MAA FOCUS

Newsmagazine of the Mathematical Association of America

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From the Editor

With the fall term winding down, I'm thinking about what went well this semester and what things I hope to improve. During an MAA MathFest Project NExT talk last summer, I started thinking critically about implementing a better organizational method and way of "getting things done." I have gotten more efficient about responding to email (although this doesn't mean that I always respond in a timely manner) and better about doing things immediately (if I can) instead of adding them to my to-do list.

However, I am also continuing to think of better ways to engage students, encourage students, and help them succeed. Like many institutions of higher learning, Lamar University is trying to address the changing needs of our students and focus on ways to better serve and retain them. The MAA Instructional Practices Guide, the GAISE advice for redesigning introductory statistics, and the national focus on quantitative literacy (instead of college algebra) are all on our radar as we create the next iterations of our courses and hope to retain students—many of whom are underprepared.

I'm looking forward to the Joint Mathematics Meetings in Baltimore as a time to speak with others about who have similar concerns and to make connections with others also doing this difficult work. We should share stories and techniques to help our students better succeed.

What are your plans for the winter break? Hopefully many of you will be at the JMM. Feel free to introduce yourself while we're there, and let me know what articles you'd like to see in the 2019 issues of MAA FOCUS! Perhaps you could author one!

Jacqueline Jensen-Vallin

About the Cover

"Real snowflake macro."
Credit: TothGaborGyula.

Cool Math Facts about Snowflakes from Mathnasium of Wauconda (Wauconda, IL)

- Snowflakes have six points and are hexagonal.
- Snowflakes have from 180 billion to 10 quintillion (10^{19}) molecules of water.
- They fall at a rate of 3.1 miles per hour.
- Snowflakes have 6 basic types based on their 3 dimensional shape: flat, column, stars, dendrite, lacy, needle, and capped column.
- The temperature of the air and the humidity where the snowflake forms determines the type of snowflake that will form. Dendrites form when the air temperature is between –8 degrees Fahrenheit to 14 degrees Fahrenheit.
- Snowflakes do not have perfect symmetry.
- A branch of geometry called fractal geometry helps explain the figures of snowflakes. A mathematician, Helge von Koch, created the Koch snowflake based on the Koch fractal curve.

For other stunning macrophotographs of snowflakes go to bit.ly/2DjNK8Q.

MAA FOCUS

Mathematical Association of America

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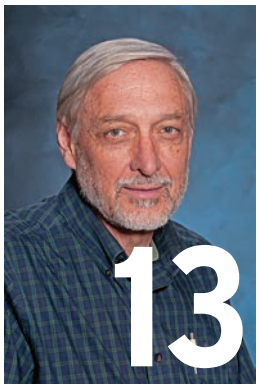

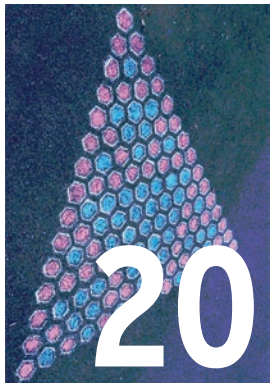

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departments

MAA MathFest Deadlines

December 15	Workshop, Panel, Poster, and Town Hall Session proposals due
December 31	Other Mathematical Session proposals due
January 31	SIGMAA Session proposals due

FOUND MATH

Skelly's Farm Market constructed one of their corn mazes this year as a collection of "impossible figures." Background information about Skelly's Farm Market and their 20-year run of corn mazes is at skellysfarmmarket.com/corn-mazes/

Submitted by Darrah Chavey, Beloit College

MAA Project NExT

NEW EXPERIENCES IN TEACHING

MAA Project NExT introduces new application cycle!

The first round of applications for the 2019 cohort of MAA Project NExT was due on October 15. New(ish) faculty who are already in full-time teaching positions should have used that deadline. Decisions will be made by December 1. Those accepting positions during this academic year (to start Fall 2019) will have a second application deadline of April 15, 2019. For more information, visit projectnext.maa.org.

MAA AMC

American Mathematics Competitions

AMC Deadlines

AMC 10 and AMC 12

10/12 A	Early Bird Registration	January 8, 2019
	Regular Registration	January 9–22, 2019
10/12 B	Early Bird Registration	January 22, 2019
	Regular Registration	January 23–28, 2019

AMC 10/12A Competition will be held on February 7, 2019.
AMC 10/12B Competition will be held on February 13, 2019.

National Research Experience for Undergraduates Program

Applications for MAA's National Research Experience for Undergraduates Program are being accepted through **December 15, 2018**. NREUP supports the participation of mathematics undergraduates from underrepresented groups in focused and challenging research experiences to increase their interest in advanced degrees and careers in mathematics. NREUP aims to reach students at the transition point between lower division and upper division studies, provide mentoring in a challenging summer program that will support students as they continue their undergraduate studies, and encourage students to pursue graduate studies and careers in mathematics.

Learn more and apply today: maa.org/nreup.

JMM

JOINT MATHEMATICS MEETINGS

BALTIMORE • JAN 16–19, 2019

AMERICAN MATHEMATICAL SOCIETY
MATHEMATICAL ASSOCIATION OF AMERICA

Important Deadlines

December 13	Hotel reservations thru JMM website
December 27	Advance registration ends
January 8	Deadline to cancel for 50% refund

2019 Grant Opportunities

There are several upcoming funding opportunities within the MAA.

The Dolciani Mathematics Enrichment Grants provide funding for middle or high school mathematical enrichment programs with the goal to reach students who are looking for more challenging work and encourage them to further their mathematical studies. Projects should provide enrichment activities for students that lead to heightened interest and appreciation in mathematics. The deadline for proposals is February 12, 2019. Learn more and apply now at maa.org/dolciani.

Tensor Grants for Women and Mathematics support projects designed to encourage college and university women or high school and middle school girls to study mathematics. Projects can vary in style, such as holding a conference for counselors to prepare them to encourage women and girls to continue to study mathematics, or bringing high school women onto a college campus for a Math Day and facilitating a substantive follow-up. The deadline for proposals is February 12, 2019. Learn more and apply now at maa.org/tensorwomen.

Tensor-SUMMA Grants: Strengthening Underrepresented Minority Mathematics Achievement support programs are designed to encourage the pursuit and enjoyment of mathematics among middle school, high school, and/or beginning college students from groups traditionally underrepresented in the field of mathematics. Projects can be math clubs, math circles, or any enrichment piece that supports the advancement of underrepresented groups in mathematics. The deadline for proposals is February 12, 2019. Learn more and apply now at maa.org/tensorsumma.

PIC Math prepares mathematical sciences students for industrial careers by engaging them in research problems that come directly from industry. University faculty will hold a semester-long course in the spring that challenges students to solve an industrial problem presented by an industrial partner. Faculty will receive training the summer before facilitating their course. Proposals should be submitted by university faculty who would like to hold a PIC Math course at their campus. The deadline for proposals is March 1, 2019. Learn more and apply now at maa.org/picmath.

Who Wants to Be a Mathematician Championship at JMM

Saturday, 1:00 PM–2:45 PM

Show your support for top high school students from the U.S., Canada, and the U.K. as they compete for a US$5,000 first prize for themselves and US$5,000 for their school's math department. Come match wits with the contestants, support their mathematical achievement, and have tremendous fun at the same time.

New MAA Member Benefits

MAA members are lifelong learners who seek out new learning opportunities and professional development resources. MAA is excited to announce two new member benefits available to MAA members. Learn more at maa.org/newbenefits.

MAA Video Library

The new MAA Video Library includes exclusive content from featured speakers at MAA MathFest and other MAA events. The video library currently features over 12 hours of content and is growing.

How do MAA members access the benefit?

- Log in to your MAA profile on maa.org using your MAA username and password.
- In My Profile, scroll down on the left and click on the "Video Library" tab. Browse or search the video selection from there and hit play.

Discounts on The Great Courses Plus Subscription

MAA members can now receive an exclusive discount on a subscription to stream lectures from *The Great Courses Plus* —only $5.99/month on a quarterly plan. Through this discounted subscription, MAA members can stream more than 10,000 video lectures from world-class teachers and experts on topics from mathematics to cooking to art. A number of MAA members are Great Courses lecturers including James Sellers, David Kung, Art Benjamin, Michael Starbird, James Tanton, and more. Stream the lectures from your laptop, TV, tablet or phone.

How do MAA members access the benefit?

- For more information and to sign up for a subscription to *The Great Courses Plus* at this special MAA rate, log in to your MAA profile on maa.org using your MAA username and password.
- In My Profile, scroll down on the left and click on "The Great Courses Plus Discount" tab to sign up for the subscription on *The Great Courses Plus* website. (This page on their website is exclusive to MAA members and should be accessed by logging into maa.org.)

January CMJ

Dominic Klyve's inaugural issue of *CMJ* will be out soon, don't miss "When Fractions Make Cycles," which explores the surprising mathematics that arises when continued fractions are constructed using subtraction, and "A Birthday in Saint Petersburg," which examines a beautiful pair of paradoxes.

Joint Mathematics Meetings 2020 Proposal Deadlines

January 31, 2019	Themed Contributed Paper Session proposals due
February 7, 2019	Minicourse proposals due
March 15, 2019	Invited Paper Session proposals due
April 15, 2019	Workshop, Panel, Poster, Town Hall, SIGMAA, and Other Mathematical Session proposals due

Congratulations to Math Horizons on its 100th Issue!

The November 2018 issue was Horizons' 100th. Look for interesting articles like "Prof. Engel's Marvelously Improbably Machines" and "Proofs are Like Love Songs." A bit of the history of MH can be found in "Broadening Horizons since 1993."

Did you know that members can access current and **all** past issues on T&F? Login at maa.org and start reading!

Colby College

Tenure Track Assistant Professor of Mathematics

Tenure-track assistant professor position beginning September 1, 2019. The department of mathematics and statistics seeks an exceptional teacher with a dynamic research program in combinatorics, graph theory, or a closely related area of discrete mathematics. The teaching responsibility is an average of 4.5 courses per year. Candidates must have a Ph.D. in mathematics and must have at least one year of full-time teaching and/or research experience distinct from the Ph.D. program. Applications must include evidence of potential for a strong continuing research program and exceptional teaching and mentoring of undergraduates with diverse backgrounds and demographics.

For a full description of the position, please go to www.colby.edu/math.

Looking for a Placement Test Suite?

The Möbius MAA Placement dramatically enhances the ability of colleges and universities to assess students' knowledge of math. The Web-based nature of the system provides convenient access for students and saves valuable time for institutions. Universities can place their students in the right courses quickly, easily, and at a fraction of the cost associated with traditional placement tests.

Benefits of Möbius MAA Placement Tests

Student success: Correct placement ensures higher success rates for students.

Created by experts: MAA placement test items are written and MAA placement tests are constructed by panels of college mathematics teachers who are directly involved with teaching students the courses served by the placement tests. Final approval for each test comes from the MAA.

Statistically rigorous and validated: Before a test can become an MAA standard or calculator-based placement test, it is first administered at select institutions. The results undergo detailed analysis, with modifications and further trials as required.

High content validity: MAA placement tests have high content validity in the judgement of college faculty members who either helped construct the tests or piloted the tests at their institutions.

For more information, including articles and answers to frequently-asked questions on how to implement placement testing on your campus, visit DigitalEd's site at bit.ly/2qKJA2w, or contact DigitalEd Sales at 1-800-268-2935.

MAA Departmental members receive a discount!

Spring MAA Section Meetings

ALLEGHENY MOUNTAIN
April 5–6, Shepherd University, Shepherdstown

EASTERN PA & DELAWARE
March 23, King's College, Wilkes-Barre

FLORIDA
February 15–16, Polk State College, Lakeland

GOLDEN
February 23, American Institute of Mathematics

ILLINOIS
March 29–30, Southern Illinois University-Carbondale

INDIANA
April 5–6, University of Indiana, Indianapolis

KANSAS
March 29–30, Pittsburg State University, Pittsburg

KENTUCKY
March 29–30, Centre College, Danville

LOUISIANA-MISSISSIPPI
February 21–23, Mississippi College, Clinton

MD-DC-VA
April 12–13, Hood College and Frederick Community College, Frederick

MICHIGAN
April 5–6, University of Detroit Mercy

MISSOURI
April 4–6, Lindenwood University, St. Charles

NEBRASKA - SOUTHEAST SOUTH DAKOTA
April 5–6, College of Saint Mary - Omaha

NEW JERSEY
April 13, 2019, Raritan Valley Community College

NORTH CENTRAL
April 5–6, 2019, Augsburg University, Minneapolis

OHIO
April 5–6, University of Akron, Akron

OKLAHOMA-ARKANSAS
March 28–30, Northeastern State University, Tahlequah

PACIFIC NORTHWEST
April 12–13, University of Portland, Portland

ROCKY MOUNTAIN
April 5–6, Fort Lewis College, Durango

SEAWAY
April 5–6, St. John Fisher College, Rochester

SOUTHEASTERN
March 7–9, Lee University

SOUTHERN CALIFORNIA - NEVADA
April 6, California State University - Channel Islands

SOUTHWESTERN
April 12–13, Western New Mexico University, Silver City

TEXAS
March 28–30, Tarleton State University, Stephenville

WISCONSIN
April 12–13, Carthage College, Kenosha

For the most up-to-date information on your section's activities go to maa.org/sections and click on the link for your section.

MAA Section Elections

The MAA sections listed to the right will be holding elections for section officers from February 5 to March 12. Voting will be done electronically. You will receive an email with instructions if you are in a section that is voting. If you do not have an email on file you will receive instructions by postal mail.

EPaDEL-Eastern PA & Delaware
Florida
Illinois
Intermountain
Iowa
Maryland-DC-Virginia
Michigan
Southern California/Nevada
Texas

MAA MATHEMATICAL ASSOCIATION OF AMERICA

Dear MAA Community,

Your support remains integral to the Mathematical Association of America's success, in pursuit of our mission: to advance the understanding of mathematics and its impact on our world.

As the year draws to a close, we ask that you support MAA's future by making a contribution.

As a supporter of MAA, you already know that we have a long history of outstanding exposition of mathematics through our publications. We hope you are finding the new online platform for accessing our journals as convenient as we do, but even more, the quality of our journals is only possible through the hard work of the editors and their boards.

MAA MathFest has become the premiere summer mathematics meeting, with an outstanding program that reflects the varied mathematical interests of our community. At MathFest 2019 in Cincinnati, Erik Demaine will deliver the inaugural Martin Gardner Lecture. We'll also celebrate 25 years of MAA Project NExT welcoming early-career faculty and providing opportunities for professional development and creating a network of peers to sustain them throughout their careers.

We recently completed the MAA Instructional Practices Guide, which offers evidence-based guidance to improve the teaching and learning of mathematics. The IP Guide's leadership team lays out a compelling case for our discipline to expand access to "improve and to collectively succeed at teaching mathematics to all students so that our discipline realizes its full potential as a subject of beauty, of truth, and of empowerment for all," reflecting the MAA's long-term commitment to expanding access and build a diverse, vibrant mathematical community.

The MAA Career Resource Center provides information about the role of mathematics across diverse fields, as well as access to current employment opportunities. Some of these stories come from the MAA Preparing for Industrial Careers in Mathematics, an NSF-funded effort that allows students to work in teams on problems from business, industry, and government, and has already reached more than 2,000 students at almost 200 institutions.

Every year, the MAA American Mathematics Competitions program reaches hundreds of thousands of students, both in the U.S. and internationally. Intended primarily to engage middle- and high-school students in high-quality problem solving experiences, the program also serves to identify extraordinary mathematical talent. Through the invitational and Olympiad training programs, the MAA ultimately selects six students to represent the U.S. at the annual International Mathematical Olympiad (IMO), where our team has taken first place in three of the last four years. And, the U.S., with MAA in the lead, is set to host the IMO in 2021, the first time in 20 years.

None of this is possible without the generous support of our members.

Join with us by making a contribution today that will keep our community strong and thriving for generations to come.

Sincerely,

Michael Pearson
Executive Director

Deanna Haunsperger
MAA President

Visit maa.org/donate to make your contribution today!

News

A Guide to Large Meetings

Robert W. Vallin

What are these meetings?

There are two large (the number of attendees in the thousands) meetings that the Mathematical Association of America (MAA) participates in annually. Each January are the Joint Mathematics Meetings. This is so-named because along with the MAA and American Mathematical Society, there are events sponsored by the National Association of Mathematicians, the Association for Women in Mathematics, the Association for Symbolic Logic, the Society for Industrial and Applied Mathematics, and others. With over 5000 people in attendance, these meetings are held in large cities, either at the convention center or split amongst two large hotels. The winter meeting has talks on a myriad of subjects including mathematical research, the science of teaching and learning, and attracting and retaining students. In late July or early August the MAA, holds MAA MathFest, which draws between 1200 and 1500 (and sometimes more than 2000!) participants and tends to be more focused on mathematics accessible to undergraduates. At either meeting you can listen to speakers, participate in student-centered events like student workshops or events like Radical Dash or attend the Graduate School Fair. You can also give your own talk or present a poster on your recent work. In order to get the most out of your experience it helps to know what to expect and that is where this guide comes in.

How do I register for a meeting?

Once you decide you want to attend a meeting, talk with your department chairperson or a faculty advisor. These people can help you (a) navigate the on-line registration process for attending and abstract submission when you are ready to give a talk, and (b) request money from your department, the Dean, the MAA, or elsewhere to defray your costs. Registration information is available at maa.org/mathfest, and information about writing abstracts is at bit.ly/2ApQyzt.

What are the different types of talks?

Invited addresses are hour-long talks given by well-known mathematicians. These are general talks in front of a large audience with divergent interests. The speaker will make sure the talk is suitable for everyone. The room fills up, so go early to get a good seat. For instance, Sarah Koch (University of Michigan) will present "What is the Shape of a Rational Map?" as an Invited Address for JMM 2019 in Baltimore.

Invited Paper Sessions or *Special Sessions* are sets of talks, usually with a theme (example titles include *Bridging Network Science and Graph Theory*, *Geometric Ideas and Where to Find Them*, and *Spectral Calculus and Quasilinear Partial Differential Equations*). The organizers of the session are looking for the top experts in that area. Each speaker gives a 15 or 20-minute talk, which is usually more specialized than an invited address. While all the talks fit a theme, it does not mean all the talks mesh together. You do not have to attend the first three talks to walk in and enjoy the fourth one. Although the mathematics may sound intimidating, anyone can attend these talks as well.

Contributed Paper Sessions are for people who have something to speak about, but speakers volunteer to talk rather than are invited to do so. Some contributed paper sessions have a theme (*Mathematics of Sudoku*, for instance) while others are just titled *Contributed Paper Session in Algebra* and will contain talks covering a variety of topics in algebra.

Some things worth noting:

- Both contributed paper sessions and invited paper sessions tend to run 3+ hours. You do not have to stay the entire time. It is acceptable to enter or exit between talks.
- This is not like being in a classroom. The speaker will be giving an overview of results rather than a detailed, proof-filled talk. You do not have to take notes. If you really like what you hear, walk up to the speaker after the talk and ask if he/she has a copy of the paper. A speaker will be happy to share. Or you can find it in ArXiv.
- Typically the first part of a talk is introductory and very general. Toward the end, especially at research talks, things tend to get very technical. Do not worry if it gets too deep. This happens to everyone except experts in that field.

How do I decide which talks to attend?

Find more information about MAA MathFest at maa.org/mathfest and more information about the Joint Mathematics Meetings at jointmathematicsmeetings.org. There you can find the programs for the meetings. In the program are the titles and times of each talk or session. Making a list of what sounds interesting to you will be helpful. There's a lot going on and it can be overwhelming without a plan.

How do you know what is interesting? Look at the abstracts. An abstract for a math talk is a short description of the content of the lecture. These are meant to whet your appetite and help you decide whether or not to go to that talk. Abstracts will be posted online and, when you arrive at the meeting, you can find the abstracts in book form. When you write everything out, you will find the inevitable time conflict: two talks, occurring simultaneously, both of which sound really good. This happens and you just need to choose, maybe at the last moment.

Keep an eye on the MAA web site for new ways to find out about the meetings and follow #MAAthFest on social media

Is anything else going on?

With so many people at a meeting, multiple events besides talks keep people engaged. Meetings are a very sociable time. You'll see reunions for students and faculty from various universities, and social hours for participants in REUs and other summer programs. There are groups devoted to a common interest (e.g., mathematics and knitting) that get together for receptions. Both national meetings host a reception for first-time attendees as well as for undergraduate and graduate students. Every day, the Student Hospitality Center is open to give students a place to relax, find important information, and connect with their peers. Panel discussions (How to Apply for Jobs in Academics), activity sessions (Origami, Polyhedra, and Mathematics), and games (Math Jeopardy and Who Wants to be a Mathematician), all of which are for students, will be going on. Awards are given for the undergraduate talks at MAA MathFest and the undergraduate poster session at the Joint Mathematics Meetings.

Finally, there is the exhibit area. Booths, set up by various publishing companies, software designers, recruiters, and merchants of all types, fill the hall. Here you can find the book on *Mathematical Cranks* that you want to read, purchase a DVD on the art of Escher, get sold on the latest version of MAPLE, buy a glass Klein Bottle, or finally own the t-shirt that expresses your love of π. This guide would be remiss if it did not also mention all the FREE STUFF. To attract you to their booths, exhibitors give away tote bags, Frisbees, mugs, pens and pencils, pads of papers, and buttons. There are also raffles for books, ties, gift baskets, and even iPads.

What else should I know?

When trying to make up your list of where to go and what to do, don't forget the resource right in front of you. Talk to the faculty at your school. They have the experience, plus, if your school is helping you with some of the cost, there may be some events they will require you to attend. That aside, be warned that going to meetings is expensive. There are ways to cut the cost down. You do not need to stay at one of the major hotels. Usually cheaper hotels are within walking distance to the meeting site. Find roommates for the meeting. Fill a room with other students from your institution. Bring, or buy, a cheap cooler. Once you've arrived find a market and buy snacks, breakfast and lunch food, and drinks. Going back to your room for lunch and eating a sandwich and chips is much cheaper than spending $10+ on fast food for every meal.

We look forward at seeing you at a meeting soon! ■

Robert W. Vallin is an associate professor at Lamar University.

This guide is an update of the update of an article written by Dan Kalman that appeared in the November 1998 issue of *Math Horizons*.

Some Events for Undergraduates at JMM

Radical Dash!
Organizers: Stacey Muir, *University of Scranton*, and Janine Janoski, *Kings College*

Radical Dash Kickoff Meeting: Wednesday, 10:20-10:50 AM and Radical Dash Prize Session: Friday, 10:30-11:00 AM.

The Radical Dash is a multi-day scavenger hunt for teams of undergraduates filled with math challenges and creative activities.

MAA Panel: What Every Student Should Know about the JMM
Wednesday, 9:00-10:20 AM

The panel will provide guidance for students attending the Joint Mathematics Meetings.

Reception for Undergraduates
Wednesday, 4:30-5:30 PM

Estimathon!
Thursday, 10:00 AM-12 noon

If you're looking for a mindbending mixture of math and trivia, look no further!

Grad School Fair
Friday, 8:30-10:30 AM

Meet representatives from mathematical sciences graduate programs from universities all over the country.

MAA Lecture for Students
Friday, 1:00 PM

"Drawing Conclusions from Drawing a Square" by Annalisa Crannell, *Franklin & Marshall College*

MAA Student Poster Session
Friday, 4:30-6:00 PM

Organized by Chasen Smith, *Georgia Southern University*, and Eric Ruggieri, *College of the Holy Cross*

This session features research done by undergraduate students.

Mathematically Bent Theater
Friday, 6:00-7:00 PM

Featuring Colin Adams and the Mobius-bandaid Players

Theatrical presentation of several short humorous mathematically inclined pieces.

Backgammon!
Friday, 8:00-10:00 PM

Organizer: Arthur Benjamin, *Harvey Mudd College*

Learn to play backgammon from expert players.

MAA Interactive Lecture for Students and Teachers
Saturday, 10:00-10:50 AM

"Tic-Tac-Toe (or, What is Mathematics?)" by Ben Orlin, *Math with Bad Drawings*

Math Wrangle
Saturday, 10:30 AM-noon

Organizers: Ed Keppelmann, *University of Nevada Reno*, and Phil Yasskin, *Texas A&M University*

The Math Wrangle will pit teams of students against each other, the clock, and a slate of great math problems.

For info about these and other events for students go to bit.ly/2FnbKL7.

News

Ideas from the Departmental Members Panel Session at MAA MathFest 2018

Steve Coolbaugh

On August 3, 2018, three MAA Members shared how they are using their Departmental Membership to enrich teaching, create math club activities, generate capstone experiences, and introduce their students to the broader mathematical community that so many of you consider your professional home.

MAA Departmental Membership includes full MAA membership benefits for one faculty member and all mathematics students (graduate and undergraduate) that your department chooses to enroll. This includes our two exciting new benefits:

- **MAA exclusive discount on The Great Courses Plus** video-on-demand streaming service. For only $5.99 per month (with the MAA quarterly plan), you gain access to thousands of in-depth videos taught by the world's greatest professors, who take you on an immersive journey into the worlds of mathematics, physics, finance, history, the arts, languages, health, philosophy, personal development, and so much more.
- Exclusive video content for members only from MAA MathFest featured speakers and other MAA events. The **MAA Video Library** features over 12 hours of stimulating content and is growing.

Here are a few suggestions from these engaged Departmental Membership Administrators:

1. Require students to sign up for MAA Membership and login as part of an assignment, which counts toward their course grade.
2. Use articles in MAA journals, accessible to students online through their MAA Membership, for class assignments, undergraduate research projects, and other activities in or outside of the classroom.
3. Use problems from MAA journals to challenge your math club students or for upper level classes.
4. For graduate students, encourage use of MAA journals to develop teaching skills and learn about pedagogy, best practices, and the MAA community more broadly.
5. Make students aware of MAA's Career Resource Center (maa.org/careers), where they can find career advice, helpful book titles (such as *101 Careers in Mathematics*), employer information, and job postings.

Panelists, from left to right: Joyati Debnath (Winona State University), Ximena Catepillán (Millersville University), Kira Hamman (Membership Committee Chair, Penn State Mont Alto), Diane Davis (Metropolitan State University of Denver).

6. Take students to your local MAA Section Meeting (maa.org/section-meetings) where they can hear math talks at an appropriate level and give talks about their own work.
7. Take students to MAA MathFest (maa.org/mathfest) and the Joint Mathematics Meetings, where they can present their work, participate in poster sessions and fun competitions, hear talks aimed at both undergraduates and graduate students, take part in numerous social events, meet like-minded students, and gain an appreciation of the broader mathematical community that is the MAA.
8. Enroll in MAA's PIC Math (maa.org/picmath) program, an NSF grant-funded program that provides faculty training and content for a semester-long, credit-bearing course focused on solving industrial problems. Students work on actual problems facing a business, industry, or government partner, and submit a video presentation and report detailing their solution.
9. Take advantage of the Departmental Member discount on hosting WeBWorK (webwork.maa.org), to reduce costs (save $100 per course) and enhance learning—at no additional cost to students.
10. Save even more with your Departmental Member discount on Möbius MAA Placement Test Suite (maa.org/placement_tests). ■

Steve Coolbaugh is Director of Membership at the MAA. He can be reached at scoolbaugh@maa.org.

MAA Thanks Gerard Venema for his Service as Associate Secretary

Michael Pearson

The MAA has great national meetings. Our meetings are made up of exceptional scientific exhibition and have been core to who we are and how we serve our members. Development of the scientific program for our meetings requires hard work on the part of many committees, volunteers, and staff to solicit and review proposals, and to develop a schedule that provides the great opportunities we've come to expect. The center of the meetings effort is the MAA Associate Secretary, who works year-round to oversee and coordinate the many, many moving parts.

We're privileged to have had Gerard Venema serve in this position for the last decade. Gerard's tenure began with MAA MathFest 2009, in Portland, Oregon, and concluded at MAA MathFest 2018 in Denver. Hortensia Soto has stepped into this key role, and has already done much of the work to prepare for JMM 2019 in Baltimore. See bit.ly/2Dc4EGe for an interview with Hortensia as she steps into this role.

The quality of the meetings, the introduction of invited paper sessions to contribute to the mathematics at MF, and Gerard's strength as a research mathematician made the ten years golden as far as meetings are concerned.

— Barbara Faires

Gerard spent a year as Associate Secretary-elect, during which he shadowed Jim Tattersall during Tattersall's final year in that position. I was on the front lines for meeting planning at the time and talked to Jim and Gerard a lot about our goals to expand and improve MAA MathFest. While the program was in a state of growth it was also beginning to gain momentum. Gerard persevered and helped to create a program built on excellent mathematical talent and rich topics.

Throughout the last decade, Gerard not only managed to get through the various challenges that a complex meeting necessarily presents, but also continued to work with the MAA Meetings Management Committee, the various committees tasked with particular aspects of the scientific program, and the entire MAA community to sustain and improve the quality of MAA meetings. A glance through programs of recent meetings will remind you of how successful he's been (and I'll give a special mention to the MAA Centennial meeting in Washington, DC, in summer 2015—a truly monumental effort!).

A few of us gathered in the MAA suite at the close of MAA MathFest in Denver to thank Gerard for his service. He was gracious as always, and modest about his role in the success of the meeting. Those of us who know what goes into these meetings, however, recognize the massive effort that goes into planning these events. I hope you'll join me in thanking Gerard for leaving MAA meetings in great shape, allowing us to build on his work and plan for a great future. For more specific details about Gerard's accomplishments, see bit.ly/2DroBd9. ■

Mathematical Art Exhibit at JMM

A popular feature at the Joint Mathematics Meetings, this exhibition provides a break in your day. On display are works in various media by artists who are inspired by mathematics and by mathematicians who use visual art to express their love of mathematics.

The exhibition will be located inside the Joint Mathematics Exhibits and open during the exhibit hours, including from 9:00 AM to noon on Saturday, January 19. For questions about the Mathematical Art Exhibition, please contact Robert Fathauer at tessellations@cox.net.

News

Charlie Hadlock Named New Pólya Lecturer

Jacqueline Jensen-Vallin

We are very excited to add Charlie Hadlock (Bentley University) to our list of esteemed Pólya Lecturers. Starting in fall 2019, Hadlock will join Kristin Lauter as the 2019–2020 Pólya Lecturers. The George Pólya Lectureship was established in 1990 to encourage and continue dissemination of high-quality exposition of mathematics. Previous Pólya lecturers include Edward Burger, Eric Demaine, Judy Walker, Ken Ono, and former MAA presidents Joe Gallian and David Bressoud. The EPaDel, Iowa, Metro New York, North Central, Pacific Northwest and Southwestern sections are eligible for a visit from a Pólya lecturer in 2018–2019; the Florida, Kansas, Michigan, Northeastern, Rocky Mountain, and Texas sections are eligible in 2019–2020; and the Illinois, Kentucky, Missouri, Golden, Seaway, Wisconsin sections are eligible in 2020–2021 (the second year of Hadlock's lectureship).

Hadlock received his BS in mathematics from Providence College and his MS and PhD in mathematics from the University of Illinois. He is the author of five books, including *Field Theory and Its Classical Problems* (1978) which was the first winner of the Beckenbach/MAA Book Award. His recent publications include the book *Six Sources of Collapse: A Mathematician's Perspective on How Things Can Fall Apart in the Blink of an Eye* (MAA, 2012), "Service-Learning in the Mathematical Sciences" (*PRIMUS* 23(6) (2013), 500–506), and the upcoming "Optimizing Management of Emergency Gas Leaks: A Case Study in Business Analytics." We spoke to Hadlock about his thoughts on being named a Pólya Lecturer.

MAA FOCUS: What are you most excited about doing as a Pólya lecturer? What is the message you're hoping to convey?

CH: First, this is a tremendous opportunity to meet math faculty and students around the country and to hear what they're up to and share ideas with them. I will have just retired from Bentley University as my Pólya term begins, so this is a particularly welcome way to share some experiences and keep my foot in the business. I taught my first college class as a TA in 1967, and I've seen quite a bit between then and now, aside from a long stint in the consulting industry. The math field is constantly changing in terms of areas of greatest interest, and it's important for us to be willing to adapt our curricula and teaching methods to changing times. Sometimes we are a bit slow in doing this either because we don't appreciate its importance or we're not well equipped to go about it. I'm particularly eager to meet with students on some of these visits to see what their thoughts are about their own futures.

MAA FOCUS: When you are invited to speak, what might sections expect you to speak about?

CH: First of all, I would expect to follow the interests or requests of any section that might invite me. There may be different cultures for section gatherings in different parts of the country. There's been quite a lot of interest in some of the themes in my book on collapse processes, so that's a natural topic for me if the section wants. I've also been very fortunate to have had a chance to speak to student groups at many colleges, and that's one of my own favorite things, whether I'm introducing them to game theory, environmental modeling, complexity theory, or helping expand their ideas about careers. Maybe I could serve a section meeting in this way, now that many more students seem to be attending. But then there is also the possibility to share ideas with faculty on teaching and curriculum. I could imagine running a lively interactive discussion on where things should go and how to get there. I don't know if any section would entertain a session like this, but it could be fun to try. Then I've even toyed with what I myself might most enjoy hearing if I were in the audience, and that might be a return to famous classical results that one hasn't seen for a long time but might like to review or rethink: why is the area of a circle πr^2; why can't you trisect an angle; why is e transcendental; why is the Central Limit Theorem true; why does the binomial distribution converge to the normal? Some of these things make great extra credit projects for students even when their proof might go beyond the courses where they first arise. And most of us probably haven't rethought their logic for many years unless we specifically teach the advanced courses where they are pursued in depth. But they might have been the sparks that got us into this business in the first place. Anyway, wherever I go and whatever people want me to do, I'm sure we'll have fun. ■

Rosenhouse Welcomed as Editor-elect of Mathematics Magazine

Jacqueline Jensen-Vallin

***Mathematics Magazine* is published** five times per year, and publishes "lively, readable, and appealing exposition on a wide range of mathematical topics." Members can read articles behind the member portal. Former editors include Frank Farris, Paul Zorn, Martha Siegel, and Gerry Alexanderson. Mike Jones is the current editor, who will end his term in 2020. In early 2019, Jason Rosenhouse will begin his service as editor-elect, getting ready to take over as editor at the end of Jones's term.

We spoke with Rosenhouse about the MAA and his upcoming editorship.

How did you first get involved with the MAA?

I have been a fan of the MAA ever since I discovered its magazines in graduate school. *Mathematics Magazine* in particular struck me as featuring some of the best expository mathematical writing I had seen anywhere, and its articles reminded me of how much fun math could be even as I was struggling with the stress of graduate school courses and exams. After I settled down to a permanent position, the MAA section meetings eventually became my favorite conferences. What a terrific vehicle for meeting mathematicians in your general geographical area!

What made you interested in serving on MAA committees and editorial boards?

Mathematically, I have always taken a strong interest in writing and editing. Mathematics is so beautiful and enjoyable when it is presented well, which makes it all the more painful that so many textbooks and journal articles are turgid, dull, and frequently unreadable even by professionals. Hence my interest in serving on editorial boards. Moreover, I so appreciate what the MAA does that I wanted to do my part to help it continue. Currently I am the Program Chair for my section of the MAA.

What was your motivation for applying to be editor of Math Mag? What about that project is exciting and fun?

As I've mentioned, writing and editing is something I have long been passionate about, and as much as I enjoy all of the MAA's publications, *Mathematics Magazine* has long been my favorite. For me it has always had the perfect balance of mathematical seriousness and readability. What greater satisfaction could there be than to be part of continuing its tradition of mathematical and literary excellence?

What is your vision for the future of Math Mag? What elements do you hope continue very similarly? Any changes or evolutions that you are looking forward to implementing or exploring?

When it comes to writing about mathematics, my editorial philosophy is that if you are forced to choose between rigor and clarity, then clarity should win every time. And if you do not think you ever have to make that choice, then you are wrong and need to rethink your views. I have edited enough mathematical papers to have become frustrated with mathematicians who, when asked to write in a manner that will appeal to undergraduate math majors, do not seem to understand what you are asking them to do. Moreover, in addition to the usual fare the magazine publishes, I am also very much interested in publishing articles that are "math adjacent." That is, articles that are in some way related to mathematics, but are not articles centered around solving a specific problem. I especially like articles that connect mathematics with the humanities. Universities are under siege like never before, and our colleagues in the humanities sometimes come in for especially unwarranted abuse. This is a time for all of us to work together and not retreat into a two cultures mentality. ■

Get More

As editor-elect Rosenhouse will be accepting submissions to the *Mathematics Magazine* in January. Submissions are required via our Editorial Manager System (editorialmanager.com/mathmag/). For more information on submitting an article go to maa.org/pubs/submissions.

Participants in the 2018 IAS/Park City Mathematics Program summer conference. Photo by Dave Titensor.

Equity in Mathematics Education:

Five Mathematicians Reflect on the 2018 PCMI Workshop

Sarah Bryant, Christina Eubanks-Turner, Charles Moore, Sarah Reznikoff, & Josephine Yu

The IAS/Park City Mathematics Program hosts an intensive residential conference every summer in Park City, Utah. The authors were among 15 participants chosen for the 2018 special session *Shape of the River: Workshop on Equity and Mathematics Education*. This workshop advertised, among other objectives, for participants to "develop ideas about methods for working toward inclusion and equity in mathematics; share their own work related to broadening participation in mathematics [...]; and make connections with others concerned with these issues who work in related environments." In this article a group of five mathematicians share personal experiences about the workshop and offer suggested prompts for faculty to use to reflect on equity in their classrooms and departments.

We arrived in sunny Park City in July with varying backgrounds but with some common hopes and expectations.

Charles: As a mathematician, I often wonder what I can personally do to address issues of equity. As a member of the profession for nearly 40 years, in that time I have seen small gains in the number of mathematicians from underrepresented groups, but I wonder why this progress has been so slow and so little. As a department chair, I take very seriously my responsibility to create an environment in which all can thrive.

Christina: As I received my acceptance to the PCMI Equity Workshop I was excited, yet apprehensive. As a person who attended equity workshops in the past, I was unsure exactly what this workshop would entail. Sure I read the workshop description, but from past experiences, sometimes I left these workshops feeling

confused and helpless, still not having a clear understanding of equity and how you actually go about achieving it in higher education.

Sarah B: I had flown in to Utah directly from Texas, where I had been teaching measure theory at EDGE (Enhancing Diversity in Graduate Education). I have a long history with EDGE and I know how important it is to me and many others. In Park City, I hoped to learn more about what equity is and to improve in my efforts at recognizing, building, and supporting equity efforts in mathematics.

Josephine: I wanted to learn how to think about, talk about and work toward equity, and I hoped to learn concrete ways to improve equity in my teaching.

Sarah R: I expected to interact with both mathematicians and educators all eager to better understand and develop strategies to address equity issues. As my department's Graduate Program Director, I strive to create an equitable environment; learning more about what different experiences students may have had as undergraduates and in school would help me better develop our program to pursue this goal. I also expected to communicate to others in the group various issues that arise in graduate school, in case this might inform their preparation of students for these challenges.

Many of us had participated in diversity-related workshops or events before, yet it was quickly apparent this one was going to be different. The workshop leaders, Dr. Gerunda Hughes and Dr. Deena Khalil, both of Howard University, were experts in education, as were approximately half of the participants. The very first collaborative activity (a no-talking, design-thinking activity) made it clear this workshop was going to keep us on our toes. Throughout the workshop, discussions were a large part of the learning experience.

Christina: The first day took me by surprise. We did a design challenge where we were required to build a tower and I questioned the relevance of this activity. I thought we would start with background knowledge or theoretical frameworks for our approach to equity. Hesitant to participate, I indulged the speaker and participated, questioning how much I would get out of the week. Later, I learned that the approach to equity being presented was from a design thinking perspective, which was a unique and inventive approach.

Sarah R: I have participated in many organized discussions on the topic of equity with mathematicians: at JMM, the Field of Dreams conference, MAA MathFest, and elsewhere. At all of those, participants from underrepresented groups are in a minority. On the other hand, most members of our PCMI group were themselves members of underrepresented populations in mathematics. This made a huge difference in the dynamic of the conversation and made me realize how dominant the voices of majority-group members usually are. I also discovered that there was a communication and information gap between mathematicians and educators. In particular, math educators present are not fully aware of efforts academic mathematicians are making to broaden participation. Meanwhile, we are not fully aware of the obstructions and barriers met by educators working in the context of public schools.

Charles: I was surprised to find that the majority of participants were in mathematics education and that we came from a wide range of institutions. An opening session centered on a discussion regarding what we mean by "equity," something I had never thought about despite the fact I was striving for it in my department. I had always considered it the same as equality or equal access, but learned that a distinction can be made: equality treats all as equals, yet equity considers making sure all have the same opportunity, allowing for compensation for past experiences.

Josephine: I went to the workshop hoping to learn concrete ways for creating more equitable classrooms. It was enlightening to hear about students who are not even in our classes because of systematic problems such as tracking, sorting, and placement. Discussion with other participants helped me understand the magnitude of inequities in education extending way beyond our classrooms. We need to understand about the context, the intentions, and effects of our actions.

As the week progressed, we were introduced to some of the literature surrounding issues of equity in mathematics education. This included the work of Dr. Rochelle Gutierrez of the University of Illinois, who proposes four dimensions regarding issues of equity: access, achievement, identity, and power.

Charles: Later in the week, participants divided ourselves into groups to put together a final presentation. Not terribly surprisingly, a group coalesced that consisted of mathematicians working in mathematics departments. I was most comfortable with them. After some extensive discussion, we settled on the project of putting together a guide of "best practices" informed by Gutierrez' dimensions. But rather than a simple list of practices to create a more equitable environment, we pose questions for self-reflection, with the underlying idea that progress towards creating equitable environments should involve a mindset and a way of thinking.

Sarah B: The aspect of the workshop I am most grateful for is the chance to have discussions with such a passionate group of people. Every single person there taught me something new. Some particularly useful insights came

Group session at the conference. Photo by Dave Titensor.

from NSF Program Officer Karen King, as she spoke to us about the NSF's Big Ideas and shared some recurring themes and concerns about proposals aimed at broadening participation. She spoke to a need to align work with a theory of action and report research-backed impacts for such grants.

Christina: As the week went on I realized this was not going to be a typical workshop. Although atypical, looking back I felt it was one of the best workshops on equity I have ever attended as I feel I truly walked away with a lot. First, the organizers chose participants who were mathematicians and mathematics educators, which allowed for different expertise and perspectives. The space also felt very safe for everyone to freely express their opinions and experiences.

Throughout the week we learned about various approaches to equity in higher education, and split into working groups to create deliverables. This group of mathematicians joined together because we felt a need to learn more about equity issues in higher education. We all wanted to leave the workshop with a tangible plan for creating change in our departments. We focused on two related questions. First, how should an instructor create and maintain an equitable classroom? Second, how can we make the process of evaluating instructional quality more equitable?

We decided to explore these questions by creating a document that would provide guidance for faculty and administrators in higher education as they reflect on their beliefs and the impacts of their practices. The document's structure would appeal to Gutiérrez's equity framework. We offer here a few guiding questions for faculty to use as a way to examine their own practices.

Overall, we learned there is no single way to approach equity issues as context matters. Disrupting inequitable systems takes action from committed individuals who want to address the effects of oppression on higher education.

Suggested Reflection Questions for Faculty

Access: Who has easiest access to teachers, resources, experiences, and environments that invite participation and promote learning? Who comes to office hours? Who is comfortable asking questions?

Achievement: How do assessments measure student progress as well as mastery of the material? How might a given system of determining grades conflate learning the material with pro forma activities?

Identity: How do I recognize each student's humanity and identity in the classroom? When the material affords such a possibility, do assignments or discussions allow students to apply or share aspects of their culture or identity?

Power: Where is the power centered in my classroom? Is it shared? How might I disrupt any biases the students have? Have I built in opportunities for group learning? Have I set a culture of acceptable group dynamics?

Reading List

Gutiérrez, R. (2009). Framing equity: Helping students "play the game" and "change the game." *Teaching for Excellence and Equity in Mathematics*, 1(1), 5–7.

The Joint Committee on Standards for Educational Evaluation (2003). *The student evaluation standards: How to improve evaluations of students*. Arlen R. Gullickson, Chair. A joint publication of Corwin Press, Thousand Oaks, CA, and ETS: Educational Policy Institute.

MAA Instructional Practices Guide, the Mathematical Association of America, 2018. Available at maa.org/ip-guide.

Sarah Bryant is a Visiting Assistant Professor of Mathematics at Dickinson College. Christina Eubanks-Turner is an Associate Professor of Mathematics at Loyola Marymount University. Charles Moore is a Professor of Mathematics and Department Chair in the Department of Mathematics and Statistics at Washington State University. Sarah Reznikoff is an Associate Professor of Mathematics at Kansas State University and is currently her department's Graduate Program Director. Josephine Yu is an Associate Professor of Mathematics at Georgia Tech.

The Workshop on Equity and Mathematics Education at the IAS/Park City Mathematics Institute Summer Session 2018 was funded under National Science Foundation award DMS-14441467.

Hands-on Outreach Activities Using Fractal Geometry

Victor Donnay, Jane Long & Mary O'Keeffe

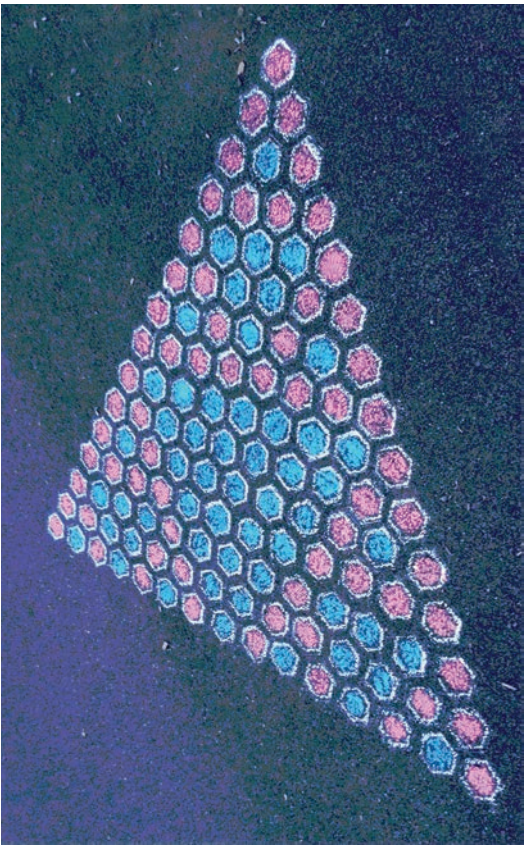
Mathematics is fun! In studying shapes and patterns, mathematics explores phenomena that humans are hard-wired to find interesting and intriguing. The following are hands-on mathematical outreach projects in which participants create ephemeral public math art installations (à la Christo et Jeanne-Claude, en.wikipedia.org/wiki/Christo_and_Jeanne-Claude) based on a relatively new field of mathematics—fractal geometry. In traditional geometry, as one looks at a shape on smaller and smaller scales, the shape simplifies. In fractal geometry, the shape retains its complexity at all scales.

Our projects focused on the Sierpinski triangle and its close cousin the Sierpinski pyramid. Participants created these shapes using a variety of materials: sidewalk chalk, plastic K'NEX pieces, and paper. By casting mathematics in a new light, such hands-on experiences with non-traditional math can kindle curiosity and inspire further exploration of mathematics.

Sidewalk Chalk Triangles for Urban Math Outreach: Mary O'Keeffe

For those of you interested in a project that can be undertaken individually and at low cost, consider this subversive guerrilla marketing approach to spreading the fun of mathematics that simply involves blacktop and sidewalk chalk. Thanks to a 2009 MSRI Great Circles workshop by Paul Zeitz I learned how easily a Sierpinski triangle can be generated by coloring the odd and even cells in Pascal's triangle in two different colors.

There is a lot of blacktop in the underserved community of Hamilton Hill, near Schenectady, NY. This medium is perfect for creating and experimenting with fractals. We use a hexagonal stencil to trace the outline of a large triangular array of empty cells on a stretch of blacktop where we think people may pass by. Plastic polydron frameworks work particularly well for stenciling, but cardboard cut-outs also work. We do not put numbers in the cells. We use a simple cellular automata method: begin by coloring all the cells along the two outside diagonals in red. Then apply the rule that if the two parent cells have the same



color, the baby cell is blue, otherwise the baby is red.

Our experience is that curious passersby, of all ages, come along. Some just look at us strangely and move on. But some ask what we are doing. We don't say "It is math," we just explain the simple rules we are following and invite them to help if they would like. After they get comfortable and engaged, all kinds of conversations naturally arise. Nearby we have markers and small whiteboards that fit comfortably in a lap (12" ×18") if anyone seems interested in learning about the underlying numbers and other patterns in Pascal's triangle. We take these conversations anywhere the passerby wants to go. Some folks just want to experience the patterns, some have curiosity to learn more. It can be fun to pose the question, "If this pattern continued forever, what would be the odds of hitting a red cell?" The answer guesses change as the pattern scales up, leading naturally to the idea of a limit. Some folks may be interested in using other rules to generate other patterns.

While this activity can be managed by an individual, it can also be done in partnership with a local organization in a way that support the organization's goals. The Hamilton Hill Arts Center is a beloved grass roots community organization dedicated to preserving the arts and culture of the African diaspora. Geometric African art has long been an important part of HHAC programs. Through the ethnomathematics work of Ron Eglash at nearby Rensslaer Polytechnic Institute, the HHAC leadership has recently learned that African arts, crafts, architecture, and religion embodied sophisticated fractal mathematics for centuries before white mathematicians started studying the phenomenon. HHAC is offering design classes empowering community members to create fractals for textile designs, quilts, and cornrow hairbraiding. The sidewalk chalk fractal activity is a natural outreach and recruiting tool for those classes.

Using K'NEX Pieces to Make Sierpinski Triangles: Victor Donnay

When my two sons were young, we built shapes out of plastic K'NEX pieces, including Sierpinski triangles. Starting with one small triangle (the zeroth stage), one produces the first stage Sierpinski triangle by combining three of these basic triangles. Combining three first stage triangles produces the second stage triangle. And so on. With my sons and their friends, we succeeded in reaching the fourth level before running out of pieces! Out of this fun project, a dream was born—use K'NEX pieces to create the world's largest Sierpinski triangle!

We partnered with the Wagner Free Institute for Science of Philadelphia to realize this dream by creating a hands-on community event as part of the 2016 Philadelphia Science Festival. In developing the activity, we faced several logistical issues.

1. Size of triangle. We used the yard outside the Institute's building as the site for the build. We determined that there was room for an 8th stage Sierpinski triangle. This stage consisted of $3^8 = 6561$ basic triangles made up of a total of 29,526 edge and corner pieces, with external triangle 89 feet long and 44.5 feet wide. We used a spreadsheet to track our calculations, which was particularly useful for determining the number of corner pieces which is given, not by a closed form expression, but by an inductive formula.

2. The cost. When we contacted the K'NEX company, they agreed to give us a 50% price discount. In the end,

Donnay's sons and friends celebrate successful completion of a 4th Stage (Sierpinski) Triangle.

the overall cost of the pieces was about $2000.

3. Time needed to construct the triangle. Out of concern that we would not be able to complete the entire construction in the three hours that had been set aside, we decided to do a "pre-build" on our college campus. We invited the entire Bryn Mawr community to build a slightly smaller triangle (7th stage). We then partially disassembled this triangle into smaller pieces to take to the Wagner.

4. Fundraising. Having the pre-build on campus let us make a strong case to the President's Office as well as the Math Department for funding support. The Wagner covered part of the cost, we crowdsourced funds via the internet and research funds completed the funding.

5. The build. We had beautiful sunny weather for both the pre-build and the Wagner build with lots of participants both days. We had a table with bins containing the pieces. People could assemble several levels of triangle and then insert their piece into the large triangle. Or, they could take some of the already assembled pieces from the pre-build and put them into the large triangle.

By the end of the three-hour time block, we had succeeded in constructing the 8th stage Sierpinski triangle!

A Fast, Collaborative Paper Sierpinski Pyramid: Jane Long

Each year, the STEM Research & Learning Center at Stephen F. Austin State University hosts a high school STEM Day. Three to four hundred students and their teachers visit our campus and rotate to various activities in groups of about 20. In 2014, a major focus of the day was a collaborative project in which visitors folded and assembled 2^{12} = 4,096 paper tetrahedra to make a 12 foot, 11-inch Sierpinski pyramid. We completed the entire assembly in a record-setting 2 hours and 11 minutes!

During the lunch break, visitors gathered in nine separate rooms to do the folding and preliminary assembly. We recruited college students to help supervise them. Visitors cut pre-preprinted figures, three of which fit on a page, out of 100-lb. cardstock immediately prior to folding. Printing costs for these figures were reasonable, only $110 at our university print shop.

To create our final sixth-stage pyramid, the first three iterations were secured with Scotch tape, while later iterations were reinforced with packing tape. The fourth-stage pyramids were brought to the main assembly area below a second-floor balcony. The next stage required some support. We built three of the fifth-stage pyramids on the ground level, while the final one was attached to a metal pole and lowered from the balcony. The pyramid was able to support its own weight for a few seconds. After that, to prevent its collapse, we again supported the top pyramid from above.

Were we to undertake this activity again, we might attempt to gather in a large auditorium or gymnasium to construct the pyramid so that the entire

process was more visible. Doing this activity with younger students has proved difficult, as participants must have sufficient manual dexterity for precise cuts and folds.

Future Work

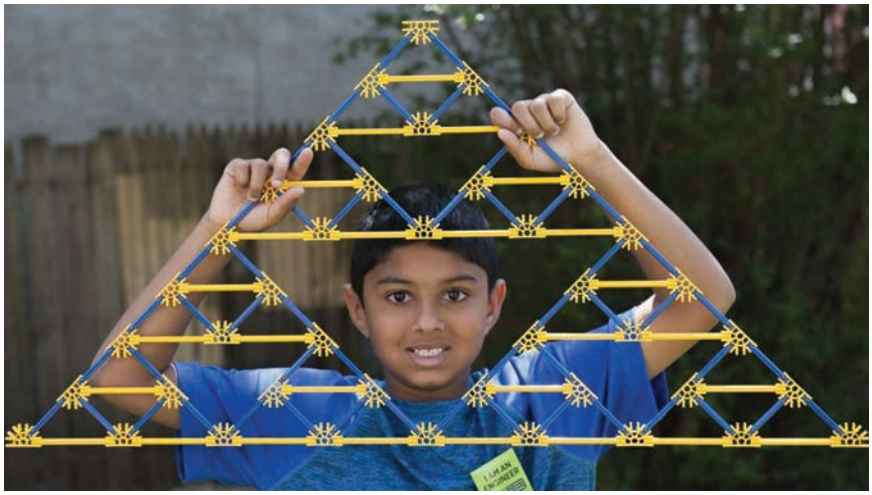
In each of these projects, community members collaborated on an exciting and unusual project, learning some nonstandard mathematics while having fun. Beyond the beautiful geometry involved in fractals, there is much accessible algebraic mathematics involving measurement, counting, modeling, exponents, and induction underlying these projects. One could deepen the impact of these projects by working with school partners ahead of time and having students explore other mathematical aspects of fractals. For example, students could do the mathematics required to plan the activities, such as computing the amount and cost of materials needed, the size of the installation, and the time to complete the project.

A variety of news outlets reported on these activities, generating positive publicity for mathematics and for our institutions. Further information on the projects, including pictures, videos, and links to news coverage, as well as references to other such fractal projects, can be found at our website (bit.ly/2K7OPIH).

We encourage you to consider sponsoring these or other engaging, participatory activities (see *Mathematics in Service to the Community*, MAA Notes #66, Charles Hadlock editor, 2005 for other ideas) to share the beauty and excitement of mathematics with a wider audience. Create your own Christo-like math installations! ■

Photos of children creating K'Nex Sierpinski triangles for the Wagner build are courtesy of radio station WHYY.

Victor Donnay is professor of mathematics on the William Kenan, Jr. Chair at Bryn Mawr College. Jane Long is associate professor of mathematics at Stephen F. Austin State University and a Bryn Mawr mathematics alumna from the class of 2002. Mary O'Keeffe is adjunct professor of economics at Union College and a Bryn Mawr mathematics alumna from the class of 1975.



Departments

TOOLKIT

Preparing a Poster Presentation

— Tyler Kloefkorn and Azadeh Rafizadeh

We are thrilled that you are interested in presenting a poster! Poster sessions offer you opportunities to showcase your work, improve your communication skills, interact with other members of the mathematics community, and best of all, talk about mathematics. We always look forward to poster sessions because they are great venues to socialize and network in a friendly environment.

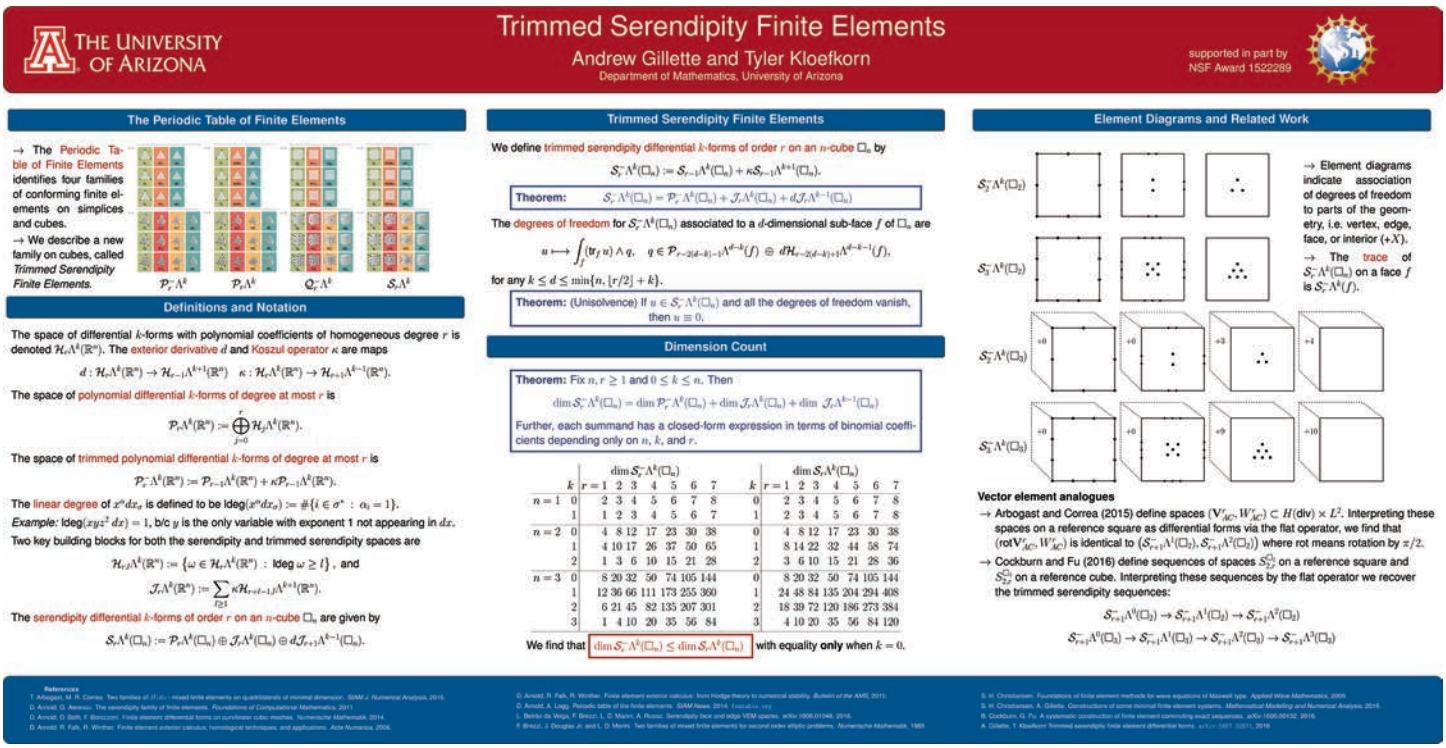
The mathematics community has high expectations for poster presentations. To help you get the most out of your experience, we provide advice for formatting, writing, and presenting your poster. For undergraduates, our guidelines and suggestions are based on our experiences as advisors, researchers, and poster session judges.

Poster Design

Your poster should follow a common format and be easy to read and follow, as in the sample image. We prefer to use LaTeX for our posters because it can easily handle mathematical notation. Your creativity is important, so your poster does not have to look exactly like the one shown in the figure, but it should have certain characteristics. In particular, your poster should have: size 36″ by 48″ or 36″ by 54″, a top header, a white background, and three or four columns below the top header. Pick a template, in LaTeX or in another platform, that is somewhat similar.

From that template adjust text, colors, spacing, etc. As you create, choose one common and readable font style for your entire poster, with a consistent size and color throughout. Most of your text should be black, unless the text appears on a colored header. Section titles should have a consistent size larger than the bulk of the text. Your abstract, key definitions, and main results should be easily distinguishable from the rest of the poster, either by color, boxes, or boldface/italics font. In general, stay away from using colors such as pink, yellow, orange, or other light colors as these are harder to read. Overall, the format and design of your poster should not distract the reader from the mathematical content. With all of that said, your poster design should be unique to you—be creative in how you adhere to these guidelines.

While you can make a poster in LaTeX, Microsoft Power Point, Microsoft Publisher, Apple Pages, Adobe Illustrator, Adobe InDesign, or Inkscape, LaTeX is our preferred software for all things mathematical, but LaTeX has a learning curve for new users. Sample LaTeX templates can be found in Overleaf at bit.ly/2zUG1e6 and in ShareLaTeX at bit.ly/2PyukEw.



Further tips can be found in the June/July 2018 issue of MAA FOCUS at bit.ly/2xu4upn.

Main Components

Title and Author(s) Top Header

Your title should appear with large font, with the list of authors just below in alphabetical order and in a large font (but slightly smaller than the font for your title). We recommend an asterisk next to your name, indicating that you are the presenting author. For each author, you must give their institution affiliation. You will need to include if your work was supported by a grant or completed while attending an REU away from your home institution. The top header does not need to have a white background but be mindful of its readability.

Abstract

Your abstract is a short summary of your project, and was required when applying to participate in the poster sessions. Replicate your abstract on your poster.

References

A list of references should appear at the bottom of your poster, or at the bottom of the right column with a consistent format—we recommend using the AMS Author Handbook, bit.ly/2ThsGW5.

Background Information and Key Definitions

It is a common misconception, especially among undergraduate students, that all mathematicians are experts in all areas of math. To make sure that your audience can follow your work, include key definitions and basic examples either as an introduction, immediately following your abstract, or as part of the poster's narrative.

Lemmas, Propositions, Theorems, or Conjectures

In the body of your poster, be sure to include any proposition, theorem, or conjecture important for your project. These should be clearly marked (within a box, or in background) and they should include proper citations to distinguish your main results from the work of the others. You may include a separate section on your poster showcasing your main results. Proofs of your main results may be too long to fully reproduce on your poster, but you might include short outlines of the proofs supported by illustrative figures. It might also be helpful to include some simple computations and examples of your results.

Results and Summary

At the end of your poster, give a summary of what was known before you tackled the problem, what we know now because of your work, and list future directions worth investigating. This will give your audience motivation to examine your poster closely.

Presenting Your Poster

To better share your work with others, a carefully prepared script should supplement your poster. Before the poster session, prepare a one-minute summary that is an intriguing answer to "Will you tell me about your work?" Be sure to practice this summary. Also prepare a more in-depth presentation for those interested in a longer conversation about your work. Practice your presentation several times with a trusted colleague or advisor. Be able to explain everything that is written on your poster. People will ask questions (ranging in difficulty) about various parts of it and you should be able to provide suitable answers. In preparation, think of questions that might come up and prepare answers ahead of time. Lastly, know the scope of your poster. If you are asked about related work and you do not know the answer, it is perfectly acceptable to say, "I do not know", or "I am not familiar with that result/paper."

To best represent your work, you should dress appropriately in business or business-casual attire. Make eye contact when delivering your presentation. If you are comfortable doing so, also make eye contact with those passing by your poster to encourage them to ask you about your poster. Do your best to relax - this will help you speak clearly and with an appropriate tempo.

Undergraduates should be aware that some judges listen carefully to your conversation with others, so do your best job no matter who you are talking to. Also, some judges do not introduce themselves as judges. If you are presenting with fellow student collaborators, make sure that everyone is involved in the presentation.

Final Thoughts

As you prepare you poster presentation, remember that you have worked hard and accomplished a lot. With your poster presentation, we hope that others will understand and appreciate your accomplishments. A poster session can be intimidating for undergraduate students and faculty presenting, but is an opportunity to celebrate your work and interact with the mathematical community. You will be surprised at how much you learn from discussing your project with a diverse crowd of mathematicians.

Please let us know how your poster presentation is received. Good luck! ■

Dr. Tyler Kloefkorn is a AAAS Science & Technology Policy Fellow at the National Science Foundation and a member of the MAA Subcommittee on Research by Undergraduates. Dr. Azadeh Rafizadeh is an Associate Professor of Mathematics at William Jewell College and a member of the MAA Subcommittee on Research by Undergraduates.

Departments

TOOLKIT

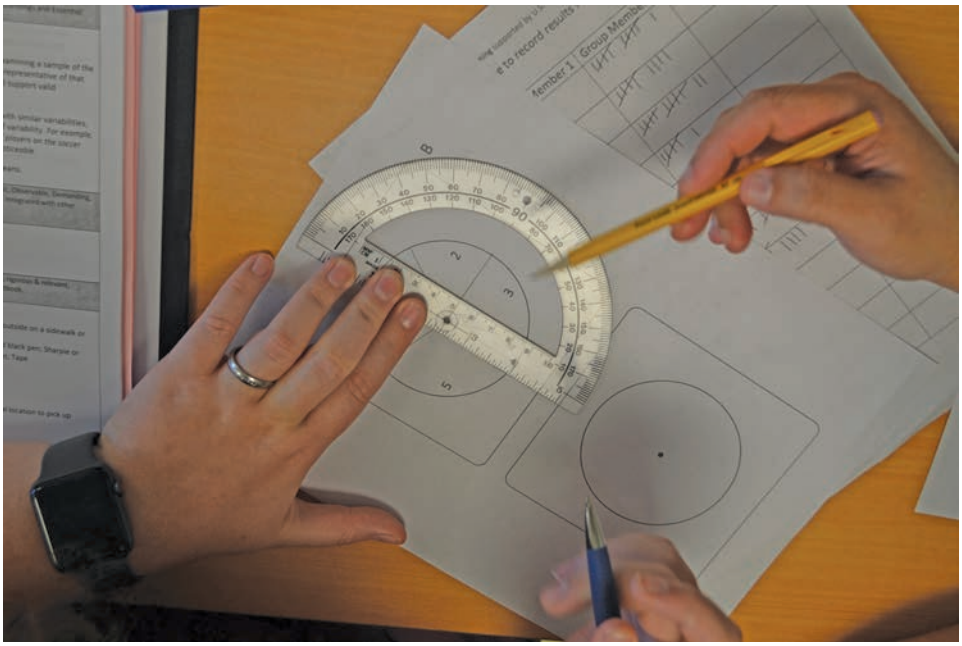
Using Lesson Plans to Facilitate Work with K–12 Educators

— Elliott S. Elliott

Lesson plans can be an effective tool to help mathematicians communicate with K–12 teachers. In the April/May 2016 MAA FOCUS, Merow described the need for mathematicians to be involved in K–12 education, and she emphasized the importance of communication in this process. Lesson plans provide a format with which K–12 educators are comfortable, and lesson planning can help college faculty understand what will actually work in a K–12 classroom.

Collaborative lesson planning can help a mathematician understand some requirements and constraints faced by K–12 teachers and can help a mathematician and a K–12 teacher appreciate each other's strengths. Both the mathematician and the teacher can contribute in their areas of expertise while broadening their awareness of the various levels of education. A teacher can gain a deeper knowledge of mathematics, and by deliberately thinking about pedagogy, a mathematician might become a better teacher.

A lesson plan involves far more detail than a typical set of college lecture notes. The plan specifies requirements for space, time, equipment, and materials. There is consideration of how to group students, how to differentiate instruction based on individual student needs, and how to conduct formative assessment during the lesson. The plan includes questions to prompt students' learning and sorts these questions using a classification system of cognitive skills, such as Bloom's Taxonomy. An ideal lesson plan contains enough detail that a substitute teacher, even with little content expertise, could successfully conduct the lesson with no other references. Actual lesson plans may not achieve that ideal but are an effective way to organize mathematics content within a sound K–12 pedagogical framework.



The STEM Center for Teaching and Learning at the University of Tennessee at Martin conducts professional development workshops for local K–12 teachers. Participants have reported higher levels of satisfaction since the introduction of lesson plans during the design and presentation of these sessions. In practice, we poll teachers by email to find topics of greatest concern to the teachers. College mathematics faculty write lesson plans on these topics clearly specifying the mathematical content. After presenting the lesson to a group of teachers, usually during a summer workshop, we discuss issues such as grouping students and differentiation strategies. We provide an electronic copy of the plan so that teachers can refine the plan for their classrooms following the discussion.

Here are some considerations for successful use of lesson plans in professional development settings that can promote collaboration between mathematics faculty and K–12 teachers.

Align the plan to standards

No matter how exciting or important an idea is in mathematics, if it is not a listed standard, then a K–12 teacher probably does not have time to devote a lesson to the idea. K–12 mathematics contain two types of standards which may vary by state but are usually available on each state's department of education website. A content standard is something that a student should know or be able to do by a particular grade, such as the kindergarten standard "Write numbers from 0 to 20," from the *Common Core State Standards for Mathematics*. The second type, called a practice (or process) standard describes attitudes or approaches to mathematics and applies at all grade levels. A lesson

plan should address both types. Further, when creating lesson plans to share with K–12 teachers, consider content standards across several grade levels to understand the intended progression of knowledge and skills. It is often appropriate to rephrase content standards as "I can . . ." statements in grade level language. For example, a lesson addressing part of the fourth grade standard "Fluently add and subtract within 1,000,000 using appropriate strategies and algorithms," might involve the student saying "I can add two six-digit numbers." This rewording is part of the plan and can be an effective way to answer the question "Exactly what should they learn today?"

Format the plan to be consistent with a teacher evaluation instrument

The main purpose of a lesson plan is to ensure that students have the best opportunity to learn, but another purpose is to show an administrator that a teacher has satisfied a job requirement. The format of the plan can make this easy for the administrator without detracting from instruction. If the evaluation rubric calls for differentiation of content, processes, and products, then have a section of the lesson plan that describes this differentiation. Like standards, teacher evaluation instruments vary by state or even within a state. As examples, Tennessee specifies the Tennessee Educator Acceleration Model for statewide use (bit.ly/2acZuuH), while New York provides a menu of instruments from which local districts may choose (bit.ly/VPzk7j), and many states use edTPA (www.edtpa.com/) for their teacher candidates' initial licensure process.

Most of these instruments have rubrics describing goals for planning, management of the classroom, assessment of learning, and instructional delivery. Many call for the use of questions of various complexity levels to stimulate students' engagement with the content. Mathematicians have the expertise to create and classify such questions even without familiarity with Bloom's Taxonomy—the mathematician understands whether a question requires mere recall or thinking deeply. Mathematicians can also suggest ways to represent ideas verbally, visually, symbolically, and numerically, and these strategies can help teachers to tailor instruction for individual students. In contrast, most mathematicians know little about K–12 classroom management, and this is a critical component of lesson planning and delivery. It is important for both members of the team to value each other's contributions and ideas.

Use a locally recognized format

As Merow's article indicates, working with K–12 educators requires a mathematician to have a network of educators. After creating or joining a network of local teachers, discuss lesson plans with them. They probably have an effective format, or their school system may specify a format. Faculty in a department of educational studies probably have also already solved the formatting issues for their local setting. Their solution may be particularly effective when working with recent graduates of the educator preparation program. The point is not to create a perfect format, but to frame useful conversations between mathematicians and K–12 teachers. A familiar lesson plan format can facilitate effective collaboration benefitting both the mathematician and the K–12 teachers. ■

Elliott S. Elliott is an associate professor at the University of Tennessee at Martin.
Work with K–12 teachers was supported by U.S. Department of Education grant U336S140076. The opinions expressed here do not necessarily reflect those of the Department of Education.

Departments

TOOLKIT

Taking Curve Sketching from Computation to Collaboration

— Martha Byrne

Think back to curve sketching, typically taught in differential calculus. Intercepts, asymptotes, end behavior, and the derivative tests are all concepts that need to coalesce in a single graph. As a student, I enjoyed finally being able to find the graphs of nonstandard functions, but the tasks I was asked to do were not particularly engaging: Pick a function. Get organized. Run the first and second derivative tests. Label everything. Plot points. Connect points appropriately. Done.

As described above, curve sketching is often simply a list of computations to complete and an algorithm to run. What happens when you ask a group of students to perform a calculation? Most likely each student will either perform the calculation on his or her own, or watch someone else do it. Eventually group members may compare answers. If their answers disagree, the students may then engage in discussion to see where someone went wrong, but often the less confident students will adopt the calculations of the more confident students. At best, I have seen individuals working alone on the same task, little conversation, and a lack of substantive discussion.

What I see in curve sketching is the potential for a quality team assignment as defined in *Team-Based Learning: A Transformative Use of Small Groups in College Teaching* (Michaelsen, Bauman Knight, & Fink, 2004):

> In most cases, team assignments will generate a high level of interaction if they require teams to use course concepts to make decisions that involve a complex set of issues, and enable teams to report their decisions in a simple form (p. 33).

To correctly sketch the graph of a function, students must synthesize the concepts of intercepts, symmetry, domain and range, continuity, asymptotes, differentiability, extrema, concavity, points of inflection, and horizontal asymptotes to make decisions about a function's behavior. In the end they must output a graph, which is simple to share and display. While this is true also of the standard curve sketching assignments, by shifting the emphasis from calculation to synthesis, a quality team assignment is able to generate the desired level of interaction.

One way to make this shift is with an activity called *Card Curves* that I designed for my calculus course. The focus is on synthesis and decision making, since this activity bypasses the computations and starts by giving students the results instead. There is a set of cards with the possible results for six categories of function behavior (see Figure 1): end behavior left, end behavior right, positive first derivative, negative first derivative, positive second derivative, and negative second derivative. The cards are color coded to make it easier for students to stay organized as they work and easier for instructors to check student work with easy visual cues. Each group of students receives a randomly dealt card for each category.

Students are told that they can decide what the behavior of the function is on any interval not specified by their cards. In this example, students could sketch the graph of a function that is discontinuous at $x=-3$, because the derivatives are not specified there, but the graph must be continuous at $x=4$ because the cards indicate a positive second derivative there. Similarly, students may graph a function where $f''(x)>0$ anywhere but on $(-1,0)$.

When using this activity, incredible discussion and interaction between students has occurred, particularly when the students are faced with contradictory information. This happens because not all combinations of cards in the deck can actually be used to sketch a graph. For example, if your group's set says that a function is nowhere concave down, and nowhere decreasing, then it cannot have a horizontal asymptote in the positive direction. When students believe they have an impossible set, they must explain why the pieces do not work together and select a card to swap out. The team then tries again to produce a graph with their new information.

As is common in good collaborative activities this activity has enough variation to accommodate classes with differently paced groups. Faster performing groups have material to keep them engaged while other groups continue to work. One variation is to give groups more information about their function such as local extreme values or locations of zeros. When multiple groups finish quickly, they can exchange sets of cards. Then they compare the generated graphs to check for accuracy and discuss differences.

A word of caution: Activities such as this are a necessary but not sufficient part of building a collaborative classroom culture. While this activity can be used as a stand-alone activity in any Calculus I class, it was the regular use of activities involving decision-making, complex sets of ideas, and simple reporting that led to rich discussions and the transformation of my student groups into high-functioning teams of students. Scattered collaborative activities are valuable, but to get the highest benefit from them, students need to trust each other and be comfortable working together, which comes with regular practice and an intentional work building a

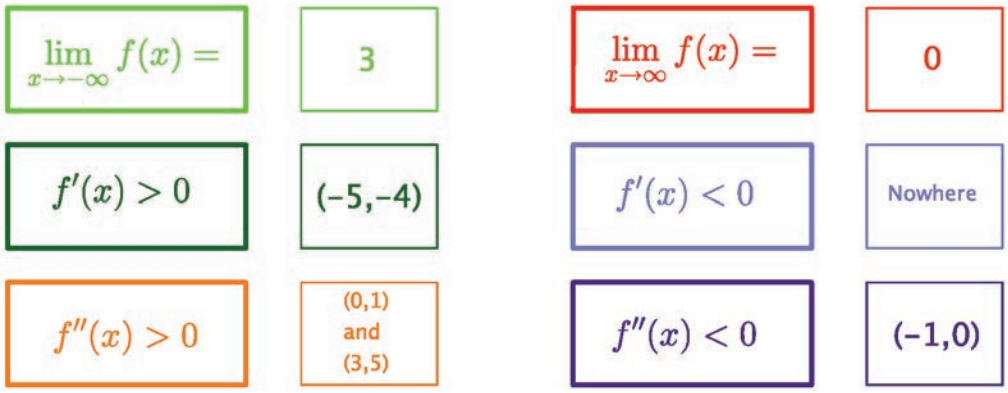


Figure 1. Example Criteria for Activity. Activity set available from author.

classroom community that is more than a set of students taking a class together.

With students accustomed to working together, *Card Curves* is a rich, engaging activity that can transform how they engage with curve sketching and fundamental concepts in differential calculus. ■

Martha Byrne's intellectual home is contained in the union of mathematics and math education and has nonempty intersections with both areas. Her professional home is at Sonoma State University where she is officially a Math Educator in the Department of Mathematics and Statistics.

MAA Poster Session in the MAA Pavilion

Recreational Mathematics: Puzzles, Card Tricks, Games, and Gambling

Friday, 9:30 AM–10:30 AM

Organized by Paul R. Coe, *Dominican University,* Darren Glass, *Gettysburg College,* and Robert Vallin, *Lamar University*

Puzzles, card tricks, board games, game shows, gambling, and sports provide an excellent laboratory for testing mathematical strategy, probability, and enumeration. The analysis of such diversions is fertile ground for the application of mathematical and statistical theory. Solutions to new problems as well as novel solutions to old problems are welcome.

Submissions by undergraduates or examples of the use of the solutions of these problems in the undergraduate classroom are encouraged.

This session is sponsored by the SIGMAA on Recreational Mathematics.

Joint Policy Board for Mathematics Communication Award

Margot Lee Shetterly will receive the 2019 Joint Policy Board for Mathematics (JPBM) Communications Award for her book and subsequent movie "Hidden Figures," which opened science and mathematics to a new generation of women and people of color by bringing into the light the stories of the African-American women who made significant contributions to aeronautics and astronautics, and, ultimately, to America's victory in the space race.

Shetterly will be presented with the JPBM Communications Award at the Joint Mathematics Meetings (JMM) in Baltimore, Maryland, on Saturday, January 19 at 11:00 A.M. in the Baltimore Convention Center Hall Room 309/310, followed by an hour onstage interview and opportunity to meet her. The public is invited to the presentation and event, which is a highlight of the full day of free Mathemati-Con sessions and events sponsored by JMM, the largest mathematics meeting in the world.

The Spirit of Ramanujan STEM Talent Initiative

A unique program that aims to discover, cultivate and enable future STEM fireballs who will propel human thought forward. Inspired by the legacy of Srinivasa Ramanujan, the initiative supports emerging gifted STEM students who lack traditional institutional support through financial grants and mentorship opportunities.

Now in its third year, the program has widened its international talent search to all STEM fields and will award up to $5K to 30 students to fund participation in research programs around the world or individual research with an approved sponsor. In the last two years, awards were made to 16 students worldwide.

Call for entries are now open until December 31, 2018. spiritoframanujan.com/home/

Departments

MEET A MEMBER

Emille Davie Lawrence

What is your current job and how long have you been there?

I am a Term Associate Professor of Mathematics and Statistics at the University of San Francisco. It is a somewhat small Jesuit school in the heart of San Francisco. I've taught there for seven years.

How long have you been an MAA member, and why did you initially join?

I will answer this question in two ways because I think being a member and being actively involved are two separate issues. I first became a member shortly after finishing my postdoc at UC Santa Barbara in 2010. This was a time in my life in which I was trying to "check all the boxes" of being a professional mathematician by joining professional organizations. I paid my dues, and voila! I was in. Honestly, I didn't pay much attention to what the MAA was actually doing for the mathematics community and did not attend MathFest (my first MathFest was actually Chicago in 2017!). I also was not in Project NExT because it was not on my radar when I graduated from the University of Georgia in 2010, and back in those days you could not join unless you were a new PhD. I let my membership expire a few times over the years but renewed when I got around to it. So, you could say I was a member in name only. However, in the last few years, I've made successful efforts to be much more involved in the MAA. This change was spawned by my being at a teaching focused institution, and frankly, by seeing Francis Su as MAA president. I was so inspired by his grace speech that I'd read on the internet some time before, and when he became president of the MAA, I knew that I needed to give the organization more of my time and energy. First, I joined the Research in Undergrad Mathematics Education (RUME) and Undergraduate Research (UR) SIGMAAs. Then I accepted an invitation to be on the Committee on Undergraduate Students which facilitates student programming (such as poster sessions, student lectures, and student activities) at national meetings. I also co-organized a town hall called "Mathematical Mamas: Being Both Beautifully" at the most recent MathFest with future plans to hold a similar town hall at MathFest in Cincinnati. I am also honored to serve as one of two Representatives At-Large for Minority Interests on the MAA Congress. I really try to do service that is meaningful for me on a personal level, and the MAA, along with other professional organizations such as NAM, have given me an opportunity to make positive contributions to the mathematics community.

How long have you been on the MAA Congress?

The Congress is a fairly new structure which replaced the Board of Governors. I have been in my position as a Representative At-Large for Minority Interests on the Congress since February 1, 2018.

What has kept you an MAA member since then?

The people. I plainly see that the people in leadership in the MAA are working to adhere to the mission and core values of the organization. Evidence of a commitment to teaching and learning mathematics can be seen throughout my section (the Golden Section), and I am sure others, as well.

Describe the MAA in four words.

Awesome people doing good.

The MAAs values include community, communication, inclusivity, and mathematics teaching and learning. What do you hope the MAA Congress and the MAA Board of Directors will address in the next five years in relation to one (or more) of these goals?

Changing the climate of the mathematics community to be more inclusive of those who have historically been underrepresented takes a village. In other words, every person reading this should ask themselves how they can personally make a difference—big or small. That being said, the MAA Congress and MAA Board of Directors are in a position to provide the framework to engage people in these important conversations which will, in turn, inspire action. This framework could be anything from an Inclusivity and Outreach Taskforce to a special interest group to programming at MathFest. Hey, why not all of the above!? ■

Departments

PRESIDENT'S MESSAGE

State of the Association

—Deanna Haunsperger

I took great pride in being part of the Centennial Planning Committee for the MAA's Centennial year in 2015. A centennial is a great opportunity for celebrating where we've been and what we've accomplished, but it's an even better opportunity to plan for the future. How do we keep the MAA strong and vibrant? How can we build on our core strengths —membership, meetings, and publications/communications —to maintain our leadership position in the mathematical community?

Improvements since the centennial

After much data analysis and discussion with a variety of constituencies, we have made a number of improvements since our centennial.

We put into place a new publishing agreement with Taylor & Francis Group to publish our journals, bringing them into broader even international markets, and making electronic access to our journals much easier on various devices. The journals are still produced in the same way and with the same high quality, but members might have noticed a Taylor & Francis imprint on the covers and improved access electronically across various platforms. And we signed a publishing partnership with our sister organization, the AMS, whereby books from MAA Press are now published as an imprint of the AMS Books Program. As with the journals, we continue to focus our expertise on what we do best—the editorial work and featuring outstanding exposition. The AMS Publications program is robust and has plans to get MAA Press books out in front of more people. A year along in this transition, things are going smoothly and the AMS plans to publish at least fifteen books with the MAA Press imprint in 2019.

We remodeled the governance structure with a new, smaller, agile MAA Board of Directors to respond to the rapidly changing environment, and an MAA Congress representing our MAA Sections and various constituencies to discuss and advise the Board on strategic planning and to be the conduit for communication between national MAA and the sections. Under Su Dorée's leadership, Congress has now started a collection of Congress Learning Communities (CLiCs) in which the representatives learn about various aspects of the Association in depth so that they can be sources of information for both the Congress and the Board.

We updated the MAA mission, core values, and vision to more accurately reflect who we are in our association now. Our new mission is "to advance the understanding of mathematics and its impact on our world." Our values are, in short: Community, Inclusivity, Communication, and Teaching & Learning. The updated MAA vision is a society that values the power and beauty of mathematics and fully realizes its potential to promote human flourishing. For more details, see maa.org/about-maa.

We started thinking about different ways that we meet as MAA members so that all of our members can be active in our meetings and governance. We are encouraging committees to meet by videoconference (MAA can set up a Zoom videoconference for any committees that wish), which allows more people to serve on committees, even those who cannot afford to go to national meetings. We also decided to have just one national meeting each year (see the Oct/Nov MAA FOCUS article Meeting the Future: MAA and the Joint Mathematics Meetings, bit.ly/200cEMh), so after JMM 2021, we will hold all of our governance and meetings at MAA MathFest. We may still have a minor role (as other associations currently do) in a winter meeting with AMS, but these plans are still being discussed. We can now redirect some of the resources which were earmarked for JMM to reach members closer to where they live by increasing support for MAA Section meetings and SIGMAAs.

I hope many of you have had the opportunity to attend an MAA MathFest in the past few years. They are extraordinary conferences, with a diverse array of talented expositors giving some truly outstanding talks; when you walk by the exhibit hall, you can see from a distance that the fresh, new MAA Pavilion is the place to be, filled with community and conversation; the President's Membership Jubilee is just one of many new opportunities for old friends to get together and new friends to be made.

What's going on now or in the near future?

The Membership Team at MAA has been looking into membership categories and benefits. Their recommendations,

such as reinstating life memberships or a membership category for retirees, both ideas in response to a task force on senior members earlier this year led by Bud Brown, are being discussed this fall and winter. Some new, exciting benefits for members that were introduced this fall include:

- Member-only access to online videos of the fantastic invited addresses at MAA MathFest that I mentioned above. Log in to your MAA account, then look under "Video Library." This will be a great resource to you when you're looking for something fun to show your math club! More videos will continue to be added from previous years' conferences.
- A new blogging platform of the MAA, Math Values, to share the diverse voices of mathematics and discuss topics related to, and affected by, mathematics. Bringing together new voices and established mathematics writers, the mathematical community can use the new MAA blog to learn about community, inclusivity, communications, and teaching & learning. Explore how mathematics supports new discoveries and analyses in a variety of fields.
- A special offer exclusively for MAA members to access over 11,000 engaging video lectures on a wide variety of topics through The Great Courses Plus for $5.99/month with the MAA quarterly plan! Have you always wanted to take up Tai Chi, Spanish, cooking, drawing, or photography? Or maybe you're more interested in the brain, oceans, engineering, or zoology. Sign up and you'll always have something fascinating to watch and learn.

This fall a task force, led by Lisa Marano, will be making recommendations about ways in which the MAA can support MAA Section meetings more, perhaps by helping with some of the logistics of the meeting, perhaps by providing free national speakers more frequently. The Board of Directors will begin discussing the task force's recommendations in January 2019.

We are beta-testing a new communications platform that I believe will revolutionize the way committees and SIGMAAs and sections communicate with each other. The community-building platform by Higher Logic will allow for easy communication and file-sharing amongst members of SIGMAAs or committees of the MAA.

We continue to have an impressive grant portfolio through both federal grants ($10.2 million) and privately funded programs ($485,000). Included among these are Preparation for Industrial Careers in the Mathematical Sciences (PIC Math); Professional Development Emphasizing Data-Centered Resources and Pedagogies for Instructors of Undergraduate Introductory Statistics; Get the Facts Out: Changing the Conversation around STEM Teacher Recruitment; and What Difference Does Early-Career Faculty Development Make? A Research Study of Multiple Models.

MAA Project NExT is celebrating its twenty-fifth class this year. MAA Project NExT began with a class of 50 fellows. This year, this flagship professional development program is going strong and will celebrate a class of 100 fellows!

The MAA American Mathematics Competitions (AMC) program continues to reach out to countless students in secondary school with classroom enrichment activities through James Tanton's Classroom Inspirations, and to over 300,000 students through the AMC for middle school and high school students. We are excited to celebrate the third win in four years by the MAA-organized Team USA at the International Mathematical Olympiad, and the second-place finish by the US team at the European Girls' Mathematical Olympiad! We continue to design ways to make this a talent development program for all students. We look forward to hosting the International Mathematical Olympiad in 2021, the first time the U.S. has hosted this event in twenty years.

Although the Association has experienced operating deficits for nearly a dozen years, changes in our publications, hard work by the MAA staff, and a couple of gifts meant that 2017 ended (and 2018 will end) in the black. The Association investments of nearly $12,000,000 (much of it restricted as to use) are performing well under the management of the TIAA Trust Company. Our financial situation continues to improve.

We are in the beginning stages of a thorough look at our committee structure. As we all know from experience, it's easier to add a new committee than dissolve an existing one. In late 2018, I will constitute a task force to talk to our nearly 100 committees and councils and propose a reorganization of our committee structure.

In 2019, Congress will be advising the Board of Directors on several strategic initiatives including how best to increase support of MAA Sections and to help more members benefit from the many programs, services, and products the MAA provides.

Looking forward

We're a few years into our second century now, and we are in a great place to continue our role as a leading mathematical association. The MAA supports mathematicians and mathematics educators from secondary school through careers in academia, business, industry, and government. We welcome all mathematics enthusiasts to join our community and help us advance the understanding of mathematics and its impact on our world. Thank you for being a member.

This is my last FOCUS column as President, and I wanted to tell you what an honor and a privilege it's been to serve you all and work with the great MAA staff. Thank you for this opportunity. ■

Deanna Haunsperger is MAA president and professor of mathematics at Carleton College (email: dhaunspe@ carleton.edu*).*

Departments

TOOLKIT

Careers in Math Speaker Series

—Michael Dorff

Why do companies want to hire math majors? What are the three top things recruiters say a math major should do to get a job in industry? Wouldn't it be great to hear the answers to these questions from mathematicians who work in industry? Several years ago, we discovered something puzzling at Brigham Young University in Provo, Utah: we had students who liked mathematics but did not want to be math majors. When we asked them why, they responded that they did not want to be a teacher or a professor (ouch!). Although we could tell the students about a few math jobs in industry such as being an actuary or working at NSA, we wanted to do better in broadcasting the message of possible non-teaching careers for math majors.

To do this, we started a Careers in Math speaker series in 2008 and have continued the series every fall semester since then. For the series we invite 5–7 speakers who have a strong background in mathematics and who can show how mathematics can be used in the real world. The goal is to show students that mathematics is used in many careers and that studying math is beneficial. Speakers come from various careers: data science (Google, Facebook, Nike, Microsoft), programming (Epic Systems, MathWorks, Bloomberg), engineering (Raytheon, General Dynamics, Bell Helicopter), scientist (National Security Technologies), operations research (Lawrence Livermore Labs, Department of Defense), finance (Goldman Sachs, Capital One), medical fields (Center for Disease Control, Pharsight Pharmaceuticals), law (Franklin Pierce Law Center), actuarial sciences, NSA, and even the film industry (Disney, Pixar, independent CGI technical director). Typically, 100–150 students attend each presentation.

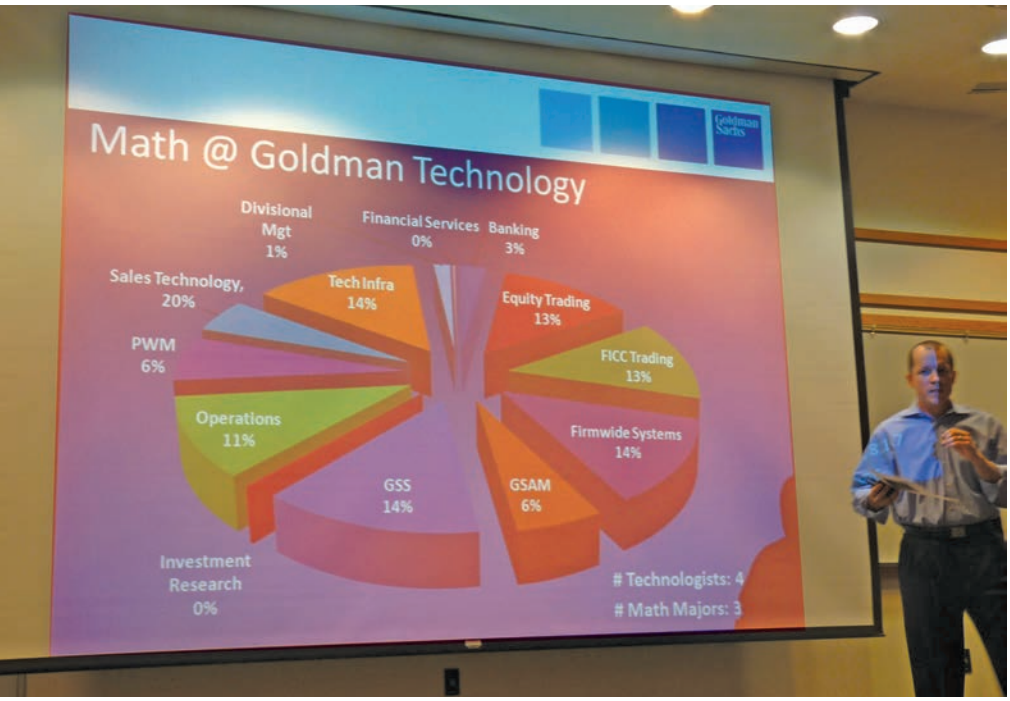
How do we fund this?

Funding has been based upon the model of starting small, promoting successes, and being flexible. When the idea was first proposed, the department chair liked it and was able to find some departmental funds to help us start the speaker series. The first year our expenses were small since I used local speakers and alumni who were visiting campus.

That first semester, I had one particular speaker whom I knew would give an excellent presentation! I made sure that a lot of students would be attending (offers of extra credit in classes and free donuts work like magic). Also, I invited the dean. This presentation was fabulous and the dean was so impressed that he offered me a little more funding for the next year to support the speaker series. Then, we received an internal grant from the university to support internships among majors and adapted our speaker series by bringing in speakers from organizations that had summer internships for students. Later, we were able to include some funds for the series in a National Science Foundation (NSF) grant supporting a different (but related) project. Also, I learned that some larger organizations have specific recruiters who are eager to visit our campus to give a presentation about their organization and will pay their own expenses.

How do we find speakers?

I am a theoretical mathematician working in complex analysis who has been a teacher my entire career. When I started the Careers in Math speaker series, I did not know many non-teaching careers, let alone know people who worked in industry. So, first I obtained a copy of our alumni list, which in some cases included their email addresses and where they worked. I picked a few alumni who



Right: Mark Freshwater from Goldman Sachs giving a talk.
Facing page, top: Students listening to one of the career speakers.
Bottom: Helen Moore from Pharsight Pharmaceuticals talking to a student after her talk.

seemed like good candidates and emailed them. I explained what the Careers in Math speaker series was, that we were doing this to create awareness of career opportunities for math students, and invited them to be one of our speakers. I was amazed by the positive response from alumni whom I did not know but who were eager to talk about mathematics and their careers. From there, things just grew.

Other ways to find speakers included noting when people from industry speaking were going to be on campus speaking in another department, and seeing if they would also present in the mathematics department. Additionally, you could ask recruiters from companies that are on campus for a career fair if they would be willing to speak in the math department. After a few years we started having an internship panel present on one of our Career speaker days. The panel consisted of some of our majors who had done a summer internship in industry. It was enlightening for math majors to see that several of their peers had done a math internship the previous summer. Some of the companies wanted to send presenters on a regular basis, and they contacted us about presenting again. Now, we have more potential speakers than we have spots!

Finally, after scheduling a speaker, make sure to prepare her or him. Since many of the speakers do not have much experience in giving talks to university students, we have suggested guidelines for presenting a talk and we send this to the speakers. If you would like to see these guidelines, feel free to email me.

Benefits for Students

Most of the speakers tell students that they want to hire math students. Why? They like math majors, because of their ability to solve problems, learn new things on their own, break complicated problems into solvable small pieces, pay attention to detail, and approach a problem in a different way. By the way, these points make a great outline for math majors to begin a job interview.

Now, speakers have emphasized that just majoring in math is not enough. Students often ask, "What should we do to prepare ourselves for these careers?" The speakers recommend that students additionally have good coding or programming skills, good speaking and writing skills, and experience working intensively on a hard problem such as those that come from an internship or undergraduate research.

The speaker series has been a tremendous success. This, along with some other activities we have done in the BYU mathematics department, has doubled the number of math majors during the past 11 years. And now I always have an answer to the students' question, "When am I ever going to use this?" ■

Michael Dorff is chair of the department of mathematics at Brigham Young University. He is also co-director of MAA's PIC Math program and President-Elect of the MAA.

Departments

PUZZLE PAGE

Bishop's Sudoku

—David Nacin

Place 27 bishops so there are three in each row, column, and three-by-three square cage. A clue indicates there is a bishop in that square, and gives the number of other bishops that piece can attack. Pieces do not block the attacks to other pieces. ■

Regular

	2			5				
		2						0
								1
3								
2						3		
				0			2	

Hard

	6							2
				3				
								2
			7		5			
2								
				3				
2							2	

Easy

			3	2				
						1		3
	5							
4	1							
				3				
							4	3
							4	
1		3						
				1	4			

David Nacin is a professor at William Paterson University. He enjoys designing and studying puzzles that involve groups and Lie algebras, partition identities, the motion of chess pieces, and other mathematical structures. He maintains a free puzzle blog at quadratablog.blogspot.com.

BOOK REVIEW

The Inner World

—Review by Michael Berg

Mathematicians, An Outer View of the Inner World, is an irresistible book, now available in softcover format from the AMS. It consists of 92 positively stunning portraits by Mariana Cook (evidently the last pupil (or protégé) of Ansel Adams) accompanied by brief introspective essays by her subjects on the facing pages. The 92 subjects span the entire spectrum of the art, to use a loaded phrase, from theoretical computer science to harmonic analysis, from differential geometry to algebraic number theory.

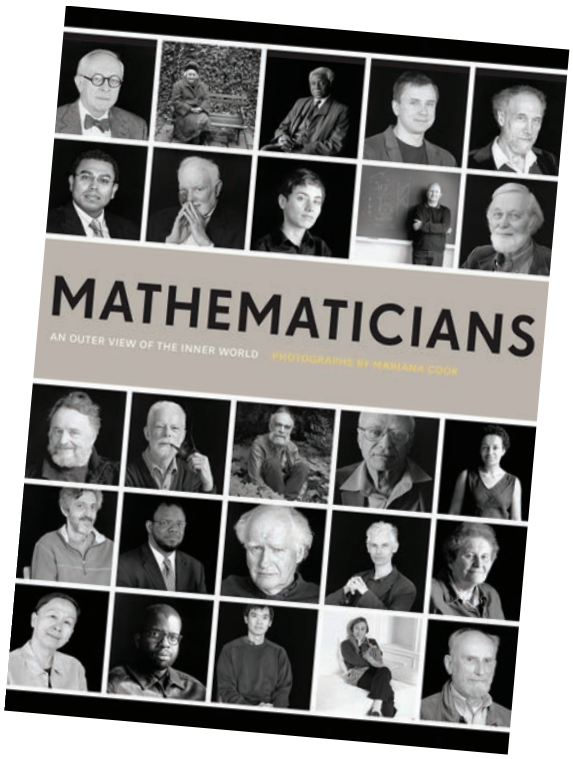
The choice of subjects is outstanding: almost everyone in the mathematical world has met or corresponded with at least some of these representative scholars, and many among the latter are household words. So it is that the personal reflections accompanying the marvelous photographic portraits more often than not come across as chats with friends or acquaintances, modulo the fact that there is certainly a general awareness that the invisible interlocutor is not a fellow mathematician. Still, it's all "Mathematician Speak," and all of us will feel entirely at home in the conversation.

This is much more than a coffee-table book. It's the sort of thing that will gulp up oceans of time once the book is cracked by anyone in the field: turn the page and find another one whom you've heard of, or even know, and whose comments are a source of tantalizing interest, then do it again, and again…. When the book arrived I intended to spend just a minute or two browsing through it: off by an order of magnitude.

So *Mathematicians, An Outer View of the Inner World* is bound to be a favorite in mathematical circles, and, in view of the objective fascination provided by the introspective prose of the players, also among those who interact with us mathematicians, from the members of our families to visitors from the real world resting a while in our living rooms. Put the book on your coffee table and watch what happens.

Here is a quiz:

1. Whose mother said: "If he hadn't looked so bright, I might have been worried. He was really quite slow. He didn't say his first sentence until he was twenty-four months old…"?
2. Who said: "I usually evade the question [of what kind of mathematician I am] by saying that I am a geometer in the broad sense, secure in the comfort that 'God is a geometer'…"?



Mathematicians, An Outer View of the Inner World
Mariana Cook

Paperbound, AMS, 2009, reprinted with corrections in 2018.
Print ISBN: 978-1-4704-4838-7
List Price: $35.00
AMS Member Price: $28.00
MAA Member Price: $31.50

3. Who said: "In a sense mathematics is like the classical Chinese language—very polished and very elegant…"?
4. Who said: "… any really good work in mathematics always has in it beauty, simplicity, exactness, and crazy ideas…"?
5. And who said this? "[T]he decisive ingredient [in my being admitted to Princeton for graduate school] turned out to be my mother's insistence on including a large photo of her son taken as I teetered on the tip of the granite spire on North Palisade. Many years later I learned from Ed Nelson… that he was in the office with Fox when my late-arriving application was brought in. According to Ed, when Ralph tore open the envelope, the picture fluttered to the floor. Ralph picked it up and said, 'Let's admit this one.' I had told my mother that it was completely inappropriate to include a picture and that they would make their decision on scholarly factors. She had been an actress and told me, 'Everything is show business.' On this occasion she was right."

Answers can be found on pp. 172, 30, 38, 132, and 72, respectively. ■

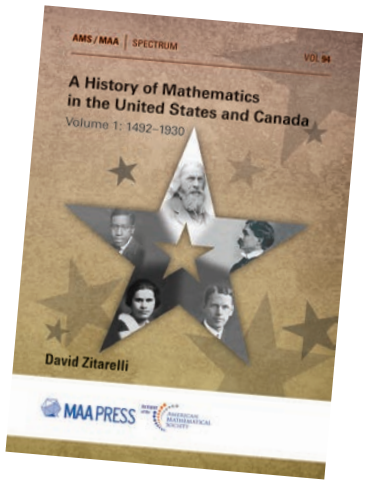
Michael Berg is Professor of Mathematics at Loyola Marymount University in Los Angeles, CA.

Departments

MAA BOOKS BEAT

Geniuses and Scalawags

—Stephen Kennedy



A History of Mathematics in the United States and Canada (Volume 1): 1492–1930
David E. Zitarelli

The history of mathematics is not just the evolution of concepts and theories. At least, it is not only that in David Zitarelli's fascinating *A History of Mathematics in the United States and Canada.* It also includes the story of journals and of colleges and universities and of professional societies and conferences and of textbooks and curricula. And, mostly, more than anything else really, it is the story of the people who lived mathematical lives.

People like Isaac Greenwood (1702–1745), the first Hollis Professor of Mathematicks and Natural and Experimental Philosophy at Harvard. Greenwood was something of a character, Zitarelli describes him as "a scalawag." After graduating from Harvard he made a voyage to England in 1723 carrying with him a thank-you letter to Thomas Hollis for his donation of a 24-foot telescope to Harvard the previous year. Greenwood made an impression on Hollis as, three years later, Hollis endowed a chair at Harvard and recommended Greenwood for it. This in spite of Greenwood's affinity for "demon rum" and in spite of his having run out on his London landlord leaving his rent, and other debts, unpaid. In February 1728 Greenwood assumed his chair, the only required duties of which were to lecture (to students of his choosing) on Wednesdays at 2 P.M.

Greenwood was the most accomplished mathematician of colonial times. He published three papers in the *Philosophical Transactions* of the Royal Society; he published the first mathematics book written by someone born in what is now the United States, *Arithmetic, Vulgar and Decimal*; and he taught algebra and calculus at a time when other US colleges offered no study higher than arithmetic. Zitarelli describes him as an "especially effective teacher" who delivered "remarkably lucid lectures." He fought a lifelong battle with alcoholism that led to repeated run-ins with the authorities at Harvard culminating in his dismissal from his chair in 1738.

And it's the story of people like Christine Ladd who gained her education in the time Zitarelli describes as the age of the "rugged individualist" in American mathematics. The period from 1800–1876 when mathematics and mathematicians began truly to flourish but did so in an environment nearly devoid of the institutional and communal support provided by professional societies, journals, and colleagues that wouldn't develop until the final quarter of the nineteenth century. Nathaniel Bowditch and Benjamin Peirce are the two most prominent rugged individualists. But there are scores of others, including Ladd, who graduated from Vassar in 1869. Over the next nine years, while working as a high school teacher, she proposed and solved problems in various publications. In 1877 while teaching in Boston and taking courses at Harvard she, in Zitarelli's words, "crossed the Rubicon from problem solver to independent investigator" by publishing two short research notes in the *Analyst*. At around the same time, in an expository note in the same journal she acerbically commented on the state of mathematical activity in the US by noting, "It is not greatly to the credit of the mathematicians in the vicinity that *Crelle's Journal* lies on the shelves of the Boston Public Library with uncut leaves."

Ladd was permitted to attend courses at Harvard but denied the right to formally enroll. Frustrated she wrote to Sylvester in 1878 and asked whether Johns Hopkins would permit her to enroll. She was awarded a fellowship but not officially enrolled. Four years later she wrote a dissertation under Charles Saunders Peirce, *On the Algebra of Logic*, but was not granted the degree she had thereby earned. This dissertation eventually appeared as a chapter in one of Peirce's books. She also published a handful of articles in Johns Hopkins's homegrown journal, *The American Journal of Mathematics.* Ladd married Fabian Franklin, also a graduate student at Hopkins, and went on to a distinguished career as Christine Ladd-Franklin. In 1926 as part of their semi-centennial celebrations, Johns Hopkins offered her an honorary doctorate for her work in optics. Ladd-Franklin responded that she would prefer to be granted the PhD she had *earned* 44 years earlier. At age 78, she got it.

I could go on. There are scores of detailed stories of famous individuals: the Moores, E.H. and R.L.; the elder Birkhoff; Nathaniel Bowditch; both Peirces (B.O. and C.S.); Oswald Veblen: Solomon Lefschetz; and Norbert Weiner. There are even more stories of minor and obscure individuals who enrich the tale Zitarelli is telling. He tells the stories of the colonial colleges: Harvard, Yale, William and Mary, and Dartmouth, etc. And how the American research community came to adulthood at Johns Hopkins, Chicago, Clark,

Pennsylvania, Stanford, and Berkeley. And how we came to have journals and books and professional societies. It is a rich tapestry of the ideas and personalities and institutions that formed mathematics in the US and Canada in the years 1492 to 1930. It paints a vivid picture of the establishment and growth of a mathematical enterprise in North America as the activity of people—heroes, geniuses, scalawags, and ordinary and extraordinary folk. Volume two, which rounds out the rest of the twentieth century, should appear in 2020. ■

Stephen Kennedy (Carleton College) manages acquisitions for MAA Press. Contact him if you're interested in writing a book for MAA Press: kennedy@maa.org.

MAA Pavilion Events at JMM

Come check out some of the member engagement events happening in the MAA Pavilion. You'll find a diverse selection of events and activities for people in the mathematical community who are curious to learn more about the various programs offered by MAA. There's something for everyone!

On-the-Spot Caricature Illustrations

Wednesday, January 16, 12:15–4:00 PM

Organizer: Kerry G. Johnson

Celebrate the grand opening in the MAA Pavilion and walk away with a caricature to add to your meeting experience. Make it a solo caricature or bring a friend, created in 5–7 minutes by a local Baltimore artist.

Gathering 4 Gardner

Thursday, January 17: 10:30-11:30 AM

Friday, January 18, 12:30-1:30 PM

Come to engage in the fun legacy of Martin Gardner and learn about the new MAA Lecture in his honor being launched at MathFest this coming August!

Mathematical Outreach Exchange

Thursday, January 17, 12:15–1:00 PM

Organizers: Rachelle DeCoste, Director, MAA Tensor Women and Math; Rosalie Dance, Director, MAA Tensor-SUMMA; and Nancy Neudauer, Director, MAA Dolciani Mathematics Enrichment Grant

Join the directors and award recipients of the MAA Tensor Women, Tensor-SUMMA, and Dolciani Mathematics Enrichment grant programs for open conversation on issues of diversity, inclusion, and student programming. Light refreshments will be served.

MAA Journals: Connect, Engage, Publish

Thursday, January 17, 4:00–5:00 PM

Organizers: Susan Jane Colley, Editor, *American Mathematical Monthly*; Dominic Klyve, Editor, *College Mathematics Journal*; and Jason Rosenhouse, Editor-Elect, *Mathematics Magazine*

Visit the MAA Pavilion to meet with the editors of the MAA journals. Discover valuable information about all the author resources available from MAA Press and Taylor & Francis. Connect with MAA journal editors face to face. Transform your mathematical results and ideas into great expository writing and submit it to one of the MAA's internationally read, peer-reviewed journals. Popcorn will be served!

Meet SIGMAA-Rec

Friday, January 18, 11:00 AM–12:00 PM

Organizer: SIGMAA-Rec

The aim of the SIGMAA on Recreational Mathematics is to bring together enthusiasts and researchers in the myriad of topics that fall under recreational math. If you are looking for new research avenues, if you want to enjoy some fun topics, or if you just want to talk to us to find out more, officers of the SIGMAA-Rec will be spending time at the MAA Pavilion. Stop by to chat and join us for a fun activity.

MAA Project NExT Turns 25!

Friday, January 18, 2:30–3:30 PM

Organizer: Dave Kung, Director, MAA Project NExT

We are celebrating 25 years of success with Project NExT! Come by the MAA Pavilion for fellowship with current and previous NExT Fellows and program directors. Light refreshments will be served.

Undergraduate Poster Session: Pick-up and Perk-Up

Saturday, January 19, 9:00–10:00 AM

Come network with undergraduates in the MAA Pavilion. As a follow-up to the Undergraduate Student Poster Session, students will have the opportunity to receive their feedback packets, explore career resources, network with graduate students about their experiences, and interact with SIGMAAs. Coffee and pastries will be provided.

January 16–19, 2019 MAA Pavilion - Baltimore Convention Center - JMM Exhibit Hall

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