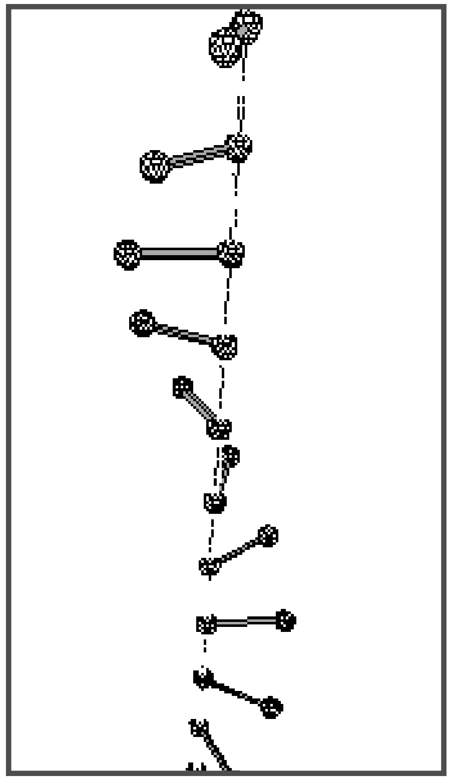
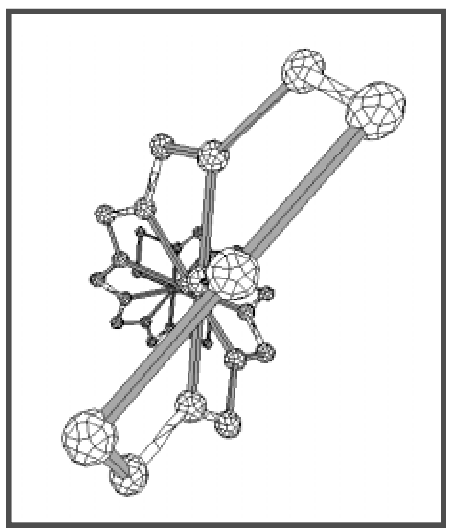
Spiral Symmetry

Zome System

Builds Genius!

Mathematics
Intermediate Concept





Lesson Objective:
Students will learn how combinations of rotation symmetry and translation symmetry can generate spiral symmetry in 3 dimensions.

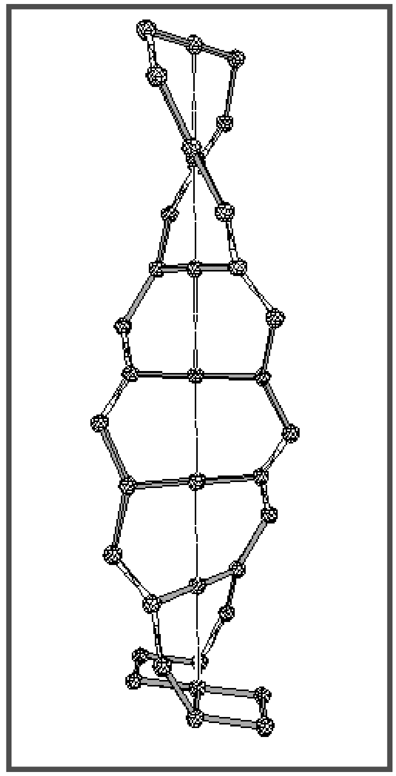
Prerequisite Skills:
Ability to differentiate between different types of symmetry (“What is Reflection Symmetry,” “Multiple Reflection Symmetry,” “Rotational Symmetry,” “Translational Symmetries in Tilings,” “Tilings with Multiple Symmetries,” “Plane Patterns,” “Triangle Tiles - I,” and “Triangle Tiles - II”).

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

Materials Needed:
- Two Zome System Creator Kits for class of 25-30 students
- Objects, or pictures of objects, displaying spiral shapes.

Procedure:
Prepare for the class by building a Zome System spiral consisting of 10 short red struts in a line. On each node in the line put a short blue strut at right angles to the line. Each successive blue strut in the line should be rotated 36° relative to the previous blue strut. This will generate a spiral shape around the red line. The bottom node can have 5 equally spaced blue struts to form a base.

Inform the class that they are going to continue their exploration of symmetry concepts. Show them the model of the spiral described above, and initiate a short discussion about it. *What is the name of this type of shape* (spiral)*? Where do we encounter this shape in nature? How about in architecture, advertising, or other man-made objects?* Examples



can include a DNA molecule, a water vortex (whirlpools), curved animal horns, sea shells, climbing vines, spiral staircases, candy canes, barber poles, metal springs, slinkys, wood screws, and so on. If available, let students study some objects, or images of objects, with spiral shapes. *Why do spirals occur in nature? Why are they useful to us. Why would we choose to build a spiral, as opposed to a regular, staircase? Why does a wood screw have a spiral pattern?*

Divide the class into teams of 3-4 students, and distribute the Zome System pieces evenly. Their first task is to either build a copy of your model, or design a spiral model of their own. While they build they should discuss what kind, or kinds, of symmetry, if any, the spiral has. They must make notes of their discoveries. Allow 15-20 minutes for this segment. Circulate and assist as necessary.

The teams should present their models to the rest of the class. *What kind(s) of symmetry can they find in the model? Can they have a combination of more then one type of symmetry?* List ideas on the board. Discuss the list until the students realize that both translation and rotation symmetries are needed to generate the spiral symmetry in their models. For instance, in the demonstration model, each new position on the spiral is generated by a translation along one short red strut, followed by a rotation of 36° around the axis. Contrast this combination of symmetries with those that can be found in tilings (“Tilings and Multiple Symmetries”).

Close the class by asking each student to give a written definition of spiral symmetry. Their report should show how the symmetries are displayed by the model they built during the class.

Assessment:

Observe the teams while they experiment, and review notes in their math journals. To meet the standard the students must design a spiral model, and show that is symmetrical. To exceed the standard they must write an accurate definition of the spiral symmetry in their model.

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:

Further explorations of symmetry and spirals in 2 and 3 dimensions (“Finding Tau”). Discussion of the use of spirals in architecture, design, engineering, biology, etc.