History of Mathematics

James Tattersall, Providence College (Chair)
Janet Beery, University of Redlands
Robert E. Bradley, Adelphi University
V. Frederick Rickey, United States Military Academy
Lawrence Shirley, Towson University

Introduction. There are many excellent reasons to study the history of mathematics. It helps students develop a deeper understanding of the mathematics they have already studied by seeing how it was developed over time and in various places. It encourages creative and flexible thinking by allowing students to see historical evidence that there are different and perfectly valid ways to view concepts and to carry out computations. Ideally, a History of Mathematics course should be a part of every mathematics major program.

A course taught at the sophomore-level allows mathematics students to see the great wealth of mathematics that lies before them and encourages them to continue studying the subject. A one- or two-semester course taught at the senior level can dig deeper into the history of mathematics, incorporating many ideas from the 19th and 20th centuries that could only be approached with difficulty by less prepared students. Such a senior-level course might be a capstone experience taught in a seminar format. It would be wonderful for students, especially those planning to become middle school or high school mathematics teachers, to have the opportunity to take advantage of *both* options.

We also encourage History of Mathematics courses taught to entering students interested in mathematics, perhaps as First Year or Honors Seminars; to general education students at any level; and to junior and senior mathematics majors and minors. Ideally, mathematics history would be incorporated seamlessly into all courses in the undergraduate mathematics curriculum in addition to being addressed in a few courses of the type we have listed.

All History of Mathematics courses should incorporate the reading of original sources. Many outstanding mathematicians have acknowledged the benefit they have received from reading the masters.

Cognitive Learning Goals. Mathematics history courses are especially effective in helping students improve in the following areas:

- Integration of ideas usually found in several different mathematics courses;
- multiple representations of concepts and multiple ways of understanding them;
- generalizing from examples to more and more abstract characterizations of ideas;
- written and oral communication of mathematical ideas and techniques.

The objectives (and outcomes) for math history courses also include clear, critical, creative, and flexible thinking, and an appreciation for the beauty and joy of mathematics.

It is important for students to develop an understanding of mathematics both as a science and as an art. Mathematics as a deductive science is emphasized in most mathematics courses; as an art,

mathematics is a creative subject that includes the application of inductive insights and intellectual curiosity to the solution of problems and the formulation of theorems.

Also important is the ability to develop a broad concept of the mathematical sciences as approachable from several points of view, including:

- problem-solving as a basis for the initial development of many concepts;
- mathematics as a human endeavor created by individuals of both genders with their insights and idiosyncrasies;
- mathematics as a cultural heritage and the evolving role of mathematics in cultures throughout the world;
- the impact of social, economic, and cultural forces on mathematical study and creativity;
- interrelations among the various branches of mathematics, especially their role in the solution of significant problems and in extending the horizons of mathematics;
- and the dynamic nature of mathematics, including recent developments in pure and applied mathematics and the increasing role of technology.

Diversity of Students and Courses. In recent years, History of Mathematics courses have been taught at a variety of levels to several different student audiences. In addition to courses for mathematics majors and minors, there are courses for graduate students, courses to satisfy general education requirements, and courses for prospective elementary teachers. Essentially, the audience includes every student at all interested in mathematics!

The background of the students very much determines the level of the course. It is a challenge to accommodate students with different backgrounds. One approach is to study the history of ideas that are common to the students' mathematical background. This can be done in a manner that challenges, deepens, and develops students' understanding of that mathematics. Extending the students' mathematical knowledge is encouraged provided that attention is paid to both the historical and mathematical development of the subject. For example, a course composed mainly of general education students might require only high school algebra and geometry and would consist largely of a study of how arithmetic, algebra, and geometry have been understood and developed over time and in various cultures. Such a course also could include an introduction to combinatorial topics new to most of the students, such as counting of permutations and combinations, properties of the Pascal triangle, and/or existence of Euler circuits in networks (graphs), via historical treatment of these topics. Topics for individual (or small group) student projects could be assigned based on individual student backgrounds, depending on the extent to which students are expected to share their projects with the rest of the class.

The largest audience for History of Mathematics courses has been mathematics majors and minors, especially those preparing to teach secondary school. Future secondary mathematics teachers are served not only by giving them a good sense of how mathematics developed but also by providing them with ideas about how the history of mathematics can be incorporated in their classrooms to motivate and instruct their own students. The common mathematical knowledge of students in such courses may extend only through the Calculus. Students in such courses certainly should study the rich (and related) histories of algebra, geometry, and calculus, but also could be introduced to topics in combinatorics, number theory, and higher algebra and analysis via their histories. Again, topics for individual (or small group) student projects could be

assigned based on individual student backgrounds, depending on the extent to which students are expected to share their projects with the rest of the class.

Even when mathematics history is taught as a senior seminar or capstone course, the common mathematical background of the students may include a relatively small number of mathematics courses or fields. As in the courses addressed above, most of the students' common experiences in this course should include mathematics common to all of them, with mathematics new to any of them introduced as new mathematics via its history. Students could and should pursue their own mathematical specialties and interests via individual projects.

In addition to gaining a deeper understanding of mathematics at the appropriate level, all mathematics history students will obtain an appreciation of the role mathematics has played for centuries in western culture and to recognize achievements in other cultures. We hope mathematics history courses will help to counteract the fear and hatred of mathematics that many general education or liberal arts students express. We hope that students who love mathematics will feel even more closely connected to culture and society after studying the central role played by mathematics in both. We also hope studying mathematics history will help these students better communicate mathematical ideas to those whose mathematical understanding is not as great as theirs.

Prerequisites. The requirements for three disparate groups are the following:

1. Mathematics majors and minors, especially those preparing to teach secondary school mathematics: These prerequisites vary, but often include only Calculus I, II, and/or III; sometimes Linear Algebra and/or an introduction to proofs course.
2. Masters degree students preparing to teach or currently teaching secondary school mathematics: same as above, but perhaps not as recently.
3. General education students: high school algebra and geometry.

Methodology. In most states prospective secondary teachers are required, in order to obtain a teaching certificate, to take a course in the history of mathematics. This positive development took place in the past two decades and has put a burden on departments to find willing and qualified teachers. The NCTM standards have encouraged college faculty to model the student-centered interactive instruction that future teachers are expected to use. Thus the lecture method of teaching has been discouraged in favor of in-class activities, group work, discussion, and student presentations. Perhaps the biggest change in the teaching method used in History of Mathematics courses is the use of original sources. To read an original piece of mathematics, even in English translation, gives the student a much better understanding of how its author thought about, understood, and developed mathematics and of what it means to do history of mathematics. Usually, instructors who wish to have students grapple with original sources use reading from sourcebooks from the list below and/or material found on the web. They often have students work through passages from original sources in small group discussion outside of class or, more commonly, in small group or whole group discussion in class, and they sometimes have students explain these passages in writing.

Although mathematics history instructors assign their share of rather traditional mathematics homework exercises or problems, many of them provided in the math history texts they use, student presentations and research papers are more common in mathematics history courses than in other math courses. These presentations and papers vary in length (from course to course or within a single course), but typically focus on individual mathematicians or on individual results or topics in mathematics history. Those who use William Dunham's *Journey Through Genius: The Great Theorems of Mathematics* (see list of texts below) as a text for their courses often assign a "great theorem paper" written in the form of an additional chapter for the text as a major paper or final project for their courses.

If possible, a history of mathematics course should include a field trip. Here are three suggestions.

1. Visit a museum to see the impact that mathematics has had on our world and our culture. For example, the sculpture of Henry Moore was influenced by the string models that Theodore Olivier designed to teach descriptive geometry. Salvador Dali used concepts of higher dimensional geometry in his art.
2. Students could visit a rare book room and experience the thrill of holding a copy of a work by Euclid, Descartes, Newton, Euler, etc., in their own hands. Seeing pictures on the internet is a good first step, but seeing, smelling, and, if possible, touching the real thing is an inspiring experience that can enhance the students' desire to understand the knowledge contained in the books.
3. Of course, it would be wonderful to take students to England, France, Germany, Italy, Greece, India, and/or China to view sites where mathematics has been created and to view some of the great science and art museums in those countries. A somewhat more realistic adventure for students in the U.S. might be to visit Maya ruins, museums, and cultural centers in Belize, Guatemala, and Mexico.

Technology. While there are several books of original sources in mathematics, there are also several internet sites where such sources and projects that use them can be found. As in other mathematics courses, computer animations and interactive applets can be helpful in developing students' mathematical understanding.

Perhaps the most important and pervasive goal for students in mathematics history courses is the understanding of the history and evolution of mathematical ideas common to the mathematical education of all students in the course, thereby gaining deeper understanding of these mathematical concepts. Mathematics history courses also should emphasize the understanding of mathematics as a significant and central human endeavor motivated as much by human curiosity as by practical application, to include (a) relationships between culture and mathematics and (b) biographical information about human inventors (or discoverers) of mathematics. Finally, they should include some consideration and understanding of how history is done, e.g. what's our evidence, what constitutes good evidence, how do our own beliefs and world view influence our interpretation of evidence and our understanding of history and mathematics, etc.

Sample topics.

A textbook-based course:

- Egyptian geometry and arithmetical operations
- Babylonian geometry and number system
- Euclid's *Elements*
- The Geometry of Archimedes and Eratosthenes
- Chinese mathematics and problem solving
- Islamic mathematics and art
- Medieval mathematics, especially solving the cubic
- The Copernican revolution
- Newton and Leibniz and the calculus
- Eulerian contributions.
- Gauss, Cauchy, Riemann and rigorous calculus/analysis
- Ethnomathematics
- Women and mathematics
- Modern mathematics

A course based on primary sources:

- Hippocrates' quadrature of the lune
- Euclid's proof of the Pythagorean theorem
- Euclid and the infinitude of primes
- Archimedes' determination of circular area
- Heron's formula for triangular area
- Fibonacci and the rabbit problem
- Al-Khwarizmi on quadratic equations
- Cardano and the solution of the cubic
- Napier and logarithms
- Newton's binomial theorem
- Newton & Leibniz on the calculus
- Euler on number theory
- Cantor and the infinite

Bibliography

Popular Textbooks: The most popular current textbooks for History of Mathematics courses.

Remark*: The presence of a text on this list is not meant to imply an endorsement of that text, nor is the absence of a particular text from the list meant to be an anti-endorsement. The texts are chosen to illustrate the sorts of texts that support various types of courses.*

1. Berlinghoff, William P., and Fernando Q. Gouvêa, *Math Through the Ages: A Gentle History for Teachers and Others*, Expanded Edition, Oxton House and MAA, 2004.

   Excellent overview of the history of mathematics, good for students with little or no calculus and post-calculus. The expanded edition is rich in exercises and projects; first edition lacks these.

2. Boyer, Carl B. and (revised by) Uta Merzbach, *A History of Mathematics*, New York: John Wiley, 2nd ed., 1989.

   This stands second to Katz in quality and comprehensiveness of coverage.

3. Burton, David M., *The History of Mathematics: An Introduction*, 7th ed., McGraw-Hill, 2011.

   Good general text, aimed at upper division mathematics majors. Organization is both chronological and thematic. Rich in exercises. Non-Western mathematics is somewhat limited.

4. Dunham, William, *Journey Through Genius: The Great Theorems of Mathematics*, Penguin, 1990.

   Wonderfully readable! Not designed as a textbook, but often used as one. The history of mathematics is told through a series of 12 episodes, arranged chronologically. Each chapter features a "great theorem." Proofs are modern, in the spirit of the originals, but not the originals. No exercises in text, but the author has published a set for each chapter online at MAA *Convergence*.

5. Katz, Victor J., *A History of Mathematics: An Introduction*, 3rd ed., Addison-Wesley, 2009.

   Excellent general textbook, aimed at upper division mathematics majors. Organization is both chronological and thematic. Includes a large number of exercises. Part 2, on Medieval Mathematics, has significant concentration on non-Western mathematics. A brief edition appeared in 2004. Every instructor should have a copy of this text for reference.

Source Books: Source books from which instructors have chosen examples to use in an original sources based course.

6. Barnett, Janet, David Pengelley, *et al*, "Primary Historical Sources in the Classroom: Discrete Mathematics and Computer Science," *Convergence* (online), MAA, 2013.

   Sixteen teaching modules designed to help guide students through original writings.

7. Calinger, Ronald (ed.) *Classics of Mathematics*, Englewood Cliffs, New Jersey: Prentice Hall, 1995.

   A source book with more than 130 readings, from one to a dozen or so pages in length. Includes a reasonable number of non-Western sources. The introduction and biographies are useful.

8. Fauvel, John and Jeremy Gray (eds.), *The History of Mathematics: A Reader*, MAA, 1996 (Macmillan, 1987)

   Comprehensive selection of relatively short passages from original sources with plenty of introductory material.

9. Katz, Victor J. (ed.), *The Mathematics of Egypt, Mesopotamia, China, India, and Islam: A Source Book*, Princeton, 2007.

   Detailed collection of original writings in non-European mathematics.

10. Laubenbacher, Reinhard and David Pengelley (eds.), *Mathematical Expeditions*, Springer, 1999.

    Focuses on sources in geometry, set theory, analysis, number theory, and algebra.

11. Knoebel, Arthur, Reinhard Laubenbacher, Jerry Lodder, and David Pengelley (eds.), *Mathematical Masterpieces*, Springer, 2007.

    Includes sources relevant to curvature, the quadratic reciprocity law, solving equations, and summability.

12. Smith, D.E., *A Source Book in Mathematics* (2 volumes), McGraw-Hill, 1929; Dover, 1959.

    Large collection of original sources, *Treviso Arithmetic* (1478) into late 1800s.

13. Stedall, Jacqueline, *Mathematics Emerging: A Sourcebook 1540-1900*, Oxford, 2008.

    Aimed at upper level courses. Includes facsimiles of originals.

14. Struik, D.J. (ed.) *A Source Book in Mathematics, 1200-1800*, Princeton, 1986.

    Collections of original writings, Fibonacci and Recorde to Gauss and Monge.

Supplementary Textbooks and Instructor Resources: These works have sometimes been used as supplementary textbooks or are useful as a resource for the teacher.

15. Aaboe, Asger, *Episodes from the Early History of Mathematics*, MAA, 1964.

    More of a resource for instructors than a textbook. There are four episodes: Babylonian tablets, Euclid, Archimedes, Ptolemy. It is somewhat dated but well-written.

16. Albers, Donald J. and G.L. Alexanderson (eds.), *Mathematical People*, Birkhauser, 1991, *More Mathematical People*, 1900, and *Fascinating Mathematical People: Interviews and Memoirs*, Princeton, 2011.

    Biographical essays on modern mathematicians that students find fascinating.

17. Ascher, Marcia, *Ethnomathematics: A Multicultural View of Mathematical Ideas*, Brooks-Cole, 1991 and *Mathematics Elsewhere: An Exploration of Ideas Across Cultures*, Princeton, 2002.

    Examples of mathematical thinking in non-Western cultures.

18. Bell, E.T, *Men of Mathematics*, Simon & Schuster, 1937.

    A classic collection of biographies and stories. When chapters of this book are assigned to students, very good discussions can arise as students recognize the author's prejudices and discrepancies with more recent sources.

19. Bidwell, James, and Robert Clason, *Readings in the History of Mathematics Education*, NCTM, 1970.

    History and original source material on the development of school mathematics in the U.S.

20. Bunt, Lucas N. H., Phillip S. Jones, and Jack D. Bedient, *The Historical Roots of Elementary Mathematics*, Dover 1988.

    History of elementary mathematics, mostly pre-modern. A good source of exercises.

21. Cooke, Roger, *The History of Mathematics: A Brief Course*, Wiley, 1997.

    A textbook for a History of Mathematics course.

22. Dahan-Dalmédico, Amy and Jeanne Peiffer, *History of Mathematics: Highways and Byways*, MAA, 2010.

Contains and informative overview of several aspects of the history of mathematics aimed at students, teachers, and to a general audience.

23. Dauben, Joseph and Christoph Scriba, *Writing the History of Mathematics – Its Historical Development*, Birkhäuser, 2002.

As a historiographic monograph for a general audience, this book contains an informative and detailed survey of the professional evolution and significance of an entire discipline devoted to the history of science.

24. Davis, Philip, and Reuben Hersh, *The Mathematical Experience*, Birkhauser, 1981.

Discusses mathematics philosophy and meaning in terms of how mathematicians work.

25. Devlin, Keith, *The Man of Numbers: Fibonacci's Arithmetic Revolution*, Walker, 2011.

History of Fibonacci's introduction of Hindu-Arabic numeration to Europe.

26. Dewdney, A.K., *A Mathematical Mystery Tour*, Wiley, 1999.

Historical essays based on stops at historical places in an actual trip by the author.

27. Dunham, William, *Euler: The Master of Us All*, MAA, 1999.

Biography of Euler and his work, preparing for the 300th anniversary of his birth.

28. Eves, Howard *An Introduction to the History of Mathematics*, Saunders, 1990.

A once standard and still popular history of mathematics.

29. Fauvel, John and Jan van Maanen (eds.), *History in Mathematics Education: The ICMI Study*, Kluwer, 2000.

Reports from an International Commission on Mathematical Instruction review of the use of mathematics history in mathematics education.

30. Gardner, Martin: many articles and books on recreational (but substantive!) mathematics; now his monthly columns are collected in *Martin Gardner's Mathematical Games: The Entire Collection of his Scientific American Columns* (CD format), MAA, 2005.

31. González-Velasco, Enrique A., *Journey Through Mathematics: Creative Episodes in Its History*, Springer, 2011.

Not so much a textbook for students, but more a guide for instructors. Organized thematically. Topics include trigonometry, logarithms, calculus, power series. No exercises, carefully footnoted.

32. Gowers, Timothy (ed.), *The Princeton Companion to Mathematics*, Princeton, 2008.

Massive one-volume collection of articles on all areas of mathematics.

33. Grabiner, Judith V., *A Historian Looks Back: The Calculus as Algebra and Selected Writings*, MAA, 2010.

A collection of her essays, many of which were prize-winning.

34. Green, Judy and Jeanne LaDuke, *Pioneering Women in American Mathematics: The Pre-1940 PhDs*, AMS, 2008.

An in-depth look at every American woman who obtained the Ph.D. in mathematics before 1940.

35. Greenwald, Sarah and Jill Thomley (eds.), *Encyclopedia of Mathematics and Society*, Salem, 2011.

Three volumes of articles of mathematics interacting with society—including historical examples.

36. Grinstein, Louise S. and Paul J. Campbell, *Women of Mathematics*, Greenwood, 1987.

There is a lot of literature on women mathematicians, but this is the best.

37. Hawking, Stephen (ed.), *God Created the Integers: The Mathematical Breakthroughs that Changed History*, 2nd edition, Running Press, 2007.

The first edition lacks index and has accuracy issues. The second edition is better and includes four more authors. Original sources, with excerpts of significant length from 21 authors. Each is accompanied by biography and commentary. Mostly 19th and 20th century sources, demanding an advanced mathematical level.

38. Jones, Philip (ed.), *A History of Mathematics Education in the United States and Canada* (32nd Yearbook), NCTM, 1970.

Developments in American mathematics education over two centuries.

39. Joseph, George, *The Crest of the Peacock: Non-European Roots of Mathematics*, Penguin, 1992.

Covering history of mathematics in China, India, Middle East, and generally non-European.

40. Katz, Victor, J. (ed.), *Using History to Teach Mathematics: An International Aspect*, MAA, 2000.

This book brings together articles from well-known contemporary authors and provides many insights into how the history of mathematics can find application in the teaching of mathematics itself.

41. Katz, Victor J. and Karen Dee Michalowicz (eds.), *Historical Modules for the Teaching and Learning of Mathematics*, MAA, 2004.

This CD contains materials for eleven topics that are normally taught in the secondary curriculum; they can be used in classes from Pre-Algebra up through Calculus. Each topic contains a historical background, student pages, and teacher pages with teaching suggestions and solutions to the student problems. The activities vary in length, and the time frames vary from fifteen minutes to one or more weeks.

42. Kline, Morris, *Mathematical Thought from Ancient to Modern Times*, Oxford, 1972.

Detailed history, with much mathematics content included, Babylonians to early 20th century.

43. Knorr, Wilbur, *The Ancient Tradition of Geometric Problems*, Birkhäuser, 1986.

This study focuses on attempts by Hippocrates, Archimedes, and other ancient Greeks to solve three classical problems: cube duplication, angle trisection, and circle-quadrature.

44. Kramer, Edna, *The Nature and Growth of Modern Mathematics*, Princeton, 1981.

From Babylonians through foundationism of early 20th century, often in cultural context.

45. Lumpkin, Beatrice and Dorothy Strong, *Multicultural Science and Math Connections*, J. Weston Walch, Portland, Maine, 1995, and
Lumpkin, Beatrice, *Algebra Activities from Many Cultures*, J. Weston Walch, Portland, Maine, 1997.

Middle school activities and projects.

46. May, Kenneth, *Bibliography and Research Manual of the History of Mathematics*, Toronto, 1973.

A detailed guide to doing research and writing in the history of mathematics.

47. Nahin, Paul J., *An Imaginary Tale: The Story of* $\sqrt{-1}$, Princeton, 1998.

History of the effort to understand imaginary numbers.

48. National Council of Teachers of Mathematics, *Historical Topics for the Mathematics Classroom* (31st Yearbook), NCTM, 1969, 1989.

Historical essays on broad areas of mathematics and many "capsules" on specific topics.

49. Newman, James (ed.), *The World of Mathematics* (4 volumes), Simon & Schuster, 1956.

A large collection of a wide variety of articles about mathematics, including historical essays.

50. Parshall, Karen H. and Rowe, David E., *The Emergence of the American Mathematical Research Community, 1876-1900: J.J. Sylvester, Felix Klein, and E.H. Moore*, AMS, 1994.

Concerns the origins of graduate research in mathematics in the United States.

51. Perkins, David, *Calculus and Its Origins*, MAA, 2012.

A collection of results showing how calculus came into being from its roots in ancient Greece to its discovery in the seventeenth century.

52. Perl, Teri, *Math Equals: Biographies of Women Mathematicians and Related Activities*, Addison-Wesley, 1978.

Biographies of women mathematicians, aimed at classroom use.

53. Robson, Eleanor and Jacqueline Stedall, *The Oxford Handbook of the History of Mathematics*, Oxford, 2009.

Thirty-six essays on various aspects of the subject.

54. Stewart, Ian, *In Pursuit of the Unknown: 17 Equations That Changed the World*, Basic Books, 2012.

Development of 17 keys equations, including several in applied mathematics.

55. Stillwell, John, *Mathematics and Its History*, Springer-Verlag, 1989, 2010.

Undergraduate textbook, with some topics often not covered, and contextual essays. Consists of twenty-five thematic chapters, including a significant amount of 20th century material. Good selection of demanding exercises that will challenge upper division undergraduates.

56. Struik, D.J., *A Concise History of Mathematics*, Dover, 1995.

Old, but still useful for more advanced mathematics.

57. Suzuki, Jeff, *A History of Mathematics*, Prentice-Hall, 2002.

A general textbook for a History of Mathematics course. Includes two chapters on non-western mathematics. Reasonable selection of exercises.

58. Swetz, Frank (ed.), *From Five Fingers to Infinity: A Journey Through the History of Mathematics*, Open Court, 1994.

A large collection of articles on the history of mathematics, from ancient to modern.

59. Swetz, Frank, *Learning Activities from the History of Mathematics*, J. Weston Walch, 1994.

Trying out historical ideas as classroom activities.

60. Swetz, Frank, John Fauvel, and Otto Bekken (eds.), *Learn from the Masters! (Classroom Resource Materials)*, MAA, 1995.

Activity lesson material, for using the history of mathematics in teaching mathematics, also appropriate for mathematics history courses.

61. Swetz, Frank, and Kao, T.I., *Was Pythagoras Chinese?*, Pennsylvania State/NCTM, 1997.

Examples of Chinese mathematics, including some that were also studied in Europe.

62. Swetz, Frank, *Mathematical Expeditions: Exploring Word Problems across the Ages*, Johns Hopkins, 2012.

A collection of over 500 culturally and historically diverse mathematical problems.

63. Swetz, Frank, *The Search for Certainty: A Journey through the History of Mathematics from 1800-2000,* Dover, 2012 and *The European Mathematical Awakening: A Journey through the History of Mathematics from 1000 to 1800,* Dover, 2013.

    Collections of articles from the now out-of-print *From Five Fingers to Infinity.*

64. Szpiro, George G., *Kepler's Conjecture: How some of the greatest minds in history helped solve one of the oldest math problems in the world*, Wiley, 2003.

    400 years of struggle to solve a seemingly simple problem of efficiently stacking spheres.

65. Wardhaugh, Benjamin, *How to Read Historical Mathematics,* Princeton, 2010.

    Every instructor should read this short text for it will aid their teaching when original sources are used.

66. Zaslavsky, Claudia, *Multicultural Mathematics: Interdisciplinary Cooperative-Learning Activities,* J. Weston Walch, Portland, Maine, 1993 and *Multicultural Math: Hands-on Math Activities from Around the World,* Scholastic Books, Jefferson City, Missouri, 1994.

    Set up as a series of exercises to explore the mathematics of various cultures.

67. Zaslavsky, Claudia, *Africa Counts: Number and Pattern in African Culture*, Lawrence Hill, 1999.

    Examples of mathematics applications in traditional African cultures.

Online resources

68. The goals of History of Mathematics courses vary from instructor to instructor and from course to course. For a collection of the aims of History of Mathematics courses, see http://fredrickey.info/hm/mini/.

69. *Convergence* is the MAA's online magazine on the history of mathematics and its use in teaching. It includes articles on the history of mathematics; material on the history of mathematics that can easily be used in teaching; reviews of books, websites, and teaching materials relevant to the history of mathematics; and more.

70. MacTutor History of Mathematics Archive: On this website one can find listings of many historical topics and brief biographies of over 2000 mathematicians.

71. Dr. Duncan Melville (St. Lawrence University) has compiled information on Mesopotamian Mathematics, including a calculator (without such a device it was very difficult to check the connections between the numbers on Plimpton 322), as well as a syllabus for his course on Ancient and Classical Mathematics. It can be found on his website.

72. The Story of Mathematics website covers the whole of the history of mathematics, but there is less detail than is desirable. Good for lower-level students.

73. Mathematicians of the African Diaspora website contains a wealth of material. Africa tends to be ignored in HM courses, yet many of our students are interested. Here is one place where they can go to learn and create projects of their own.

74. National Curve Bank: This site has animations of most of the curves that are mentioned in a History of Mathematics course. If students find something missing, or something that they can do better, then they can publish their work here.

75. Vignettes of Ancient Mathematics: There is a great wealth of material here about ancient philosophy and physics.

76. History of Mathematics websites: a list a websites dedicated to the history of mathematics.

77. British Society for the History of Mathematics

78. Learning Discrete Mathematics and Computer Science via Primary Historical Sources.

This website contains information on the history of mathematics by region and subject.

Twitter: Also, you can get approximately daily tweets from the British Society for the History of Mathematics: @mathshistory