Math Teachers' Circle Program continues to expand

When Mary Fay-Zenk, a math teacher and assistant principal at Miller Middle School in Cupertino, CA, attended math circles with her students, she loved the math—but hated being relegated to the sidelines. "They have a rule that adults are not allowed to participate," she explained. "This was very frustrating because it was so interesting! It was then that I decided that we needed something like this for teachers." Fay-Zenk teamed up with Tatiana Shubin, a professor of mathematics at San Jose State University, and her Math Circle colleagues, Tom Davis, formerly of Silicon Graphics; Joshua Zucker, then a math teacher at Castilleja School in Palo Alto; and Sam Vandervelde, co-founder of the Mandelbrot Competition, to organize a workshop at the American Institute of Mathematics. This event launched the first Math Teachers' Circle (MTC) in August, 2006.

The success of this original MTC has led to AIM's current initiative to launch 100 MTCs nationwide by 2014. Two years after the first workshop, AIM's MTC program has grown to encompass seven active MTCs in seven different states, with an additional twelve teams of teachers, mathematicians, and administrators from ten more states who plan to begin MTCs within the next year. With the addition of these twelve new circles, MTCs will be meeting in a total of 19 communities in 17 states by the end of next summer.

The Rational Tangles or "rope dance" session, led by Tom Davis (center), was especially popular at both workshops.

The national MTC program is aimed at math teachers at U.S. middle schools. Its mission is to enrich the teachers' experience of mathematical problem-solving and enable them to tackle open-ended problems with confidence. Each local MTC consists of a residential summer immersion week for 20 to 25 middle school teachers, followed by monthly meetings during the next academic year, and indefinitely thereafter. MTC meetings are based on the Eastern European model of student math circles, which typically involve middle or high school students meeting after school with a mathematician for collaborative problem-solving. Through their participation in a local MTC, middle school math teachers engage in an ongoing dialogue about math with colleagues and professional mathematicians and also develop a base of support as well as resources that empower them to promote open-ended problem-solving in their classrooms.

The location of existing and future Math Teachers' Circles.

People often wonder why the MTC program focuses on the middle school level. The short answer is that "Elementary school is too hard and high school is too late," says Joshua Zucker, a founding co-organizer of the MTC program. Indeed, there is ample evidence that U.S. middle school mathematics education is in need of some extra attention. According to the recently released Mathematics Teaching in the 21st Century study,

conducted at Michigan State University and funded by the National Science Foundation, middle school math teachers in the U.S. ranked in the middle to the bottom internationally in terms of content knowledge. In addition, middle school math teachers tended to be less prepared pedagogically than their elementary school counterparts and less prepared mathematically than secondary school math teachers. The performance of U.S. middle school students has also been lackluster, with U.S. eighth graders scoring significantly below nine other countries (five Asian and four European) in the latest Trends in International Mathematics and Science Study.

While the MTC program focuses on math enrichment for teachers, an underlying consequence is that it will result in better middle school math education for students as well. "The beauty of the program is that by exposing one teacher to the kind of open-ended problem solving you encounter in a Math Teachers' Circle, you can potentially affect thousands of students over the course of that teacher's career," explained AIM Executive Director Brian Conrey. "By the time we have 100 Math Teachers' Circles around the country, the program will impact up to five percent of all U.S. middle school students each year."

The nationwide MTC initiative got off the ground in the summer of 2007 with the first "How to Run a Math Teachers' Circle" workshop. Seven teams comprising teachers, mathematicians, and administrators, from seven different states attended that workshop and spent the week participating in mock MTC sessions as well as developing plans for how to launch their own MTC, specific to their own particular challenges. Six of those seven teams—Charlotte, NC; Lincoln, NE; St. Louis, MO; Salt Lake City, UT; South Bend, IN; and Tucson, AZ—currently have active MTCs. Each of these MTCs has preserved the program's focus on problem-solving but has also developed creative "hooks" to attract teachers. These include having a classroom-ready handout at each meeting (Lincoln), using the successes of an existing student math circle program (Salt Lake City and Charlotte) as a starting point, or even hosting "Math and Margarita" nights (South Bend) to attract potential recruits.

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>
> *— Mary Fay-Zenk*

In 2008, twelve additional teams attended "How to Launch a Math Teachers' Circle" workshops. One of these was held in June in Palo Alto; the second took place in July at the Mathematical Association of America's Carriage House conference facility, in Washington, D.C. Support for the D.C. workshop came from the Mathematical Association of America, the American Mathematical Society, the National Security Agency, and the National Science Foundation. Shubin, Davis, Zucker, and Matthias Beck, an assistant professor of mathematics at San Francisco State University, organized both workshops. The summer workshops began each day with mock MTC sessions. While many of the sessions were run by the organizers, guest mathematicians also participated. David Patrick of the *Art of Problem Solving* led a math session at the Palo Alto workshop, and Professors Paul Zeitz of the University of San Francisco and Dan Ullman of George Washington University led sessions at the D.C. workshop.

In the afternoons, workshop facilitators guided teams through some of the important aspects of planning their MTC, including developing a team vision and strategies for recruitment, evaluation, and fundraising. The

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Participants in the D.C. workshop explore the geometry of Zome tools.

Math Teachers' Circle *(Continued from page 9)*

workshops culminated in team presentations of each group's plans. D.C. participant and professor of mathematics at Iowa State University Elgin Johnston remarked, "The Math Teachers' Circle workshop was outstanding. The experience will be very valuable in helping us bring a fun, enriching, and rewarding mathematics experience to central Iowa mathematics teachers."

Several common themes emerge when teachers who attend MTCs are asked about their experience with the program. First and foremost, they say they are more confident in the classroom and more knowledgeable about math. Says one participant from the original AIM MTC, "When I was taught basic arithmetic, geometry, and algebra, I was never taught the underlying math inherent to these ideas. My understanding has been enhanced, and therefore my teaching has improved." Another teacher, who credits winning *Teacher of the Year* in part to her participation in MTC meetings, summed up her MTC experience by writing, "The collaborative effort of solving a complex problem has been a new experience for me.... I have found that math 'comes alive' when it is shared and used to reach a common goal."

The sense of mathematical community developed through the program is valued by the teachers and mathematicians alike. To be a part of their closest MTC, teachers have often made extraordinary commitments. To attend the Lincoln meetings, teachers regularly travel up to 50 miles each way; one Utah teacher drives over 200 miles each way and stays overnight in order to attend meetings of the Salt Lake City MTC. Mathematicians also appreciate being able to share their enjoyment of math in a relaxed atmosphere. Harold Reiter, a professor of mathematics at UNC-Charlotte and a leader of the Charlotte MTC, says that "Saturday morning meetings are my favorites" because of the winning combination of coffee, bagels, and math.

AIM is pleased to announce two "How to Run a Math Teachers' Circle" workshops next summer, to be held June 22-26, 2009, in Palo Alto, and July 27-31, 2009, at the MAA Carriage House in Washington, D.C. Applications are now being accepted from teams of teachers, mathematicians, and administrators or other community representatives who are interested in launching their own MTC. For more information and to apply, please visit *http://www.mathteacherscircle.org/program.html.* For general information about the MTC Program, please see *http://www.mathteacherscircle.org.* ■

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Activities at the recent "How to Run a Math Teachers' Circle" workshop in Washington, D.C.

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