

This is a summary of my work on mathematical art, some completed with help from the funds provided by the *University Services Summer Grant*. I was awarded the grant with the primary purpose being the continued development of a course that synthesizes mathematics with visual art, MATH 326.

Lessons Developed

With money from the grant, I hired two Cal Poly students, Jen Nemecek and Nicole Silkton. Under my direction, these students developed four complete teaching units on (1) constructions and symmetries of regular polygons, (2) paper snowflakes and symmetry, (3) counting and pattern designs, and (4) one- and two-point perspective. I have developed other units on cyclic groups, dihedral groups, border and wallpaper patterns. Each unit includes lectures, class activities, homework tasks, quiz and test items, and examples from historic and/or contemporary art. Also, each unit identifies relevant items from the *California Frameworks* for teaching mathematics and the arts.

Dissemination

Teaching Mathematics and Visual Art at Cal Poly

The primary area for dissemination of this work will be in the offering of the course for up to 20 students every Spring quarter. In Spring 2005, 19 students attended the course, including one lecturer. This year, 2006, 17 students are enrolled and attending. I was awarded money for release time to develop the course and purchase art supplies including a color printer so that I may easily show my students numerous examples of mathematic art during lectures.

I have supervised four senior projects on topics related to mathematical art.

Professional Meetings and Professional Development Institutes for Teachers

The grant provided me with money to attend and present at one conference. I have presented at least ten talks and workshops on mathematical art at regional, national, and international meetings. The topics of these talks include quilts, Cayley (multiplication) tables, dahlia tilings, square tilings, origami and regular polygons, symmetries of a border and wallpaper patterns, symmetries of beaded beads, and Celtic knots. Over 100 mathematicians attended my last talk in January.

Publications

I have had six papers published or accepted for publication on mathematical artwork, one of which was coauthored with a Cal Poly student. I have had an additional five articles accepted for publication in nationally known craft magazines, some with readerships of over 100,000 subscribers. Included in these publications are two covers.

Art Exhibits

I have shown my mathematical artwork at four mathematical venues including regional and national meetings. Three of my mathematical quilts are currently hanging at the Mathematical Sciences Research Institute at UC Berkeley.

MATH 326: Outline of Course Content

Unit 1: Regular Polygon Construction

- 1: Introduction to Regular Polygons
- 2: Regular (Equilateral) Triangles
- 3: Squares (Regular Quadrilaterals)
- 4: Regular Pentagons
- 5: Regular Hexagons and Heptagons
- 6: Regular Octagons
- 7: Cyclic Groups, Dihedral Groups and Paper Snowflakes
- 8: The Color Wheel
- 9: Review & Discuss Project
- 10, 11: Dahlia Tilings

Unit 2: Infinite Symmetry Groups

- 19: Defining the 4 Planar Isometries
- 20: Properties of the 4 Isometries
- 21: Introduction to the 7 Border Patterns
- 22: Matching Border Patterns
- 23-26: The 17 Wallpaper Patterns
- 27: Matching Wallpaper Patterns

Unit 3: Tilings of the Plane

- 28, 29: The Regular and Semiregular Tilings of the Plane
- 30, 31: M. C. Escher Tilings
- 32: Quasi-periodic Tilings of the Plane

Unit 4: Origami and Paper Art

- 33: Introduction to Origami & Tangrams
- 34: A Few Classic Folds
- 35: Unit Origami
- 36: Slide Together: George Hart
- 37: Popup Books and Infinite Series
- 38: Final Projects Due: Classroom Critique

Future Projects

I have been solicited by a publisher to submit a proposal for a mathematical art textbook due in July. I plan to write this textbook with my coauthor, Blake Mellor, who teaches a similar course on symmetry at Loyola Marymount University.

To assess what my students learn from this course, I will conduct a study of the effects of my course on students' spatial reasoning skills. To this end, I worked with a senior project student to write a review of the literature on the assessment of spatial reasoning skills at they relate to mathematical artwork.