Final Report
National Association Math Circle
H98230-14-1-0269
Final report on NSA-MEPP Grant H98230-14-1-0269

NSA-MEPP Grant H98230-14-1-0269 funded the Math Circle Grant Program administered by Mathematical Sciences Research Institute (MSRI) in conjunction with the National Association of Math Circles (NAMC), an organization operated by MSRI. The principal aim of the Math Circle Grants Program was to start, sustain, and assess new Math Circles around the country. The Math Circles that benefited offered extracurricular mathematics education to hundreds of K-12 students and teachers annually with the ultimate goal of fostering their interest in mathematics and mathematically intensive STEM disciplines. The program has funded 85 Circles through 138 separate grants over the course of three years.

Math Circles are a form of education outreach and enrichment through which mathematicians and mathematical scientists share their passion with K-12 teachers and students. The Math Circle landscape includes two types of programs that can operate standing alone or in coordination: Math Students’ Circles and Math Teachers’ Circles. Math Circles bring K-12 students or K-12 mathematics teachers together with mathematically sophisticated leaders in an informal setting, after school or on weekends, to work on interesting problems or topics in mathematics. Math Circles combine significant content with a setting that encourages a sense of discovery and excitement about mathematics through problem solving and interactive exploration. Ideal problems are low-threshold, high-ceiling; they offer a variety of entry points and can be approached with minimal mathematical background, but lead to deep mathematical concepts and can be connected to advanced mathematics.

Math Circles migrated to the United States from Eastern Europe in the 1990s. Today, more than 180 Math Circles are operating across the country. Since 1994 more than 210 Circles registered with the NAMC at their website, www.mathcircles.org. Math Circles adopt a range of practice in terms of venue, the grade level and backgrounds of participants served, and the types of mathematical professionals who are engaged. In some, but not all settings, Math Students’ Circles and Math Teachers’ Circles affiliate their activities. Math Circles are designed to provide an easy entry point for mathematicians with limited experience working in K12 mathematics outreach.

The Math Circle Grant recipients were required to complete a final report. Dr. Brandy Wiegers prepared a summary of the reports that is appended to this message. These reports provide the initial survey of the Math Circle community, showing the distribution of funds and resources used for different Math Circles. We are currently working to expand these smaller scale surveys to a larger national survey that will provide insight into the general trends and values shared by the ongoing Math Circles.

The graphics on the next page summarize the distribution of grants under the program.
From 2012-2015, 138 Math Circles Grants ranging in size from $500 to $2,000 were distributed.

Eighty-seven individual Circles benefitted from these funds, 59 of which are Circles for students and 28 are Circles for teachers.
2014-2015 Math Circle Grants

New Math Circle Seed Grants
- Rice Math Circle
- Cedarville Math Circle
- Maize and Blue Math Circle
- The Oshkosh Math Circle
- Waubonsee Math Circle
- Boise Math Circle
- Smoky Mountain Math Teachers' Circle
- Wayne County Math Teachers' Circle

Continuing Math Circle Seed Grants
- Mid-Hudson Math Teachers' Circle
- San Benito County Math Talks
- San Diego Math Teachers Circle
- Greater Nebraska Math Teachers Circle
- Mid-Cities Math Circle
- The Bard Math Circle
- Philadelphia Area Math Teachers' Circle (PAMTC)
- Thousand Oaks Math Teachers' Circle
- San Joaquin Math Teachers' Circle

Exchange Math Circle Seed Grants
- New York Math Circle (NYMC)
- North Louisiana Math Teachers' Circle
- Omaha Area Math Teachers' Circle
- Smoky Mountain Math Teachers' Circle
- New York Math Circle

2013-2014 Math Circle Grants

New Math Circle Seed Grants
- Eugene Math Circle
- CSUSM Math Circle
- Evanston Math Circle
- Montana Math Teachers’ Circle
- New Haven County Math Teachers' Circle
- San Joaquin Math Teachers' Circle
- WSU Math Circle
- Math Teachers’ Circle of Oklahoma (MTCOK)
- Westchester Area Math Circle
- Math Circle at FAU
- Circle Around Math
- The Math League of Southeast Ohio
Continuing Math Circle Seed Grants

- Talking Stick Math Circle
- Kinawa-Chippewa Mathematics Circle
- Bard Math Circle
- Los Angeles Math Circle
- Temple University Mathematics Circle
- Islander Math Circles
- Seattle Math Teacher Circle
- Greater Nebraska Math Teachers Circle (GNMTC)
- Navajo Nation Math Circle
- Mid-Cities Math Circle
- San Francisco Math Circle
- UCI Math Circle
- Willamette Math Circle
- Mid-Hudson Math Teachers Circle

Exchange Math Circle Seed Grants

- North Louisiana Math Teachers' Circle
- Fairfield County Math Teachers' Circle (FCMTC)

2012-2013 Math Circle Grants

New Math Circle Seed Grants

- East Texas Teachers
- Islander Math Circle
- UCSC Teachers' Circle
- Math Teacher's Circle Stonybrook
- Rice Math Circle
- Canisius College Math Circle
- Mid-Hudson Teacher's Circle
- Rocky Mountain Math Circle
- Navajo Nation Math Circle

Continuing Math Circle Seed Grants

- Central Kentucky Math Circles
- Central Nebraska Math Teachers’ Circle
- Kinawa-Chippewa
- Greater Nebraska Math Teachers' Circle

Exchange Math Circle Seed Grants

- Talking Stick Learning Center
2011-2012 Math Circle Grants

New Math Circle Seed Grants

- Eastern Kentucky Math Teachers' Circle (EKMTC)
- Fairfield County Math Teacher's Circle
- Chippewa Valley Math Teachers' Circle
- Williamette Math Circle
- Winston-Salem Math Teachers' Circle
- Acadiana Math Teachers' Circle
- Northern Colorado Math Teachers' Circle
- Los Angeles Math Circle
- Temple University Mathematics Circle
- Texas A&M
- Talking Stick Learning Center
- San Diego Math Circle
- San Benito Count Math Teachers' Circle
- KSU Math Circle
- Philadelphia Area Math Teachers' Circle
- New York Math Circle
- Newark Area Math Circle
- Natural Math
- Denver Math Circle
- Fullerton Math Circle
- Charlotte Teacher’s Circle

Continuing Math Circle Seed Grants

- Bard Math Circle
- Marin Math Circle
- Orange County Math Circle
- North Louisiana Math Teachers' Circle
- Art of Inquiry
- Mid Cities Math Circle
- Math Circle at ASU Tempe
- Kansas State University Math Circle
- Tufts Math Circle
- Mankato Area Math Circle
- Melrose Math Circle
- Rockport Elementary Math Circle
- Pi Math Learning Center
- Math Circle in the Triangle
- Prime Factor Math Circle
- OMSI Math Circle
- Oregon Museum of Science and Industry
- Rocky Mountain Math Teacher’s Circle (Aspen/Carbondale)
- East Lansing Math Circle
- The Math Circle (Southampton)
• Penn State Math Circle

**Exchange Math Circle Seed Grants**

• Mankato Area Math Circle  
• Math Circle in the Triangle  
• East Lansing Math Circle  
• Rocky Mountain Math Teacher’s Circle/ Hawaii Math Teachers' Circle

**2010-2011 Math Circle Grants**

**Math Circle Seed Grants**

• Art of Inquiry  
• Bard Math Circle  
• Central Kentucky Mathematics Circles  
• Claremont Gateway to Exploring Mathematical Sciences  
• East Lansing Math Circle  
• Fairfax Math Circle (FMC)  
• Hearthstone Math Circle  
• Mankato Area Math Circle  
• Marin Math Circle  
• Math Circle at ASU Tempe  
• Math Circle Seminar at Kansas State University  
• Melrose Math Circle  
• Metroplex Math Circle  
• North Louisiana Math Teachers' Circle  
• OMSI Math Circle  
• Orange County Math Circle  
• Penn State Math Circle  
• Pi Math Learning Center  
• Portland Math Circle  
• Prime Factor Math Circle (Seattle)  
• Rockport Elementary Math Circle
2014-2015 Math Circle Grant Report Summary

The online survey presented to Math Circles
https://docs.google.com/forms/d/1H-Df8IFlgwBFISN7U7Q-JXfdKI8IXi3iuHIMrQP2laE/viewform

Total Number of Circles that Responded: 15
(5 Math Students' Circles, 10 Math Teachers’ Circles)

Circles that Responded:
Student Circles:
• Bard Math Circle, bardmathcircle.org
• Boise Math Circle, http://math.boisestate.edu/circle
• Maize and Blue Math Circle, http://www.umdmathcircle.org
• Mid-Cities Math Circle, http://midcitiesmathcircle.org
• Waubonsee Math Circle, http://www.waubonsee.edu/mathcircle

Teacher Circles:
• Greater Nebraska Math Teachers' Circle, http://scimath.unl.edu/gnmtc/
• Mid Hudson Math Teachers’ Circle
• Oshkosh Math Circle, http://www.uwosh.edu/mathematics/circle
• Philadelphia Area Math Teachers' Circle, www.pamtc.org
• San Benito County Math Talks
• San Diego Math Teachers' Circle, sdmathteacherscircle.org
• San Joaquin Math Teachers’ Circle
• Smoky Mountain Math Teachers' Circle, https://www.facebook.com/sm2tc
• Wayne County Math Teachers’ Circle, www.math.lsa.umich.edu/WCMTC

Total number of participants (students and teachers) represented in these Circles: 716
Program Details

Where does your Math Circle meet?

- College/University Campus: 8 (57.1%)
- K-12 School: 1 (7.1%)
- Community Building: 1 (7.1%)
- Church: 0 (0%)
- Other: 4 (28.6%)

How often did you meet?

- Weekly: 4 (26.7%)
- Monthly: 6 (40%)
- Yearly: 0 (0%)
- Other: 5 (33.3%)

Total number of participants (students and teachers) represented in these Math Circles: 716 (202 students, 514 teacher and other adult participants)

Average number of participants at typical Math Circle meetings this year

- 1-10 participants: 4 (26.7%)
- 11-20 participants: 8 (53.3%)
- 21-30 participants: 2 (13.3%)
- 31-40 participants: 1 (6.7%)
- 41-50 participants: 0 (0%)
- 51-60 participants: 0 (0%)
- More than 60 participants: 0 (0%)
Mathematics Details

Institutional Role of Math Circle Director

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<th>Role</th>
<th>Count</th>
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<td>Staff</td>
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<td>Undergraduate Student</td>
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<td>Parent of Math Circle Student</td>
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<td>0%</td>
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<tr>
<td>Other</td>
<td>1</td>
<td>7.7%</td>
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</table>

What approach does your Math Circle take for developing your Math Circle lesson schedule for the year?

- Typical schedule included a block of lessons all focused on developing one mathematical topic: 3 (20%)
- Typical schedule was a different math topic every lesson: 11 (73.3%)
- Other: 1 (6.7%)

What approach does your Math Circle take for finding Math Circle instructors?

- 1-5 instructors teach a majority of the lessons for the whole year: 10 (71.4%)
- There is a wide variety of different math instructors over the year: 2 (14.3%)
- Other: 2 (14.3%)
Math Circle Goals

What is the primary goal of your Math Circle? – Math Students’ Circles

• We offer opportunities for students to explore mathematics outside of the typical school curriculum.
• Grade school mathematics differs greatly from upper-level mathematics practiced by researchers. Lower level math classes up through calculus include challenging problems, but these problems often have a clearly defined method and solution. Research-level mathematics involves open-ended questions, exploration, discovery, conjecture, and proof. Our main goal is to give students with an interest in math the opportunity to be exposed to this upper-level style of mathematics.
• Our primary goal is to show students that mathematics is enjoyable and they can have fun as they learn it. Most of our students come from Detroit metro area schools and having hard time to see mathematics outside of a rigid high school curriculum. We aim to present them interesting and relevant face of mathematics. We start each session with a mathematical oriented game, like Set or similar board games. After playing [a] little bit, we bring up the mathematical content of the game in a natural way. They are usually amazed at formulating the rules and strategies of the game in mathematical context. We hope that they will gain this skill at our circle and start using mathematics to formulate and solve different problems.
• Our main goals are to attract students’ attention to mathematics and motivate them to excel in the subject; as well as to help those who are already attracted and need to develop their talent and skills. One particular goal of our math circle is to prepare the students for mathematical contests. Lectures on various topics are presented by distinguished mathematicians and these lectures are normally the highlights of the math circle. The main goal to prepare the participants for competitions was definitely achieved – we have one USAMO participant, and about 4 AIME participants. (Note: USAMO = United States of America Mathematical Olympiad, AIME: American Invitational Mathematics Examination (AIME))
• Math content enrichment outside the normal school curriculum.

What is the primary goal of your Math Circle? – Math Teachers’ Circles

• Math Teachers Circles are designed to bring together teachers of mathematics (especially of grades 6-12) and mathematicians with the goal of discovering and sharing with students the excitement and richness of problem solving in deep yet accessible mathematical topics. More specifically, the main goal of the GNMTC [Greater Nebraska Math Teachers’ Circle] is to bring these enriching networking opportunities to teachers from rural communities, who might otherwise not have access to participation in a teachers circle. A secondary goal is that we hope the experiences at the GNMTC meetings have an impact in teachers’ classrooms.
• The Mid-Hudson Math Teachers’ Circle provides enrichment activities for Middle and High School teachers primarily serving Duchess, Ulster, Orange counties of New York State.
• Our goal is to support teaching through mathematical problem solving and to create an ongoing, supportive, and collaborative community of teachers, mathematicians, and mathematics educators.
• Our primary goal is to provide an intensive, challenging, fun mathematical experience for middle school math teachers as well as promote a community of problem solvers.
• To use College and University professors and mathematicians to create higher level thinking about mathematics among K-12 mathematics teachers.
• The San Diego Math Teachers’ Circle is an informal monthly program that aims to engage teachers and mathematicians in working together on intriguing and stimulating problems. Through this collaborative process, we seek to provide teachers with an opportunity to enrich their knowledge
and appreciation of mathematics. We feel that problem-solving abilities and critical thinking engender success in many fields, and that promoting these abilities in teachers will, in turn, foster them in their students.

- The goal of the San Joaquin Math Teachers’ Circle is two-fold: to build a community of math lovers among middle school mathematic teachers and professional mathematicians and to foster a culture of problem solving in the middle school mathematics classroom.
- To establish an encouraging, collaborative, and non-competitive community of mathematics educators in Western North Carolina for the purposes of exploring rich mathematics tasks and encouraging personal, professional growth through fun and engaging experiences.
- The primary goal of the Thousand Oaks Math Teachers’ Circle is to provide a forum for local middle and high school math teachers to engage with a professional mathematician on a variety of math topics. Most of these topics can be described as "low-entry, high-exit", [in] which most everyone in the Circle can appreciate the basics, and explore some basic problems, and those who feel more inclined can explore the topics to a considerable depth. Another goal of the Circle is to act as a kind of "support group" for teachers to simply talk to each other about matters relating to their jobs. Finally, another goal of the Circle is to provide an avenue for CLU to engage in outreach with the local community.
- The primary goal of this Math Teachers’ Circle is to support teachers’ personal growth as mathematical problem-solvers, reasoners, and practitioners.

What were the goals of the Math Circle?
Math contest preparation [How important were each of the following to your Circle?]

- The central goal of the Circle: [Bar graph]
- A goal of this activity: [Bar graph]
- A small goal of this activity: [Bar graph]
- Not a goal of this activity: [Bar graph]

Math content enrichment [How important were each of the following to your Circle?]

- The central goal of the Circle: [Bar graph]
- A goal of this activity: [Bar graph]
- A small goal of this activity: [Bar graph]
- Not a goal of this activity: [Bar graph]

Safe community of students gathering for a fun session [How important were each of the following to your Circle?]

- The central goal of the Circle: [Bar graph]
- A goal of this activity: [Bar graph]
- A small goal of this activity: [Bar graph]
- Not a goal of this activity: [Bar graph]

Professional development for teachers [How important were each of the following to your Circle?]

- The central goal of the Circle: [Bar graph]
- A goal of this activity: [Bar graph]
- A small goal of this activity: [Bar graph]
- Not a goal of this activity: [Bar graph]
Were there other goals or central goals of your circle not reflected in your above responses?

Math Student Circles:
- The Bard Math Circle seeks to bridge the gap between academic and recreational mathematics; critical thinking skills learned here are applicable both at school and in general.
- Once again, we do not seek to provide any specific mathematical content, but rather mathematical methodology, beauty, thought, etc.
- Unlike some other circles I have been to, our circle has less college-bound students (although our students are quite talented) due to the location we serve. Another circle I worked with before had at least 80% of students related to faculty on campus and had [an] already well-planned education plan in front of [the circle]. It is quite different at our circle. We try to attract more students from Detroit public schools to our circle. We aim to work on their mathematical skills and also provide a general mentorship for future plans after high school, possibly choosing mathematics or related fields to study in college.
- Several graduate students attend our math circle and they plan to start their own math circle once they graduate. So, another goal of our math circle was to help and encourage future math circle organizers.

Math Teachers' Circles:
- Bringing enriching networking opportunities to teachers from rural communities who are often isolated and might otherwise not have access to participation in a teachers circle.
- Provide teachers with models of hands on exploration activities that can be modified for use in their classroom. Deepen the mathematical knowledge of participating teachers.
- Establishing and maintaining a relationship between university math faculty and secondary mathematics teachers.
- A central goal (perhaps THE central goal) involves supporting teachers in building their pedagogical content knowledge (PCK, Shulman, 1986, 1987), a fundamental tenet for research-based, high-quality mathematics education professional development; we therefore have discussions related to pedagogy embedded in and influenced by particular content areas and what it means to study content.
- Other goals: doing authentic, low-floor/high-ceiling problem-solving sessions (rather than content specific lectures), developing problem-solving capacity, building community and growing as a community, making connections to curriculum / analyzing curriculum, reshaping how we regard the discipline of mathematics (epistemological goals), fundraising and sustaining our group.
• Building a network of middle school math teachers in San Diego County.
• Related to the goals above, we want teachers to engage their students in more problem solving. This year, we focused on the book, Powerful Problem Solving by Max Ray. During our Classroom Connections portion of the meeting, we highlighted key ideas from one chapter and engaged in a problem-solving task that either came from the chapter or illustrated the ideas/strategies from the chapter. Teachers were asked to read the chapter before the next meeting and engage in some of the activities with their students. To further support our teachers, we provided additional handouts and articles on problem solving and any resources/handouts from the problem solving session through our online Edmodo group.
• For teachers to re-kindled their interest for the subject matter while gaining confidence in their ability to share it with others.
• Other goals are to support teachers’ use of mathematical problem-solving and math practices in the classroom and increase participants’ enjoyment of mathematics and productive attitudes towards learning and teaching mathematics. A meta-goal underlying all of these is to build a welcoming and supportive community of math teachers and mathematicians.
Expenses and Funding for Math Circles

Math Circle Budgets

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<th>Director Stipends</th>
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Other funds were used for
- We paid registration fees to participate in the AMC contests.
- Reimbursements for invited presenter air travel.
- Printing costs (brochures, postcards) and web domain registration fees.
- Table PC for attendance record keeping and workshop use.
- Quarterly dinner meetings of leadership team.

**Math Circle Funding**

**Were fees charged of the Math Circle participants?**

- No Fees charged: 13 (66.7%)
- $0-$50 for the year: 2 (13.3%)
- $51-$100 for the year: 0 (0%)
- $101-$200 for the year: 0 (0%)
- More than $200 for the year: 0 (0%)
Are you currently receiving additional funding for your Circle (beyond student fees and the NAMC Math Circle Grant?)

- Yes 7 46.7%
- No 8 53.3%

If you are receiving additional funding please indicate the source:

- Funding from university department/college/campus 2 25%
- Funding from local foundation 2 25%
- Funding from local corporation 0 0%
- Funding from community donations 0 0%
- Funding from state grant 0 0%
- Funding from NSF grant 0 0%
- Other 4 50%

Other funding sources included:
- Funding from university department/college/campus.
- Funding from local foundation.
- Funding from San Benito County Office of Education.
- American Institute of Mathematics Math Teachers’ Circle (AIM MTC) seed grant.
- Local chapter of NCTM (National Council of Teachers of Mathematics).
- County level math and science center.
One paragraph summary of Math Circles from Directors

- The Bard Math Circle is a mathematics enrichment program for upper elementary and middle school students, families, and teachers. This year we ran a monthly library program at the Tivoli and Kingston libraries, a competition program, featuring the AMC 8, 10, and 12 contests and the Purple Comet. The highlight this year was our first one-week summer day program in August 2014, which we plan to repeat in August 2015.

- The Boise Math Circle invites regional middle- and high-school students for Saturday morning discussions, each about a self-contained math topic. The students work together in groups, and also with mentors including Boise State faculty, graduate students, and undergraduates. The discussions are discovery-based, with students engaging in activities, looking for patterns, making conjectures, and attempting to argue proofs. The topics include relatively simple discoveries as well as advanced questions that expose students to higher mathematics.

- Our circle met total of 16 times last year, 8 times each semester. We had a consistent group of students with more than half of them female African American students from Detroit. We had 5 different presenters who worked on topics ranging from combinatorics to numerical analysis. One of our participants attended a state-wide math competition and placed in top 50 students among more than 2000 students in Michigan. Three of our participants worked on individual projects and were invited to the state-level competition. One of these three projects has been invited to Intel's international science project fair too. Overall, students enjoyed the circle and they were sad that we don’t meet over the summer. Especially, Detroit area families are encouraging us for a summer math and science camp program.

- This school year we had two guest speakers who delivered outstanding lectures. These two lectures can be considered as the highlights of the math circle. The first lecture was by Frank Sottile from Texas A&M University on "The shape of space". The second lecture was delivered by Peter Trapa from University of Utah and the title of the lecture was "Share the wealth". We also had several blocks of lectures on counting, invariants, polynomials, graphs, geometry, AMC, AIME and others.

- The goal of the Waubonsee Math Circle is to engage students with mathematical experiences that they normally would not have in a standard mathematics curriculum. We did not explore contest preparation or teacher enrichment. This goal was achieved to a limited extent. Everything ran smoothly and the students who found the circle and attended the meetings were extremely enthusiastic about the project. The quality of presentations was very high and the range of topics covered was impressive. Outside presenters remarked at how engaged and inspired the students seemed to be. However, the low attendance at the circle is a major downside. There was a meeting with only one student in attendance, and our maximum attendance was six.

- The composition of the GNMTC is unique in that it consists of a fall 'kick-off' meeting (where the topic for the season is introduced) followed by one or more meetings at each Nebraska location coordinated by a local leader. The kick-off event takes place the evening prior to the annual Fall Conference of the Nebraska Association of Teachers of Mathematics (NATM). While those teachers who will serve as organizers of a GNMTC meeting in their own communities are especially encouraged to attend, all teachers participating in the NATM conference are welcomed. Both an elementary and a secondary kick-off session convene at this time. During the 2014-2015 AY, the GNMTC inspired two unique circles in Grand Island; one for middle school students and their families, another for elementary teachers.

- On October 20, 2014 a workshop was held from 4:30 until 7:00 pm at Bard College. The topic of the session was "Enrichment Problems for Your Classroom." A variety of classic problems were explored including Hilbert's Hotel Infinity Problem and the Pirate Game Theory Problem. Professors Lauren Rose (Bard College) and Jeff Suzuki (Brooklyn College) led the discussion. Eleven participants attended, three men and eight women. On March 14, 2015, we took our Math Circle on the road and presented a set of Math Circle enrichment problems at the Ten County Mathematics...
Association held at North Rockland High School in Thiells, NY. Beth Goldberg (Linden Avenue Middle School) and Eleanor Pupko (Spackenkill High School), steering committee members of the Mid Hudson Math Teachers’ Circle led the one-hour workshop at the conference. Twenty-one teachers attended, five men and sixteen women. On March 21, 2015, Beth Goldberg and Debby Mosher (Linden Avenue Middle School), travel to the Annual Hudson-Mohawk Valley Area Math Conference to lead a math circle on "Perplexing Probability Problems." Thirty individuals attended the session, ten men and twenty women. On April 13, 2015, a Math Circle was held at Bard College. Entitled "Linking Art to Mathematics In Your Classroom," this engaging session explored tessellations and the art of Escher. Twenty-one teachers attended, three men and eighteen women. We are now in the process of planning and preparing for our THIRD Annual Summer Intensive Workshop. The workshop is scheduled for July 6-8 at Bard College. In the past, about 40 teachers attended.

- The Oshkosh Math Circle is an informal meeting of middle and high school math teachers from around Northeast Wisconsin and math professors at UW Oshkosh. We meet the second Tuesday of each month in the evening during the school year to work on interesting problems in mathematics in a relaxed setting. Teachers and mathematicians work together at our meetings in solving rich problems that can generate conversations about teaching, problem-solving strategies, and a variety of mathematics concepts. The Oshkosh Math Circle met nine times during the 2014-15 academic year.

- PAMTC continues its mission of supporting middle-school math teachers through a partnership with local colleges, universities, and area schools. It has monthly meetings, held at The Philadelphia School, a private K-12 institution in downtown Philadelphia. Seven meetings were held during the academic year 2014-15, three in the fall and four in the spring. We are particularly pleased that we have seen an increase in the number of participants this year and that, through the use of a consultant, are improving our social media presence.

- The San Benito County Math Circle "Math Talks" met each month to discuss a variety of math problems and have fun with math. Topics included Pick's Theorem, Prime Pairs, Math and Literature, CCSS Math strategies, the Pythagorean Theorem, and the Difference of Two Squares. Each of the workshops allowed participants to delve a little deeper into their understanding of math concepts and notice things they had not seen before. Many of the teachers used the information in their classroom to help their students understand math better. Perhaps the best part of the Math Circle was the collaboration and time spent getting to know teachers from around the county. The group consisted of teachers from all grade levels and mathematical backgrounds, but everyone was able to enhance their understanding of math and gain ideas to help their students.

- We had 6 monthly meetings during the 2014-15 school year, with several new participants. The highlight were the "polyhedral origami" made by participant Dave Honda as a "thank-you" gift to the circle -- the photo of these objects were featured on the mathteacherscircle.org homepage and in the MTCircular newsletter, and the geometry of these objects led to an unplanned impromptu math circle lesson late in the year.

- This is the second year that the San Joaquin Math Teachers’ Circle has provided middle school math teachers the opportunity to come together for a fun evening of problem solving. Due to funding, we started late in the year, but were able to meet five times. Our session topics varied from a focus on the history of mathematics with Babylonian Arithmetic and Proofs of the Pythagorean Theorem, to number theory with Divisibility and Logic and a game called Prime Club. The Prime Club session was particularly engaging and we hope to revisit the game at a more complex level. Our final session, Zome Geometry, was also very engaging due its hands-on nature. In the future, we hope to do more sessions utilizing the Zome Tools.

- For our fall pilot, we met on the WCU campus. We did the brownie problem with real brownies. For the spring pilot, we met in a community room in nearby Sylva. We focused on pi, since our meeting
was near "Pi Day." For both pilots, we have enjoyed a lot of interest. These pilots have really helped grow interest in our MTC and interest in our upcoming summer immersion workshop.

- **The Thousand Oaks Math Teachers’ Circle** has been meeting regularly (6 times per year) on the CLU campus since spring 2011. Hala King and Nathan Carlson (faculty at CLU) initially utilized pre-existing partnerships between the CLU School of Ed and local school districts to establish and advertise the Circle in Ventura County. Fawn Nyugen and Erin Hanley at Mesa Union Middle School became part of our leadership team in 2012, whose efforts to advertise and spread the word about the Circle have been exceptional. Our Circle attendance has more-or-less stabilized between 12-20 attendees each session, which we've found to be a favorable group size. Highlights of the past year included a well-received presentation 4/27/15 by CLU faculty Michael Gagliardo on Mobius strips, which included hands-on creation and cutting of strips, and an Oct. 27, 2014 session led by Joshua Zucker on "Volume, Duality, and Beyond". We were fortunate to have a Math Circle star such Josh make the trip from the Bay Area to lead our Circle.

- This Math Teachers’ Circle is still in its formative stages. Our first meeting will be a one-day immersion on August 11. After that, the Circle will meet once/month for three hours. There will be two meetings each month and participants will choose a primary one to attend. One will meet the third Tuesday of each month in the evening, and the other will meet the following Saturday in the morning. We chose to have two circles in order to make the program as accessible as possible for a diverse array of districts. Highlights in the past year have included: a leadership team attending the AIM training in DC in July 2014, quarterly meetings of the leadership team, a presentation to Detroit Area teachers at an annual conference in November 2014, a presentation to Detroit math instruction leaders in May 2015, and two publications to advertise the Circle--one in September 2014 at the state level and one in March for Detroit-area teachers. We’ve also made good connections with the county-wide Math and Science Center and the Detroit Area Council of Teachers of Mathematics (DACTM).
What do you consider the biggest success of your Math Circle program over the past year?

- We expanded our programming to include a summer math program for local middle school students.
- There isn't any specific thing. This was our first year, so just running consistently was a joy. We forged relationships with a diverse community of really special students. We found many mentors to donate their time each week, and also to plan and run sessions. We developed and delivered session materials, many from our own mathematical experience. We blogged out a summary and the materials after each meeting.
- I think our biggest success was maintaining a consistent group of African American (mostly) female students from Detroit metro area. We had 6 students (5 female, 1 male) regularly attending to our circle. I think, they enjoyed their time and learned a lot at the circle. I hope that the circle helped them to make definite plans for their future studies.
- It was a transition year (seven former math circle participants went to college) and the biggest success was to recruit three new students. We were happy to have a few outstanding lectures given by guest lecturers (as mentioned in the highlights) and by local teachers and graduate students. One of our participants, Luke Robitaille, scored a perfect score on the AIME exam. He was among the six kids in the nation who did that he is just eleven years old.
- Engaging and exciting presentations from a wide variety of speakers.
- One of the leaders of the kick-off session chose to hold a math teachers circle event for her 7th grade students and their families in Grand Island, NE. Also, our first elementary focused session (outside of the kick-off event) took place in Grand Island.
- We have a core group of teachers that return to our workshops. Our summer workshop is so successful that many teachers ask us in advance for the dates so that they can plan the summer schedule around attending the sessions.
- We are also invited annually to present at local conferences. We use these events as an outreach opportunity to introduce our math circle to a wider audience. We capture the email addresses of the teachers in attendance and then include them on our mailing list of upcoming events.
- Our biggest success is that our Math Circle is helping our teacher participants to have a greater impact in the classroom. Several participants have thanked us personally for giving them new ways to think about math and how this will help him with his teaching. Other participants have reported they have told their students about the math circle and the problems we work on. One teacher said her students ask her every month about the problem and want to work on it, too.
- This year, we experienced significant growth in the mean number of teacher- and mathematician-attendees per session.
- This year we had on average, 12 participants. The participants consisted mainly of teachers whose assignments ranged from 1st grade through 12th grade. Although they came with a broad range of math knowledge, everyone left the workshops feeling like they had a better understanding of math in general. In addition, many of the teachers used the concepts with their own students.
- Consistent higher attendance, new instructors.
- The biggest success of our Math Circle program was the increase in participation this year. Last year we averaged about 6 teachers each meeting. This year, our average increased to about 9 teachers, with our first three meetings hosting 11-12 teachers. In addition to our participants spreading the word about our first year, we think the new registration fee and accompanying book (Powerful Problem Solving) increased the perceived value of the program. Another success was the development of our faculty members as session facilitators. This year, we did not bring in visiting
facilitators, which encouraged our leaders to develop their own session problems. Next year we hope to have a mixture of facilitators so our leaders can learn from visiting facilitators.

- The biggest success is that these pilots have been very successful recruiting tools for our upcoming summer intensive.
- Perhaps the biggest success is in getting reasonably stable attendance of 10-20+ participants in each session. Also, we always consider it a success when we can arrange to have someone like Joshua Zucker lead one of our sessions--such sessions galvanize the energy in our Circle. Finally, the two middle school teachers on our leadership team (Fawn Nguyen and Erin Hanley) have continued to be absolutely stellar in advertising and promoting the Circle in the local schools.
- Getting the leadership team together and setting the stage for monthly sessions.

If you have written evaluations, feel free to include a summary of the best comments.

- We did not collect evaluations of our program, but we did collect preliminary data on the kinds of math students do at home, school, math circle, etc. We hope to use this information to launch a more formal study next year.
- We haven’t had evaluations but the following piece appeared in [a] newspaper. [http://michiganjournal.org/2014/09/30/math-circle-influences-students-to-challenge-themselves/]
- "Connecting with others is always beneficial to my teaching, I learn something from each of them. In a small district, communicating with other math teachers is difficult. This provides a chance to do so."
- In evaluations, teachers have asked us to link our materials to the common core in some way so that they can adapt what they learn at the math circle for classroom use. Overtime we have managed to modify our sessions in response to their feedback. We received particularly positive feedback at our session linking art to mathematics. Teachers have asked us to spend more time on this topic at a future session so we plan to have an expanded follow up at our July summer workshop.
- Comments from participants included:
  - Everyone is so positive and excited!
  - I appreciate stretching my mind in a welcoming environment. I’ve made a number of classroom changes based on work in this group the last 2 years—math centers and exploration, for example, which had not been done before.
  - Everything! [In response to: What have you enjoyed or benefitted from, this year?]
  - Solving problems with others [In response to: What have you enjoyed or benefitted from, this year?]
  - I enjoy learning about deeper math connections; informs what I teach and think about for students’ later experiences
  - Can’t think of any. You all do a really terrific job. Fun math + great food + coming away with improved teaching skills and a positive viewpoint on math = EXCELLENT

- Comments from participants included:
  - "Nice brain work"
  - "this workshop made me think more about how to play with the fraction concept with my students"
  - "I intend to use the information to challenge my students in the classroom"
  - "The most significant thing I learned today was how powerful patterns are!"
What are your plans for next year?

- We plan to expand our involvement of undergraduate math majors by holding more math circle events on campus. Off-site travel is a challenge for them.
- We intend to leave our basic format largely unchanged. Our biggest goal lies in recruiting. We would like to fill the 30 seats in our classroom, and ideally receive many more than 30 applicants. We would like to select applicants not necessarily based on grades or past school success, but based on interest level. Assuming we reach a larger number of students, we would like to split the classroom based on grade band (still leaving a lot of interaction at times). This will additionally require more mentors to accomplish. Finally we are starting a math teachers circle, and we would like to involve these teachers as mentors and program designers for the student circle.
- Next year, we plan to involve more high school math teachers to the circle. Their contribution is tremendous. I am planning to visit Detroit area math teachers monthly meetings and tell them more about the program. I will also work on finding funds to cover transportation expenses of teachers. I think this will be a good initiative to encourage them to join.
- I plan to invite more graduate students to help with the math circle organization and with the advertising on the social media. We may have to start a participation fee, as our resources are quite limited.
- The primary lesson learned is that we need to go to the high schools in person and network with the math clubs and math contest coaches in the area, to get attendance.
- We plan to look for other funding sources for next year so that we can continue to offer Math Teachers Circle events to Nebraska teachers from small communities.
- We are looking forward to our three day summer conference. We will continue to identify hands on activities linked to interesting problems that can be used in the classroom.
- Next year we will move the meeting time up...from 6 to 8, in order to attract more participants, based on some feedback we have received. We also plan on having a broader range of session leaders (this year the sessions were planned by only two people), including some guest speakers.
- We are currently building a new website and mobile apps; we would like to continue to invest in these efforts, including, possibly, providing online resources for teachers and offering ways to collaborate. Included in this effort is a new monthly newsletter with strategies and event notices for teachers. We are also hoping to continue deepening and developing relationships in the local
education community (e.g., Philly Ed Fund, local universities and non-profits, other thought partners, district officials, and K-12 schools). We also plan to continue fundraising and recruiting efforts.

- Next year, we will continue to host a variety of speakers so participants are exposed to many different mathematical concepts. We also hope to get the word out to more teachers, especially at the elementary school level, so that we can continue to develop teachers' math skills. In addition, we may research the possibility of hosting a kid's "Math Talks"/Math Circle.

- Working with re-established local NCTM chapter to make more teachers aware of the circle [and] increased variety of session leaders.

- Next year we hope to have seven monthly meetings, September 2015 through April 2016 (no meeting in December). We plan to finish reading the Powerful Problem Solving book, continuing to focus on a strategy chapter each month. Based on participant feedback, we need to continue to build teacher confidence in problem solving, particularly for those participants who struggle more than others. Facilitators need to build on teacher discourse and collaboration and model more differentiation strategies. Our goals for next year will be to increase teacher participation, offer a wide variety of sessions (varied facilitators and topics—including more hands on activities), and provide more support for teachers to implement problem solving in their classroom.

- We'll have our summer intensive at the end of June. So far, we've learned to be clear about start and end times of the sessions. During our spring session, we suggested a spontaneous dinner afterwards, but no one took us up on it. Teachers have very tight schedules, and we must honor their time.

- First, our hope is to arrange our sessions for Fall 2015 early in the summer. During the transition from Fall 2014 to Spring 2015 we did not arrange our sessions early enough and we were left scrambling a bit to find session leaders. Our goal for this upcoming year it to arrange our sessions much earlier in advance. Our hope is to have Paul Zeitz of the Univ. of San Francisco lead one of our sessions this fall. (He has done so twice in previous years).

- Most of what I described in this form applied to NEXT year, not this past year. In particular, all of the budget details are for the upcoming year.