

Connecting Origami Skills with Mathematical Tools

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In this presentation we will describe and discuss a two-week origami workshop that we designed and have taught for the past 20 years as part of the SummerMath program at Mount Holyoke College. SummerMath is a month-long residential program for high school girls of all backgrounds and is devoted to helping girls develop confidence and find interesting connections with mathematics. While our students are academically capable, mathematics is often their least favorite subject and has no attraction beyond earning a good grade. Our curriculum allows students to concretely experience mathematical ideas that they have previously encountered only abstractly. The beauty of the paper and the objects that are constructed provide motivation to work through challenging and difficult projects

Our origami workshop is designed to develop and deepen:

- patience, confidence, and strategies for frustration tolerance
- the ability to see, interpret, and independently follow two-dimensional illustrations and directions (e.g., instructions on paper) to make 3-dimensional origami models, such as modular triangular and hexagonal boxes, and modular polyhedra
- the ability to learn, analyze, and use characteristics (edges, faces, vertices, symmetries) of polyhedra to construct and color modular origami polyhedra. For instance, if the model is a cube or other hexahedron, the student must learn how its edges are oriented in 3 dimensions and how many edges meet at a vertex. This information is then used to interpret the directions about tab/pocket connections of the folded pieces and how the specified number of pieces fit on the model.
- the understanding that mathematics is not always cold and distant and that mathematics and beautiful objects are often related
- flexibility in learning new material presented from different perspectives.

As the workshop progresses, we offer a more analytical approach where students are given written directions for a model, which they must interpret. The teacher's role becomes one of questioner, particularly about geometric aspects of the diagrams. Students must peruse the directions in detail, matching the emerging folded piece to the diagrams. They must develop and use geometric knowledge (as described above) to bring the unit into 3 dimensions and to interweave units. Students use mathematical information presented earlier, and they articulate this knowledge as they construct models. Students also have the opportunity to pick out a model made by one of the teachers and construct it themselves. This project requires the student to first analyze the model's geometric (and often color) properties (i.e., how many vertices, faces, and edges are there and how this translates into number of units required). Then the student must figure out how to fold a unit, either by reverse engineering or finding instructions for making the units and fitting them together.

The specific projects (including ways that origami skills and mathematical knowledge are connected), timeline, and outcomes of our workshop will be detailed during the presentation.