For Your Information

Survey about the *Notices*

A brief survey about the *Notices* is taking place on the Web at `http://www.ams.org/survey/notices/` and lasts until July 16. Readers with access to the Web are encouraged to participate.

The survey is being conducted by an ad hoc subcommittee of the AMS Committee on Publications. It is expected that such surveys will be conducted in the future every four years.

—Ted Gamelin

Approved Comparative Pricing Data for Journals to Be Available Online

The AMS has announced plans to make available on its Web site comparative raw pricing data for mathematics journals. For each of approximately 250 journals, the plan is to include the subscription price in local currency and the number of pages published per year for each of the past four years. The data have been approved by the publishers.

The information is to be available in a form that can be conveniently downloaded to a spreadsheet. The Web address is `http://www.ams.org/membership/journal-survey.html`. At this writing, the expectation is that the data will be posted about June 1, 2000.

In each future year the plan is that the data for the past year will be added until ten years of data have been posted, and thereafter only the ten most recent years will be retained.

—Anthony W. Knapp

Updated NCTM Standards Released

The National Council of Teachers of Mathematics (NCTM) has released *Principles and Standards for School Mathematics*, which describes an ambitious vision for mathematics education from prekindergarten through high school. The much-awaited document was made public at a standing-room-only press conference at the NCTM's 78th annual meeting in Chicago on April 12, 2000.

The original NCTM standards, issued in 1989, provided much of the impetus and philosophy behind the mathematics education reform movement that swept the U.S. in the 1990s. The standards also had a large effect outside mathematics by inspiring groups in other disciplinary areas, such as English and physics, to establish educational standards of their own. In addition to its first set of standards, which focused on curricula and evaluation, the NCTM issued a set of teaching standards in 1991 and a set of assessment standards in 1995.

In 1996 the NCTM formulated a plan for updating the standards and unifying the three documents into one. The plan, known as Standards 2000, was structured to allow a great deal of input from various groups having an interest in mathematics education. Many different organizations, including the AMS, established formal Association Review Groups to provide input and advice. In October 1998 the NCTM published a discussion draft and circulated 30,000 copies; many people also obtained the draft on the World Wide Web. In addition, twenty-five individuals were commissioned to provide in-depth reviews of the draft. The NCTM received hundreds of reactions.

The result of this extensive process is a complex, 400-page document that touches on a variety of issues pertaining to mathematics education. It begins with a discussion of general guiding principles for mathematics education in the areas of equity, curriculum, teaching, learning, assessment, and technology. For example, the discussion of equity notes that giving all students equal opportunities to learn mathematics does not imply that they should all be given identical instruction. In particular, the document states that mathematically talented students "may need enrichment programs or additional resources to challenge and engage them." The discussion of teaching principles emphasizes that mathematics teachers must have deep knowledge of their subject and be able to present the "big ideas" of mathematics. They also must understand the students they are teaching, what difficulties the students are likely to have, how to encourage and orchestrate learning, and so on. The discussion of learning principles emphasizes the fact that students must learn mathematics "with understanding," as opposed simply to memorizing procedures or facts.

The next chapter presents the ten standards: number and operations, algebra, geometry, measurement, data analysis and probability, problem solving, reasoning and proof, communication, connections, and representation. The following four chapters elaborate the role of each standard in mathematics instruction in four "grade bands": prekindergarten to second grade, third to fifth grade, sixth to eighth grade, and ninth to twelfth grade. The idea is that every standard should be part of mathematics education at all grade levels and should be treated at a depth and sophistication appropriate to the level. For this reason, the emphasis the standards receive varies across the grade levels. For example, the standard "number and operations" figures prominently in prekindergarten to second grade, while "algebra" is presented only informally; the emphasis is reversed for the high school grades. These chapters contain many sample problems, student solutions, and descriptions of classroom interactions.

Among the many differences between the 1989 standards and the new version, two in particular are immediately noticeable. First, the 1989 standards included tables that starkly listed topics recommended to receive increased emphasis and topics recommended to receive decreased emphasis. There are no such tables in the new document. Second, discrete mathematics is no longer a standard on its own, as it was in the 1989 version. The new document explains that "the main topics of discrete mathematics are included, but they are distributed across the Standards, instead of receiving separate treatment."

In the mathematics education reform movement, one of the most hotly debated topics has been the use of calculators in the classroom. The updated standards document comes down firmly in favor of using technology when it can enhance understanding. On the other hand, it puts as much, or perhaps more, emphasis on the need to ensure that students can "compute fluently" without the aid of calculators and that they can estimate well. The document also recommends that computers and graphics software be available in the mathematics classroom. For example, in the section about the problem-solving standard for grades nine to twelve, there is a long description of a classroom discussion involving software that allows one to graph lines. Without the availability of this software it is unlikely that the discussion would have arisen in the way it did.

Like the original standards, the new document sets as a goal increased mathematical understanding on the part of all students. It recommends that all students should take a mathematics course in each of the four years they are in high school, regardless of what their career plans might be. Not much is said about students with special talent for mathematics beyond suggesting that additional materials or courses should be available for such students.

The purpose of the updated standards is to provide broad outlines to guide teachers, education leaders, and policymakers as they develop curricula and assessment instruments for school mathematics. But the document really lives inside the mathematics classroom: The most vivid parts train a microscope on sample problems, students' attempts at solving them, how teachers interacted with students, and the understanding that grew out of these processes. The final chapter discusses the difficult task of marshalling the efforts of a wide variety of people and organizations to make this vision of the mathematics classroom a reality.

Principles and Standards for School Mathematics is available on the World Wide Web at `http://www.nctm.org/`.

—Allyn Jackson

About the Cover

This image is a trajectory of a dynamical system representing the motion of two pendula coupled by a spring whose tension comes through twisting. The equations of motion are

$$\ddot{\phi}_1 = -\sin(\phi_1) + 0.01 * (\phi_2 - \phi_1),$$
$$\ddot{\phi}_2 = -\sin(\phi_2) + 0.01 * (\phi_1 - \phi_2).$$

The coordinate axes are the variables ϕ_1 and ϕ_2, and color represents the value of $\dot{\phi}_1$.

The trajectory lies in the singular energy level of this conservative system that contains equilibria with both pendula standing upright. These equilibria lie along the diagonal of the figure at the "base" of the petals. For a single pendulum, each trajectory either swings back and forth with its phase never changing more than 2π or it never changes the direction of its motion. This picture shows that two coupled pendula are far more complicated. This trajectory executes a motion in which each pendulum both crosses the upright position and reverses its direction many times. The petals facing out from the diagonal of the vinelike structure are created when one pendulum crosses the upright position while the second stops and reverses direction. The trajectory moves back and forth along the diagonal in a seemingly erratic fashion.

The figure was produced with dstool, which is described in the article: A. Back, J. Guckenheimer, M. Myers, F. Wicklin, and P. Worfolk, "dstool: Computer assisted exploration of dynamical systems", *Notices* **39** (1992), 303–309. The image comes from joint ongoing work with Don Aronson, Sebius Doedel, and Bjorn Sandstede.

—John Guckenheimer