MCS-115 Project

Rationale: A great way to really understand mathematics is to learn and discover it on your own. You will select a mathematical topic outside of those discussed in class, read and teach yourself any necessary background to understand it and then investigate the topic. You are strongly encouraged to work together in groups of two. By working together, you can learn from each other and share the experience. Please get permission from your instructor if you have a compelling reason not to work in a group of two.

Possible topics:

- Secret Codes (§2.5 in text)-this topic is challenging.
- Irrational numbers (§2.6 in text)
- Real numbers (§2.7 in text)
- Infinity in Geometric Objects (§3.5 in text)
- Art Gallery problem (§4.2 in text)
- Symmetry, Frieze patterns or Penrose tilings (§4.4 in text)
- Non-Euclidean Geometry (§4.6 in text)
- Knots and Links (§5.4 in text)
- Fixed points and why there are places on opposite sides of earth with same temperature (§5.5 in text)
- Julia and Mandelbrot sets (§6.4 in text)
- Fractal dimension (§6.6 in text)
- Probability and expected value (§7.4, §7.5 in text)
- Other types of number systems–Mayan, Babylonian, etc. including non-base 10 systems
- Other calendar systems -Julian vs. Gregorian, Jewish and Islamic, Mayan, etc. -conversions to our system
- The role of the Platonic Solids in Plato's philosophy
- The Archimedean (or semiregular) solids
- the regular star polyhedra (Kepler-Poinsot polyhedra)
- The artwork of Escher and geometry (symmetry §4.4, hyperbolic geometry §4.6)
- the Alhambra and other use of symmetric patterns in Islamic art
- Other topics relating math and art or architecture.
- mathematics of musical scales (equal temperament vs. just temperament, etc.)
- symmetry in J.S. Bach's *Musical Offering* or other musical works

- Juggling patterns
- Report on a topic in one of the following books (available in the library):
  - *Innumeracy* by John Allen Paulos (about mathematical illiteracy and its consequences)
  - *Godel, Escher, Bach: an eternal golden braid* by Douglas Hofstadter
  - *What is Mathematics?* by Courant and Robbins
  - *The Mathematical Experience* by Phillip Davis, et. al.
  - *The Shape of Space* by Jeffrey Weeks
  - *The Knot Book* by Colin Adams
- Read and report on mathematics in the Tom Stoppard play *Arcadia*, or another play with mathematical themes.
- Voting Theory
- Fair division (how to cut a cake so everyone is happy)
- Euler circuits (and mail delivery or snow removal)
- Other topics are welcome, but you should run it by me first.

What is Expected: You and your partner will write a three to four page report (double spaced, typed) and create a poster describing the new mathematics that you learned. You may want to include examples. Be careful not to rewrite what you read. You need to write what you learned in your own language, and write in a self-contained way. If you are exploring a topic in the text, you may want to explore some of the homework problems, and possibly write up their solutions in your report. In addition to your report, you should include a brief personal statement (about a paragraph) from each author, indicating how the author felt during the project (frustration, triumph, indifference, etc.). No mathematical content is necessary for the personal statements.

Timeline:

Due 11/16/04: A written description of the topic you have chosen and the names of the members of the team. This can be a paragraph or even a couple of sentences. (5%)

Due 12/10/04: Final version of paper including personal statements. (50%)

Due 12/13/04: Poster (in class). (45%)