Math Circle taps kids’ creativity in problem-solving
by Troy Rummler, Letters and Science

If you’ve never thought of math as a creative art, you’re probably not alone. But three Letters and Science professors will disagree with you.

Gabriella Pinter, Chris Hruska, and Boris Okun, all professors within the Department of Mathematical Sciences, teach middle and high schoolers how to find creative solutions to unconventional math problems through the UWM Math Circle.

At each of Math Circle’s weekly sessions, the professors use an entire hour to pose one or two problems to the youth. They do not suggest a method; they do not even promise that there is an answer. They do, however, guide the students in brainstorming ideas, working together as a class, and recognizing the underlying patterns and principles involved in the problem. What’s more, this circle has a point.

“It’s giving them a feel of what it is like to actually do real mathematics,” said Hruska. “Or any real science,” added Okun.

A different kind of classroom

Real-world problems of any kind, they said, are rarely as straightforward as the ones you find in a textbook. The Math Circle complements classroom experiences by posing open-ended, frequently abstract questions that encourage young students to draw on a variety of skills, including their own ingenuity, to approach the problem.

One problem they discussed involved dominoes and a chessboard. They took a chessboard – an eight by eight grid – and removed two opposite corner squares. They then asked the kids to cover the board with dominos so that every domino covered exactly two squares. The problem is admittedly contrived, but it’s also more difficult than it first appears.

Pinter, Hruska, and Okun make a point to distinguish the experience of the Math Circle from that of a traditional classroom. Aside from the unusual problems, they also deliberately remove common classroom elements. “There’s no homework, and there’s no commitments that you have to do something by a certain date,” said Hruska. “They come if they are interested, and if they continue to be interested they continue coming. And if they are not interested, they just don’t come back.”

The professors further distinguish their program from a math class by focusing the teens on learning to articulate the root of a problem – why an approach does or doesn’t work – rather than only coming up with an answer. For example, it turns out the chessboard problem is impossible, and most students reach that conclusion after much trial and error. But explaining why it’s impossible means understanding the fundamental predicament behind it, which the professors try to draw out of the students through discussion.

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Getting a grip on graphene

by Laura L. Hunt, University Relations

For all the promise of graphene as a material for next-generation electronics and quantum computing, scientists still don’t know enough about this high-performance conductor to effectively control an electric current.

Graphene, a one-atom-thick layer of carbon, conducts electricity so efficiently that the electrons are difficult to control. And control will be necessary before this wonder material can be used to make nanoscale transistors or other devices.

A new study by a research group in the Physics Department will help. The group has identified new characteristics of electron transport in a two-dimensional sheet of graphene layered on top of a semiconductor.

The researchers demonstrated that when electrons are rerouted at the interface of the graphene and its semiconducting substrate, they encounter what’s known as a Schottky barrier. If it’s deep enough, electrons don’t pass unless rectified by applying an electric field – a promising mechanism for turning a graphene-based device on and off.

The group also found, however, another feature of graphene that affects the height of the barrier. Intrinsic ripples form on graphene when it is placed on top of a semiconductor.

The research group, led by Lian Li and Michael Weinert, UWM professors of physics, and Li’s graduate student Shivani Rajput, conducted their experiment with the semiconductor silicon carbide. The results were published in the November 21, 2013, issue of *Nature Communications*.

The ripples are analogous to the waviness of a sheet of paper that has been wetted and then dried. Except in this case, notes Weinert, the thickness of the sheet is less than one nanometer (a billionth of a meter).

“Our study says that ripples affect the barrier height and even if there’s a small variation in it, the results will be a large change in the electron transport,” says Li.

The barrier needs to be the same height across the whole sheet in order to ensure that the current is either on or off, he adds.

“This is a cautionary tale,” says Weinert, whose calculations provided the theoretical analysis. “If you’re going to use graphene for electronics, you will encounter this phenomenon that you will have to engineer around.”

With multiple conditions affecting the barrier, more work is necessary to determine which semiconductors would be best suited to use for engineering a transistor with graphene.

The work also presents opportunity. The ability to control the conditions impacting the barrier will allow conduction in three dimensions, rather than along a simple plane. This 3D conduction will be necessary for scientists to create more complicated nano-devices, says Weinert.

Other contributors on the paper include Mingxing Chen, postdoctoral researcher working with Weinert, Yaoyi Li, and Ying Liu, postdoctoral researchers in the Li lab (Liu is now at the Institute for Quantum Computing in Waterloo, Canada.)

See the paper at: [http://www.nature.com/ncomms/2013/131121/ncomms3752/full/ncomms3752.html](http://www.nature.com/ncomms/2013/131121/ncomms3752/full/ncomms3752.html)
The Department of Biological Sciences celebrated the opening of their new greenhouse this month, a facility that stands toe-to-toe with those at leading research institutions across the country. The rooftop location above the Northwest Quadrant (NWQ) replaces greenhouses formerly attached to Lapham Hall and the Great Lakes WATER Institute and comes with updates that outclass what had previously been available.

“This is really phenomenal. … I’m overwhelmed by the opportunities this will provide our faculty and staff, and our campus,” said Chancellor Michael Lovell at the ribbon-cutting on December 4, 2013.

Dean of the College of Letters and Science, Rodney Swain, shared similar sentiments. “It’s a jewel for our campus. We’re very excited about the groundbreaking research that will occur in this space.”

The excitement centers mainly on the expanded size of the space and the state-of-the-art environmental controls. The 9,200 square foot greenhouse is subdivided into eleven different rooms and compartments, and each can host a distinct environment with controls for light, temperature, humidity, and carbon dioxide. There is also 1,200 square feet of outdoor planting beds.

The set up of UWM’s greenhouse is fairly rare. Many greenhouses, even at major universities, keep their entire collection in a single open space under the same conditions, compromising the needs of a huge variety of plant life with a middle-of-the-road approach.

In contrast, said Paul Engevold, greenhouse manager, “We can design an environment that the faculty want versus the faculty needing to design their research around the environmental conditions.”

Jeffrey Karron, Associate Professor of Biological Sciences, is making full use of the greenhouse’s features in his study on the long-term effects of self-pollination in monkey flowers. With the new controls, he can simulate the change of seasons indoors and raise three generations of plants in the time he could previously only raise one. And, he can do so without affecting the other plants in the facility.

Neither of the former greenhouses had air conditioning, humidity control, or up-to-date lighting fixtures. These limitations meant that some plants thrived while others struggled and required constant attention.

Engevold said that many of the plants look healthier and more natural than they ever have since moving into the NWQ in late September.

That’s good news for Kasey Fowler-Finn, a biological sciences postdoctoral fellow whose research depends on growing healthy plants. “It takes so much effort to keep the plants happy. I usually have three or four undergraduates working with me just to keep these plants alive,” she said.

Fowler-Finn studies the mating songs of treehoppers, a type of insect that communicates through vibrations in the stem of the plant it lives on. She is trying to determine why the insects sing at different pitches, but her data is only reliable if her plants are uniformly healthy.

To support her bugs, Fowler-Finn raises hundreds of plants at a time which had led to some difficulties arising from a lack of space. All her plants fit in the previous Lapham Hall greenhouse, but the tight quarters were overcrowded and led to outbreaks of pests and disease, causing substantial delays in Fowler-Finn’s research. Now, because airflow is controlled independently in each room and filtered through a fine mesh, neither Fowler-Finn nor any of the other researchers have to worry about cross-contamination. Overcrowding is an issue of the past, too, since the new greenhouse is the size of both former greenhouses combined.

Fowler-Finn said that with healthier plants she hopes to be able to collect in one year the same volume of data that she gathered over the previous three. That efficiency, she added, reflects positively on the

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The gardens that students in Dr. Mai Phillips’ Conservation and Environmental Science class built and planted on campus are yielding a harvest not only rich in produce, but also in knowledge. They’ve raised vegetables which will help feed many of Milwaukee’s hungry this winter and learned important lessons about food disparities and sustainable growing practices.

This hands-on project is supported by a Cultures and Communities partnership grant which brings Phillips’ class together with The Gathering, a community meal program preparing and serving over 100,000 meals annually to the hungry and homeless in Milwaukee. Food cultivated by the class will be donated to The Gathering’s Fresh Produce Preservation Project (FPPP) which preserves produce for use in winter meals to help boost the nutritional value of those meals. By the end of the semester, students will also be schooled in food-handling, preservation and storage by the produce project.

Becky Long, of The Gathering, says the FPPP and the UWM class are a good fit. The Gathering was working to increase donations of fresh produce and develop additional space to cool and store it when she connected with Phillips. “We know preservation,” she says. “Mai knows cultivation.”

Indeed she does. Phillips brings to her class a wealth of experience in sustainable agriculture. Her background includes work in Kenya where she demonstrated how to set up sustainable gardens for people with HIV/AIDS – a group for whom access to a nutritious, balanced diet is critical but often difficult. Given a lack of space, the gardens in Kenya needed to be small enough to be tended by one person – just a square meter – and follow some simple principles including keeping compost manageable, planting a diverse number of vegetables and rotating crops.

“We are faced with some of the same issues here,” Phillips says, noting that many groups suffer food insecurity and hunger, a situation in which communities are dependent on food that comes from miles away. But she wants people to know that with compost, cardboard and some wood framing, small, sustainable gardens can be built almost anywhere.

Although some of her students may never have grown a vegetable, Phillips believes they leave her class thinking differently about food, be it growing, harvesting, preservation, or issues like erosion and water resources. They also leave with a feeling of accomplishment. “When you see something

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university and its faculty when they apply for grants. She believes the greenhouse will make UWM more competitive for those awards in the future.

As an instructional space, the greenhouse will host approximately 1,700 students throughout the year. Abundant examples of plant physiology, biodiversity, and evolution provide an ideal learning space for classes at all levels.

“What we’re able to provide now is this living environment” for student learning, said Karron. He explained that without the greenhouse “you have specimens on a bench, but they’re not living specimens – you have the skeleton of a rabbit or something preserved in a jar. It makes biology into this very sterile discipline, and it’s not the same experience. Biology should be the study of life and its living organisms.”

This new environment, he hopes, will resonate with individuals and inspire them.

And it seems to be off to a good start. Chancellor Lovell, when he visited the completed greenhouse for the first time remarked, “I want to make this a tour stop for when people come to campus to visit because I think it’s so impressive.”
Bringing the Circle to Milwaukee

The UWM Math Circle is the only math circle in Milwaukee, though the idea is not entirely novel. It happens to be a common extracurricular activity in eastern European countries, and immigration from those countries since the 1990s has brought the tradition to the United States. Today, math circles are scattered throughout the country, usually attached to a university and a bit more prevalent on the East and West Coasts than in the Midwest. Both Pinter and Okun, who grew up in Hungary and Russia, respectively, attended math circles as kids and said that their own positive experiences were major factors in initiating the program here. They’ve patterned this math circle after ones they enjoyed but have also incorporated ideas from successful math circles they’ve researched as adults. The goal in the UWM Math Circle has always been to help youth develop critical thinking skills and confidence in approaching situations they haven’t encountered before.

“If you’re afraid that ‘Oh, I don’t want to do this problem because I don’t know how to do that type of problem,’ then you won’t be very successful in your adult life no matter what career you’re in,” said Hruska.

“From my experience,” said Okun, “most of my classmates in math circles didn’t go into math careers, but they were successful in other areas. The point is to develop some sort of analytical thinking which is important in many careers.”

In other cities, math circles sometimes operate differently to meet different needs. One based in Madison, for example, functions to generate interest in math careers by presenting students unusual but true problems in math history as a lecture series similar to the UWM Science Bag. Other circles are gathering places for educators interested in brainstorming new ways to teach traditional subjects in their classes.

Teaching creativity

When asked how she would like to see the UWM Math Circle grow in the future, Pinter responded that she would like to extend the program to elementary school students. She believes in the importance of showing students early in their education that math relies on creativity and diverse thinking. And though funneling kids into math careers has never been the purpose of the program, she feels that more students would choose to pursue those fields if they recognized this.

“These students who are typically very creative and who can put things together in interesting ways – they cannot use their creativity in the math classroom, typically, so they turn to different things like music, for example, where they can freely express their creativity. I think you can do that in math also, but they don’t see it,” Pinter said.

Creativity is important to math because not all problems are solved with an equation. For instance, one way to explain the chessboard problem is to take a Sharpie and color one half of a domino black and leave the other half white. You do this to show that no matter where you place the domino on the board, it’s going to cover one black square and one white square. You realize, then, that opposite corners of a chessboard are always the same color. This means when you cut two corners out, you’re stuck trying to cover a board that has more squares of one color than the other with dominoes that can only cover an equal number of each. It’s impossible, but it takes a little creativity to explain why, and that’s the real point of the problem.

UWM Math Circle runs throughout the school year on Wednesday nights at 5:30 p.m. in room E424A of the Engineering and Mathematical Sciences (EMS) building. Anyone interested is welcome to attend; however, problems are selected to be most appropriate for students in grades 7-12.

More information can be obtained by contacting Gabriella Pinter at gapinter@uwm.edu.
Video stories

Assistant Professor of Sociology Marcus Britton discusses his research on race, housing, and place-based inequality. His most recent study, with Assistant Professor Heeju Shin, looked at the relationship between residential segregation and very pre-term birth. http://youtu.be/AKDuWra7FeE

Multi-language New Year’s greetings in sixteen languages from the College of Letters & Science. http://youtu.be/np4D1d6CsMs

L&S people in print


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Find us at UWMilwLetSci
Upcoming events

January 14
Author Visit: Arnie Bernstein. 7:00 pm Boswell Book Company. *Swastika Nation* is a story of bad guys, good guys, and a few guys who fell somewhere in-between. Co-sponsored by the Sam and Helen Stahl Center for Jewish Studies. [http://bit.ly/19t5MSV](http://bit.ly/19t5MSV)

January 17 through March 7
Planetarium Show: Colorful Nebula. 7:00 pm Fridays. UWM Manfred Olson Planetarium. Marvel at the beauty of space through celestial clouds such as the Eagle, Horsehead and Cat’s Eye, and learn how nebulae are connected to the age of stars. $2 admission. [http://bit.ly/WJ7tUO](http://bit.ly/WJ7tUO)

January 27
Info session for graduate programs in Nonprofit Management. 6:00 pm. UWM Alumni House. Learn about admissions requirements, curriculum and financial aid. Advanced registration required by e-mailing balord@uwm.edu or calling 414-229-3176.

In the media and around the community

The first conference devoted to the study of Franco-Ivorian poet, novelist, artist, public intellectual, and academic, Véronique Tadjo, took place in Johannesburg, South Africa, from November 23 to 26, 2013. Sarah Davies Cordova (French, Italian, and Comparative Literature) co-organized the conference with her colleague at the University of Johannesburg (UJ), Désiré Wa Kabwe-Segatti. Funding for “Veronique Tadjo: Literary Postcoloniality, Post-Femininity or Asserted Africanness ?” was provided by the Universities of Johannesburg and of the Witwatersrand, the Institut français d’Afrique du Sud -Recherche, The Institut français, South Africa, and the Ministère des Affaires étrangères (France). Thirty-five academic literary critics and translators from the U.S., Europe and Africa examined and assessed the place of Tadjo’s body of work in post-colonial literatures.


Many faculty and students from the Communication Department had papers accepted for presentation at the National Communication Association 2013 Conference held in Washington D.C.:

- **Erin Ruppel** (with T.J. Burke and V.J. Young) – “Investigating self-presentational motives on Facebook: The role of social competence and social anxiety”
- **Emily Cramer, Sang-Yeon Kim, Anna Herrman, Nathanael England, H. Kim, Jihyun Kim** – “Culture and context dependency: The impact on patient-physician communication”
- **Emily Cramer** – “Advancing a communication-based theoretical approach to understanding the use and prevalence of text messaging”
- **Emily Cramer, Kelly Tenzek, Mike Allen** – “Recognizing success in the chaplain profession: Connecting perceptions to practice” (Top Four Paper, Spiritual Communication Division)
- **Rachel Davidson** – “Myth, anecdote, and audience agency: Complicating narrative validity in the 2012 presidential debates”
- **Lindsey Harness** – “Defining the LGBT citizen in the It Gets Better Project”
- **Rebecca Mullane** – “Integrating interpersonal communication theories with small group communication”
- **Kathryn Olson** – “Do/how might presidential debates matter? The case of 2012”

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Media and community  continued from page 7

- Kim Omachinski – “Communication strategies to connect members working in virtual teams”
- Erin Ruppel (with S.A. Rains) – “Channel complementarity theory and the health information-seeking process: Further investigating the implications of source characteristic complementarity”
- Erin Ruppel – “Self-disclosure via communication technologies: The role of relationship development”
- Erin Sahlstein Parcell – “Imagining and doing presence in the communication present” and “A celebration of continued growth in researching interpersonal relationships: Connections across diverse qualitative methods, studies, and analysis”
- Ha Song (with J. Kim, Y. Jung, and R.J. Kwon) – “Fear appeal through enactive role playing: A serious game for smoking cessation”
- Ha Song (with H. Shin, and Y. Kim) – “Perceived stigma of alcohol dependency: Comparative influence on patients and family members”
- Ha Song, Anne Zmyslinski-Seelig, Jihyun Kim, Adam Drent, Angela Victor, Kikuko Omori, Mike Allen – “Does Facebook make you lonely? A meta analysis”
- Jeremy Adolphson – “The priestly and prophetic voice of the public intellectual,” “Hot Girls, Direct to your Room in Twenty Minutes: The commodification & fetishization of female sexuality through the Las Vegas flip cards,” and “The surgical spectacle – Horrific bodies in the Human Centipede films”
- Kelly Tenzek, Emily Cramer, Mike Allen – “Spirituality and coordinated management of meaning: Examining the chaplain’s role in social constructions of a ‘good death’” (Top Four Paper, Social Construction Division)
- Jansen Werner – “Chasing connections: Deconstructing and reconstructing the Rand Paul filibuster,” “(Re)presenting the presidential debates: Presidential campaign ads that incorporate debate footage,” and “Chris Kluwe’s failed rhetorical leadership: Social advocacy, same-sex marriage, and hegemonic masculinity”
- Karina Willes, Kim Omachinski – “Connecting colleagues through LGBT training in the workplace”
- Kaori Yamada – “Redefining citizenship and community: A rhetorical analysis of the dissent by the Fair Play Committee in the Heart Mountain Internment Camp”
- Rebecca Mullane, Emily Cramer, S. Schneider – “These experiences shape your life for good and bad: Integrating student and educator ideologies into anti-bullying initiatives”

Kim Omachinski (Communication) made four presentations at the National Association for International Educators Bi-Regional (V and VI) Conference in Indianapolis:
- “Why YOU should participate in NAFSA’s Advocacy Day!”
- “So you want to get a job (or move on) in International Education, do you?”
- “Challenges and benefits of working with faith-based organizations”
- “When I first came to conferences, I had a lot of the questions, now I have many of the answers... what is there for me?”

Erin Ruppel (Communication) presented “Weighing the evidence: Classification of quitline practices by evidence for efficacy and reach” at the National Conference on Tobacco or Health, held in Ottawa, Ontario, Canada.

Passings

We mourn the loss of Sean Deely (’09, Global Communications). Sean passed away on December 5, 2013, at the age of 28. In addition to being an alumnus of the College of Letters & Science, Sean also worked for the College’s IT office for four years, providing exceptional technical customer service to faculty, staff and students. He is remembered for his kindness and sense of humor, and for his exceptional musical talent. Sean had been living and working in Tokyo, Japan, growing professionally as a marketer and event planner while also fully engaged in his passion for music, playing with his band at gigs around the world. He is survived by his parents, John and Cathy, brothers Marc and Ethan, his grandmother, Dorothy, many other relatives and friends, and his girlfriend, Hina Taguchi.