Mathematics 131
Geometric Reasoning: Geometry as Earth Measures
Spring 2010

Course Description:

This course has a multi-dimensional focus on geometric reasoning. These dimensions address geometry through: visualization, drawing and construction of figures; correspondence to structures in the real, physical world; by reference to abstract mathematical concepts; and by argumentation and discussion within a logical-mathematical system.

Meeting Place and Time: WIH 21
11:00 AM-12:15 PM Tuesdays & Thursdays

Instructor and Office Hours:

Dr. Jeffrey Barrett STV 329 B 438-7849
jbarrett@ilstu.edu
Wednesdays @ 2:00 until 4:00 PM;
Fridays @ 2:00 PM until 3:00 PM;
or **by appointment**.
(Also, the Blackboard site through ISU contains course documents and notes)

Required Textbook:

Kinsey, L.C & Moore, T.E. (2002) *Symmetry, Shape and Space: An Introduction to Mathematics Through Geometry*. Key College Publishing: Emeryville, CA;

(free, via the internet): http://aleph0.clarku.edu/~djoyce/java/elements/elements.html
A website hosted by Clark University professor, D. Joyce; copyright 1996, 1997, 1998. This website provides a virtual version of Euclid's Elements (approximately 300 B.C.).

Required Materials:

(1) Ruler and compass and protractor;
(2) Geometer's Sketchpad (version 4.0 or 5.0) computer software (student version may be purchased for your own computer, www.keypress.com , at approximately $35-40);
(3) Calculator;
(4) Graph paper, multi-color pens or pencils

Course Objectives:

This course is designed to develop students' understanding of mathematical concepts by providing opportunities to investigate and reason about geometric ideas and principles in a variety of contexts. Too often students' previous experiences with geometry have caused them to believe geometry is only a rather meaningless process of proving ideas that seem to be readily apparent, or memorizing terminology and formulas. Consequently our understanding of what geometry is and how geometry can be used in daily life is rather limited and narrow. And yet geometric reasoning consists of much more. The multi-dimensional focus of this course allows students to explore geometry & measurement from several viewpoints, but especially as an axiomatic system.

The course will utilize a ***problem-solving instructional methodology***. Here content is explored in context of various problem situations as described in different forms and contexts including visual, quantitative, graphic, historical, artistic, scientific, and abstract. From these problems we will focus on the various dimensions of geometric reasoning: investigating and exploring shapes, measures, and relationships; describing, analyzing, and applying; reasoning and conjecturing; justifying and verifying; connecting ideas within mathematics and across other disciplines; and communicating our understanding and findings.

Students will make drawings with hand tools and computer tools to explore geometric principles and properties; dynamic "sketchpad" software will be used as one method of exploration and investigation and it will be connected to compass and straightedge constructions. Geometric ideas such as similarity and proportion, symmetry, and transformations will be explored. These ideas can be historically linked to art, architecture, and culture, and lead into the study of another perspective on geometry.

The second dimension students will explore is geometry in relation to the real, physical world. Geometric ideas of repeated patterns, spirals and branching are seen in a variety of natural physical situations. These can be as simple as a honeycomb, or as advanced as the astrophysicist's use of geometric models for the structure of the universe. In addition, through virtually every aspect of life we are faced with measurement concepts that are closely related to geometric relationships. Thus, measurement and related topics will be explored.

The third dimension for exploring geometry will be the representation of abstract mathematical ideas and concepts. Possibilities to be explored could include algebra, coordinate geometry, analysis & symmetry of functions and relations, or underpinnings of calculus such as the area under a curve, optimization, related rates, and volumes of solids of revolution. Any such relationships will be studied through the analysis of problem situations and the geometric models that can be used to represent them.

Fundamentally, the idea of geometry as a logical axiomatic system will be explored through the development of logical arguments and justifications. While many students have experienced this in a high school level geometry course, the proofs they attempted were often proofs of relationships that seemed obvious or of limited usefulness. We will look at proof as a vehicle for explaining and understanding ideas. This is different than making an argument for the validity of a theorem, relying instead on our effort to defend the theorem to help us understand and connect that theorem to relevant geometry. To clarify the importance of the axiomatic structure, and its usefulness in investigating real-world phenomena some basic explorations into non-Euclidean geometries, such as spherical or finite geometry will be used. Throughout all these dimensions, connections to other areas of the curriculum and to the historical underpinnings of modern mathematics will be used to help students develop a more complete picture of the role geometry has played in our modern lives as well as various cultures throughout history.

In summary, this course will provide you with the opportunity to:

- **Experience what it means** to understand geometry in a variety of contexts and applications;
- **Learn mathematics** by investigating, conjecturing, and justifying;
- **Engage in investigations and problem solving** while working with others;
- **Gain insight** into how geometry has been used to describe the world around us and appreciate its interdisciplinary role;
- **Use technology** to solve and generate problems;
- **Learn to communicate** mathematics through written and oral presentations; and
- **Learn the connections** between geometry and historical or cultural events.

Academic Integrity is expected in all classroom endeavors.
Academic Integrity is an important part of this University and this course. Academic Integrity is required of you the student and myself as the instructor. Students are expected to be honest in all academic work. A students placement of his or her name on any academic exercise shall be regarded as assurance that the work is the result of the students own thought, effort, and study. Students who have questions regarding issues of academic dishonesty should refer to the Code of Student Conduct, B1 (Academic Integrity), which outlines unacceptable behaviors in academic matters. In certain circumstances (such as cheating or plagiarism) I may be required to refer a student(s) to Community Rights & Responsibilities for a violation of Illinois State University's Code of Student Conduct. If you are uncertain about whether or not something is dishonest, please contact me. Academic penalties regarding academic dishonesty may range from a

failing grade for a particular assignment (F) to a failing grade for the entire course (F) based on the seriousness of the infraction.

Classroom Behavior should conform to standards of the professional workplace.
Students are expected to behave in a manner consistent with being in a professional environment. Open discussion and disagreement are encouraged in a respectful manner. Open hostility, rudeness, and incivility are discouraged and will result in appropriate action. Mechanical disruptions (cell phones, pagers, electronic toys, music players, etc.) are also strongly discouraged. Students acting in a disruptive or uncivil manner may be dismissed from the class for the remainder of the class period. If necessary, referrals may also be made to Community Rights & Responsibilities for violations of the Code of Student Conduct.

Tentative Course Requirements and Relative value of various evaluations:

Quizzes (3-5 quizzes will be graded)	10%
Participation in presentations and proofs**:** **a journal record** of your presentations and participation in class discussions**,** and **a proof notebook.**	10%
Exams (2-4 exams will be given)	55%
Final Exam	25%

Journal Record:
This is a written reflection of the significant ideas you learn during the semester. You should write at least **eight different entries, describing lessons you select from eight <u>different</u> weeks** of our course (the semester is about 16 weeks long). Each written reflection should describe what we learned in class that day, and what you learned on that topic through homework and your further study or research including assigned presentations. You may describe the process of learning these topics, in specific detail about the CONTENT of the course. This will be a document showcasing ideas you have learned, and the document should be *organized to show the dates of your journal entries*.

Proof notebook: This is a collection of ***eight*** **or more different proofs** based largely on your own thinking and work from our class. You may rely primarily on statements we work on proving during class discussions to build this set of model proofs. You should elaborate, clarify, and reflect on difficulties with these proofs. You may reflect on any four of the proofs we learn in Euclid, and four other proofs we develop from other activities, from our text, or from our work in GSP.

Attendance and participation: It is important in any mathematics course that you be present; however, it is even more important when the text does not tell you step by step procedures for all tasks, but instead asks questions we are to explore and discuss. As a result, absences make it difficult to understand the course content, and generally have a negative impact on quiz and project grades.

Quizzes and Tests:
There will be quizzes in alternation with exams. Quizzes will be given during a shorter period of time, usually from 15-20 minutes in duration. Quizzes will not be made up.

There will be three or more **exams** during the semester. Each will be 60-75 minutes in length. If you are absent the day of an exam, a make-up will be given ONLY if you have notified me in advance of your absence. This means that if you are not going to be in class the day of an exam, I need a phone call, voice mail message or e-mail dated and timed prior to the start of class that day. If you do not notify me of your absence in advance the exam, a make-up will not be given, and your grade will be recorded as a zero for that exam.

Final Examination:
The final exam is scheduled according to the university final exam schedule for Wednesday, at 10 AM of Final Exam Week. This schedule allows exactly two hours for the final exam. It will be a **cumulative exam**, relating to previous material addressed on quizzes and tests and topics specified as critical topics throughout the course in discussions and projects and assignments.

A full distribution of grades from A to F is plausible with A's being reserved for outstanding performance. A grade of C represents the minimal acceptable performance. The following rubric describes the levels of performance typically associated with each grade:

A Outstanding performance. Student demonstrates solid conceptual understanding and insight. The student not only demonstrates mastery of the course content, but also is able to make extensions or apply that knowledge to new situations. Assignments and tests are excellent quality and the student contributes substantially to positive class discussions.
B Good performance. Student demonstrates good understanding and mastery of course content. Assignments and tests are of good quality but not exceptional. The student regularly contributes positively to the class discussion.
C Adequate performance. Student demonstrates adequate understanding and mastery of course content but has difficulty extending or applying the knowledge to new situations. Assignments and tests are adequate. Student may not contribute as regularly to class discussions.
D Inadequate performance. Student demonstrates inadequate understanding of course content. Assignments and/or tests are inadequate, but show effort. Student contributes little to class discussions.
F Unacceptable performance. Student demonstrates little or no understanding of the course content. Assignments are not completed, are late, or of poor quality. The student does not contribute to class discussion. The student's work provides little evidence of effort.

Semester grades are based on the requirements stated above. Exams (and quizzes) will be scored on a rubric that is directly related to these criteria, and you will be able to track your grade by computing a weighted average of the portions of your grade detailed earlier in this document (see above).

Available Resources:

The mathematics computer lab (STV 314) is usually open from 9 a.m. to 4 p.m., M-F. Check posted hours. There are multiple copies of many books, booklets, pamphlets, and journals related to mathematics education, as well as manipulative materials for teaching mathematics in Milner Library, and the Mathematics Library may be open during part of the Spring 2009 semester. **Other Important Information**:

All assignments should be submitted during class on or before the date indicated.

Late assignments will not be accepted.

Any major emergencies will be handled on an individual basis.

If at any time you are unsure about what is expected of you, either in class or on assignments, please make an appointment to discuss this with me immediately.

Do not wait until an assignment is due to ask questions!

Important Dates:

?	Last day for withdrawal with no assigned grade
?	Last day for withdrawal with WX assigned
April 29, 2010	Last day of MAT 131

For class that meets regularly at 11:00 on Tuesdays and Thursdays:	Final Exam meets: 10:00 AM on May 5, 2010 in our scheduled classroom.

Any student needing to arrange a reasonable accommodation for a documented disability should contact Disability Concerns at 350 Fell Hall, 438-5853 (voice), 438-8620 (TDD).