Preface

Mathematical Time Capsules offers teachers historical modules for immediate use in the mathematics classroom. Relevant history-based activities for a wide range of undergraduate and secondary mathematics courses are included. The genesis of this volume was a Contributed Papers Session on *Using History of Mathematics in Your Mathematics Courses*, organized by the editors at the Joint Mathematics Meetings, San Antonio, Texas, in January of 2006. That session was very well attended, which prompted Andrew Sterrett from MAA publications to suggest that we put together our second volume for the MAA Notes series.

Purpose

For a wide variety of reasons, instructors are looking for ways to include the history of mathematics in their courses. It is not uncommon to see requests for "how to" posted to the History of Mathematics Special Interest Group of the MAA (`www.homsigmaa.org`) email list, such as this 2008 posting:

> *...I am a newcomer to HOM. Where and how should a newcomer begin? Right now, I would liketo include HOM in a meaningful way in the courses that we teach. Weteach courses from college arithmetic to linear algebra.*

In response to such inquiries, we hope to serve the broader mathematical community by offering practical suggestions on how to use the history of mathematics quickly and easily in the mathematics classroom.

A *time capsule* can be defined as a container preserving articles and records from the past for scholars of the future. Of course our volume does not fit that precise definition, but readers who open this book will find articles and activities from mathematics history that enhance the learning of topics typically associated with undergraduate or secondary mathematics curricula. Each capsule presents one topic or perhaps a few related topics, or a historical thread that can be used throughout a course. The capsules were written by experienced practitioners to provide other teachers with the historical background, suggested classroom activities, and further references and resources on the chapter subject. An instructor reading a capsule will have increased confidence in engaging students with at least one activity rich in the history of mathematics that will enhance student learning of the mathematical content of the course. Most of the historical topics contained in a capsule can be implemented in one class period with minimal additional preparation on the part of the teacher.

How to use Mathematical Time Capsules

Teaching styles have been categorized along a spectrum from lecture-oriented practices at one extreme to student-centered approaches in which the teacher guides student work in the classroom. *Mathematical Time Capsules* respects the diversity of teaching styles which individual teachers adopt. Some of the capsules are, in some sense, ready-made lectures the instructor can adopt and adapt as appropriate. Examples of those include Victor Katz's "Copernican Trigonometry," Roger Cooke's "Numerical Solution of Equations," or Jim Tattersall's "Finding the Greatest Common Divisor and More... ." Other capsules clearly engage the students more actively, such as Vicky Klima's "A Different Sort of Calculus Debate." But the capsules should not be categorized as appropriate for one pedagogical approach or the other. For example, "Finding the Greatest Common Divisor and More..." could be adapted for use as a student project to be presented by the student(s) in class after the Euclidean algorithm is covered.

The reader may note that the authors of the capsules demonstrate a variety of approaches to integrating history. The differences are consistent with the nature of this volume, created with respect for the diversity of our authors and our readers. We acknowledge that many teachers prefer to develop their own course materials, and we encourage readers to modify the offerings of the authors.

Mathematical Time Capsules is organized in three sections. The first capsules have as their target mathematical topics that are usually addressed in courses taught in secondary school, at two-year colleges, or during the first two years of the undergraduate mathematics curriculum. These courses are not often taken by mathematics majors, and include, for example, algebra, geometry, mathematics for elementary teachers, trigonometry, or precalculus.

The third section of capsules address topics included in courses traditionally taken by mathematics majors, such as calculus, differential equations, number theory, abstract algebra, differential equations, and analysis.

As an interlude between the first and third, we offer some ideas that can be applied to a wide variety of courses throughout the undergraduate (including two-year college) or secondary curriculum. These interlude capsules (15, 16, and 17) are of a general pedagogical nature, not mathematical, and could be adapted for use in any course.

We could have arranged the capsules differently, and we ask that the reader not limit investigating the offerings in this book thinking that lower-level material is in the front and upper-level material at the back. For example, a teacher interested in historical ideas for a numerical methods course should consider Roger Cooke's "Numerical Solution of Equations," Randy Schwartz's "Rule of Double False Position," Clemency Montelle's "Roots, Rocks, and Newton-Raphson Algorithms for Approximating $\sqrt{2}$ 3000 Years Apart," and Dick Jardine's "Euler's Method in Euler's Words." Some teachers are interested in having students read original sources in the history of mathematics, and Montelle's "Amo, Amas, Amat! What's the Sum of That?" and Jardine's "Euler's Method in Euler's Words" provide opportunities to do just that with brief excerpts in the words of the originators.

Where possible, we grouped the capsules within the sections according to mathematical subject area. As an example, there are three capsules that address Pythagorean triples, but each of those capsules approaches the topic in a very different way and from the perspective of a different era of the history of mathematics. That latter notion is significant, as it is important for students to see the evolution of a mathematical idea and how it is viewed through a different lens depending on how mathematics was done at various times in history. One of the goals of *Mathematical Time Capsules* is to provide a vehicle for teachers to help their students learn the historical context for a mathematical development while they are learning the specific mathematical concept. Learning the history of an idea promotes deeper understanding of the idea.

Additional purposes—assessment and teacher certification

Beyond a teacher's personal interest in using the history of mathematics in teaching, accrediting agencies and state certifying agencies now require pre-service teachers to be well-versed in the history of mathematics in specific content areas. The requirement that school teachers demonstrate understanding of the connection between a mathematics topic and the history of that specific topic is explicitly documented in state and national standards. It is becoming an imperative that many college teachers introduce the history of mathematic in their teaching of mathematics in order to pass muster for state and national certification of teacher education programs. The National Council for Accreditation of Teacher Education (NCATE) and the National Council of Teachers of Mathematics (NCTM) have published standards which list *within the content areas* a requirement that candidates for teacher certification demonstrate their knowledge of the historical development of that content area. For example, the current content Standard 10 is on the subject of algebra. For certification, in addition to demonstrating expertise in the usual algebra concepts, candidates must "Demonstrate knowledge of the historical development of algebra including contributions from diverse cultures" [2].

In this era of outcomes-based assessment, to satisfy state and national evaluators it is not sufficient to show that history was included in the syllabus or to claim that history was included in a lecture. *Actual student work* (interestingly for us interested in history, the student work is called an *artifact* in current assessment jargon) must be presented to the accrediting agency or state department of education evaluators. The material presented herein will provide teachers with actual activities that students can do. The products of these activities become the artifacts necessary to validate that students are engaged in learning the historical development of the mathematical topic. *Mathematical Time Capsules* provides materials enhancing student understanding and interest in mathematics, always keeping the learning of mathematics clearly at the center of each capsule's focus.

Acknowledgements

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References

1. Amy Shell-Gellasch and D. Jardine, ed., *From Calculus to Computers: Using the Last 200 Years of Mathematics History in the Classroom*, Mathematical Association of America, Washington, 2005.

2. *NCATE/NCTM Program Standards (2003), Programs for Initial Preparation of Mathematics Teachers, Standards for Secondary Mathematics Teachers*

   `www.nctm.org/uploadedFiles/Math_Standards/`,

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