Montserrat 108N – Mathematics Through Time
Syllabus – Fall 2010

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Course Homepage: `http://mathcs.holycross.edu/~little/Montserrat1011/Fall.html`

> Euclid alone has looked on Beauty bare.
> Let all who prate of Beauty hold their peace,
> And lay them prone upon the earth and cease
> To ponder on themselves, the while they stare
> At nothing, intricately drawn nowhere
> In shapes of shifting lineage; let geese
> Gabble and hiss, but heroes seek release
> From dusty bondage into luminous air.
>
> O blinding hour, O holy, terrible day,
> When first the shaft into his vision shone
> Of light anatomized! Euclid alone
> Has looked on Beauty bare. Fortunate they
> Who, though once only and then but far away,
> Have heard her massive sandal set on stone.
>
> *Edna St. Vincent Millay, 1892-1950*

Course Description

Mathematics has always been an important component of human thought. Counting, measuring, and studying shapes, human beings use mathematics to understand and deal with the natural world. Moreover, primarily because of these practical applications, learning at least the rudiments of mathematics has long been a part of basic education. The subjects taught in mathematics at the high school level throughout the world have become quite standardized.

But where did the arithmetic, algebra, and geometry that we all learn at that point in our educations come from? Who invented (or discovered?) this material and when and why did it happen? Why are these things still taught today? Why do human beings study mathematics, and why do some of them devote their whole lives to that study? And ultimately, is mathematics really about the natural world at all?

In this course, we will address these and other questions through a study of several topics from basic algebra and geometry – most notably

- the solution of quadratic equations by techniques including the *quadratic formula* from algebra, and

- the *Pythagorean theorem* from geometry.

You have certainly all studied the *finished forms* of these topics before. The emphasis of *this course*, though, will not be on the "how," by on the "why." That is:

- We *will not* focus on developing facility of calculation of roots of equations, or on using the Pythagorean theorem to solve other problems.
- We *will try* to understand how these statements developed from mathematics studied by the ancient Egyptians and Babylonians.
- More generally, we will focus on what constitutes evidence for saying a mathematical statement is true, why these and other statements have stood the test of time, why they are important even today, and what they tell us about mathematics as a human undertaking.

In the centerpiece of the semester, we will make the acquaintance of the Greek mathematician Euclid, one of the great thinkers of the ancient world, "in his own words," through a close reading of Book I of his masterwork called the *Elements*. (In case you are concerned, we will not read this in the original Greek, but in a modern English translation. Of course if you have studied ancient Greek, it might be interesting to look at a Greek text too!) It is fair to say that among all the books humans have produced, the *Elements* has had an influence in Western civilization second only to that of the Bible. We will experience a section of it first-hand, and then try to understand why it has had such a major impact.

For these reasons, I think you will probably find the course to be very different from any mathematics course you have taken before: It will be part mathematics, part history, and part philosophy. But I hope you will find this mathematical journey through time to be enlightening and stimulating. If you come to see mathematics in a new light, then the course will have been a success!

Course Objectives

The major objectives of the course will be:

1) To examine the history and development of mathematical ideas through time, using some of the original sources to understand how and why those ideas were developed.
2) To deepen your understanding of mathematics as an area of human study.
3) To further your development as writers and speakers.
4) To participate in and contribute to the common activities of the Natural World Cluster of the Montserrat program. *Note:* Dates and times will be announced on the course homepage.

Texts

The main mathematical texts for the course are:

1) M. Kline, *Mathematics for the Nonmathematician*, Dover.
2) P. Rudman, *The Babylonian Theorem*, Prometheus Books.

3) Euclid, *Elements*, Book I, online at:

`http://aleph0.clarku.edu/~djoyce/java/elements/elements.html`

We will also read and discuss the Natural World Cluster common reading:

4) R. Skloot, *The Immortal Life of Henrietta Lacks*, Crown.

Course Schedule

A detailed day-by-day course schedule and listing of required and suggested outside events will be maintained on the course homepage. That listing is a tentative, evolving schedule, so you will probably want to refer to it frequently. Any important changes will also be announced in class well in advance.

Assignments and Grading

1) Midterm Exam (15 % of course grade) – tentative date: Friday, October 22.
2) Final Exam (25 % of course grade) – the final will be given at the established time for MWF 9 am classes, when that is determined.
3) Problem Sets (about 6 through the semester – 10 % of course grade)
4) In-class group work (about 6 assignments – 10 % of course grade)
5) Three short (roughly 3 to 5 page) papers related to the common reading and other topics. (More information and guidelines to be distributed later) (25 % of course grade)
6) *Presentation*: During our reading of Euclid, each student, working with a classmate, will prepare a 15-minute oral presentation on one of the Propositions in Book 1, as assigned by me (10 % of course grade)
7) Class participation (5 % of course grade)

I will be keeping your course average in numerical form throughout the semester, and only converting to a letter for the final course grade. The course grade will be assigned according to the following conversion table (also see Note below):

- A – 94 and above
- A- – 90 - 93
- B+ – 87 - 89
- B – 84 - 86
- B- – 80 - 83
- C+ – 77 - 79
- C – 74 - 76
- C- – 70 - 73
- D+ – 67 – 69

- D – 60 - 66
- F – 59 and below.

Note: Depending on how the class as a whole is doing, some downward adjustments of the above letter grade boundaries may be made. No upward adjustments will be made, however. (This means, for instance, that an 85 course average would never convert to a letter grade of B- or below, although it might be a B+ in some circumstances.) If you ever have a question about the grading policy or your standing in the course, don't hesitate to ask me.

Advice On How To Succeed In This Class

A good "work ethic" is key. As you should be able to tell from the course description above, you do not need to be a "math genius" to do well in this course. But you will need to put in a consistent effort and keep up with the reading and assignments.

Come to class. Unless you are deathly ill, have a genuine family emergency, are away at a game or meet of a college athletic team, etc. plan on showing up here at 9:00 am every Monday, Wednesday, and Friday this semester. Many of the class meetings will be structured around discussions or student presentations. Your participation is expected and needed for the success of the course!

Take notes and use them. This may seem obvious, but it is worth saying! Used intelligently, your notes can be a valuable resource as you work on problem sets and prepare for exams.

Use the texts and class notes actively. Reading about mathematics is not like reading a novel. You will probably need to read and think over things more than once. You may want to work through examples or draw your own diagrams to understand some of the Euclidean proofs that we do.

Set up a regular study schedule and work at a steady pace. It's not easy to play catch-up in a mathematics course (even when the course is part of a first-year program with additional goals beyond the mathematics). You should expect to budget at least 6 hours in a typical week for work outside of class. The best way to use your time is to do a few problems, some reading from the books, and reviewing of class notes every day.

Most importantly, if you are having difficulty learning something, get help as soon as possible. You can do this by asking questions during class (any time something isn't clear), or seeing me during office hours.

Statement on Academic Integrity

All education is a cooperative enterprise between teachers and students. This cooperation works well only when there is trust and mutual respect between everyone involved. To be become an engaged and advanced learner, you must be able to think and work both independently and in concert with your peers. The College academic honesty policy states: "As an institution devoted

to teaching, learning, and intellectual inquiry, Holy Cross expects all members of the College community to abide by the highest standards of academic integrity. Any violation of academic honesty undermines the student-teacher relationship, thereby wounding the whole community. The principal violations of academic honesty are plagiarism, cheating, and collusion.

Plagiarism is the act of taking the words, ideas, data, illustrative material, or statements of someone else, without full and proper acknowledgment, and presenting them as one's own.

Cheating is the use of improper means or subterfuge to gain credit or advantage. Forms of cheating include the use, attempted use, or improper possession of unauthorized aids in any examination or other academic exercise submitted for evaluation; the fabrication or falsification of data; misrepresentation of academic or extracurricular credentials; and deceitful performance on placement examinations. It is also cheating to submit the same work for credit in more than one course, except as authorized in advance by the course instructors.

Collusion is assisting or attempting to assist another student in an act of academic dishonesty.

The full statement on Academic Honesty in the College Catalog will be posted on the Natural World/Montserrat Moodle site and is available at

`http://www.holycross.edu/catalog/academic-honesty-policy.pdf`

The temptation to engage in an act of academic dishonesty will almost certainly arise, but the chance to possibly enhance a single grade is not worth the loss of your personal integrity. If you do not know how to correctly cite reference materials, consult with your professor, the campus Writers Workshop, or visit one of the links below (also posted on the Natural World/Montserrat Moodle site).
Department of History:

`http://www.holycross.edu/departments/history/website/academichonesty.htm`

Department of English (link to Houghton Mifflin booklet, "Understanding Plagiarism: A Student Guide to Writing Your Own Work"):

`http://college.cengage.com/english/plagiarism_prevention.html`

Houghton Mifflin, "The Plagiarism Zone"

`http://college.hmco.com/english/plagiarism_prevention.html`

NOTE: If in doubt about what you plan to do or write violates academic honesty, PLEASE ASK!

Specific Guidelines for this Course

In this course, all examinations will be closed-book. No sharing of information with other students in any form will be permitted during exams. On group discussion write-ups, close collaboration with the other members of your group is expected. On the individual problem sets, discussion of the questions with other students in the class and with me during office hours is allowed, *even encouraged*. However, your final problem solutions should be prepared individually

and the wording and organization of your final problem solutions should be entirely your own work. Moreover, if you do take advantage of any of the above options for discussion of problems with others, you will be required to state that fact in a footnote accompanying the problem solution. Failure to follow this rule will be treated as a violation of the College's Academic Integrity policy. For the papers, if you do consult a source other than the course texts, include a full reference in a bibliography section at the end of your paper, and identify any direct quotations. Information about the acceptable formats for doing this will be distributed with the paper assignments.