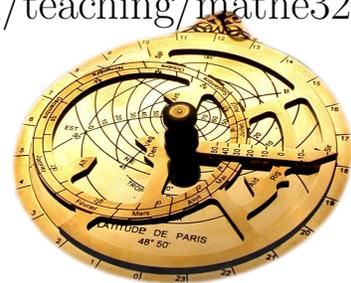


E-320: Teaching Math with a Historical Perspective

Oliver Knill, Harvard Extension, Spring 2022

Key information:

- **Website:** www.math.harvard.edu/~knill/teaching/mathe320_2022
- **Class:** Zoom, Mon 05:50 PM-07:50 PM
- **Instructor:** Oliver Knill
- **Email:** knill@math.harvard.edu



Abstract:

In this panoramic tour of mathematics we look at it on a grand scale, both topic as well as time wise. Each week covers an other part of mathematics ranging over several thousand years. The process of learning mathematics correlates with the history of mathematics. Also the struggle of research mathematicians exploring new mathematics is similar to the challenges which we students experience when learning already established mathematical theories. This process continues today. New mathematics is constantly developed and refined and taught. In our stroll through the landscape of all mathematics we get acquainted with various personalities and cultures. The visits of other epochs includes also our present time. It will help us to widen the horizon and to inspire other learners.

Prerequisites:

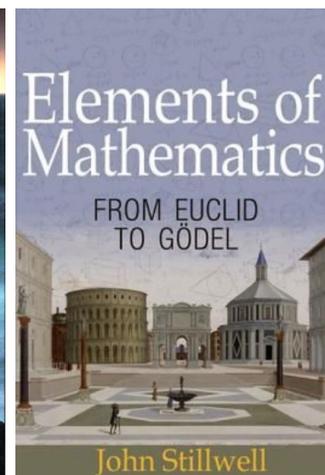
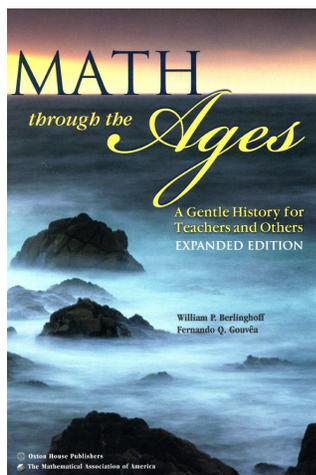
Any previous mathematics background is of advantage. More important is an open mind. Beautiful but unfamiliar mathematics can also be enjoyed without a vast background knowledge. Of course, more benefits can be drawn if it relates to other already familiar areas of mathematics.

Methodology:

The range of mathematical topics is broad. Our main goal is to stimulate interest, get a global view and see connections between different fields and different areas, different times and different approaches. After a general overview of mathematics in the first lecture, we will work in each week with a specific branch and in particular also focus on its historical context. We mainly follow the **case method** rather than a systematic **encyclopedic approach**. We also recommend some light reading on the side. Specific stories can be engaging and each “case” can serve as a crystallization point for an entire subject. In a time, when knowledge explodes fast and a plethora of possibilities are offered electronically, teaching requires both to be broad as well as some care for details. The dilemma of combining these two extremes can be achieved with a “short story approach” combined by mixing different teaching elements like presentation, story telling, experimentation, discussion, problem solving and identify historical highlights. Participants can adapt such models for their own teaching. Also pedagogical questions will come up. One main theme will be a general general principle: difficulties for the pioneers developing a topic reverberate today in the classroom.

Text:

No textbook is required. Reading material is provided. For background, the book "Math through the Ages", by William Berlinghoff and Fernando Gouvea or the book of "Elements of Mathematics" by John Stillwell have been proven good choices.



Project:

The project topic this spring is:

“Mathematics: art, science or tool?”

Write an essay about this and discuss it in three different chapters: from -4000 to 1000 from 1000 to 1700 and from 1700 to now. In each of these epochs, pick a mathematician, then let him or her introduce him or her self, then answer the above question.

Course policies:

We follow the standard Harvard Extension School's policies on academic integrity. It can be accessed online at

[www.extension.harvard.edu/resources – policies/student – conduct/academic – integrity](http://www.extension.harvard.edu/resources-policies/student-conduct/academic-integrity)

This document also describes how to use sources responsibly. In particular, the project in this course and the quiz should be written and completed by each student individually. For the homework assignment, discussions among students is encouraged.

Grades:

We expect attendance by video conference with video turned on. The course grade is based on three parts:

- Quizzes: 20 percent
- Homework: 20 percent
- Class participation: 20 percent
- The final project: 40 percent

Day to Day Syllabus:

The lecture sequence has worked well when the course was taught in the past. We use part of the lecture to get an overview over the topic in a lecture. We then discuss a particular problem in the subject. We then use part of the discussion to review the lecture and prepare for the quiz done in class.

Lecture	Topic	Presentation
January 24, 2022	0) Mathematics	What is mathematics?
January 31, 2022	1) Arithmetic	Number Systems
February 7, 2022	2) Geometry	Symmetries and Shapes
February 14, 2022	No class	Presidents day
February 21, 2022	3) Number Theory	Primes and Equations
February 28, 2022	4) Algebra	Puzzles and Structures
March 7, 2022	5) Calculus	Summations and Differences
March 14, 2022	6) Set theory	Infinities and Paradoxa
March 21, 2022	7) Probability	Chance and Processes
March 28, 2022	8) Topology	Polyhedra and Invariants
April 4, 2022	9) Analysis	Fractals and Dimension
April 11, 2022	10) Cryptology	Codes and Ciphers
April 18, 2022	11) Dynamics	Chaos and Time
April 25, 2022	12) Computer Science	Artificial Intelligence
May 2 2022	13) Project	Writing projects