Syllabus for MA 241
Geometry for Middle School Teachers
(For Elementary and Middle School Majors ONLY)
Fall 2002

Course: MA 241, MW 10:00–10:50, CB 63 (Mathskeller) (NOTE CHANGE OF ROOM).

Instructor: Carl Lee

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Office Hours: MWF 11:00–11:50 in the Mathskeller, and by appointment.

Prerequisites: One semester of calculus (MA123 or MA113).

Text:

- Shapes and Designs
- Covering and Surrounding
- Ruins of Montarek
- Stretching and Shrinking
- Filling and Wrapping
- Looking for Pythagoras
- Kaleidoscopes, Hubcaps, and Mirrors
- CliffsQuickReview Geometry

All but the last book are student editions of the Connected Mathematics middle school curriculum.

Calculator: A graphing calculator will sometimes be helpful.

Grading:

Homework and Quizzes	50%
Exams	30%
Final Exam	20%

A	90–100%
B	80–89%
C	70–79%
D	60–69%
E	0–59%

The University of Kentucky *Bulletin* explains: Grade A represents exceptionally high achievement as a result of aptitude, effort, and intellectual initiative. Grade B represents a high achievement as a result of ability and effort. Grade C represents satisfactory achievement. Grade D represents unsatisfactory achievement and is the minimum grade for which credit is given. Grade E represents unsatisfactory performance and indicates failure in the course.

Homework and Quizzes: Homework will be assigned on a regular schedule (usually weekly). Late homework will not be accepted (unless it is the result of an officially excused absence). There will be occasional, possibly unannounced, quizzes, during the semester. Missed quizzes may not be made up (unless this is the result of an officially excused absence).

Exams: There will be two or three exams during the semester, dates to be determined.

Final Exam: Friday, December 20, 10:30–12:30 pm, in our regular room.

Working Together: It is ok to work together on homework. However, when it comes time for you to write up the solutions, I expect you to do this on your own, and it would be best for your own understanding if you put aside your notes from the discussions with your

classmates and wrote up the solutions entirely from scratch. Working together on exams, of course, is expressly forbidden.

Absences: A University excuse from a scheduled class activity such as an exam must be presented in writing no later than two weeks prior to the date of the absence. An absence due to illness or family emergency may be excused, provided that you can supply acceptable written evidence if required, and that you notify me *as soon as possible*. Notification is almost always possible immediately upon occurrence of an emergency. If you're too sick to telephone, you can get a friend to do it. Failure to make such timely notification may result in denial of your request. For an explanation of valid excused absences, refer to U.K.'s *Student Rights and Responsibilities*, http://www.uky.edu/StudentAffairs/Code/part2.html.

Cheating: The University's *minimum penalty* for cheating or plagiarism is *a failure in the course*. Cheating or plagiarism can lead to expulsion from the university. See *Student Rights and Responsibilities* for information on cheating, plagiarism, and penalties, http://www.uky.edu/StudentAffairs/Code/part2.html. . It's not worth it, so don't do it.

Expectations: I expect that everyone will maintain a classroom conducive to learning. I like an informal atmosphere, but it must be orderly. Thus, everyone is expected to behave with basic politeness, civility, and respect for others. In particular, talking in class is ok if it's part of a class discussion or directed to me. Private communications are not, especially during quizzes and tests. Neither are reading extraneous materials, using electronic equipment, or sleeping.

Suggestions: Suggestions for improvement are welcome at any time. Any concern about the course should be brought first to my attention. Further recourse is available through the offices of the Department Ombud and the Department Chair, both accessible from the Main Office in 715 Patterson Office Tower.

Course Content

The following description comes from the original proposal for this course, and reflects the approach I will attempt to take this semester.

Overview: Kentucky's teacher education institutions lack a course in geometry and measurement specifically designed to provide prospective middle school teachers with the mathematics background required in these areas to teach by state and national standards. The proposed course will be designed to increase the depth of the students' understanding in (a) the geometry and measurement standards identified in the *Kentucky Mathematics Core Content for Assessment for Grade 8* and in the *Kentucky Program of Studies for Grades 6-12*, and (b) the Geometry and Measurement Standards of the *NCTM (2000) Principles and Standards for School Mathematics, Grades 6-12*. Teaching and learning in this course will model the NCTM Process Standards: Problem-Solving, Communications, Connections, Reasoning and Proof and Representations. The content of the course will also align with the geometry and measurement items of the Middle School Mathematics Content Test of *PRAXIS II* (passing score required to obtain teaching certification in Kentucky).

Objectives: The course has three main objectives: (1) Increase the students' awareness and understanding of the scope and nature of geometry, including recent developments and applications, and connections to nature and art. (2) Follow selected fundamental themes and concepts in geometry as they are developed in the middle school, high school, and college curriculum. (3) Approach geometry in an investigative manner, using such techniques as collaborative learning; exploration and problem solving to formulate, test, and prove or disprove conjectures; and written and oral assignments to develop effective communication skills; and such tools as physical manipulatives; models; and software.

Nature and Scope of Geometry: Despite many developments in geometry (some quite recent), such as aperiodic tilings, graph theory, computational geometry, convex polyhedra and mathematical programming, discrete geometry, and solid modeling, the main focus of most pre-college and college geometry courses in Kentucky is still the axiomatic method as applied to two-dimensional Euclidean geometry. Most teachers have had little or no exposure to anything else, nor are encouraged to alter their curriculum they are asked to teach. This is completely contrary to recommendations such as those articulated, for example, in *Heeding the Call for Change*: "Mathematics departments should encourage prospective teachers to be exposed to both the depth and breadth of geometry." Course topics will be selected to draw the students from their more traditional background in geometry into its modern

manifestations.

Development of Themes: There still appears to be a tendency for prospective teachers to wish to dismiss geometry above the level at which they intend to teach as largely irrelevant to their intended profession. More care must be taken to demonstrate how certain geometric themes or topics that they will be teaching to their middle school students will reappear and be articulated in greater depth and sophistication as their students leave them to advance through high school and college. One motivation for teachers to master their subject beyond their level of teaching is to be consciously aware of what they are preparing their students to meet in the future. The *NCTM Standards* provide good guidelines for this development, and *Heeding the Call for Change* encourages, "More emphasis should be placed on central conceptual aspects of geometry, such as geometric transformations and their effects on point sets, distance concepts, surface concepts, etc." Topics in the course can be introduced using, for example, some of the modules in the NSF-funded middle school curricula: *Connected Mathematics Project*, *MATHThematics*, *Mathematics in Context*, and *Mathscape*. Then the topic can be revisited from more advanced perspectives, incorporating high school activities, college-level analysis, and applications. Some specific themes to be addressed are: one- two- and three-dimensional shapes; spherical figures; coordinates and analytical geometry; distance and length; perimeter, area, surface area, and volume; measurement and approximation; congruence and similarity; transformations; axioms and deduction. Of course, these topics are deeply intertwined, and it will not be possible to treat any one of them completely and comprehensively, but this interconnectedness will be reflected in the course work, and students will be exposed to important elements of each theme.

Investigative Approach: In consonance with the *NCTM Standards*, *Heeding the Call for Change* makes recommendations on methods of presentation that will be incorporated into the geometry course: "Geometric objects and concepts should be studied more from an experimental and inductive point of view rather than from an axiomatic point of view." Resulting conjectures can then be proved or disproved. "More use of diagrams and physical models as aids to conceptual development in geometry should be explored." Many geometry manipulatives (such as Polydron) are still rather expensive, but two-and three- dimensional models can be constructed from less costly materials. "Group learning methods, writing assignments, and projects should become an integral part of the format in which geometry is taught." The NSF-funded curricula are currently being used in some middle schools throughout Kentucky. Therefore, collaborating middle school teachers can provide examples of students' responses to aspects of the lessons (e.g., students' work, journals, projects, scripts of classroom discourse, and videotapes of students small group discussions). Such examples will give students in the course an opportunity to discuss and analyze the thinking

and concept development of "real middle school students."

Taking Advantage of Technology: *Heeding the Call for Change* also emphasizes that a "wide variety of computer environments should be explored ... both as exploratory tools and for concept development." AMATYC, addressing general technology, declares, "The technology must have graphics, computer algebra, spreadsheet, interactive geometry, and statistical capabilities." For this geometry course, both geometry-specific software, such as Geometer's Sketchpad, and computer algebra software with graphics, such as Maple, can be used effectively for exploration and modeling.

References:

1. *Connected Mathematics Project*, http://www.mth.msu.edu/cmp.
2. *Crossroads in Mathematics: Standards for Introductory College Mathematics Before Calculus*, AMATYC, 1995.
3. The Geometer's Sketchpad, http://www.keypress.com/sketchpad.
4. *Mathematics in Context*, http://www.edc.org/mcc/cmic.htm.
5. *Mathscape*, http://www.edc.org/mcc/cscape.htm.
6. *MATHThematics*, http://www.edc.org/mcc/cstem.htm.
7. *The Praxis Series: Professional Assessments for Beginning Teachers*, ETS, http://www.teachingandlearning.org/licnsure/praxis/index.html.
8. *Principles and Standards for School Mathematics*, NCTM, 2000, http://www.nctm.org/standards.
9. L.A. Steen, editor, *Heeding the Call for Change: Suggestions for Curricular Action*, MAA, 1992.
10. Waterloo Maple, http://www.maplesoft.com.