Mathematical

Sciences



FALL 2018



Greetings from a Griz-turned-Cat By Charles Katerba, Ph.D. 2017



My head was filled with a combination of excitement and anxiety during final's week of the Spring 2017 semester at the University of Montana. With thesis defended, coursework completed, family arriving for graduate celebrations, and a two and a half month math trip to Australia on the docket, life was feeling great.

But my job prospects seemed grim and I saw no clear direction for myself after Australia. This all changed on the evening of May 12th, the day before commencement. Elizabeth Burroughs, the chair of the Department of Mathematical Sciences at Montana State University, called to offer me a post-doctoral position at MSU. The job sounded amazing: a 2-1 teaching load with the opportunity to teach graduate and upper division undergraduate courses, and support to continue my research program. I accepted Dr. Burroughs' job offer immediately. This Griz was to become a Cat (temporarily, at least).

With employment concerns assuaged, I was free to travel to Australia with an unburdened mind. I flew to Continued on page 6

Budapest Semesters in Math-Ed By Rachael Blackman

Sziasztok (Hello)! After 22 hours of traveling, I landed myself 9 hours into the future in the capital of Hungary to study the Hungarian approach to math education. The 2018 summer program called **Budapest Semesters in Mathematics Education** (BSME) consisted of 16 university students from the United States and Canada with a passion for both math and education. This experience abroad **Continued on page 4**



Rachael Blackman in front of Budapest's Liberty Bridge

Endowment Threshold Reached for Scholarship Honoring Gloria Hewitt

Quite a few donors contributed to the *Gloria C. Hewitt Graduate Scholarship in Mathematical Sciences* since fundraising began earlier this year, and by the end of September, the total had risen to over \$18,000 – a remarkable amount in such a short time period! It was, however, still significantly short of the \$25,000 minimum endowment that had to be reached by the end of the year.

As we were beginning to get antsy, an alumnus, who remembers taking Abstract Algebra with Gloria decades

ago, stepped in and saved the day. Thanks to him and to all of you who sent in your generous contributions, this scholarship is now no longer just a dream! At this point, the new goal is to make it even stronger, and we will always be grateful for additional contributions.

In related news, we are happy to report that also the graduate fellowship in Gloria's honor at the University of Washington has now been fully endowed, at the astounding level of \$150,000! Congratulations, Gloria!

Notes from the Chair

By Emily Stone

I will lead with our not so good news first. Despite all our efforts last semester (writing extensive reports, lobbying hard for Data Science) we were hit with a substantial cut in our instructional budget. The interesting thing is that because of the way it was calculated, it could have been much worse than it was. The actual dollar amount was very high, and made it seem at first as if we would have to lose 6 faculty lines. Because we were able to write off sabbaticals and grant buy-outs, we got it down to 3 faculty lines. These cuts were achieved through attrition, which is good because no faculty will be laid off, but bad because as a result the cuts will hit our Statistics program very hard. That said, because of the love affair of the new administration with all things practical and job related, it leaves us in a good position for getting the line back in the near future. All of this is still in flux, so stay tuned!

Now to the good news.

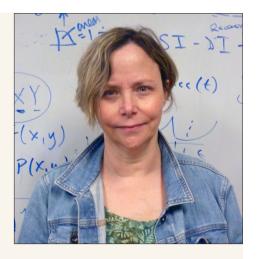
We were so pleased when an alum stepped up and presented us with a \$7000 donation to bring Gloria's grad student fund up to the endowment level! We have also heard that UW has reached its (very substantial) endowment threshold. In the future, there will be two Gloria Hewitt scholarship

students in the Pacific Northwest! For my part, working on the scholar-ship has allowed me to get to know Gloria a little better. She has always sort of intimidated me when meeting her at our picnics and so forth, so it has been wonderful to get to know the real person and hear her historical perspective on all things related to being chair of the Dept.

This past year two of our faculty received substantial external funding. Elizabeth Gillaspy received a 3-year NSF research grant and Kelly McKinnie received a 5-year Simon's foundation collaboration grant. This is wonderful and is a good snapshot of all the research activity going on in the department.

This spring we will have between four and 6 PhD students graduate! And our data science master's program is getting a small initial foothold with 1 student graduating last year, two more this year (one a PhD student who also picked up a Data Science master's), and two students starting in the program this January. That is a pretty good start. We are reaching out to nearby four-year colleges and universities to advertise this degree, and also advertise our grad program in general.

Also on the marketing front: We



are putting brochures into area high schools for the Math Dept., and starting a "Montana High School Math Award" which will bring students from regional high schools to a banquet sponsored by the Math Dept. We will have one-on-one opportunities to recruit some of the strongest students in Montana to be Math majors at this event. It is thanks to our generous donors that we are able to carry out all kinds of activities such as this. Our heartfelt thanks goes out to you all.

From all of us here in the Best Little Math Dept. in the West, we wish you all a very happy and prosperous New Year!

Gunily F. Stone

Alumni News

E. M. Risse, Class of 1960 (BA Math 1961) and JD University of California 1965, recently relocated his Regional Strategy practice from the Piedmont of Virginia to The Woodlands TX. He is working to complete his third book on human settlement patterns. His first two are available from Amazon dot com.

We'd love to hear from our graduates! Please send any items you'd like us to mention in this column to the newsletter editor at nikolaus.vonessen@umontana.edu.

Learning Assistants (continued from page 3)

class, without being a student in the course, has been a great opportunity to learn by example. Lastly, I've gained some 20 or so students that I've come to root for. Being able to aid in their learning has made me invested in their capabilities, and that in turn makes me want to be a better mathematician."

LAs in the mathematical sciences have shown themselves to be a valuable resource for transforming mathematics instruction at the undergraduate level. Personally interacting with LAs in the classroom has become a joyous part of my day. I get to know the students really well and follow them throughout their undergraduate mathematics degree. Also, having an LA in my classroom has transformed the way I teach and provides my students with an undergraduate mathematics role model.

Once Again, a Math Professor leads UM's Largest College

By Nikolaus Vonessen

From 1982 to 1987, Mathematics Professor **Howard Reinhardt** served as the dean of our college. The accompanying article about the Reinhardt Peony Garden tells

you more about his and his wife Chin-Won's interesting life, and the impact they had on UM and Missoula. He was also featured in the Spring 2000 edition of this newsletter (posted in our newsletter archive at http://hs.umt.edu/math/newsletter).

This August, our previous dean, Professor **Chis Comer**, returned to teaching and research in neuroscience after having ably and successfully led the college since 2009. And in a repeat of history, another mathematics professor took over the helm of the College of Humanities and Sciences: Dr. **Jenny McNulty** will lead the col-

lege as interim dean for the next two academic years; the search for a permanent dean is scheduled to begin in Fall 2019. Jenny faces both difficult challenges and great opportunities: restructuring and reinventing UM's largest college in light of fiscal constraints and declining enrolment. She is well prepared for this, having served as associate

dean since 2010.

After earning her Ph.D. in Mathematics from the University of North Carolina at Chapel Hill, Jenny joined our department in 1993. She was promoted to associate pro-

fessor in 1997, and has been a full professor since 2004. Her specialty is combinatorics. She said that she "uses her mathematical problem-solving skills in a variety of ways in her role as an academic administrator".

In Mathematics, Jenny has been successful as a re-searcher, teacher and mentor. She supervised three Ph.D. students and many masters' students. Supporting underrepresented groups in mathematics is one of her passions, and she has done this at many levels: from organizing programs for incoming freshmen, to being co-PI on an NSF grant. She recently co-authored

an opinion piece on diversity in the Notices of the American Mathematical Society (http://www.ams.org/journals/notices/201805/rnoti-p586.pdf). And when not working (rarely these days), she enjoys the out-doors and playing ice hockey. Best wishes for your new job, Jenny! Thanks for taking on this difficult task!

A New Approach to Teaching: Learning Assistants in the Classroom

By Kelly McKinnie

In recent years our undergraduate students have begun to make a difference in the classrooms of students following them in the math major. The idea is the Learning Assistant model, which, at UM, grew out of the Noyce Scholar Program in the Phyllis J. Washington College of Education and Human Sciences (http://coehs.umt.edu/nsfnoyce/). This program aims to transform STEM classrooms across campus into engaging, active-learning focused classrooms that depend less on the traditional lecture model. LAs and faculty members work together to present core mathematics concepts to students using activities designed to promote engagement and learning in the classroom.

During active learning activities, LAs join small groups of students with the aim of facilitating discussions, addressing misconceptions, and encouraging engagements. With the goal of improving retention and success in vital STEM courses, the math department has begun to use LAs in several of our 100 and 200 level classes, including pre-Calculus, Calculus I & II, Vector Calculus, Linear Algebra, and Statistics. Many of our LAs are recipients of the Math Department's Undergraduate Teaching or Tutorial Scholar Awards.

Besides being beneficial for students taking the class, **Matthew Kingston**, an LA for Calculus II since Fall 2018,



Pictured above are LAs **Emily Engstrom** and **Eli Ninemann** leading a "Jeopardy" style review session in Calculus II.

reports that reviewing Calculus helps as he begins the study of more complex mathematics.

lan Gonzales, Spring 2018 LA in Calculus II reports that being an LA has strengthened his "understanding of Calculus II material. Not only am I learning by being present for the lectures, but also interacting with the students allows me to engage in several thoughtful and different discussions about that week's concepts. Through their questions, I'm pushed to think more critically about what I know, and sometimes what I think I know. Also, to observe a former professor instructing and responding to a

Budapest (continued from page 1)

helped me grow as a person, and will significantly impact my future students.

I spent 5 weeks in Budapest taking classes that aimed to share the Hungarian education system. The program introduced us to the Pósa method, alternative ways to integrate technology into the classroom, problem solving techniques, and teaching through games and manipulatives. During the sixth week, we went to a small town, Mátrafüred, where we spent a week at the MaMuT summer camp. About 90 mathematically gifted students were in-

vited to spend a week solving math problems. We observed lessons in the mornings and helped run and participate in activities during the afternoons.

Obviously, the program had a heavy focus on teaching the Pósa method. Lajos Pósa is a prominent math educator in Hungary and developed a teaching style for mathematically gifted students. We experienced that method first-hand during our courses and were given the opportunity to observe a lesson taught by Pósa at the MaMuT camp. The method focuses on how to bring problem-based learning into the Hungarian education system. Emphasis is placed on giving students the chance to learn in groups and discover for themselves. Teachers create a rigorous sequence of problems where each question belongs to a thread that helps develop a student's understanding of a topic (combinatorics, strategy games, recursive thinking, etc.).

While I think problem-based learning would be beneficial to all types of students, it

is hard to visualize a direct application of the Pósa method in an American classroom where schools have a set curriculum, common standards, and deadlines for teachers and students. However, an important thing I learned is to have students reason. If they can explain why x=7 and how they got that answer, then their understanding of a concept will improve. It is important to remember what my professor, Peti, said: the main goal of every teacher is to "make the children happy", because if our students are happy they will be more excited about learning.

Not only did I fill my "teaching toolbox" with fun activities and problems, the experience helped to build my self-confidence. I was all alone as I traveled halfway across the planet, praying that I would see my suitcase at the Budapest baggage claim (which I did!). It was my first time living and cooking on my own. My feet felt like they were going to crumble after the three-mile climb up to Fisherman's Bastion. There were Saturdays when I ventured to the edge of the city by myself and stopped at every single metro stop. Not to mention the fear of going into the

market or pharmacy for the first time where it was likely people didn't speak English. I came back to America with a stronger sense of myself and my limits and strengths.

I feel more confident and motivated in my teaching abilities as well. Being around students who are truly interested in learning math and extremely engaged in your lesson is a dream for any teacher. Having the chance to talk with these kids about their country, their language, their lives, was a true experience. I also had the realization that a 12 year old boy in America isn't much different than a 12 year old boy in Hungary (farts jokes are funny across



BSME students and professors with Lajos Pósa (middle, white shirt) and Rachael Blackman (third from back left)

cultures). Working closely with my BSME peers was a reward as well. I have made connections across the world and memories with these people that will last a lifetime. All of the BSME students were women and as a women studies minor, it was exciting to study together with them. It was rewarding to see that we are working to better represent women among math teachers, which is a traditionally male dominated field.

As far as some other Hungarian travel tips, *gelato* is less than a dollar and *langos* is a great snack. The views from the bridges across the Danube are a must-see and the public baths are warm on cool summer days. Don't get caught in a thunderstorm but other than the muggy sun, the weather is beautiful every summer day. If you do visit Budapest, I recommend buying a public transit pass so you can ride the metro, which is surprisingly a very fun mode of transportation! Visit Rákóczi tér for me, my dorm metro stop, where I started to feel like a local.

Rachael Blackman is a mathematics education major; she will graduate in Spring 2019.

The Howard and ChinWon Reinhardt Peony Garden

By Alayne Dolson

In 1957, Dr. Howard Reinhardt moved to Missoula with his wife, ChinWon, and joined the faculty of UM's Mathematics Department. Howard's enthusiasm for mathemat-

ics began with study at the University of Idaho, continued with his pursuit of an MS at Washington State University, and took him to the University of Michigan at Ann Arbor, where he not only earned his doctorate (1959), but also found his lifelong mate, Chin-Won Suh.

ChinWon's path to the University of Michigan was a bit more circuitous. She spent the first ten years of her life in Manchuria, where her father was a Korean journalist, reporting on the Sino-Japanese War. There

she spoke Korean at home, Manchurian in town, and Japanese at school. The family moved to Seoul where ChinWon attended middle school and high school, and enrolled in the University of Seoul, but the outbreak of the Korean War closed the University. In 1952, ChinWon moved to the US, began her studies in journalism at Seattle University, and completed her degree at the University of Illinois. Her move to Michigan to pursue graduate study was interrupted by her marriage to Howard.

Their move to Missoula in 1957 resulted in a lifetime of service to the University of Montana and the greater Missoula community. Not only did they add three outstanding children to the population; they also dedicated themselves to excellence in teaching and in community service and support for community organizations. Howard's holis-

tic approach to education encouraged students to pursue a well-rounded course of study that would guide them in good reading habits, the ability to think and converse intelligently, and then study in depth. This work led him to chairmanship of the Math Department, and then to serve as Dean of the College of Arts and Sciences.

ChinWon and her friend, Mavis McKelvey, wife of another math professor, Dr. Robert (Bob) McKelvey, co-founded

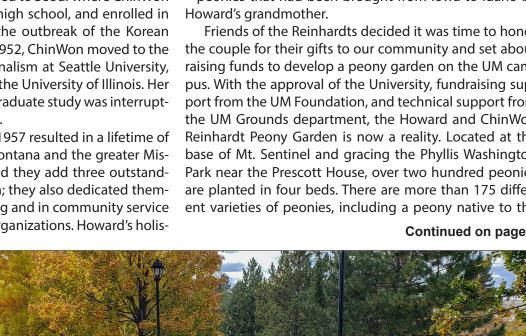
> the Missoula Farmer's Market, started KUFM's children's program, the Pea Green Boat, and found time to volunteer in the University Native Plant Garden. She also volunteered in the resettlement of Hmong families who came to Missoula after the Vietnam War.

> At the same time, their love of gardening led to the development of a spectacular peony garden at their home in the Rattlesnake. The garden began with plants from ChinWon's mentor in Ann Arbor and plants from

Howard's mother and aunt in Idaho, Howard's birthplace - peonies that had been brought from lowa to Idaho by

Friends of the Reinhardts decided it was time to honor the couple for their gifts to our community and set about raising funds to develop a peony garden on the UM campus. With the approval of the University, fundraising support from the UM Foundation, and technical support from the UM Grounds department, the Howard and ChinWon Reinhardt Peony Garden is now a reality. Located at the base of Mt. Sentinel and gracing the Phyllis Washington Park near the Prescott House, over two hundred peonies are planted in four beds. There are more than 175 different varieties of peonies, including a peony native to the

Continued on page 7





ChinWon and Howard Reinhardt

(Photo by Ken Stolz)

Planting Day at the Garden, October 12, 2018 (Photo by Ken Stolz)

Griz-turned-Cat (continued from page 1)

Sydney to work with Stephan Tillmann at the University of Sydney for a month and a half, then planned on moving to Melbourne to spend time at Monash University. After landing in Sydney and getting my bearings, I found a place to live that was a 20 minute walk from the university and half an hour by bus to Bondi beach, so, of course, I found a surfboard to play around on. It was amazing to be able to go for a surf in the morning and still make it to campus before noon.

While at the University of Sydney, Stephan Tillmann, Alex Casella, and I worked on a problem in knot theory that relates to my thesis work at UM. To describe this project,

first imagine tying your favorite knot in a piece of string. To study this knot mathematically glue the ends of the string together. This is to prevent one from untying the knot in the same way you untie your shoes and hence enables one to investigate how knotted your knot really is. Cameron Gordon and John Luecke showed that studying the negative space around the knot (i.e., the complement of the knot in 3-space) is equivalent to studying the knot

itself. This is valuable because it allows us to study knots using algebraic and geometric techniques.

Now let *N* denote the negative space around our knot. This 3-dimensional object contains special 2D shapes called essential surfaces, which are invariants of our knot. Essential surfaces in N can be difficult to find in a systematic way, but Peter Shalen and Marc Culler constructed a theory in the 1980's which allows one to use an algebrogeometric object to build essential surfaces in N. Since the development of their theory, there has been a significant effort to understand exactly which essential surfaces in N can be built with their techniques. While in Sydney, Casella, Tillmann, and I proved two negative results in this

realm. As an example of these results, we showed that the exterior of the knot 10₁₅₂ (pictured below) contains closed essential surfaces, none of which can be constructed using Culler-Shalen theory.

After a month and a half in Sydney, I went down to Melbourne to spend time with the topologists at Monash University. We discussed the work from my time in Sydney and a potential relationship between my thesis work and some quantum knot invariants. At the beginning of August, I went backpacking around the Tarkine Coast of western Tasmania, then flew back to Missoula, packed up my truck, and moved to Bozeman on August 15th. I went from camping around wallabies to a new faculty orienta-

> tion meeting in less than 72 hours and had a look to go with it: the office staff almost did not believe that I was the new hire.

> Freshly directed on my new life as a faculty member, I

needed to find a place to live in Bozeman. Fortunately, my friend, fellow UM alumnus, and at-that-time MSU graduate student Holt Bodish (B.A. 2014) had found a house and was looking for a roommate.

The downside: we couldn't move in until September 1st. Until then, we found a place to camp in Hyalite Canyon to the south of Bozeman. So when the first day of class came around, I rolled out of my sleeping bag in the woods, drove to campus, and lectured about the motivation behind the definition of an abstract topological space.

During my first year at MSU, I taught the graduate point set topology class, a section of multivariable calculus, and the undergraduate complex analysis course. It had been a long time since I had thought about vector line integrals, Stone-Čech compactification, or Cauchy's Integral Theorem and I was nervous to teach these subjects. But after

Continued on page 7

The Department of Mathematical Sciences increasingly relies on donations to support its activities. In particular, scholarships are very important for our students. Please consider a gift to the Math Department's Excellence *Fund*, to be used where the need is greatest, or to one of the other funds and endowments:

The knot 10₁₅₂

Endowed Scholarship Funds: The Adams Scholarships, Anderson Mathematics Scholarship, Gloria C. Hewitt Graduate Scholarship in Mathematical Sciences, Joseph Hashisaki Memorial Scholarship, Mac Johnson Family Scholarships, Merle Manis Award, William Myers Mathematics Scholarship

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To donate online, please visit http://hs.umt.edu/math. For information on other ways to give, please contact Suann Lloyd: suann.lloyd@supportum.org or by phone at 406-243-2646 (or call toll free 1-800-443-2593).

Department News

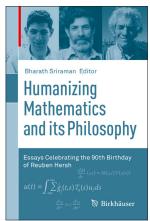
This June, faculty from our department were involved in organizing two international research conferences. Assistant Professor **Elizabeth Gillaspy** was co-organizer of the week-long workshop "Cuntz-Pimsner Cross-Pollination" held at the Lorentz Center at Universiteit Leiden in the Netherlands. And Associate Professor **Kelly McKinnie** was co-organizer of the 13th Brauer group meeting at Pingree Park, Colorado; this week-long conference was supported by an NSF grant Kelly had obtained.

Dean **Jenny McNulty** and Lecturer **Lauren Fern** organized UM's Success in Science program for incoming freshmen this year. This is a week-long intensive residential program that teaches academic skills, builds social connections of science students, provides an overview of campus resources and allows students to get acquainted with campus life before the start of the semester. New science majors spent a week on campus before classes started, then headed north for a weekend at the Flathead Lake Biological Station.

Asking questions is an important mathematical habit of mind. But often, in schools, questions are provided to students. To encourage more problem posing in schools, math professors **Fred Peck**, **Matt Roscoe** and **Ke Wu**, together with Professor **David Erickson** from the Department of Teaching and Learning organized a three-day conference for Montana math teachers at the Montana Learning Center at Canyon Ferry. Participants, including other math professors and K-12 teachers, posed questions about everyday objects (e.g., how much carbon is in this tree stump?) and mathematical objects (e.g., how is the

volume of material in the Menger Sponge related to the stage?). They then explored their questions, and shared their solutions with the community. Now these teachers are engaging their students in these same practices. One teacher shared, "after the wonderful experience, I am committing to doing an 'exploration' activity with at least one of my classes every Thursday."

The Notices of the American Mathematical Society, the world's most widely read magazine aimed at professional mathematicians, recently featured a lengthy review by Joseph Auslander of a compilation of essays edited by Professor **Bharath Sriraman**. His book, Humanizing Mathematics and its Philosophy, consists of essays celebrating the 90th birthday of Reuben Hersh, a pioneering mathematician best



known for his writings on the nature, practice, and social impact of mathematics. You can find the review at https://www.ams.org/journals/notices/201811/rnoti-p1424.pdf.

Associate Professor **Ke Wu** is leading an NSF-funded \$2.3 million research project, the Willow Project, which is a collaboration between UM, Salish Kootenai College and Sitting Bull College. This summer, the project hosted a workshop at UM for Native American faculty in STEM fields. Visit http://www.umt.edu/willow-agep for more information.

Griz-turned-Cat (continued from page 6)

settling into a routine (and moving into a house...), I realized that my time at UM had prepared me well for the task. I had been exposed to many different kinds of mathematics, mathematicians, and pedagogical techniques. This exposure gave me the knowledge and flexibility to teach many undergraduate classes, along with a healthy dose of empathy for student difficulties, especially in the case of complex analysis.

The past year and a half at MSU has flown by and my time here is quickly coming to a close. While my next job may not be in Montana, the impression left in me by the UM math department will linger for much longer. Not only did the department help mold me professionally, but it created an awesome community that I want to continue being a part of. I hope to run into you all at conferences and seminar talks, trailheads and truck stops, lift lines and coffee shops.

Charles Katerba completed his Ph.D. at UM in May 2017, under the direction of Professor Eric Chesebro.

Peony Garden (continued from page 5)

Northwest, Paeonia Brownii, and several peonies donated by the Reinhardts from their garden. Peonies will bloom from mid-May through the end of June. Howard helped the committee select peonies, and ChinWon and their daughter, Elizabeth, along with other volunteers, helped plant them. A celebration honoring the Reinhardts and the garden will be held in the spring.

Funding for this project came from friends of the Reinhardts, the Reinhardt children, and the Dennis and Phyllis Washington Foundation. Friends, alumni, and colleagues who wish to support the on-going needs of the garden may designate donations to the Reinhardt Peony Garden through the UM Foundation at https://supportum.org/give/default.php (specify the Reinhardt Peony Garden in the Comments Box). Educational materials about peonies and garden benches will eventually be added to this garden project.

Members of the Peony Committee are Gary Clark, Alayne Dolson, Mae Nan Ellingson, Steven Hesla, Sandy Sheppard, and Sue Talbot.



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Math Donors Help Establish UM's New Lightboard Studio

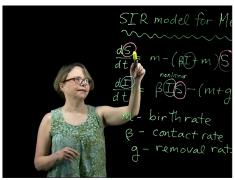
By Nikolaus Vonessen

Lightboard studios are a great new tool that make it much easier for faculty to create high-quality videos for online courses, but without the need for assistance by a professional production team. The user just has to hit one button, and... Lights! Camera! Action! – everything automatic. (Well, admittedly, the user does have to supply the "action".)

So far, this is just a "one button" video recording studio. The additional twist of a lightboard studio is that faculty can write on the board while facing the audience, and without obscuring what they are writing. This is made possible by an illuminated glass board (the lightboard) that is installed between the presenter and the camera, and on which the presenter can write in glowing script, seemingly in

the air. That is exactly what a math professor needs when recording a video. And it could not have happened without the generous support of the donors to the math department: we were able to contribute \$5,000 from our unrestricted gift funds to help the Mansfield Library complete this project.

On the right, you see a screenshot form an applied math video recorded by Emily Stone, the chair of the math department. Below it you see a photo of the recording in the Lightboard Studio. Note that in real life Emily is right-handed: But to make it possible to read what she is writing, software automatically "mirror-flips" the recorded video. So if you ever make a recording in a Lightboard Studio, don't wear a T-shirt proclaiming you a STAR.



A screenshot from a video Emily made (above), and what actually happened in the Lightboard Studio:



