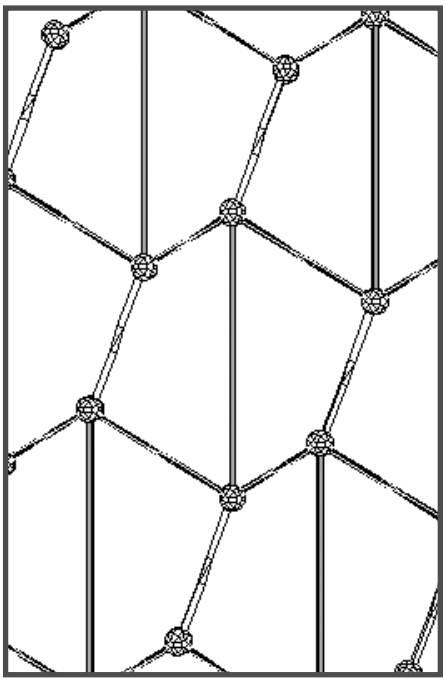

Assessment:
Question students while they are experimenting, and review their math journals. To meet the standard students must find the number of directions their pattern repeat in. To exceed the standard they must how the pattern is periodic and connect this type of symmetry to other occurrences of translation symmetry.

Standards Addressed:
* Fine Arts standards that identify and apply the elements of art in a variety of media.
* Mathematics standards addressing mathematics as a means of communications (NCTM Standard 2).
* Mathematics standards addressing the study of the geometry of one, two, and three dimensions in a variety of situations (NCTM Standard 12).

Transfer Possibilities:
Work on advanced tilings ("Non-Periodic Tilings-I: Kepler's Tilings," and "Non-Periodic Tilings-II: Richert-Penrose Tilings"). Also valuable before working on projection modeling ("Cubes - I," "Cubes - II," "Cubes - III," and "Cubes - IV").