Creating and Exploring Symmetry
Frank Farris and Steve Kennedy

This comps project is rooted in the research of Professor Frank Farris who will be the Benedict Distinguished Visiting Professor of Mathematics in our department next fall. Professor Farris has written a series of papers exploring geometric symmetry from a viewpoint different from, and richer than, the classical one. That is, the classical definition of symmetry of, for example, a parametric curve considers the curve as a set of points. Farris considers the curve as the graph of a function and asks, What is it about this function that gives rise to the symmetry we see in its graph? Changing our point of view in this subtle way leads to extremely rich insight into ways to construct symmetric parametric curves. Generalizing this insight to maps from $\mathbb{R}^2$ to $\mathbb{R}$ leads to wonderfully symmetric two-dimensional patterns. These are traditionally known as *wallpaper patterns* and it is well known (to folks who well know such things) that there are seventeen different varieties of such patterns. Farris’s construction, however, gives him the ability to continuously modify his wallpaper pattern, while preserving the symmetry, thus leading to what he calls *vibrating wallpaper*. A further generalization moves his symmetry-making machinery into the hyperbolic plane and leads to the classification of wallpaper patterns in hyperbolic space.

Professor Farris will teach a course, Math 395 Creating Symmetry, in fall next year explaining all these ideas. At the conclusion of this course he will present several different ideas for extending his ideas and constructions. Students in this project will, during winter term, explore those extensions in small groups. Early in spring term we will have a special comps symposium to present their results. Participation in this project requires registration in Math 395 Creating Symmetry in Fall term and Math 395 Exploring Symmetry in Winter term. These courses will count towards the math major in the geometry-topology category. Finally in spring term students will register three credits of Math 400 for arranging the oral and written products of the winter term research.