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An Alternative Approach to the History of Mathematics

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AN ALTERNATIVE APPROACH TO THE HISTORY OF MATHEMATICS

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Many scholars have described the value of teaching the history of mathematics. Some, such as Andre Weil, argue that studying the history of mathematics is primarily for current or future mathematicians since it can give us insights into how to tackle contemporary mathematics problems. Others agree that the history of mathematics is of particular interest to mathematicians, not so much for its utilitarian value, but rather for the enrichment one feels in understanding ones past. Still others argue that the history of mathematics is of interest to non-mathematicians and mathematicians alike. It is part of our cultural heritage, and has influenced many other aspects of our society, therefore we should study the history of mathematics, just as we study the history of art or literature. In this vein, Judith Grabiner, in her article "The Centrality of Mathematics in the History of Western Thought," argues that mathematics has influenced religion, philosophy, economics, and even the Declaration of Independence. It would seem, then, that there are many reasons to include the history of mathematics in a liberal arts undergraduate curriculum.

However history of mathematics courses are relatively rare, and when they do exist they are usually housed in mathematics departments and seen as peripheral to the core mathematics curriculum. Nor are students organizing massive protests due to the absence of such courses, which often conjure up images of dull, rote memorization of big names, dates and theorems, lacking the connective tissue that would sustain students' interests. This article is meant to explore an alternative approach to the history of mathematics, one that would be of interest to potential mathematicians and non-mathematicians alike.

History of mathematics courses are more important today than ever before. As we become aware of the necessity of recruiting more students to study mathematics, particularly groups that are traditionally under-represented, women and minorities, we must look at mathematics with new eyes, and with a wider perspective.

The traditional approach to the history of mathematics reinforces the alienation that many women and minorities feel about mathematics. They see no people they can identify with, if indeed they see people at all. How the questions of mathematics arose, and what the connections were between mathematics and the larger culture are often neglected. Someone who is not already engaged in mathematics is not likely to be inspired by such a course.

One first step therefore in the re-vision of the history of mathematics is to look for the participation of women and minorities. This includes studying the lives of women such as Hypatia (the little we can find about her), Sofia Kovalevskaia, Marie Agnesi, Ada Byron Lovelace, Emilie du Chatelet, and Emmy Noether. Simultaneously, we can begin our history of mathematics not with the Greeks but with early Egypt and Babylonia, and, in looking at the development of mathematics in Africa, consider how our Western perspective and values influence the way we evaluate the mathematics of other cultures. But it is not enough to just add the few women and minority mathematicians we can find and think we now have a more inclusive curriculum. We must continue our inquiry and investigate why there have been so few women and minorities to include. To some extent this involves studying the obstacles that have prevented the entrance of many people into the world of mathematics. But it also involves a deeper analysis of what we *define* as mathematics and how this is culturally dependent, as well as how the values of a culture shape what is considered important mathematics.

Philip Davis considers some of these issues. He reminds us of the very useful words of William James, "The community stagnates without the impulse of the individual; the impulse dies away without the sympathy of the community," and Davis goes on to ask "Is it possible to write history of mathematics along the lines suggested by this quotation?" In this article, I discuss the ways in which we can begin to think about teaching such a history of mathematics.

This past Fall, I had an opportunity to teach a history of mathematics course at Middlebury College as a freshman seminar. Since I had total freedom in designing the course I decided to structure the course to examine these questions, in particular the relationship between mathematics and its cultural context.

The Body of the Course

The course was divided into three parts, each a different way of approaching the history of mathematics. The first part focused on individual mathematicians, the second on how mathematics has developed in different cultures and the third focused on one area of mathematics, namely geometry. The goal of the course was to have the students grapple with the fundamental questions "what do we mean by mathematics?" and "what do we mean by history?" By taking three different approaches to the history of mathematics, students began to realize that answers to these questions are intimately connected to understanding the relationship between mathematics and the culture in which it is practiced.

In looking at the lives of individual mathematicians, we read biographies and autobiographies of selected people from various times and cultures. One of the first assignments the students had for the course was to write their own mathematical autobiography (an informal and ungraded assignment). This gave me an opportunity to get to know them better and to get some indication of their writing skills. It also served as an excellent device for priming their interest in the lives of other mathematicians. They had to think about what aspects of their own mathematical experience were important and why, and to begin to think about the extent to which they were influenced by environmental or cultural factors. It was natural therefore to investigate the role of mentors, family, and friends in mathematicians' development.

We considered questions such as who had the opportunity to pursue mathematics? Why did they choose to become mathematicians? What field(s) did they pursue and why? What kind of contact did they have with other mathematicians (if any)? How were they received by the larger community? How did they think about their work and the nature of mathematics? Who were the women in mathematics, and in what ways, if any, were there lives different? What has been the role of institutions (social, political, educational, and religious) in shaping mathematicians' lives and mathematics in general?

We read "The Ideal Mathematician" from *The Mathematical Experience* which was useful when reading about the lives of various mathematicians and considering the extent to which their lives agreed or disagreed with the one portrayed in "The Ideal Mathematician." The article "The Individual and The Culture" was important in raising the question of the interplay between the individual and society which was a central theme of the course.

Some articles, for example Koblitz's on Sofia Kovalevskaia, address the cultural influences directly, such as the ways in which the early Nihilist movement opened doors for Kovalevskaia by creating a social climate in which it was not only acceptable for women to pursue mathematics and science, but it was seen as a progressive mission which helped promote liberation for the people. And yet at the same time it was Kovalevskaia's very own country, Russia, that denied her access to higher education and employment, forcing her to go abroad for both. However, other readings on individual mathematicians, maintain the traditional split between mathematician's lives and the social factors that helped or hindered them. This made it more challenging for students to investigate those connections. In some cases, reading different accounts of a person's life revealed how much of a vested interest there can be in describing the mathematician's sources of inspiration, or vision of mathematics. This was most vivid in the case of Ramanujan where Hardy, Berndt, and Ranganatham present varying points of view on issues such as the role of intellect versus intuition, the role of religion, ability as a mathematician, and how a mathematician is to be judged or evaluated.

The focus in this part of the course was primarily on well known mathematicians such as Pythagoras, Euclid, Newton, Leibniz, Euler, Gauss, etc., but in looking at more contemporary mathematicians students were able to read about some less famous mathematicians which gave rise to interesting discussions about "rating" mathematicians, and thinking about whose name gets remembered and why (for example, why is the Pythagorean Theorem attributed to Pythagoras when other cultures such as Babylonia and China seem to have been familiar with it more than 1,000 years earlier). We looked at the many factors that contribute to a person pursuing mathematics, both the factors that encourage and those that discourage success. For example, until recently, most mathematicians came from upperclass backgrounds, giving them the time and resources to pursue mathematics. We considered also the similarities and differences for women in mathematics, the various obstacles they might encounter (e.g. family or community resistance, lack of access to educational institutions or professional societies, internalizing cultural attitudes that women cannot do mathematics, inability to get jobs), and how

some of them overcame these obstacles. Whenever possible we tried to examine how the various mathematicians thought about their work and the nature of mathematics, and to what extent their philosophy of mathematics agreed with their practice of mathematics.

In the second part of the course we compared and contrasted the mathematics of different cultures. In particular we looked at periods in the early history of Babylonian, Egyptian, Chinese, Greek, African, and Islamic mathematics. We tried to see in what ways the culture might influence the mathematics. What were the different cultures' concept of proof, in what ways did that meet the needs of the society? What was the status of mathematics in different cultures? What constituted mathematics in these societies, for example were art and music considered branches of mathematics, was there a focus on geometric or algebraic mathematics, why? What was considered important mathematics? In what ways did these cultures influence each other? [See the essay by Pryor and Pellett at the end of this article].

One of the outcomes of this part of the course was that students began to see what a variable concept mathematics is, that it is not something fixed in stone, defined by some external force, but rather a changing, evolving activity responding to the needs of the culture. By looking at the connection between mathematics, music, art, games, etc., students also saw the many ways mathematics is relevant to their own lives. They began to see how even such bedrock concepts as mathematical truth and proof are evolving over time and are culturally dependent.

Finally in the third part of the course we focused on one particular area of mathematics, namely geometry. Since the history of geometry is so old and rich, this part of the course tied the whole semester together quite nicely. We looked at the development of geometry from its early beginnings in Egypt to its formalization in Euclid's elements to its surprising and profound expansion in the 19th Century with the introduction of non-Euclidean geometry. We considered what the introduction of non-Euclidean geometry does to the Euclid myth, and began to think about other ways of conceiving of the nature of mathematics. Non-Euclidean geometry returned us to the philosophical questions that we grappled with at the beginning of the course, such as "What is mathematics" and as such made a wonderful ending to the class.

Central Questions

In the following sections I will elaborate on how we investigated the fundamental questions that were discussed at the beginning of the course but continued to be central throughout: "what is mathematics" and "what is history."

A. "What is Mathematics?"

Before doing any readings, the students wrote a short informal essay on "What is mathematics?" For many students this was the first time they had asked this question, though they had been doing mathematics for more than twelve years. Is mathematics discovered or created? If it is created, who creates it? Are there ground rules that everyone agrees on about what constitutes a proof? We discussed three philosophies of mathematics, Platonism, Formalism, and Constructivism (see Snapper in [7]), as students began to formulate their own opinion on the nature of mathematics. It was interesting to see how students' opinions matured (though did not necessarily change) as the class went on.

We considered the traditional popular answer to the question "What is mathematics" that Davis and Hersh label the "Euclid Myth," that mathematics is a body of truths which are derived from a set of self evident truths (the axioms). The rules of logic, which are chosen to preserve truth, are used to derive theorems from the axioms. Such a view of mathematics implies that mathematics is certain (since we start out with certain truths, i.e. the axioms), objective (it does not depend on human beings since the rules of logic firmly establish what theorems can be derived) and eternal (since it reflects truths about the universe, yet is not dependent on sense experience). This is quite a firm foundation for mathematics to rest on. As we went through the course, we considered whether this is an accurate description of mathematics over time and in different cultures.

Other questions we explored in discussing "What is mathematics" are: Is mathematics a science or an art? In what ways could it be beautiful? Is it important that it be useful? How do we decide what is important in mathematics? I had the students imagine that they were in charge of a large funding organization like the National Science Foundation. They had to think about what criteria they would use in allocating funds (tackling not only the question "what is mathematics?," but also "what is *important* mathematics?"). Finally, we discussed the different metaphors that mathematicians use to describe mathematics, and what that reveals about their vision of mathematics, as well as how their vision can affect the mathematics that they do.

B. What Is History?

The next major question that must be tackled at the beginning of the course is "What do we mean by history?" To introduce this question we did the following exercise at the beginning of a class. I had the students write for ten minutes on what happened in Tiannemen Square (any major event that most of the students knew about would do). Many students looked rather puzzled, but agreed to entertain me for such a short period of time. [When I asked who had heard of Tiannemen Square, all but one student raised their hands. I told the one student to wait and he would learn about it momentarily. Later he told me that he had indeed known about Tiannemen Square, but he couldn't believe that that is what I was referring to since it had nothing to do with mathematics. He assumed Tiannemen Square was something like the Pythagorean square or the golden rectangle!] Then I asked a number of students to read what they had written. There was a wide variety of responses. One student who had been to China and knew quite a bit about its history wrote a long fairly technical summary of political and military factors involved in the tragic event. Another student wrote a very simple synopsis, "a bunch of students were protesting for democracy at the square. The government sent in tanks and killed many of the protestors . . ." Still others took very different points of view. The point, of course, was to see how each person could have a very different perspective of a given historical event. We discussed how 2,000 years from now, one of their sheets of paper might be the only surviving document of what happened in Tiannemen Square. In the same way, when we look back 2,000 years to ancient Greece, it is difficult to piece together what really happened, or the nature of mathematical activity at the time, or what Pythagoras discovered (if he did in fact exist) from the little we have to work with. And the further back we go, the more difficult it is to gather evidence or information. For this reason it is important to take all recorded history with a grain of salt. In addition to limited records, human bias can also be a major factor in shaping our image of the past. This becomes particularly clear later in the course in looking at Western descriptions of African mathematics [see Zaslavsky].

Organization of Class

The class met two days a week, Tuesday and Thursday for an hour and a half. It was part of the freshman seminar program which had several advantages. The class size was small (enrollment is limited to 15). The purpose of the freshman seminars is to have interdisciplinary, discussion oriented classes in which faculty and students get to know each other well. There was also some funding to bring in guest speakers. The freshman seminars are writing intensive courses, hence the large amount of writing for the course.

Because this was the first time this seminar was being offered, and enrollment was not full, we did allow several upperclassmen to join the class. The benefit of having these students is that their additional experience in mathematics made the class much richer for everyone, and made for livelier discussions. One thing that became quite clear from having these older students, is that this course would be extremely successful as a junior or senior level course as well, and of course there would be much more mathematical experience to draw on.

As the syllabus indicates, the course was driven by questions. One of the major goals of the course was to have students generate their own questions; this is one of the most important aspects of learning and one that is often neglected in the classroom. In the beginning of the course students were given specific questions such as "What is Platonism?" or "What is Euclid's myth?," but as the students matured the questions became more open ended such as "What are the values underlying African mathematics?" or "What are similarities and differences between ancient Greek and Babylonian mathematics?" or "What might account for those differences?" As the course progressed, they came up with more and more questions of their own.

Assignments

Throughout the course students developed both their informal and formal writing voice. The informal voice was developed in journals which they kept throughout the term. The formal voice was used in two research papers and a final exam. The journals were an important part of the course. Students used them to take notes on the readings, give a brief synopsis of each article, critique the readings and record their own questions and thoughts about the course in general. They served as a vehicle for learning how to do close and critical readings. Having these detailed records not only made class discussions much better, it was also extremely useful as a reference for their papers and exams. I would collect them approximately once a month, and give comments.

The two research papers corresponded to the first two parts of the course. The first was on a topic pertaining to mathematical people, the second was on mathematics in different cultures. I encouraged students to find topics that were of particular interest to them. This was an opportunity for students to delve more deeply into a topic we covered in class, or to go in another direction.

The final was the culminating experience of the course. It involved two parts. The first part was to write two essays. One was to return to the original question of the course "What is mathematics," and use readings and discussions to support their position. I was interested to see how the course had affected their thoughts on this question. The second essay was "Discuss the ways in which society can influence mathematics." This was also meant to pull the whole course together and to reflect on the central theme of the course. [See comments in section on evaluation].

The second component of the final was to create a History of Mathematics timeline. This was a smashing success, and I was delighted by the results. Students were encouraged to be as imaginative as they could in creating a time line of any form. I wanted them to think about questions that were very important in the course. What will they choose to include in the timeline? What criteria will they use in making their selection? Where will they begin the timeline, how does this effect the story that is presented? They were asked to include a written rationale/explanation for their timeline, addressing these questions. They were also allowed to work in pairs if they wanted to.

The projects were indeed quite creative and varied. Two students made a History of Mathematics video, one wrote a history of mathematics children's book, some did various types of posters and maps. One excellent project was done by two women in the class. It was a mathematical quilt. Because it speaks for itself so well, I will include their essay describing the quilt in this article. I found this project significant for a number of reasons. We had spent time in class discussing the metaphors that are used for mathematics, and how one's metaphor influences the way one approaches mathematics. I found it very interesting that these two students chose the metaphor of a quilt for the history of mathematics. A quilt, being an archetypically female symbol, was a new way of conceiving of the history of mathematics, one which lends itself quite naturally to discussions of relationships: relationships between cultures (corresponding to the different colors in the quilt), relationships between different time periods (the positions on the quilt), and relationships between individual people or facts (represented by a patch) and the whole matrix of the quilt. I think it is not a coincidence that this project emerged in a course in which gender was recognized as a legitimate and significant factor of analysis. This created an atmosphere in which the students could choose a form of expression that might not have otherwise surfaced, or that they might have stifled for fear that it would be inappropriate.

Evaluation

This article is meant to generate ideas for alternative ways to approach the history of mathematics. Overall I thought the course was quite successful and most of the students seemed to agree. But as always there is endless room for improvement. One thing that must be acknowledged from the very start is that this was a kind of survey course, though it was not intended as a comprehensive survey. Perhaps a more appropriate description comes from the title of Asger Aaboe's book "Episodes in the Early History of Mathematics." It was meant to give students a glimpse at the deep and rich history of mathematics, but even more importantly to have them begin to think for themselves about the nature of mathematics, the evolution of mathematics, and the *humanness* of mathematics. My hope was that it would stimulate their interest in at least some aspect of the history of mathematics that they might pursue on their own. And at very least, that they might begin to see mathematics with new eyes, as an organic enterprise.

Because there was so much material to cover it was difficult to do justice to all aspects of the course. The third part of the course became much shorter than I had first envisioned. These kinds of balances can be played with depending on the interests of the students and the teacher.

In retrospect, I would revise the final so that there was at most one essay question (the second one). This is plenty of opportunity to pull the course together, and allows more time for the timeline projects. I would also alter some of the readings, delete some, add others. But those are the kind of changes and decisions that keep teaching stimulating.

Summary

As the demographics of our society change, we must be responsive to the changes in our population. The most notable change in higher education is the increased representation of various ethnic groups, and the now equal representation of women. In all disciplines, it behooves us to reevaluate how we teach our material, what we consider important and how we tell the story of the past.

The first step in opening the world of mathematics to other people is to find ways to make it more relevant to their lives. One way to do this is to look to the past to see how mathematics emerged in different cultures, and why. What made mathematics relevant to the lives of the people who developed it? For example, it may be that

music or art or games are the appropriate vehicles to introduce mathematical concepts of symmetry and combinatorics. If, as Steen suggests, mathematics is the study of patterns, we must decide where we look for patterns. Certainly music and art are rich sources of patterns. Simultaneously, it may be that we need to emphasize that the concept of proof has evolved over time, and to a certain extent is culturally dependent.

Most of all we need to emphasize that mathematics is a process, and to de-emphasize the pervasive image of mathematics as an external, eternal and objective truth that has little to do with human beings. By seeing the connections between the lives of individual mathematicians and the mathematics that they (or a culture) produces, students gain a sense of confidence in their own ability to use mathematics for their own needs, or to discover mathematics both as a tool and a language that we use to learn more about the world around us.

OUR MATHEMATICAL QUILT

Kathy Pryor and Anne Pellett

In attempting to determine how to structure our History of Mathematics time line, we had to face the awesome task of deciding, from the vast array of events, peoples and discoveries, which we considered most important. What we have created is largely a symbolic work. We have chosen a quilt format because we believe that, over the centuries, mathematics has developed in a variety of colors and patterns which, when all pieced together, constitute its history.

The green diamonds at the center of the quilt represent the contributions of the ancient Egyptian civilization, and the red diamonds represent the mathematical accomplishments of the Babylonians. We assigned each culture a separate color, for there is no historical evidence that they ever exchanged mathematical information. We did, however, place them side-by-side, intermingled the hues, because these primitive peoples both developed their civilizations during the period from approximately 4000 B. C. – 600 B. C. The yellow squares which surround the diamonds contain some of the mathematicians and mathematical accomplishments of the Greeks from Pythagoras through Euclid. These are followed by the blue trapezoids which consist of the mathematical advances of the Muslim and Hindu civilizations during the period from approximately the 7th through the 12th centuries A. D. We constructed the center in this fashion in order to show how the developments of each separate civilization sprang in some degree from that which preceded it. For example, the ancient Greeks gathered rules for the determination of areas and volumes from the Egyptians and advanced the process one step further by establishing symbolic proofs of these methods. Likewise, the Muslim civilization acted as the caretaker for Greek mathematical documents and added new innovations of its own such as algebra. Both the Hindu and Muslim cultures were assigned the same color because they existed geographically, and are said to have shared mathematical information with each other.

The Egyptian, Babylonian, Greek, Muslim, and Hindu civilizations were established as the focus of the quilt because they represent the foundation of the Western mathematics with which we are so familiar today, which has played such an important role in our own personal mathematical development and in the scientific and technological advances which have occurred through the ages.

At each of the four corners of this epicenter is a group of 5 squares representing a century of "Western" (that associated with Europe and the United States) mathematical development. In the upper left hand corner is the 17th century; in the upper right hand corner is the 18th century; in the lower right hand corner is the 19th century; and in the lower left hand corner is the 20th century. Each square within these four divisions consists of three sheets of construction paper. The green square represents the fact that the development belongs to "Western" mathematics, or what we traditionally *call* "Western Mathematics." The color of the square immediately on top of this represents the century (17th century = red; 18th century = yellow; 19th century = orange; 20th century = white). Finally, the hue of the topmost square represents a particular person and his mathematical contribution. We selected this structure because all of mathematical history, all of the advances which are made, take their shape from a unique combination of the advances which are made, take their shape from a unique combination of the attitudes and conditions of society during a given period of time, cultural events, whether positive or negative, and the special circumstances of each mathematician's life and work. To chronologically list theorems, etc., and to simply name their discoverers would fail to provide an adequate insight into the complex forces which together culminate in a mathematical advancement.

The manner in which we selected the mathematicians who would represent the various time periods also had a symbolic intention. Within each century, we chose

both individuals who are often hailed as the "Great Mathematicians" and some "little ones" whose contributions the world tends to pass over. For example, in the 19th century, we included Gauss, whose successes in the field of mathematics still can't be properly estimated, since he did not publish much of his work during this lifetime. He was responsible, among other things, for establishing number theory as an organic branch of mathematics. At the same time, however, we also devoted a portion of our quilt to Ada Byron Lovelace, for she was the first person to detail the process now known as computer programming, although it is only recently that she has begun to get the credit she so justly deserves. We sought to give a voice to mathematicians who are not as well known or perhaps are not as well-esteemed for their work — names that are not on the tip of the tongue when one is asked to list significant mathematicians. Although their efforts may not be regarded as gigantic achievements, they were nevertheless important because they constituted some sort of advancement, an attempt, however small, to move the field of mathematics on to greater development, not to allow it to stagnate. Besides, very often the smaller works ultimately facilitated the greater discoveries. The black squares and triangles in the quilt represent those who perhaps made mathematical innovations or worked diligently to solve some mathematical enigma, though possibly without great success, whom the history books don't even *mention*. To us, these unknowns are equally valuable as the knowns, for it is the spirit of all working mathematicians that keeps the flame of mathematical knowledge burning brightly into the future.

The squares which are half the color of one century and half the color of another are used to show that the mathematical developments which occur in one time period, ultimately have an impact on the advancements of later eras. Achievement is not made in a vacuum, but relies on the knowledge of times long gone by; it is a cumulative entry.

Finally, the red semi-circles and the orange triangles represent the mathematics developed by African and Chinese civilizations, respectively. We assigned these cultures a different shape because the mathematics "invented" by them is not historically believed to be linked with the progression of traditionally Western mathematics. To us, however, their mathematics *is* significant and valuable, and should be considered part-and-parcel of the history of this subject. It widens one's view of what specifically constitutes mathematics. The skills of pattern recognition and gesture counting, for example, which the Africans have cultivated and their proficiency in which we could not equal, show that it is possible to look at math from a different perspective. More importantly, by including these cultures in our quilt, we wanted to stress that just because their outlook is alien to ours, that doesn't mean it is any the less mathematical than our systems of formalized proof, etc.

Our quilt has been an effort to symbolize the complex forces at work in the development of mathematics. Indeed, the history of this subject contains much more than can be represented by a two-dimensional time line (_|__|__|__|_). It is a story of people of all genders, races, nationalities, etc., influenced by the times, by their cultures, and by their own unique personalities, striving to break new ground, to further the cause of mathematics. The combination of all of these motley patches together with the ones to be "sewed on" in the future (shown by the black fringe) comprises the history of mathematics. This is what we have learned and this is what we will take with use from this course.

HISTORY OF MATHEMATICS SYLLABUS FALL 1989 — HENRION

9/12

Topic:
General introduction to the course.

Assignment:
Hand in math autobiography.

9/14 – 9/19

Topic:
What is mathematics?

Readings:
1) *Mathematical Experience*, pp. 319–331, 391–399
2) "Three Crises in Mathematics" by Snapper in *Mathematics: People, Problems and Results, Vol. 2* [MPP&R, V2]
3) "The Science of Patterns" by L.A. Steen
4) "A Dialogue on the Applications of Mathematics" [MPP&R, V1], pp. 255–263
5) "Music of the Spheres" [MPP&R, V1], pp. 61–71

Discussion Questions:
1) What do we mean by mathematics? (What areas are included?)
2) Is mathematics discovered or created?
3) Is mathematical knowledge certain, i.e. always true?

4) If you were on an isolated island with other people, what kind of mathematics would you develop, if any?
5) What is the difference between pure and applied mathematics?
6) How do we decide what is important mathematics?
7) How do we decide what is true in mathematics?
8) Have the answers to any of these questions changed over time?

Assignments:

1) BEFORE doing the readings, write a short 1–2 page essay on "What is mathematics?." This is an informal essay on your reflections of what mathematics is all about. There is no right answer, I am interested in what *you* think. (DUE: Thursday, September 14)
2) Keep notes on the readings in your journal. Also write down your thoughts about the discussion questions in your journal.

9/21

Topic:
What is history? What is the history of mathematics?

Readings:

1) "History of Mathematics: Why and How?" by Andre Weil
2) "Reflections on Writing the History of Mathematics" by Philip Davis
3) "The Centrality of Mathematics in the History of Western Thought" by Judith Grabiner

Discussion Questions:

1) What is history?
2) What is the history of mathematics?
3) Is there such a thing as true history?
4) How do we decide what counts as important history?
5) Should the history of mathematics be approached differently than other types of history?
6) What would be interesting to *you* in the history of mathematics?
7) Discuss how you would go about looking for evidence of mathematical activity in an ancient culture. What would you look for? Where would you look for it?

9/26

NOTE:
Guest Speaker

Topic:
Mathematical People (Introduction)

Readings:

1) *Mathematical Experience* : "The Current Individual and Collective Consciousness," "The Ideal Mathematician," "The Individual and the Culture."
2) "Career and Home Life in the 1880's: The Choices of Mathematician Sofia Kovalevskaia" by Ann Koblitz in *Uneasy Careers and Intimate Lives.*

Discussion Questions:

1) What kinds of people do mathematics (is it possible to find similarities/themes)?
2) What motivates them (initially, sustains them)?
3) What kinds of family background (does this have bearing on their work)?
4) Personality. (Does this have bearing on work?)
5) What are the social conditions of the time? Does this effect their work?
6) How did they gain access to mathematics?
7) How do they view the nature of mathematics?
8) To what extent do mathematicians influence each other, to what extent do they work alone (i.e. role of the community)?
9) How have answers to these questions changed over time?

9/28

Topic:
Early Mathematicians (Pythagoras, Archimedes, Euclid)

Readings:

1) *A Short Account of the History of Mathematics* by W.W. Rouse Ball (on reserve in Starr Library). Chapter 2, p. 13–32 (especially material on Pythagoras); p. 50–77 (especially Euclid and Aristotle).
2) Boyer, Chapter 4 "Ionia and the Pythagoreans."
3) Chapters 7 and 8 of Boyer.

10/3

Topic:
Mathematicians 17th–18th Century (Descartes, Newton, Leibniz, Euler)

Readings:

1) [MPP&R V.1] Newton p. 113–124.
2) "The Life of Leonard Euler" by Rudolph Langer.
3) "Descartes" by Oliver Wendell Holmes.
4) "The Great Mathematicians" by Darrah.
5) Look through Chapter 19 of Boyer (many of you may not be familiar with much of the mathematics in this

chapter — that's okay, just read through what you can).
6) Boyer, p. 367–371 (Descartes).

10/5

Topic:
Mathematicians in the 19th-early 20th Century

Readings:
1) [MPP&R, V1] Gauss p. 125–133.
2) Hardy's *A Mathematician's Apology* (on reserve in Starr Library) p. 61.
3) [MPP&R V1] Mordell piece of Hardy, p. 155–159.
4) Ramanujan material.
5) [MPP&R, V1] Hamilton, p. 134–144.
6) [MPP&R, V1] Littlewood, p. 145–154.

10/10

Topic:
Modern Mathematicians 20th Century

Readings:
Choose 3 from *Mathematical People* (on reserve) — present one

10/12

Topic:
Women in Mathematics

Readings:
1) *Math Equals* by Teri Perl
2) Read whole book including summary.

Discussion Questions:
1) Who were the women in math?
2) Why so few?
3) What are the obstacles they have had to overcome to get into Mathematics and then to stay in?
4) What is the role of the larger community in their lives (support and discouragement)?
5) Are their motivations, sources of support any different than the men we've considered?
6) How do they view the nature of mathematics?
7) What do they like about math?
8) Are there historical periods in which there were more women doing math? What factors are important?

10/16

Guest Speaker

10/17

Topic:
Finish up and summary of "People in Mathematics."

10/19

Paper #1 Due
5 minute Presentations on papers

Topic: Mathematics In Different Cultures

10/26–10/31

Topic:
Early African Mathematics

Readings:
1) *Africa Counts* by Claudia Zaslavsky — Sections 1 & 2 (p. 1–58), Section 5 (p. 153–196).
2) Zaslavsky, Sections 3 and 4.

11/2

Topic:
Babylonian Mathematics (Ancient Mesopotamia = modern Iraq)

Readings:
1) Asger Aaboe, *Episodes from the Early History of Mathematics*, Chapter 1 (p. 1–33)
2) Boyer, Chapter 3.

11/7

Topic:
Early Egyptian Mathematics

Readings:
1) [MPP&R, V1] p. 3–17.
2) Boyer, Chapter 2.

11/9

Topic:
Early Greek Mathematics

Readings:
1) [MPP&R, V1] p. 18–27.
2) Boyer, Chapters 4 and 5.

11/14

Topic:
Early Chinese and Indian Mathematics

Readings:
1) [MPP&R, V1] p. 28–37.
2) Boyer, Chapter 12.

11/16

Topic:
Muslim Mathematics

Readings:
1) [MPP&R, V1] p. 38–46.
2) Boyer, Chapter 13

Topic: Non-Euclidean Geometry

11/28

Reading:
Chapter 1 "Euclid's Geometry" from Greenberg *Euclidean and Non-Euclidean Geometry.*

11/30 and 12/5

Readings:
1) Read Chapter 5 (p. 121–129), Chapter 6 (p. 140–147) from Greenberg.
2) Reread "Non-Euclidean Geometry" from *The Mathematical Experience* by Davis and Hersch.

12/7

Reading:
Read Chapter 8 from Greenberg.

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4. Berggren, J.L., *Episodes in the Mathematics of Medieval Islam*, Springer-Verlag, New York, 1986.
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Articles:

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