

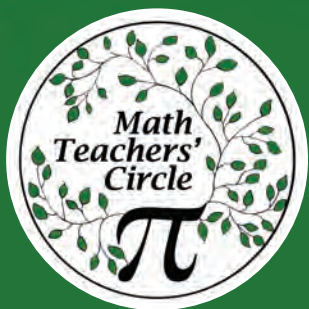
MTCircular

Autumn 2018



We the
People

Can Voting Ever Really Be “Fair?”



Surprising Shapes Dave Honda and Snapology Origami
Mystery Calculator Good Things, Unexpected Packages
Magic 8-Ball Geometry I see Platonic Solids in Your Future

MTCs as Joyful and Equitable Spaces

Dear Math Teachers' Circle Network,

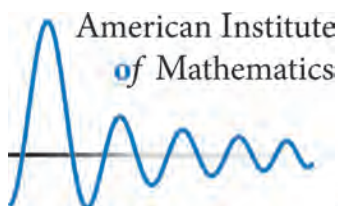
In reflecting on priorities for the upcoming school year, my thoughts are drawn again and again to this summer's MTC Training Workshop sponsored and hosted by the MAA, which was a truly remarkable experience (see p. 17). Teams of teachers and professors from all over the nation spent a week thinking deeply about how to develop inclusive MTCs that support teachers who work primarily with students traditionally underrepresented in mathematics. I look forward to continuing to work with these teams and to deepening the MTC Network's commitment to joyful and equitable spaces for learning and doing mathematics. This year, we will also continue to prioritize supporting the development of statewide and regional MTC Networks. In addition, we plan to focus on revamping our Web resources for a more user-friendly experience; stay tuned!

In this issue, we are thrilled to feature an interview with Dave Honda of the San Diego MTC, who won the Best Textile, Sculpture, or Other Medium category of the Bridges Art Exhibition at January's Joint Mathematics Meetings. (Congratulations, Dave!) We hope you'll take a few minutes to further explore Dave's beautiful artwork at his website, <http://snaporigami.weebly.com/>. For more geometric fun, check out Sayonita Ghosh Hajra's engaging MTC session on Platonic solids, which uses a Magic 8-Ball as a hook ("I See Platonic Solids in Your Future"). Nathan Borchelt shares another delightful MTC session, this one inspired by a serendipitous Christmas gift ("Good Things Come in Unexpected Packages"). And in a timely piece for November's elections, Lynne M. Pachnowski and Linda Marie Saliga give us a nicely designed inquiry-oriented approach to discovering and exploring a variety of preferential voting systems ("We the People: Can Voting Ever Really Be 'Fair'?").

Happy problem solving!



Brianna Donaldson, Director of Special Projects





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paper crown



plastic dinosaur



corny joke

I did not work.

THE MYSTERY CALCULATOR



fake mustache



MTC
IDEA!



Good Things Come in Unexpected Packages

A Festive Christmas Tradition Leads to Adventures in Problem Solving

Sometimes, a great problem for an MTC session presents itself when you least expect it. In December 2015, on a family visit to England, I sat down to enjoy a longstanding U.K. holiday tradition of opening Christmas crackers. Rather than food, these brightly colored “crackers” are short cardboard tubes wrapped in paper. When pulled apart by two people, with one person holding each end, the friction creates a small explosive “pop.” The crackers contain a variety of small gifts such as tissue paper crowns, novelty toys, and jokes.

When my son opened his Christmas cracker, he discovered “The Mystery Calculator,” a little two-player card game. Of course, I was intrigued and offered to exchange my fake mustache for his game. Little did I know where this gem of a gift would take me.

By Nathan Borchelt



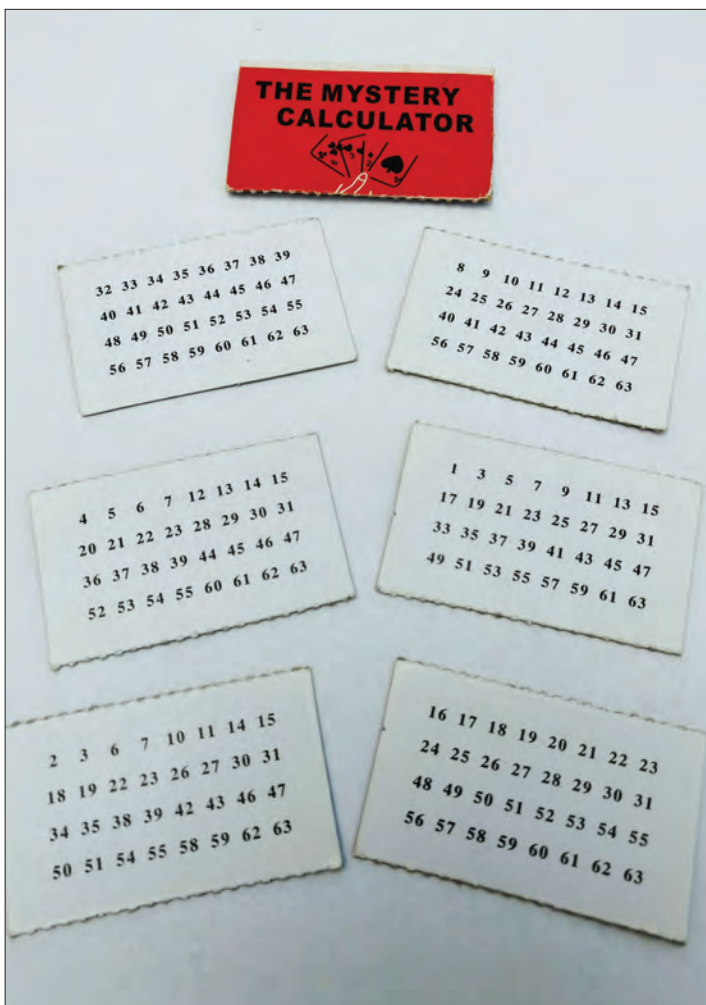
Exploring the Mystery

The Mystery Calculator turned out to be a set of six cards each containing a subset of integers between 1 and 63, as shown at left. The game begins with Player 2 secretly selecting any number visible on any of the cards. Player 1 holds up the cards one at a time, asking Player 2 whether her number appears on the card. From these responses, Player 1 quickly determines which number Player 2 selected. I enjoyed playing the game with members of my family, but obviously, I could not wait to share it with my friends in the Smoky Mountain Math Teachers' Circle. At the session, teachers paired up and each pair received a Christmas cracker. We spent a few minutes enjoying the fun gifts inside and wearing our tissue paper crowns. Then one person in each pair was handed an envelope containing large versions of the mystery calculator cards on pieces of card stock, along with the instructions shown at right.

Each set of partners played the game about five times without Player 1 giving the secret away. After that, we stopped and began our discussion of the game.

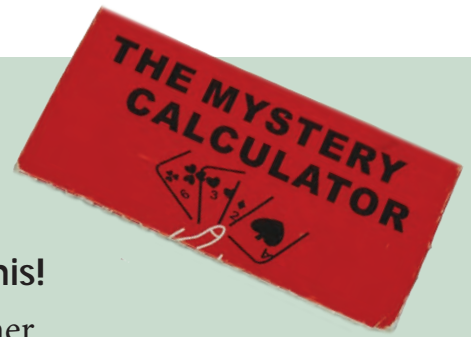
Of course, the natural question is "How does this trick work?" The numbers on the cards seem to be randomly selected numbers between 1 and 63. In fact, the card on which a given number appears depends on its binary representation. As the discussion progressed, most people referred to the cards according to the number in the upper left corner (the 2-card, the 4-card, etc.). It did not take long to recognize these values as powers of 2.

Every integer found on these cards can be broken down as a sum of powers of two. Consider writing them using their 6-digit binary representations. For example, 34 can be written as $2^5 + 2^1 = 32 + 2$. Therefore, the 6-digit binary representation of the number 34 is 100010. The first and fifth digits are 1, which is why the number 34 shows up on both the 2-card and the 32-card.



Top, a stack of unopened Christmas crackers. Above, the contents of the "Mystery Calculator" toy.

Mystery Calculator Instructions



Do the following, but do not let your partner read this!

1. Lay all six cards face up on the table in front of your partner.
2. Ask your partner to secretly select any number they see appearing on any one of the cards.
3. Now ask your partner to look at each card one by one.
4. If they see their number appearing on the card, they should leave the card face up.
5. If their number does not appear on a card, they should flip it over to face down.

Do the magic without sharing your trick with your partner!

Add together the numbers in the upper left corner of the cards that remain face up. Announce this sum as the number that they chose. Aren't you amazing?

For any card that is chosen, every single number on that card will have a 6-digit binary representation with one thing in common. For example, any number that appears on the 8-card has a 1 in the third digit of its 6-digit binary representation (e.g., $29 = 011101$, $46 = 101110$, etc.).

Similarly, any number that appears on the 16-card has a 1 as the second digit in its 6-digit binary representation (e.g., $24 = 011000$, $61 = 111101$, etc.) Exploring these patterns further helps explain why the mystery calculator trick works.

Extensions and Reflection

After cracking the mystery of the Mystery Calculator, participants began to pose and explore some other great questions: What other types of Mystery Calculators can be constructed? Could a different number base be used to do so? What would those cards look like? How many cards would be in the set?

We ran out of time discussing these questions, but that is what made it such a great MTC session.

This is a low-setup, high-fun activity! I prepared plenty of materials so that everyone could leave with their own sets of instructions and a mystery calculator. Several teachers requested additional copies of these simple materials so that they could repeat the activity with their students and colleagues. There has been only one disappointment: I have not yet had anyone else discover a Mystery Calculator inside one of their Christmas crackers. Still, watching teachers wearing tissue crowns and fake mustaches while doing mathematics makes everyone happy. Give this one a try at your next MTC holiday party! 📧

Nathan Borchelt, a co-founder of the Smoky Mountain MTC and the North Carolina Network of MTCs, is an Associate Professor of Mathematics at Western Carolina University.

Resources

For links to this article's resources and more, visit us at www.mathteacherscircle.org/newsletter.



I SEE PLATONIC SOLIDS IN YOUR FUTURE.

What is the three-dimensional shape inside the classic Mattel Magic 8-Ball toy? The first session of the Saint Paul Elementary Math Teachers' Circle, founded in 2017, began with this question. After a few minutes of thinking and playing, we said: CANNOT PREDICT NOW. ASK AGAIN LATER.

An Exploration of Platonic Solids

Platonic solids are three-dimensional closed shapes whose faces are uniform regular polygons. They have a special feature: A Platonic solid looks identical when viewed from any one of its faces. In our Circle's first session, we explored the intriguing fact that there are only five different types of Platonic solids, whereas there are infinitely many regular polygons. Participants had fun with this hands-on activity, which relates to various geometrical concepts that can be used with third- through fifth-graders.

3D Shapes from Equilateral Triangles

We began our session by reviewing regular polygons: A closed two-dimensional shape is a closed flat shape that lies on a plane, such as a circle, triangle, or square. A closed 2D shape consisting only of line segments that do not cross each other is called a polygon. A regular polygon is a polygon with all sides of equal length, and all angles of equal measure. The smallest possible regular polygon (in terms of number of sides) is an equilateral triangle, i.e., a triangle with three sides of equal length.

After reviewing regular polygons, we gave participants plastic Polydron shape tiles to play with, and we introduced the notions of *face*, *edge*, and *vertex*. Then we asked, "Is it possible to create a closed 3D shape such that two equilateral triangles of equal side length meet at every vertex?" SOURCES SAY NO, because the 3D shape cannot be closed.

However, participants realized that it is possible to create a closed 3D shape such that three equilateral triangles of equal side length meet at every vertex. This shape, called a tetrahedron, is an example of a Platonic solid and has three vertices, six edges, and four faces. In Greek, *tetra* means "four."

BY SAYONITA GHOSH HAJRA

A close-up photograph of a dark, circular, textured surface, possibly a metal lid or a piece of machinery. In the center, there is a bright blue triangle. Inside the triangle, the text "WHAT IS THAT SHAPE?" is written in a white, sans-serif font, arranged in three lines. The lighting is dramatic, with a bright yellow glow at the top of the frame and a bright light source on the right side, creating a strong contrast and highlighting the texture of the surface.

WHAT IS
THAT
SHAPE?



Next question: “Is it possible to create a closed 3D shape such that four equilateral triangles of equal side length meet at every vertex?” **OUTLOOK GOOD**. This shape, an octahedron, is also a Platonic solid and has six vertices, twelve edges, and eight faces. In Greek, *octa* means “eight.”

“Is it possible to create a closed 3D shape such that five equilateral triangles of equal side length meet at every vertex?” **WITHOUT A DOUBT!** The icosahedron, a third Platonic solid, has twelve vertices, thirty edges, and twenty faces. The prefix *icosa-* means “twenty.”

“Is it possible to create a closed 3D shape such that six equilateral triangles of equal side length meet at every vertex?” **DON’T COUNT ON IT**. Participants discovered that six equilateral triangles coming together at every vertex will never be closed. We spent some time understanding why: Because each angle in an equilateral triangle measures 60 degrees, all the angles at a vertex where six equilateral triangles meet add to 360 degrees, and continuing the pattern tiles the plane.

Participants realized that when seven equilateral triangles of equal side length meet at a vertex, the sum

of the angles at the vertex is more than 360 degrees, which forces the shape to have dents. Hence, there are no Platonic solids with more than five equilateral triangles meeting at every vertex.

Shapes from Squares

After the equilateral triangle, the next smallest regular polygon is a square. Exploring questions similar to those above, participants observed the following:

- It is not possible to create a closed 3D shape such that two squares of equal side length meet at each vertex.
- However, it is possible to form a closed 3D shape such that three squares of equal side length meet at every vertex. Such a shape is called a cube. A cube has eight vertices, twelve edges and six faces, and it is another Platonic solid.
- When four squares meet at a vertex, the sum of the angles is 360 degrees. Hence, by the same argument as for six equilateral triangles, there are no Platonic solids with more than three squares meeting at every vertex.





Shapes from Regular Pentagons

Next we considered regular pentagons and asked, “Is there a 3D shape such that all outer surfaces are regular pentagons of equal side length?” SIGNS POINT TO YES.


To investigate, participants examined different possibilities. They found that it is not possible to create a closed 3D shape such that two pentagons of equal side length meet at every vertex, as the shape cannot be closed.

With the manipulatives, participants found that it is possible to create a closed 3D shape with 12 regular pentagons such that three pentagons of equal side length meet at every vertex: a dodecahedron (*dodeca* in Greek means “twelve”). This is another Platonic solid.

Using the same logic as for equilateral triangles and squares, participants observed that if more than three pentagons meet at a vertex, the sum of the angles at that vertex will be greater than 360 degrees, meaning that there are no Platonic solids with more than three pentagons meeting at every vertex. If we consider other regular polygons with number of sides greater than 5, similar reasoning shows that it is not possible to create any other Platonic solid.

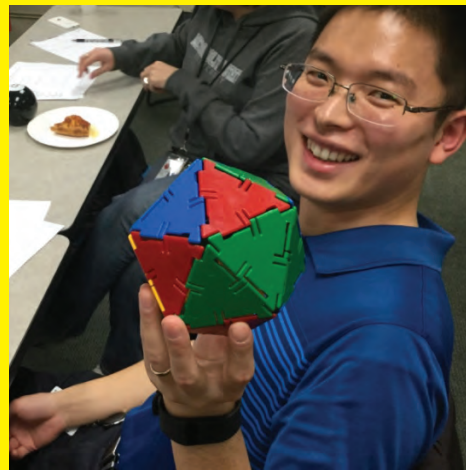
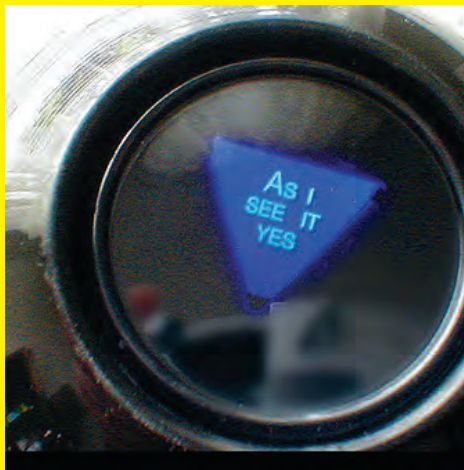
Conclusion

At the end of the session, we asked participants again to guess the shape inside the Magic 8-Ball. Participants recognized its faces as equilateral triangles, which indicates that it could be one of the following: a tetrahedron, an octahedron, or an icosahedron.

Once they started listing the answers given by the 8-Ball, they agreed the shape must be an icosahedron, as there are 20 possible answers. In fact, have you noticed that a number of the answers are scattered throughout this article? YES, DEFINITELY! 

Sayonita Ghosh Hajra, a co-founder of the St. Paul Elementary Math Teachers’ Circle in Minnesota, is an Assistant Professor of Mathematics at California State University, Sacramento. The work in this article was completed during her time as an Assistant Professor at Hamline University in St. Paul.

For links to this article’s resources and more, visit us at www.mathteacherscircle.org/newsletter.



A close-up photograph of a person's hand holding a white rectangular sign. The sign has the words "We the People" written in a large, black, stylized font. The person is wearing a dark green sleeveless top. In the background, a blurred American flag is visible. The overall image is part of a graphic with a dark grey background at the bottom.

We the
People

Can Voting Ever Really Be "Fair"?

by Lynne M. Pachnowski and Linda Marie Saliga



hat is “fair” when voting? Our Math Teachers’ Circle explored voting as a topic before the 2016 Presidential Election. As facilitators, our mathemati-

cal objectives were for the participants to apply and analyze several established methods for determining the “voice” of the majority. We wanted them to discover these methods through an inquiry-based experience, by engaging them early in a deep problem and waiting to assign definitions and terms until afterward.

To start, we formed small groups and asked participants to consider the following scenario: One hundred people are asked to rank their preference for the candidate for presidency. The five candidates listed in the table below were the five candidates on Ohio ballots in 2016. The results are as follows. Using all the data given, determine the winner.

TOTAL	37	27	22	11	3
1 st	Trump	Clinton	Duncan	Stein	Johnson
2 nd	Stein	Stein	Clinton	Johnson	Clinton
3 rd	Clinton	Duncan	Stein	Duncan	Duncan
4 th	Duncan	Johnson	Trump	Clinton	Stein
5 th	Johnson	Trump	Johnson	Trump	Trump

Table 1: The results of our election.

(Yes, it’s not realistic to believe that the 100 people created their list in one of only five ways. But for the sake of discussion, we’ll use this data to explore.) Note that using **plurality** (the candidate with the most first place votes wins), Trump is the winner. However, some participants objected that this was not the decision of the majority, and it doesn’t use all the data.

We asked participants to use all the data provided to determine the winner of the election. Most began by assigning points to each candidate according to where they were ranked on the ballot. That is, one could give 5 points for the candidate in first place, 4 for second place, 3 for third, and so on. Then, the points are multiplied by the number of voters who voted at that level. So, in the first column, 37 voters ranked Trump first, so

Trump would get 185 points (37×5), then 27 points (27×1), etc. The candidate with the highest score wins. In this case, Stein wins. This method is known as the **Borda Count** method.

We then asked, “Is there another way to determine a winner?” Some groups argued that they could consider reassigning all votes to the top two vote-getters, Trump and Clinton, according to everyone’s preference regarding these two candidates. In other words, in the first column, since 37 voters ranked Trump over Clinton, all those votes would go to Trump. In the second column, all 27 votes go to Clinton, etc. Using this method, Clinton wins. This method is known as the **Plurality with Runoff** method.

Further prodded, some groups eliminated the candidate with the fewest first-place votes from all the ballots and then recalculated the new plurality totals. For instance, in the table at left, Johnson received only 3 first-place votes. If we eliminate Johnson from the table, essentially conducting a run-off, looking at the first column, those 37 voters would vote the same. However, in the second column, we assume that Trump would now be ranked 4th, and so on. The new table would look as follows:

TOTAL	37	27	22	11	3
1 st	Trump	Clinton	Duncan	Stein	Clinton
2 nd	Stein	Stein	Clinton	Duncan	Duncan
3 rd	Clinton	Duncan	Stein	Clinton	Stein
4 th	Duncan	Trump	Trump	Trump	Trump

Table 2: Eliminating the candidate with the fewest first-place votes.

Continuing this process, we see that the person with the fewest first-place votes is now Stein, and so we create a new table eliminating her. We repeat that process two more times until we get a winner, in this case Duncan. This method of repeatedly eliminating the candidate with the least first-place votes is the **Hare Rule**.

At this point, we discussed and tried out several other voting methods to see how affected the results. For example, another method, similar to the Hare Rule,

“ THESE ACTIVITIES SPARK A GREAT CONVERSATION AMONG PARTICIPANTS ABOUT WHAT IS CONSIDERED ‘FAIR VOTING.’ IN DOING SO, THEY JOIN AN ONGOING DISCUSSION THAT HAS GONE ON HUNDREDS OF YEARS. ”

Image: iStockphoto.

eliminates the candidate with the most last-place votes. In the original table, Johnson also has the most last place votes. So, the first elimination process would still produce Table 2. However, now looking at Table 2, the candidate with the most last-place votes is Trump, so the next table would eliminate Trump. This method is known as the **Coombs Rule**, and gives the presidency to Clinton.

Another method considers how candidates would fare in a head-to-head battle based on the data. Overall, how did the voters decide between Trump and Clinton? Between Clinton and Stein? In the Trump-Clinton match, 37 percent in the first column would vote for Trump over Clinton, but in all of the remaining columns, voters ranked Clinton over Trump ($27 + 22 + 11 + 3 = 63$).

vs.	Clinton	Duncan	Johnson	Stein	Trump
Clinton	-	D:33-C:67	J:14-C:86	S:48-C:52	T:37-C:63
Duncan	C:67-D:33	-	J:14-D:86	S:75-D:25	T:37-D:63
Johnson	C:86-J:14	D:86-J:14	-	S:97-J:3	T:59-J:41
Stein	C:52-S:48	D:25-S:75	J:3-S:97	-	T:37-S:63
Trump	C:63-T:37	D:63-T:37	J:41-T:59	S:63-T:37	-
WINS	Clinton: 4 wins	Duncan: 2 wins	Johnson: 0 wins	Stein: 3 wins	Trump: 1 win


Table 3: Comparing candidates using head-to-head matches.

In the head-to-head match, Clinton is the overall winner. This head-to-head method is the **Condorcet Method**.

If the voters simply identify all the candidates they find acceptable, but without ranking (a simple “yes” or “no” method), the candidate that has the most acceptable votes would win. This is **Approval Voting**. When each voter is given a choice to vote for a candidate (+1)

or vote against a candidate (-1) and the candidate with the highest sum of the votes cast wins, this is **Negative Voting**. Ballots on which the voters list the candidates in order from top choice to last choice, like the ones used to create our data set, are **Preference Ballots**. Many different methods of determining the winner of an election have been introduced over the years, starting in the Middle Ages.

One participant discussed with great interest a method in which each voter is given a fixed number of points (such as 10) to distribute to the candidates in any way that they please. The candidate with the most points wins, but the voters have been given the option to weight their voting. A voter may choose to give all 10 votes to one candidate. Or, the voter can give 6 votes to one candidate and 4 to another. This method is known as **Cumulative Voting**.

These activities spark a great conversation among participants about what is considered “fair voting.” In doing so, they join an ongoing discussion that has gone on hundreds of years. In fact, in 1950, economist, mathematician, and political writer Kenneth Arrow proved that in an election with more than two candidates, it is impossible to develop a preferential voting method that will always be fair. 

Lynne M. Pachnowski is Professor of Education and Linda Marie Saliga is Associate Professor of Mathematics at the University of Akron. Both are co-founders of the Rubber City MTC in Ohio.


Resources

For links to this article’s resources and more, visit us at www.mathteacherscircle.org/newsletter.

Dispatches from the Circles

Local Updates from Across the Country

Connecticut •

Hema Gopalakrishnan (**Fairfield County MTC**) presented a math circle activity at the Northeastern Section meeting of the Mathematical Association of America on June 1-2. Everyone was very engaged in an activity focused on finding winning strategies for games. 

– Contributed by Hema Gopalakrishnan

Illinois •

After a year of record attendance, the **Chicago MTC** is expanding! Along with new partners at DePaul University and Chicago Public Schools, we are opening a second location in September 2018. To celebrate this growth, we are also hosting our first summer workshop: a Math Summer Jamboree on August 14. 

– Contributed by Peter Tingley


New Mexico •

MathAmigos, a Santa Fe collaborative working group related to the **Santa Fe MTC** and the **Math Circles Collaborative of New Mexico**, received a two-year, \$82,000 grant to lead mathematics professional development workshops in the Santa Fe Public Schools.

In the spring, the Math Circles Collaborative of New Mexico ran two Saturday Mathematics workshops for teachers of grades 4-6. Session leaders included Shannon Rogers of Art of Problem Solving and the **San Diego MTC**. In early May, we recruited many of these same teachers and other teachers from the

Santa Fe district to run a family math night at a local elementary school. About 250 parents and their children attended and participated in Julia Robinson Math Festival-style activities, including Exploding Dots.

In June, the Math Circles Collaborative of New Mexico organized three math circle events in Española. Altogether, 142 teachers in the Española School District participated in the math circle activities led by James Taylor of the Santa Fe MTC. The math circle activities received news coverage in the Rio Grande Sun: <https://tinyurl.com/mathamigos>.

This fall we are planning a large kick-off session, with visits and participation from two state representatives, a city councillor, the mayor, and a reporter from the Rio Grande Sun. 


– Contributed by James Taylor

Utah •

The MAA Math Horizons Journal will be publishing an article this fall based on a **Utah MTC** activity regarding the geometry of salt mountains. 

– Contributed by Troy Jones

Wisconsin •

The **Coulee Region Math Teachers' Circle (CRMC)** received \$2000 from the University of Wisconsin-La Crosse Small Foundation Grant Program. We were also featured in a story in the university campus news: <https://news.uwlax.edu/math-meetup/>. 

– Contributed by Nathan Warnberg

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Hector Rosario Honored with Hughes Award



Rosario

Hector Rosario, a co-founder of **Triangle MTC** of Chapel Hill, Durham, and Raleigh, N.C., and a teacher at South Gwinnett High School in Snellville, Georgia, was honored with the 2018 Hughes Award by the Gwinnett Alliance for Gifted Education. The Hughes Award annually recognizes any individual or group who made an outstanding contribution to the Gwinnett County Public School Gifted Program. Some of Rosario's contributions include organizing two Celebration of Mind events and the Julia Robinson Math Festival at Emory University. Rosario is also the Julia Robinson Mathematics Festival Ambassador for Atlanta. 📧

MTC Network, Initiative for Math Learning by Inquiry Receive 100Kin10 Grant

In January, 100Kin10, the national network for training and retaining 100,000 excellent K-12 science, technology, engineering, and math teachers by 2021, announced \$1 million in funding to five recipients for Teacher Experimentation Grants. 100Kin10 invited applicants to answer the question, "How can we empower teachers to experiment with their STEM instruction, or create conditions that allow them to do so?" The MTC Network, in collaboration with The Initiative for Mathematics Learning by Inquiry (<http://www.mathlearningbyinquiry.org/>), received a grant to offer teachers in Buffalo and Rochester, N.Y., additional professional development and training. The training will focus on connecting the teachers' MTC experiences with the incorporation of more inquiry-based learning into their classroom practices. Local leaders of the project include Jane Cushman (Buffalo State and **Buffalo MTC**), Keiko Dow (D'Youville College and **Buffalo MTC**), Ryan Gantner (St. John Fisher College and **Rochester Area MTC**), Yousuf George (Nazareth College and **Rochester Area MTC**), and eight teacher-leaders from school districts in Buffalo and Rochester. 📧

Registration Open for Global Math Week 2018

The Global Math Project aims to engage students and teachers around the world in thinking and talking about the same appealing piece of mathematics during a series of annual Global Math Weeks. Last year, during the very first Global Math Week, a million and a half students experienced Exploding Dots, a refreshing and powerful mathematical approach to arithmetic and algebra developed by project co-founder James Tanton and regularly described by students and teachers alike as "mind blowing." Global Math Week 2018 starts on October 10, with a participation goal of 10 million students worldwide. Learn how you can get involved and register to participate at <https://www.globalmathproject.org/>. 📧

MAA Hosts MTC Training Workshop

The Mathematical Association of America (MAA) partnered with the MTC Network to offer a MTC Training Workshop at the MAA's Carriage House in Washington, D.C., June 18-22, 2018. The workshop was designed for leadership teams of K-12 and higher-education mathematics professionals who are starting MTCs for teachers who work primarily with students from groups traditionally underrepresented in mathematics. Workshop participants included leadership teams from Dayton, Ohio; Merced, Calif.; New Orleans, La.; Savannah, Ga.; the State of Oklahoma; and the Navajo Nation. In addition to a variety of engaging MTC sessions, highlights of the week included a MAA Distinguished Lecture by Rochelle Gutiérrez (University of Illinois Urbana-Champaign), a screening of the documentary film *Navajo Math Circles*, and thought-provoking presentations about race, equity, and inclusion by Toya Frank (George Mason University), Aris Winger (Georgia Gwinnett College), and Michael Young (Iowa State University). While planning their own MTCs, participants also learned about related models such as Math Student Circles and Julia Robinson Mathematics Festivals that provide additional opportunities for both in-school and out-of-school learning in mathematics. ☐



Workshop photos courtesy of Bob Klein.

The Surprising Shape of Success

Dave Honda Wins Art Exhibition Honor with Snapology Origami



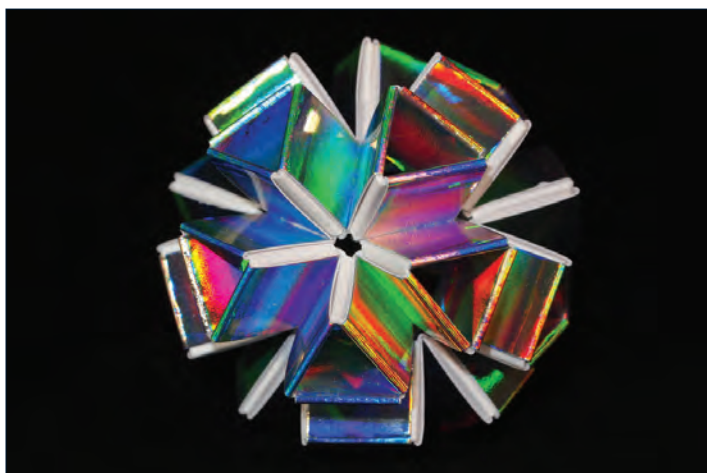
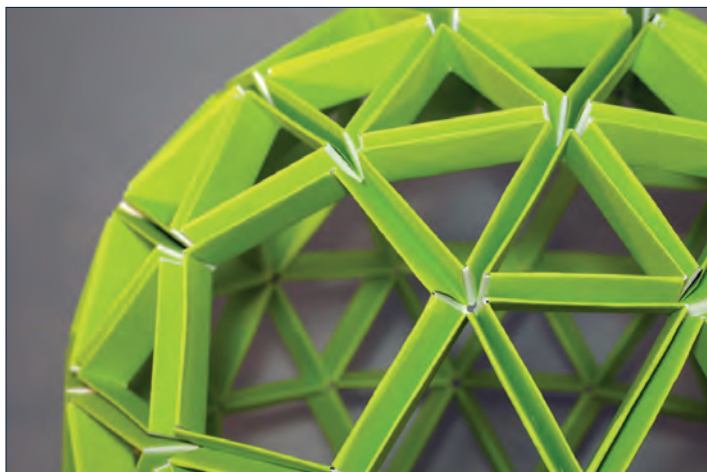
At the Joint Mathematics Meetings in January 2018, middle school math teacher and San Diego MTC member David Honda won first prize in the Bridges Art Exhibition category for Best Textile, Sculpture, or Other Medium. Honda sat down with MTCircular to talk about his prize-winning sculpture, “Dodecahedral 11-Hole Torus,” and the challenge of creating origami structures.

What inspired you to start making mathematical sculptures, especially with paper and folding?

I’ve always been interested in origami and in creating things in general. I’m a big fan of snapology—a type of origami that requires the folding of strips of paper to produce origami pieces. When I came across the work of Heinz Strobl (the originator of snapology), I was immediately hooked. I started with models that I found online, and then began to create original models.

What math goes into creating your pieces?

Snapology naturally lends itself to investigating polyhedra. The various solids (Platonic, Archimedean, Johnson, etc.) are the perfect blueprints for snapology models. The relationship between vertices, faces, and edges allows me to plan out a project. As my models grew larger I realized that I had to take weight, size, and stiffness of paper into account. In fact, my entry into the art exhibit initially started as an attempt to create a model that had an internal support structure. It was later when I talked with Yana Mohanty, one of our MTC coordinators, that she pointed out the piece’s connection to topology and tori. It’s because of these conversations I’m now exploring concepts like topology and dual solids.



How do you plan your pieces?

Most of my work starts with asking those “what if...?” questions. “What if I start with creating circles? Could I then join them and make tube-like structures? What if I try to create two intersecting pieces?” After that I usually have a basic idea of what I want to attempt, but then it’s a lot of prototyping. The piece at the art exhibit was the fourth version of that model. Often what I envision in my mind doesn’t work from an engineering standpoint and I have to rethink it. At some point I’d like to investigate the possibility of computer modeling.

What have you been working on since the Joint Math Meetings?

I reworked the 11-holed dodecahedral torus so that Yana could take photos from the inside using a 360 camera. (See below right.) I had to rethink the design so the “holes” would be large enough to accommodate her camera. My other project is unfinished: I’m trying to make two interwoven tori based upon dual solids, in this case an octahedron and a cube. I’m also working on creating kits and tutorial videos for others who are interested in learning about snapology.

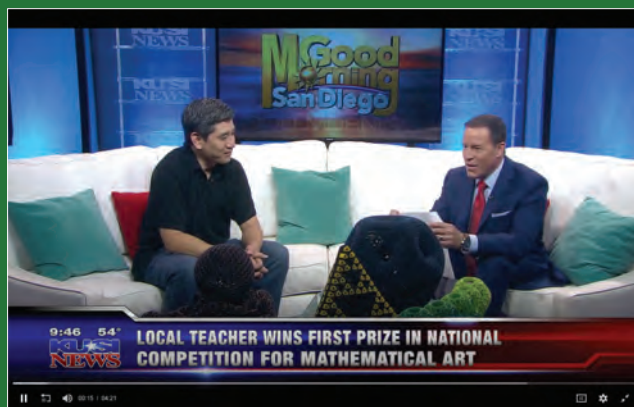
Has your Math Teachers’ Circle influenced your work at all?

MTC is a major influence on my work. As a veteran middle school teacher, I get the chance to explore and revisit math that I haven’t seen since my college days. MTC explorations often inspire ideas for my snapology work. Most importantly, if it weren’t for the encouragement of Yana and David Patrick (also a San Diego MTC coordinator), I never would have entered the JMM art exhibit. It’s because of MTC and its people that I’ve had the opportunity to share snapology with others. 📺

– Interview by Sonya Kohli

View more of Dave Honda’s work on his website at <http://snaporigami.weebly.com>.

View his interview on “Good Morning San Diego” at <https://www.kusi.com/local-teacher-win-national-competition-mathematics-art/>.



Images courtesy of Dave Honda.

Resources

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