ROWAN UNIVERSITY
Department of Mathematics

Syllabus

Math 03.305 PATTERNS IN NATURE I: VISUAL GEOMETRY

Catalog Description

Math 03.305 Patterns in Nature I: VISUAL GEOMETRY

(Prerequisites: Math 01.102, Math 02.260,0401.105,1, CHEM-05.102 and PHYS-02.150)
(Prerequisites: Introduction to Programming, Statistics, Principles of Biology, Chemistry of

Everyday Life, Physics of Everyday Life

This course for students in the math/sciences track of the Liberal Studies major illustrates the connections between geometry and the natural sciences, using computers, manipulatives, and hands-on models. Concepts covered include properties of two- and three-dimensional shapes, transformations, dimension, and non-Euclidean geometries.

OBJECTIVES

This course for students in the Math/Science track of the Liberal Studies major provides students with a thorough understanding of geometry and its connections to the natural sciences by using a variety of experiential teaching methods. The course focuses upon recent developments in geometry as well as fundamental concepts. Teaching methods stress a visual approach to understanding concepts, making conjectures, and justifying reasoning. Students use a variety of materials, from construction paper and pipecleaners to videotapes and computer sketching programs. Some proof is included but not emphasized. Students are also expected to read and analyze journal articles (e.g., Journal of Recreational Mathematics, Scientific American, World Wide Web sites) independently. Students completing this course will be able to:

- use a variety of tools, physical models, and appropriate technology to demonstrate an understanding of

geometric concepts and relationships and their use in describing the natural world;

- describe properties and relationships of shape, size, and symmetry in two- and three-dimensional space;

- use rotations, reflections, and translations in two- and three-dimensional space;

- present oral and written arguments to justify conjectures and generalizations based on explorations;

- describe the historical development of Euclidean and non-Euclidean geometries;

- read, understand, and summarize journal articles in geometry.

CONTENT

1. Shape
    a. Polygons
    b. Circles
        i. Robot arms
    c. Plane curves (e.g., cardioids and conic sections)
    d. Three-dimensional solids
    e. Connections to biology; patterns in nature
    f. Rigidity of structures

2. Transformations
    a. Rigid transformations - reflections, rotations, translations
    b. Symmetry
        i. Connections to biology
        ii. Crystallography
    c. Tessellations
    d. Similarity (scaling) transformations
    e. Circle-preserving transformations (inversions)

3. Dimension
    a. Measurement - perimeter, area, volume, surface area, star distances
    b. Spatial visualization
    c. Polyhedra
    d. Isometric drawings and perspective views
    e. Fractals and chaos - examples from the sciences
    f. Higher dimensions
    g. Cartography

3. Non-Euclidean Geometries
    a. Finite geometries
        i. Block designs
        ii. Applications to statistics and error-correcting codes
    b. Hyperbolic geometries (e.g., Poincare universe)
    c. Spherical geometry
    d. Relativity and the universe
    e. Historical development

SUGGESTED TEXT:

Caldwell, Janet H. Visual Geometry. Rowan University, 1999.

Readings from journals, chapters from books, and information from the World Wide Web.