

MTCircular

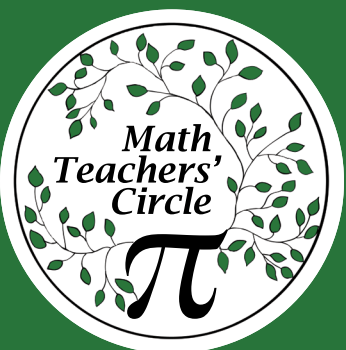
Winter 2012

ADDING IT ALL UP

TEN IDEAS FOR FUNDING YOUR CIRCLE



No Funding, No Fun? Think Again
Leading a Circle A Mathematician's Perspective
Real Math at Work Teacher Profile
Problem Circle Try This At Home



Keeping Up With the Circles

These have been an exciting few months for Math Teachers' Circles, with the publication of the first MTC-focused journal article, the award of a National Science Foundation grant to study MTC outcomes, and even a cameo appearance on the Golf Channel!

Also in this issue:

- Jessa Barniol pools the advice of several experienced MTC leaders to give us 10 great tips for finding funding on page 4.
- AIM's Deputy Director, Estelle Basor, gives us a mathematician's perspective on leading a Circle session (plus a great problem to try with your own Circle) on page 10.
- The Twin Cities MTC lets us in on their secrets to incredibly high retention on page 12.
- Teacher Elizabeth Tarbutton of the Rocky Mountain MTC describes how participating in a Circle has affected her classroom on page 14.
- Joshua Zucker describes a terrific geometry session by Alon Amit of Facebook and challenges us to think in base -4 in his Circle 360° column on page 18.

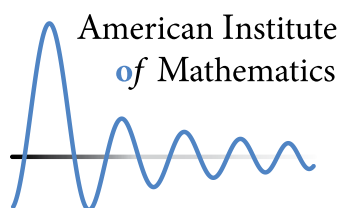
I am particularly excited about our new [online calendar of MTC events nationwide](#). Please check it out and contact us if you have events to add.

A final note: We are currently seeking teams of teachers, mathematicians, and administrators to apply for the Summer 2012 "How to Run a Math Teachers' Circle" workshops. Please help us spread the word! The workshops will take place June 25-29, 2012, at AIM in Palo Alto, CA, and July 16-20, 2012, at the MAA Carriage House in Washington, D.C. Applications are available [online](#) and are due by March 16, 2012.

Happy problem solving!



Brianna Donaldson, Director of Special Projects



The Math Teachers' Circle Network is a project
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ADDING IT ALL UP

TEN IDEAS FOR FUNDING YOUR CIRCLE

by Jessa Barniol

FUNDING. You already know it's the difference between pizza and a nicely catered meal; between a quick, no-frills meeting and an overnight retreat; between happy teachers and ecstatic, enthusiastic teachers who feel they're being truly valued for their time. You know it's the biggest thing standing between you and everything your MTC could be. Now if you only knew where to start.



As three MTC leaders—two in Louisiana and one in Hawai'i—found out, getting funding is just finding the right mix of connections, perseverance and plain old luck. But the good news is that potential funding sources are everywhere; you just have to know where to look. Here are ten tips for maximizing your funding search.

1. Use AIM resources.

Judith Covington, a professor at Louisiana State University in Shreveport and a leader of the North Louisiana MTC, said her group's funding search really got off the ground after attending an AIM [workshop](#) on "How to Run a Math Teachers' Circle." AIM Director of Special Projects Brianna Donaldson helped Covington run an [online foundation directory search](#) that yielded a surprisingly long list of potential funding sources in Covington's area. "We were able to break the list down and send letters of inquiry to everything that remotely matched our goals," Covington said. "When we finally earned a grant [for \$25,000], it was from a foundation we had never heard of, and would not have heard of, without AIM's help." AIM also supplies a wealth of information and resources for groups looking for funding in the members-only section of the [MTC website](#). For more information, [email Donaldson](#).

2. Apply everywhere and often.

There are so many different types of funding available to Math Teachers' Circles that the best advice to follow, Covington said, is to apply to everything you see, on any level: local, regional, federal, private, public. "Don't cross someone off your list just because

you've never heard of them," Covington said. "In fact, if you've heard of them, so has everyone else and your chances are smaller." Christina Eubanks-Turner of the University of Louisiana at Lafayette and her group, the Acadiana Math Teachers' Circle, had success earning a \$12,000 Pugh Grant for their summer workshop, a local grant that comes from a family that distributes private grants focusing on education, economic hardship and improving the community. Michelle Manes of the University of Hawai'i and MaTCH, the Math Teachers' Circle of Hawai'i, in contrast, has had success at the state and federal levels. Their group received \$72,550 in federal No Child Left Behind funds, which are disbursed through the College of Education at the University of Hawai'i. In addition, they garnered federal funding by piggybacking the

project on Manes' NSF Individual Investigator grant as a part of her proposal for the broader impacts of her research. This funding has enabled MaTCH to cover their unique travel requirements; a number of their members must fly in from neighboring islands to attend the group's meetings. "Everything that we come across, we apply for," Manes said. "We've actually had quite a bit of success with this piecemeal approach." Other groups nationwide have had success with



NO FUNDING, NO FUN?

MAKING IT WORK WITH LIMITED RESOURCES



If your search for funding is bearing little or no fruit, here is how to help your Circle thrive, not just survive, with fewer resources. As Manes said, "There's always a way to make it work with what is there."

1. Get creative.

Covington and her group brainstormed some ways to get food for meetings with limited funding. "Most group meals can be bought for less than \$500," Covington said. "Consider partnering with local restaurants or businesses to sponsor a meal for the Circle. Also talk directly with the food provider about possibilities for free or reduced prices on meals." She also knows of another MTC with a group leader that cooks for each meeting. Just be sure to check with your venue about their rules and requirements for bringing your own food to gatherings. Before their funding came through, Manes' group got creative with the meeting's venue by partnering with a local museum. They also capitalized on a partnership with the Hawai'i Department of Education to offer continuing education credits to teachers in lieu of a cash stipend. "We've found that continuing education credits are more than enough incentive for many teachers," Manes said. "Now that we have enough money to offer stipends, we offer teachers a choice, and more than half the teachers consistently choose credits over money."

2. Focus on the things money can't buy.

The teachers in your Circle are more interested in learning and socializing than they are in fancy food or cash stipends, Covington said. "The teachers really have just as much fun with pizza," she said. "In fact, I'm sure they would still come to the meetings even if we weren't feeding them. They're more interested in learning something new, broadening their horizons and making friends. Money is not a big decisive factor in any of those things." Try leading with a social icebreaker game, facilitating online discussions among the members of your group between in-person meetings, and making sure to offer interesting and in-demand session leaders and topics.

3. Try again soon.

In many regions, today's economic environment is not often a generous one for groups looking for money. "Some foundations simply aren't functioning in this economy," Covington said. "And even the ones that are still giving can't give money to everyone. But don't stop trying. Your group's lucky break could come at any time." □

institution-internal grants. These are often small grants that are intended to help a project get started and can go a long way toward funding meetings during the school year. Similar seed grant programs are sometimes offered by other organizations, such as MSRI or AIM. Many groups have also earned funding from both local and national private business ventures, such as banks, retailers and restaurants, looking for a way to reinvest in their communities.

3. Work with your university or school district. It is likely that your hosting institution has a non-profit 501(c)(3) status that will be invaluable when applying for funding, Eubanks-Turner said. “And don’t forget to check if they have any available funding as well,” Eubanks-Turner said. “That should be the first place you look.”

4. Broaden your network and make existing partnerships work for you. The Hawaii group has developed a great partnership with their state’s Department of Education, who provides the food for their



meetings and, even more importantly, provides the continuing education credits they offer to the Circle’s participating teachers. “When you first look at the hoops that have to be jumped through for official CE credits, it looks nearly impossible,” Manes said. “But it’s a question of finding the right person; someone who truly believes in the program and is willing to help you. We really lucked out in that regard.” Manes also said that the partnerships that may already exist in your Circle’s leadership are invaluable. “My partner is in the education department and I’m in the math department,” Manes said. “Together we have access to a broader spectrum of potential funding and we’re able to put something together that works.”

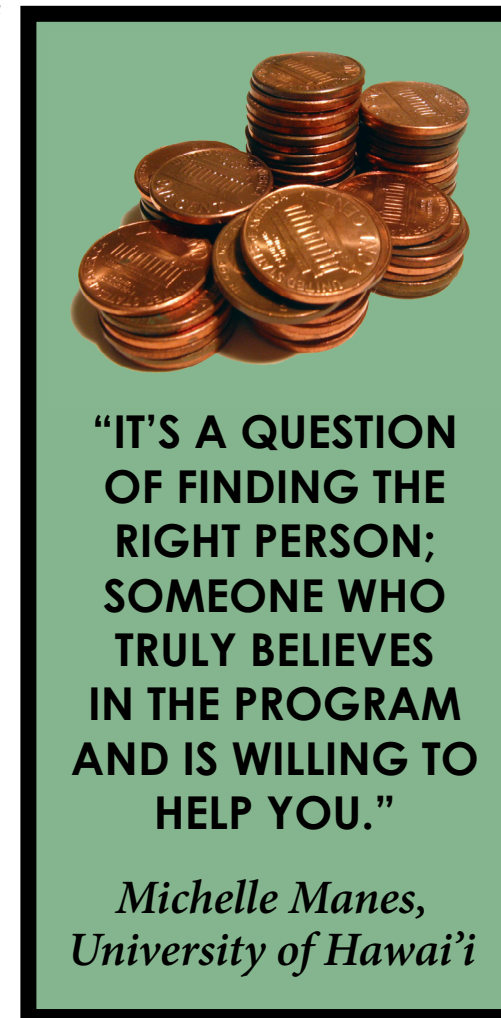
5. Take the time to explain your Circle well to a prospective supporter. If appropriate, include photos of meetings, proposed topics and testimonials from teachers in your group. Don’t forget to include a link to the [MTC network website](#). “A lot of places you write proposals to will have no idea what a Math Teachers’ Circle is,” Eubanks-Turner said. “Be sure to do it justice.” The members-only section of the MTC website includes many helpful resources to familiarize prospective donors with the MTC concept. For more information, [email Brianna Donaldson](#).

6. Remember that, in some cases, you have not because you ask not. “Think about what would make you truly happy, and ask for that in your proposal,” said Covington, who originally had some reservations about including salaries for the Circle’s leaders in the proposed budget. She decided to try it, and then was thrilled when it was granted. “Don’t undersell yourself or your group,” Covington said. “Don’t pad your proposed budget, but write for a best-case scenario. Then, if you don’t get what you ask for, adjust from there.”

7. Apply as a group. When you send your letters of inquiry and proposals, have your whole leadership group sign the letters, not just one member. This approach worked well for Covington’s group, which is partnered with more than one school district in adjoining parishes. “We had made a conscious effort to have a diverse founding group,” Covington said. “I’m in the math department, but we’ve also got a founder from the university’s education department and other founders from middle schools in different districts. We wanted to show what a wide impact this Circle would have if given the chance, and it truly made an impression on our potential funding sources.”

8. Don’t lose hope. It was nearly a year after she applied that Manes finally got the good news that she had been awarded the NSF Individual Investigator grant. “I had all but given up on the hope of ever receiving that money,” Manes said. “Sometimes, patience does pay off.” Covington agrees: “You have to be willing to reach out to 20 groups or more and only hear back from one,” she said. “But in the end, when you get the funding, all that work and waiting is worth it.” In the meantime, try getting creative with ways to keep your Circle thriving, even with limited resources. (See sidebar, “No funding, no fun?” on page 7 for ideas.)

9. Make lasting choices with the money. Congratulations! You’ve earned some funding for your Circle. Now what should you do with it? In addition to food and workshop costs, Eubanks-Turner invested some of the money from the Acadiana group’s Pugh Grant into buying an ELMO document camera, which will continue to be useful to the group for years to come. “There are usually many different ways to approaching a problem that’s presented in one of our meetings,” Eubanks-Turner said. “This way each group can show their approach to the Circle without having to redo their work on the board.” The Acadiana group also invested some of their funding into buying gift cards for each of the teachers to purchase ETA/Cuisenaire manipulative tools for each of their classrooms, which will also last for years.



10. Say thank you. Especially with funding from smaller or family-based foundations, a follow-up letter or thank-you note is an extremely important step that could lead to future funding from the same source. When Eubanks-Turner’s group took surveys of the teachers that attended the Acadiana workshop, the reviews were so positive that they decided to send copies of the surveys to their sponsoring foundation, along with a note of thanks. “It shows that you really are making an impact and doing great things with their money,” Eubanks-Turner said. “The foundation enjoyed that very much, and I think that follow-up is going to help us continue our relationship with them in the future.”

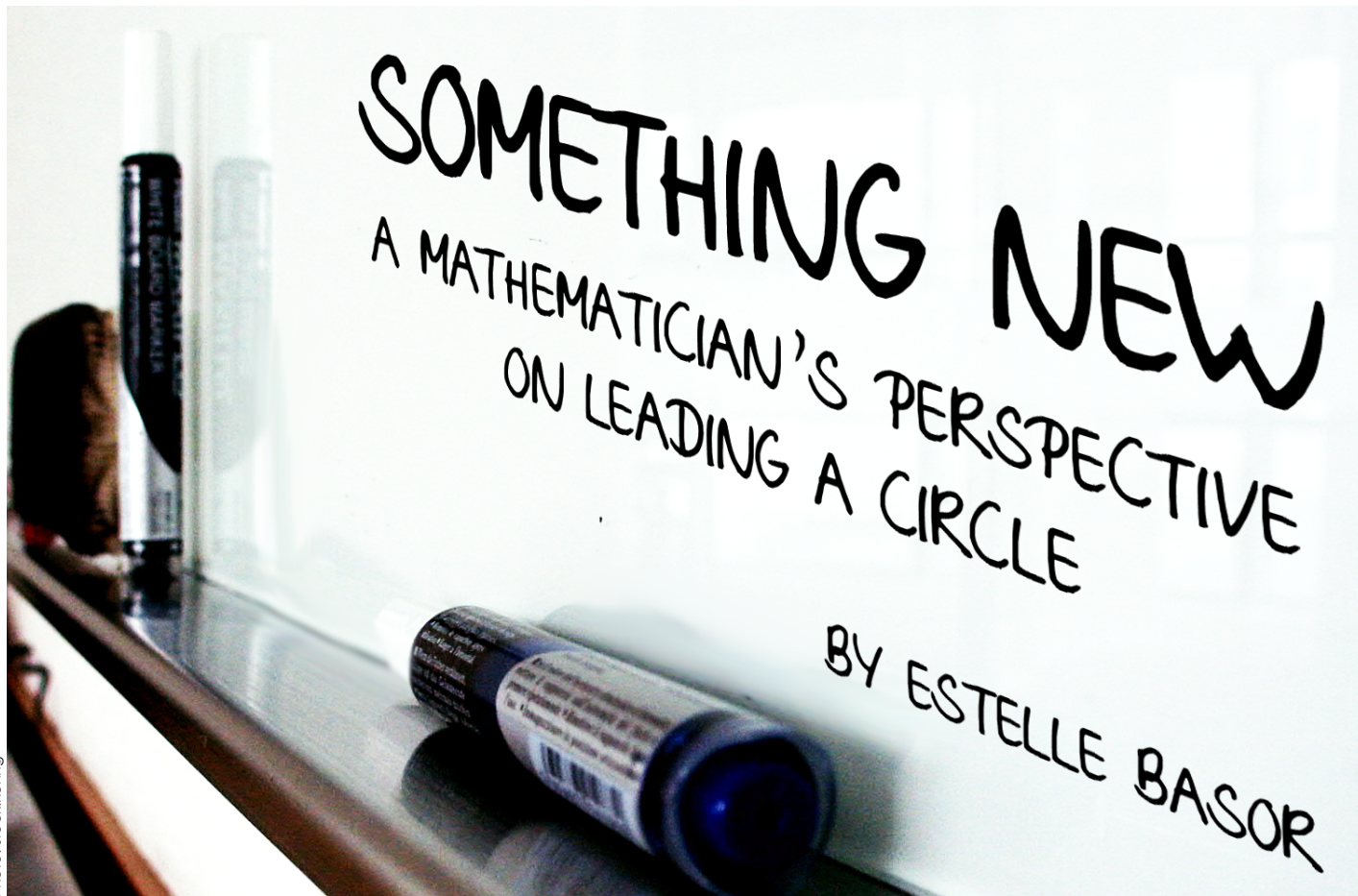


Photo: stock.xchng

When I was asked by Tatiana Subin to lead a session of the AIM Math Teachers' Circle, I almost refused. I had been asked in the past, but schedule conflicts had prevented me from participating, and I was secretly glad to avoid it. I had many misgivings about leading a session; it appeared to me that it would take special skills that I did not have. One needs to pick a good problem and be dynamic and enthusiastic, but not too helpful. Finally, however, Tatiana talked me into it and I decided to give it a try for the first time.

My first challenge was to find an appropriate problem to present, which I finally found on the [Cal Poly Math Department's Puzzle of the Week web page](#). A problem that caught my eye was to consider the following: Can one remove one of the factorials from

$1!2!3! \dots 99!100!$ so that what remains is a square? It seemed like a good problem, open to generalizations and a number of problem-solving techniques. It is a problem that raises many questions, so I knew it would be a perfect one for an interactive discussion.

When it came time for the session, I gave no hints or lectures, just presented the problem, and then

everyone started working in groups. After a time, I looked over some of the computations and noticed that most of the participants had simplified the problem and were starting to look for patterns. Some

were counting factors; some were trying to group factors; some were doing the smallest cases; but everyone was doing something!

Just to sit silently and watch the problem solving unfold was actually very hard for me. As a college calculus teacher, my instinct was to jump in and help.

“AS A COLLEGE CALCULUS TEACHER, MY INSTINCT WAS TO JUMP IN AND HELP.”

I wanted to give hints or write something on the board or suggest methods of attack. After about ten minutes of watching everyone work, I asked Tatiana if I should start to give hints or summarize. “Why would you do that?” she asked. “Everyone is still working.” As more time passed, I asked the participants if they would like me to go over the answer or to give hints, but everyone chimed in with pleas for more time to continue their own problem-solving approaches. So I waited longer, and soon realized that these teachers were learning by doing; they were busy developing their very strong problem-solving skills. They were trying examples. They were trying the simplest cases. They were talking and reasoning together. They were looking for patterns and generalizing. They were even answering a question that I had not thought about: is there more than one way to do this?

This was in such contrast to my long-time experience in a college classroom, where often the only question asked is, “How do you do number six on the homework?” In my classroom, I often end up talking too much because most students are truthfully not interested. It was so refreshing to see that these teachers were truly having fun with math. It is my hope that future calculus students, if exposed to these teachers from the group earlier in their education, might learn some of their enthusiasm and learn to love math themselves. And, most surprisingly, I found myself having a lot of fun as well. In fact, I found myself wondering why I had waited so long to try leading a Circle in the first place. ☑



Estelle Basor is the Deputy Director of the American Institute of Mathematics. Her main research interests include Operator theory and Random Matrix Theory. [Contact Estelle.](#)

Links and Resources:

View Estelle's meeting notes and handout from the session she led, “Factorials and Squares,” on [the MTC website](#).

See you in Boston!



Come visit us at the Joint Mathematics Meetings!

January 4-7, 2012
Hynes Convention Center
Boston, Massachusetts

Please participate in the SIGMAA on Circles events and stop by AIM's booth in the exhibitors' hall.

To learn more, visit the [JMM website](#) or the [SIGMAA on Circles website](#).



Photo: stock.xchng

Twin Cities Math Teachers' Circle

MTC Leaders: Melissa Loe, Brenda Kroschel and Cheri Shakiban, University of St. Thomas; Christopher Wernimont and Patty Dejarlais, Minneapolis Independent School District.

The Twin Cities MTC in Minneapolis-St. Paul, Minnesota, is known for its high retention rate and sessions that are co-led by teachers and mathematicians. Last year, their inaugural year, saw the close-knit and enthusiastic group exploring such diverse topics as coding and cryptography, exploding dots and game theory in their evening meetings. We caught up with one of the group's leaders, mathematician Melissa Loe, to discuss the group's successes and challenges, their approach to leading meetings and the mathematics of soap bubbles.

Your group boasts a high retention rate. What is your group's secret?

Our high retention rate is a direct result of the fact that our inaugural meeting was an overnight immersion workshop that lasted several days. We held it at a nice retreat center owned by the university and we made it a priority to treat the teachers like the professionals they are, with room and board away from the cares

of home and work, good food and a stipend for their time. It gave them a real enthusiasm for the program. It showed them what a high-quality interaction this setup could be, and they all really bought into it.

What is your MTC's main challenge?

It's an ongoing challenge, and one every MTC faces, and that's the problem of funding. We worked very hard to find funding from several different sources in order to make the immersion workshop possible. I'm not sure we'd be able to pull it off again, which is a shame, because the teachers so enjoyed it and there's a lot of interest in holding another one. In fact, when they learned there wasn't going to be another immersion workshop this summer, our group threw a party, which was completely organized and carried out by the teachers themselves, not the leadership. That shows how much they enjoy being together. However, if we were to start another Circle, I think another immersion workshop would be absolutely necessary. It's hard work to find the funding, but it will make the Circle last for years. Our follow-up meetings during the school year require money as well, though considerably less money, and finding that funding is an ongoing challenge.

Do you have any advice for new MTC leaders?

I would say to definitely do a summer immersion workshop, to give you momentum. Work like crazy for funding and don't give up if you hit a snag. Stick together as a group; really enjoy that collegiality and sense of community. Enjoy each other's company as much as you enjoy what you can learn from each other.

What typically happens at your meetings?

In our Circle, each session is co-led by a mathematician together with a teacher. That's different from a lot of other MTCs, but we find it keeps the meetings down to earth. It brings the expertise of a mathematician together with a peer element, so it removes some of the pressure and opens up the teachers to ask more questions and share their ideas more freely.

What was your favorite session so far and why?

At the summer workshop, we had a session involving Zometools, which are ball-and-strut kits you can use to create interesting polyhedral structures. The teachers built structures and then dipped them in soap

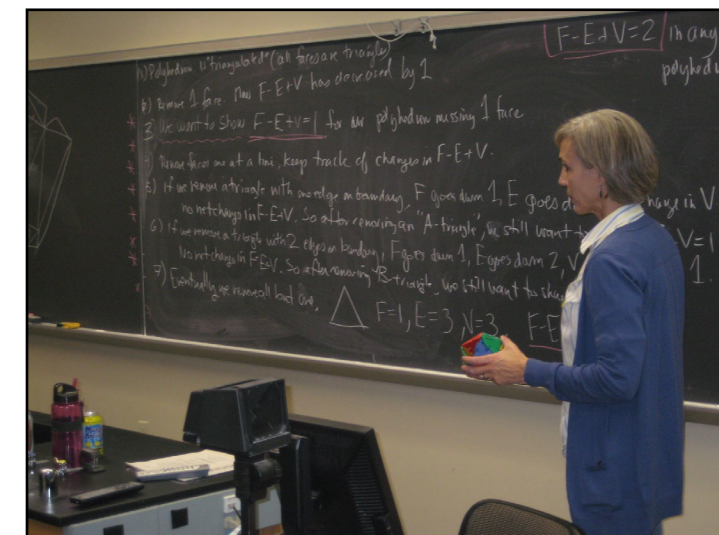
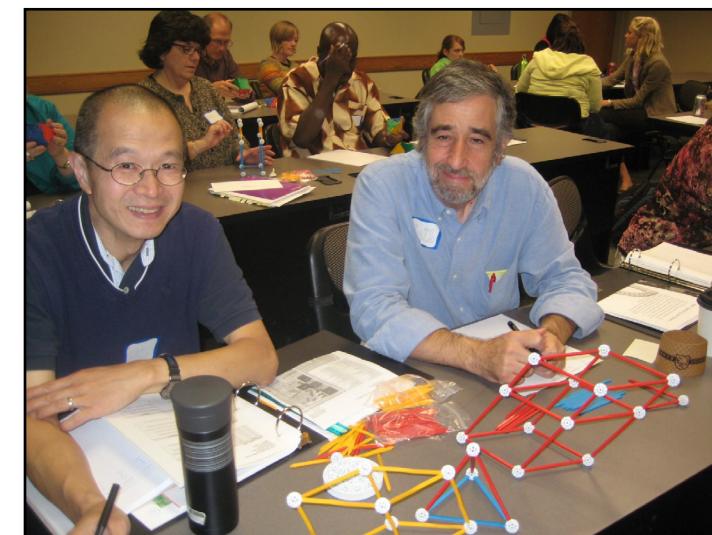
bubbles in a problem involving minimal surfaces. They were supposed to solve why surfaces of soap films had formed where they did. It was tons of fun; the teachers were enthusiastically running to dip their structures in soap buckets and then running back to share their findings. It's amazing to see how these teachers, who have been on their feet teaching all day, are still so energized and ready to learn when they arrive. There's a lot to learn from them. They're so fearless when it comes to giving something new a try. This is the future of math education, and it's truly rejuvenating to see. ■

Links and Resources:

Twin Cities MTC website

Frank Morgan, Edward R. Melnick, and Ramona Nicholson, "The Soap Bubble Geometry Contest." From *Mathematics Teacher*, December 1997, Volume 90, Number 9, pages 746-750.

Zome System Lesson Plans 1.0: Hands-on activities for students of Elementary Grades through High School, pages 49-51. [View online.](#)



Above, teachers work with Zometools at a Twin Cities MTC meeting. Far right, Melissa Loe presents the problem to the group.

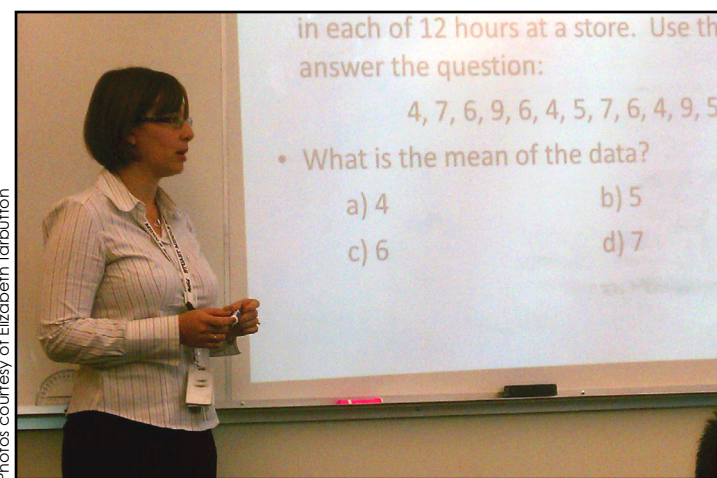
Real Math at Work

Five Questions for Elizabeth Tarbutton of the Rocky Mountain MTC

Elizabeth Tarbutton taught biology and chemistry at the University of Colorado Boulder for seven years before finding a new calling at Otho E. Stuart Middle School in Commerce City, Colorado, in the Denver area. She was hired to teach both science and math to a wide range of students in grades 6-8, from advanced classes to classes of students that were held back a grade. About a year ago, she began attending the Rocky Mountain Math Teachers' Circle in Denver, which has given her new things to try in the classroom and a new perspective on teaching.

What was it that convinced you to make a career switch from college professor to middle school teacher?

While I was at CU, I spent a lot of time and energy really trying to get involved and make a difference. But I soon realized that college kids are too far gone; if you try to get them ramped up about something, all they do is give you a weird look. I realized I could make more of a difference in a K-12 environment, with kids who are still open to learning and respond better to enthusiasm. There were very few jobs available because



Tarbutton presents a math lesson to her middle school class.

of the economy, so I guess you could say that fate led me to this middle school job. I find this much more rewarding.

What do you like best about your Math Teachers' Circle?

The community that has formed in the Circle is really awesome. It's not just about math problems. We're really good friends. Also, I like to keep myself sharp, and getting the chance to be taught instead of always teaching is great for that. It teaches me new things about myself. For example, at our summer workshop, which was several days in a row, I realized that if you leave a problem and then come back to it later, often your brain has solved it without your mind even being aware. It's also refreshing to continually have to remind myself to shift my perspective, to not get caught in a rut, to change the way I look at things and to rise to a challenge. I've started bringing my colleagues from the department to the Circles as well, and that helped them realize that there really is something to this approach. It's also helped us cohere as a group back at school, and our students benefit immensely.

How do your students benefit from your participation in the Math Teachers' Circle?

Aside from the obvious answer that I borrow problems presented in the Circle and take them back to use with my students, there are two main ways the Math Teachers' Circle has helped me in my teaching. First, in the meetings, they deliberately have us talk about our techniques and approach to the problem. When we think out loud as a group, we start to see patterns, and together we think about tools we can use. When possible, I like to integrate this approach in my classroom, giving my students the tools they need to

figure out an overarching problem and then letting them chip away at it collectively until they figure it out, rather than spoon-feeding them the process step by step and expecting them to regurgitate it for homework. Second, I've realized the importance of presenting real-world math problems to my students, rather than creating a pseudo-context that thinly disguises the problem itself. Who really cares how many cookies Sally can sell in a year? If it's a problem that involves filling a container, why not use an actual container? Then they not only learn the mathematical concept; they learn how to discern which concept to use when given a problem with no immediately apparent approach. One of the main prejudices about math, especially among middle school students, is that there is no real world application for it. I often hear, "When are we ever going to need this in real life?" The truth is, you will need this in real life. This approach makes that much more apparent. And even though there's more work required to learn it, the kids end up enjoying it so much more than being lectured at.

What is one example of a problem from an MTC session that you were able to bring back to your classroom?

One example is a series we did about a "mathemagician." We played several card games that included "magic tricks" that could be explained by mathematics problem solving. I used these card games with my students to study patterns and to use tables and expression to help describe a pattern.

What are your favorite and least favorite things about teaching math?

Kids this age hate math, because someone somewhere said that math is hard. We've got standardized testing;



Tarbutton enjoys the view on a hike in Estes Park, Colorado.

we've got state and district expectations. Trying to teach them to love math, instead of just learning concepts, is a real challenge. But the biggest challenge is also my favorite part; I love it so much because it is truly a challenge to make a difference with these kids. But then, when you finally get through, there is nothing more rewarding than that. ☑

Links and Resources:

[Rocky Mountain MTC website](#)


Tom Davis, "Mathematical Card Tricks." [View online.](#)

Stephanie Santorico, "Mathemagical Card Tricks." [View online.](#)


National Science Foundation Supports Math Teachers' Circle Research




The National Science Foundation has awarded the American Institute of Mathematics a grant of \$449,981 to study the impact of MTCs on middle school mathematics teachers. The three-year project will include research on participating teachers' mathematical knowledge for teaching and classroom practice. Researchers will also collect information about the activities and best practices of Circles across the country. The project will be carried out by co-investigators Michael Nakamaye (University of New Mexico), Kristin Umland (University of New Mexico), and Diana White (University of Colorado Denver), in conjunction with AIM Executive Director Brian Conrey and Director of Special Projects Brianna Donaldson.

The project is funded through the NSF's highly competitive Discovery Research K-12 program. The program received more than 500 proposals, and fewer than 10 percent of these were selected for funding. According to Conrey, "This is an incredible opportunity to learn more about Math Teachers' Circles and how they affect teachers' mathematical lives." 

Math Teachers' Circles Featured in Mathematics Teaching in the Middle School


In the September 2011 issue of Mathematics Teaching in the Middle School journal, Anthony Fernandes of the University of North Carolina Charlotte, together with Jacob Koehler of Teachers College Columbia and Harold Reiter of the University of North Carolina Charlotte, presented the idea of Math Teachers Circles to a wide and relevant audience with the article, "Mathematics Teachers Circle Around Problem Solving." To learn more about the article, [email Anthony Fernandes](#). To learn more about the publication, visit their [website](#). 



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Human Energy: AIM Featured on Golf Channel

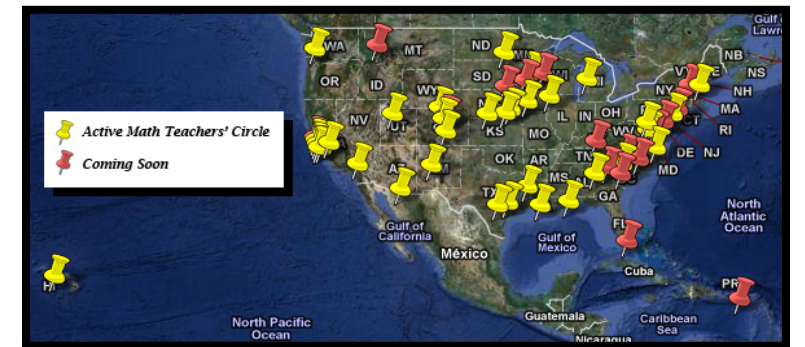


The American Institute of Mathematics and Math Teachers' Circles were recently featured on the Golf Channel's Chevron Human Energy series. Host Anthony Anderson describes AIM's programs and how they benefit from money raised by the Frys.com Open on the PGA Tour. The segment on Math Teachers' Circles begins at timestamp 3:10. To view the segment, [click here](#). 

A Warm Welcome to Our Newest MTCs

The nationwide network of Math Teachers' Circles is growing. Each of these groups sent a leadership team of around five people to one of our workshops in Summer 2011 on "How to Run a Math Teachers' Circle." It is expected that they will each start their own MTC by Summer 2012. This will bring the total number of MTCs to 51 Circles across the United States and its territories. A warm and hearty welcome to our network's newest members:


- San Diego, CA: San Diego MTC
- Greeley, CO: MTC of Northern Colorado
- Fairfield, CT: Fairfield County MTC
- Richmond, KY: Eastern Kentucky MTC
- Annapolis, MD
- Polson, MT: Mission Valley MTC
- Plymouth, NH
- Winston-Salem, NC: MTC of Winston-Salem
- Philadelphia, PA: Philadelphia Area MTC
- Columbia, SC
- Sioux Falls, SD: Sioux Falls Area Math Teachers' Circle
- Eau Claire, WI: Chippewa Valley MTC 



Click on the map to view the online version.

View All Nationwide MTC Events on Our New Online Calendar

Math Teachers' Circles Nationwide	
Today	Thursday, January 5, 2012
Thursday, January 5, 2012	
3:00pm	Joint Mathematics Meetings: SIGMAA on Circles
Saturday, January 7, 2012	
9:00am	Joint Mathematics Meetings: SIGMAA on Circles
10:00am	Joint Mathematics Meetings: SIGMAA on Circles
10:00am	Joint Mathematics Meetings: SIGMAA on Circles
1:00pm	Joint Mathematics Meetings: SIGMAA on Circles
Tuesday, January 10, 2012	
5:30pm	Mobile Math Teachers' Circle
Saturday, January 14, 2012	
8:30am	San Diego Math Teachers' Circle
Tuesday, January 17, 2012	
5:30pm	Pikes Peak Math Teachers' Circle
7:00pm	AIM Math Teachers' Circle
Saturday, January 21, 2012	
8:30am	Rocky Mountain Math Teachers' Circle
4:00pm	Tucson Teachers' Circle MEAD Conference
Monday, January 23, 2012	
5:00pm	North Louisiana Math Teachers' Circle
6:15pm	University of Utah Teachers' Math Circle
Friday, January 27, 2012	
5:30pm	South County Math Teachers' Circle

The MTC network website now includes an online calendar of any and all events, workshops and meetings being held by any MTC in our network. See what MTCs throughout the nation and its territories are up to this year. Please submit notice of your group's events to Brianna Donaldson via [email](#) to be added to the calendar. When possible, please include the session speaker(s) and topic in your description. To view the calendar on our website, click on the image of the calendar at left. 

In Session

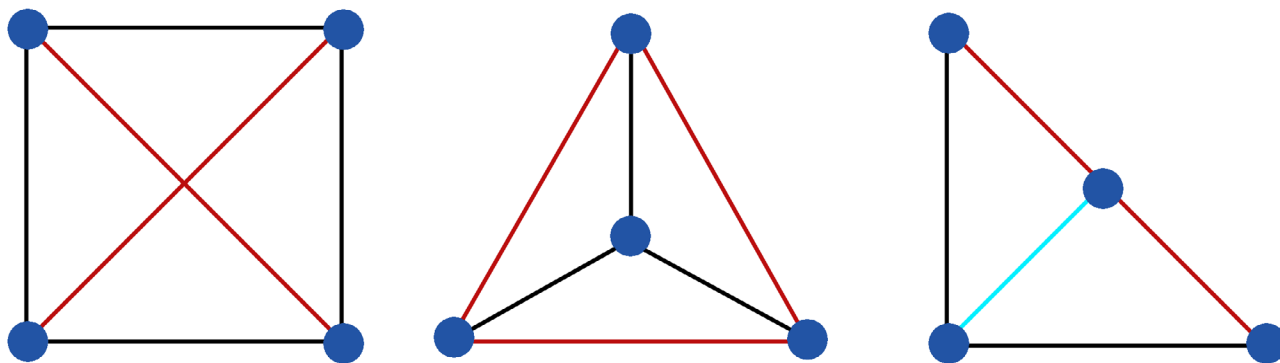
What is Like a Square?

Geometry is all too often neglected in school. For middle school and younger students, it seems that geometry is about naming shapes and using a few simple formulas, without much real depth. Alon Amit of Facebook recently showed our Math Teachers' Circle here at AIM that it doesn't have to be that way. He asks deep questions about simple things to provoke thought and provide a bridge to a wide range of mathematical topics.

In this case, his question is "What is like a square?" There are many answers to that question—a rhombus? a rectangle? a cube?—so let's make it more specific. A square is a set of four points in the plane, and when you look at the six distances among those four points, you find only two different distances. What other arrangements of four points in the plane have only two different distances? And, perhaps more importantly, how will you know when you've found all such arrangements?

Alon's discussion on his "[Affine Mess](#)" blog breaks the problem up into a wonderful sequence of ideas and connects this problem to graph theory as well. He also reminds us to check something that many of us might overlook: after you've drawn the picture and labeled the distances, how do you know that such a figure really exists? Maybe the distances, the way you labeled them, lead to a contradiction.

Another lovely thing about this problem is the way it leads to so many variations. What if you have only one distance? What if the points have to be on a line? What are the extreme cases, for the fewest different distances you can have among n points in d dimensions? A handout that includes many of these extensions, and might be usable for students with some guidance, is on the [Julia Robinson Mathematics Festival website](#). ☐



Links and Resources:

Alon Amit, [Affine Mess](#), "Four Points, Two Distances." [View online](#).
Joshua Zucker, [Julia Robinson Festival](#), "What is Like a Square?" [View online](#).

Problem Circle

Number Bases

Different number bases were a big part of math curriculum in the New Math days, but those days are long gone. We don't see as much of those topics as we used to. I wonder what else we're missing, compared to math books from days gone by? So, from Harold Reiter, we have a few questions for you.

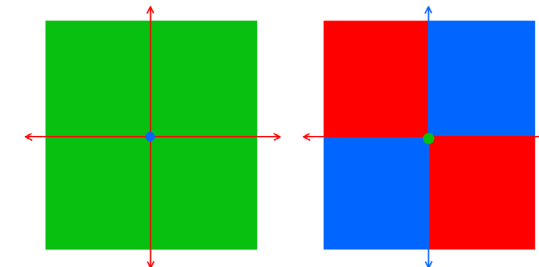
In base -4 , the place values (from right to left) are the powers of -4 : $1, -4, 16, -64, 256$, and so on.

Use only the digits $0, 1, 2$, and 3 , and no negative signs! For instance, to write three, you could write just 3 , but to write negative three, you'd write 11 , which is one group of -4 and one 1 .

- Count to sixteen.
- Explain how to add.
- Explain how to multiply. How do you know this process will result in only the digits $0, 1, 2$, and 3 ?
- How would you write a "decimal" (radix) expansion of $1/3$ in this system? Is there a unique representation? ☐

$$132 = 1 \cdot 16 + 3 \cdot -4 + 2 \cdot 1 = 6$$

Last issue's problem, "Have Colors, Will Paint," asked whether it is possible, using three different colors, to paint each point in a plane so that every straight line in the plane has exactly two different colors. At right are pictured two possible answers to this problem. Please visit the [Problem Circle page](#) on our website for a more in-depth discussion of these solutions. Congratulations to **Hema Gopalakrishnan** of Sacred Heart University, member of the newly founded Fairfield County MTC in Connecticut, for submitting an accurate solution to this problem. Send your answers (or your MTC's answers) to this issue's problem to Joshua Zucker by [e-mail](#) to be featured in a future issue of MTCircular.



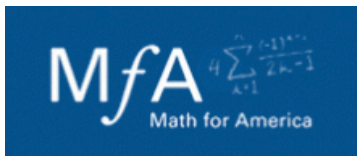
Links and Resources:

James Tanton, "Exploding Dots," page 22. [View online](#).

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