A Compendium of I-STEM Web Articles
Featuring Educational Outreach Activities of the

ILLINOIS MATERIALS RESEARCH SCIENCE & ENGINEERING CENTER

2020

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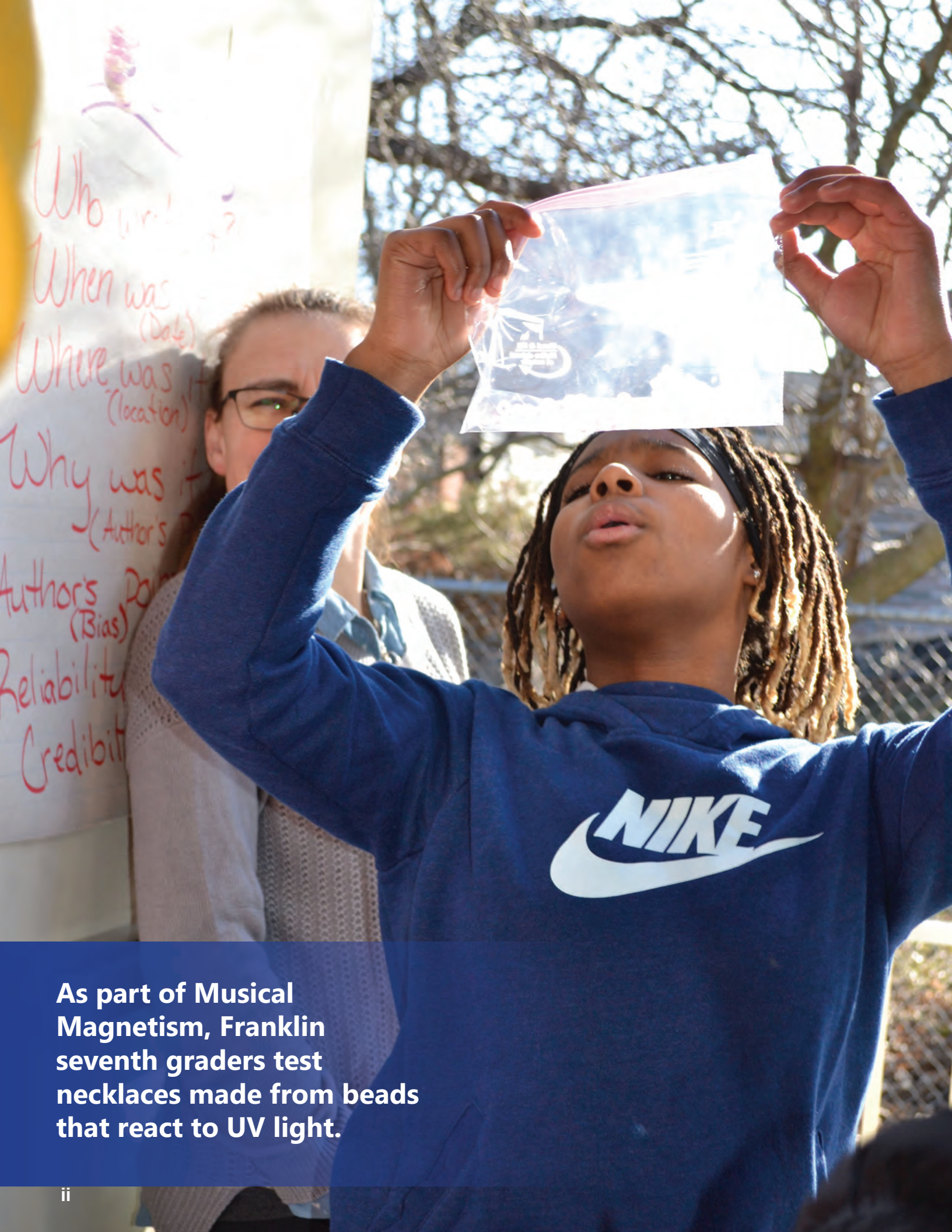


As part of Musical Magnetism, Franklin seventh graders test necklaces made from beads that react to UV light.

I-MRSEC—CREATING A MULTI-DISCIPLINARY MATERIALS SCIENCE RESEARCH COMMUNITY...

Begun in September 2017, I-MRSEC (Illinois Materials Research Science and Engineering Center) seeks to create a community around multidisciplinary materials science research; recruit and educate the next generation of researchers, including diverse students; and inform the general public through outreach. Funded through NSF's Materials Division, the center is receiving $16 million over the six years of the grant, with the possibility of being renewed.

I-MRSEC PI Nadya Mason tries out an I-MRSEC magnetism activity at the 2018 MRL Open House.

I-MRSEC has two goals:

1) innovative interdisciplinary materials research with applications to societal needs, and

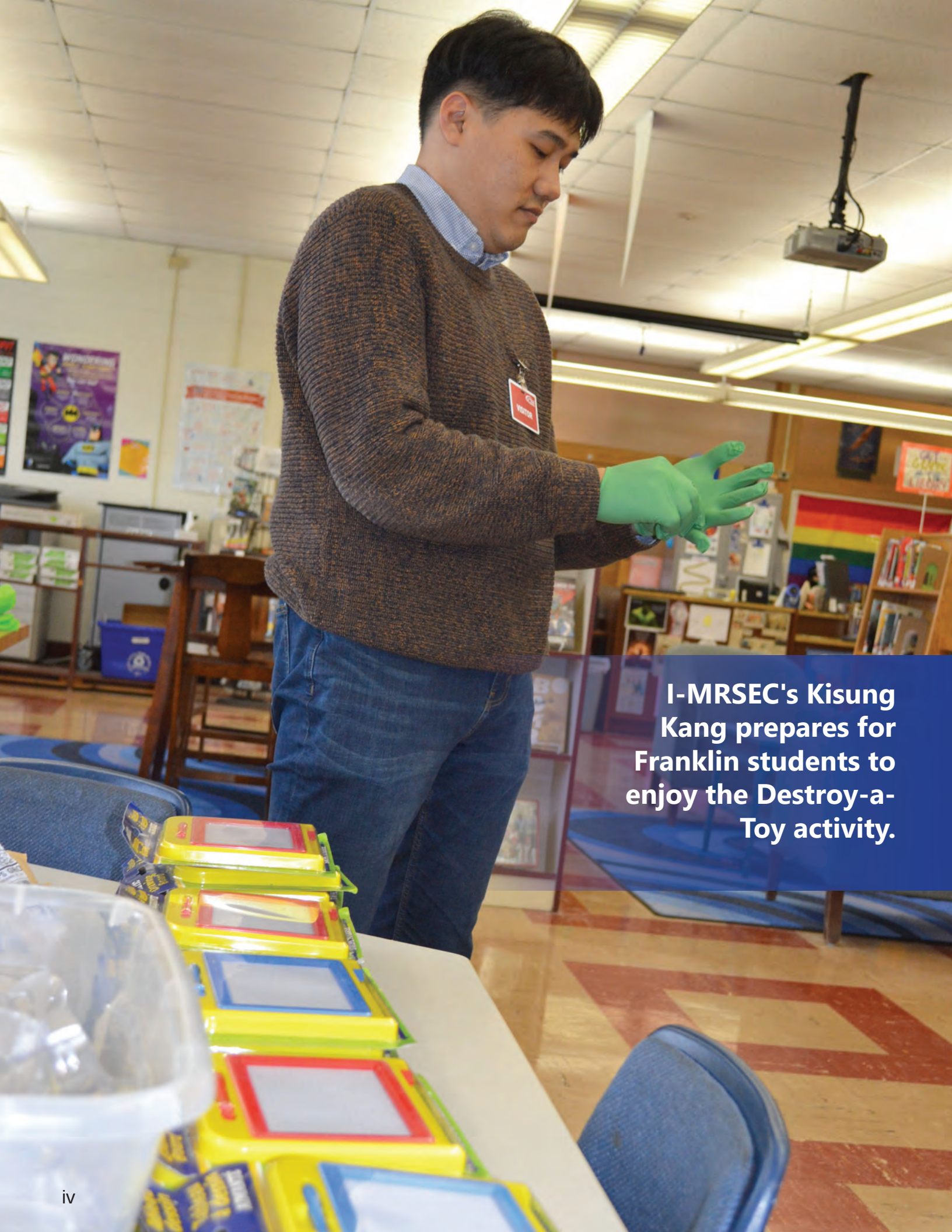
2) interdisciplinary education and training of students in materials design, understanding, and application.

According to the PI, Physics Professor Nadya Mason, the Center's overarching goal is to create a materials research community. **"It's not just about doing the best research, though that's incredibly important, but it's also about training the next generation and creating an environment where materials research is central."** She further defines what she means by community.

"So that means that you have collaborations, both interdisciplinary and international," Mason says. **"You have educational components, where you give enhanced opportunities for seminars and classes for the students in the group. It also means that you reach out to the community, both for the sake of educating the community and as a way to bring more people into materials research. The people involved in the grant also learn the importance and relevance of reaching out and having other people share knowledge and appreciate what they are doing."**

This magazine features 10 articles published on I-STEM (the Illinois Science, Teachnology, Engineering and Mathematics Initiative) website (www.istem.illinois.edu/index.html) during 2020, highlighting I-MRSEC's Materials Science education and outreach efforts to underserved K–12 students, research opportunities provided to undergraduates through NSF's REU (Research Experiences for Undergraduates) program, and training opportunities to teach Materials Science researchers how to more successfully communicate their science.

Front cover: Top left: Principiae's Jean-luc Doumont teaches I-MRSEC researchers about giving remote presentations. Top right: During a Franklin STEAM Academy field trip to MRL, I-MRSEC's Kising Kang introduces a student to Virtual Reality. Bottom: During Cena y Ciencias, Paul Ruess has fun with a youngster who's reading the temperature on a digital thermometer.



I-MRSEC's Kisung Kang prepares for Franklin students to enjoy the Destroy-a-Toy activity.

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During a field trip to MRL, I-MRSEC's Kising Kang introduces a Franklin STEAM Academy student to Virtual Reality.

I-MRSEC OUTREACH TO UNDERREPRESENTED STUDENTS

As part of Musical Magnetism, Franklin seventh graders test necklaces made from beads that react to UV light.

PHYSICS' LORENZ SHINES A LIGHT ON INVISIBLE LIGHT AS PART OF I-MRSEC'S MUSICAL MAGNETISM PROGRAM AT FRANKLIN

January 21, 2020

What better way to get Franklin STEAM Academy seventh and eighth grade students interested in science than by couching it in fun, hands-on activities and demonstrations and encouraging them to express what they've learned in some mediums they love—music, hip hop/rap, and videos. This is the goal of the Musical Magnetism program sponsored by I-MRSEC (the Illinois Materials Research Science and Engineering Center), Illinois' NSF-funded center which focuses on some of the properties of materials, such as magnetism. The main project of the Jan 13–March 6, 2020 program is this: students are to select a specific topic related to magnetism, research it, then create a music video to be previewed at a video release party on the final day of the program.

A Franklin STEAM Studio eighth grader works on a bracelet made of special UV-reacting beads.

I-MRSEC's Musical Magnetism curriculum dovetails with the school's emphasis on STEAM, which uses the Arts (A) to address STEM (Science, Technology, Engineering, and Mathematics). So for eight weeks, Franklin students will be learning about science and materials and exploring magnetism. The in-depth look at magnetism will include the opportunity to "Destroy a Toy" (take a MagnaDoodle apart), take a look at some "Magnetism Technologies," and "Build a Toy."

Franklin seventh graders examine a student's beads which have changed color after being exposed to UV light.

Virginia Lorenz and Pamela Pena Martin do an activity using infrared light. Lorenz is holding an i-Pad loaded with software that uses infrared light to detect the heat signature of a Franklin student who is hidden behind a black garbage bag, holding up several fingers, which Lorenz and Pena Martin are to guess using the infrared image.

The Arts emphasis will introduce students to various aspects of

Franklin seventh graders show off the necklaces they've made from special beads that react to UV light.

music and video making. Activities will include a presentation by guest artist Jamie Roundtree, how to make a music video, how to write lyrics, audio recording and video storyboarding, and different beats in music. Other activities will include a field trip to MRL (the Materials Research Lab, home of I-MRSEC), and a career panel comprised of an MRL staff scientist, a professor, and someone from industry.

For the program's introduction to materials sessions on January 16th, Physics Associate Professor Virginia Lorenz and two of her graduate students did an activity about materials and light with the seventh and eighth graders.

First, Lorenz discussed light—both the visible light spectrum and types of light which can't be seen by the human eye. After talking about the visible light spectrum, she explained that infrared light has a longer wavelength than visible light and is therefore invisible to the human eye. She also addressed ultraviolet light, which has a shorter wavelength than those that make up visible light. This type of light has both fun and not-so-great consequences; for instance, while it makes black-light posters glow, which everyone loves, it's also responsible for sunburned skin.

Next, the team of researchers led the Franklin students in an engaging, hands-on activity designed to test the effectiveness of sun screen in preventing sunburn. First, students received plastic bags containing special beads which turned various colors when exposed to UV light—which they immediately tested using special UV flashlights, as well trooping outdoors into the sun. The experiment involved teams of students who were to test three lotion samples (labelled A, B, and C), to see which provided the least vs. the most protection from the sun's UV rays. For the experiment, students applied the different lotions to the outside of their plastic bags to determine which provided the most protection. Following thorough testing, they discovered that A provided the least while C provided the most protection.

Finally, after the experiment, the kids got to make bracelets or necklaces from the beads, which they were allowed to keep—a stroke of genius that

Virginia Lorenz shows a seventh grader a YouTube video of someone who created a large art project using materials that react to UV light.

would remind the students of the lesson on UV light every time they stepped out into the sunshine!

Lorenz says she signed up to do her lesson on materials and light at Franklin partly because it's part of her role as the outreach director for I-MRSEC. However, she also likes to get involved outreach activities like this one because she hopes to "bring science to the public and especially children whom we'd love to see grow up to become scientists."

According to Lorenz, her goals for her activity were as follows:

"For the students to feel empowered to explore and discover things about the world on their own, to have the knowledge of scientific methods that allow them to do so, and to have a good memory of fun with science."

Lorenz shares how Musical Magnetism is beneficial for her and her colleagues:

"It's easy to forget how cool science is and how far we've come in our understanding; by working with the Franklin students we are reminded of how exciting it can be to learn something new about the world."

She shares what she considers to be one of the benefits for the kids:

"Interacting with scientists exposes them to potential careers that might seem mysterious otherwise and gives them a direct connection to that community."

Virginia Lorenz and Pamela Pena Martin do an activity using infrared light. Lorenz is holding an i-Pad loaded with software that uses infrared light to detect the heat signature of a Franklin student who is hidden behind a black garbage bag, holding up several fingers, which Lorenz and Pena Martin are to guess using the infrared image.

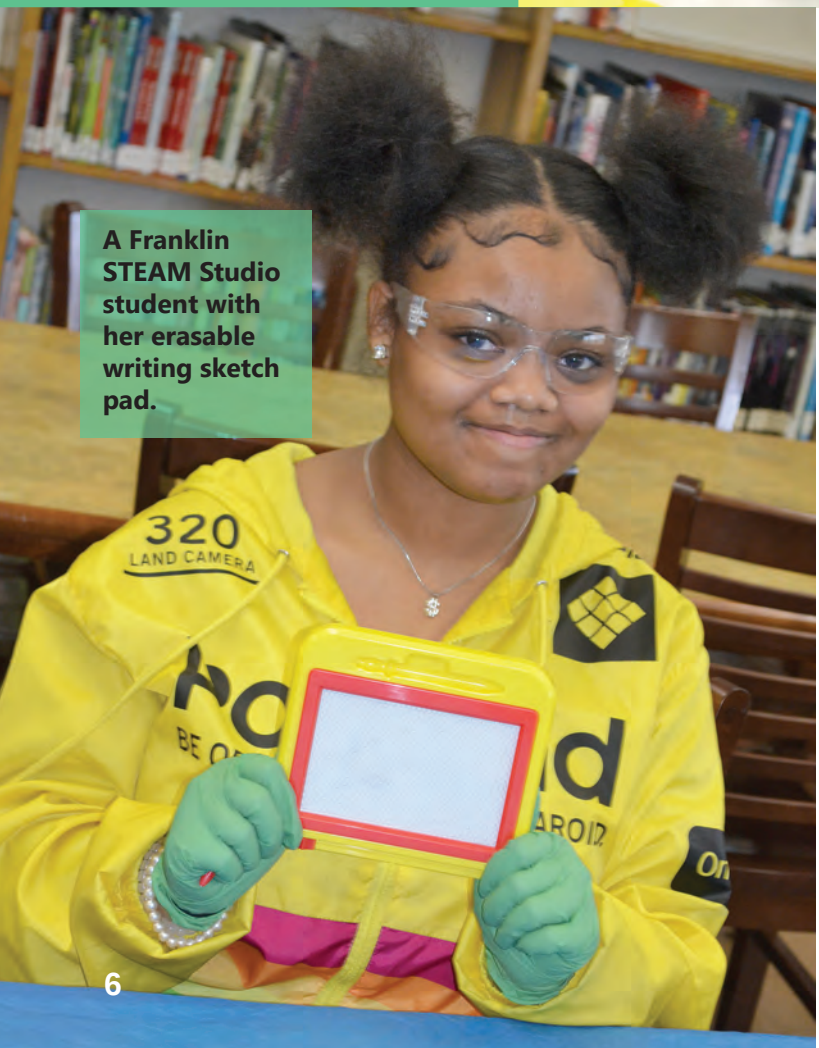
MUSICAL MAGNETISM'S DESTROY-A-TOY ACTIVITY: MESSY BUT DEFINITELY CURIOSITY-DRIVEN AND EDUCATIONAL!

February 13, 2020

"But we also want to make sure that it's, first and foremost, about the students. So, putting ourselves in their shoes and thinking about what will be engaging and interesting and encouraging at that age." – Pamela Pena Martin

The challenge for the Franklin STEAM Academy seventh and eighth graders participating in the Musical Magnetism's Destroy-A-Toy, hands-on activity was to discover what makes toys like a Magnadoodle or an Etch-a-Sketch work. After all was said and done, they learned that it was magnetism. (After all, in a program called Musical Magnetism, it's apparent that either one or the other must be involved.)

A Franklin student takes his Magnadoodle apart.



A Franklin STEAM Studio student with her erasable writing sketch pad.

Here's how the activity went. Each kid received a toy (purchased from the Dollar Store for $1 each!) Then after first doodling on the toy for a bit to see it in action, they donned rubber gloves and goggles and set about tearing the toy apart. Once they had finally gotten into the thing's innards, and once they had gotten past the ooey-gooey, noxious-smelling suspension liquid necessary for its operation, the students discovered what allowed users to sketch, why their drawing remained, and why using the slider removed their artwork. Tiny iron shavings suspended in the thick white liquid were attracted to a magnet-tipped stylus, which made the drawing and caused it to stay in place. Of course, a long magnet attached to the "wiper" served to erase the screen clean of its drawings. So what did students learn as a result of the activity? They learned one way magnets can be useful in everyday life. They also learned that through curiosity, exploration, and perseverance, one can learn a great deal.

Franklin students finish dismantling their Magnadoodles.

Helping Pamela Pena Martin, I-MRSEC's outreach coordinator, with set-up, clean-up, and more importantly, steering the inquisitive students in the right direction and underscoring their findings, were a couple of folks whose skills and passions closely align to I-MRSEC's goals: Maggie Mahmood, who encourages messy learning, and Kisung Kang, who loves magnetism.

Physics' Secondary Education Partnership Coordinator, Maggie Mahmood, is a researcher in physics education research. In fact, she used to be a physics high school teacher. Mahmood is currently researching various pathways that different groups of students take through Illinois' engineering programs. She's specifically tackling where the bottlenecks are for particular subgroups (such as women and minorities), in terms of first matriculating into engineering, then, going through the physics sequence, and finally getting a degree in engineering.

Mahmood got involved with Musical Magnetism because she actually used to do music videos with her physics and math students, which is basically what the Musical Magnetism program is doing. She says her students were "basically taking content-related vocabulary and changing the words to popular songs in order to make some sort of like content music videos," she says,

Another aspect of her job at Illinois is outreach and partnership:

> **"So this was yet another way that I felt I could be involved in the community. And so just everything kind of clicked and intersected in that way, which is nice."**

What was Mahmood's favorite part of the Destroy-a-Toy activity? She first acknowledges her least favorite part: "Well, I don't like cleaning it up," she admits. "But I really do like when the students find things out by getting messy," which is perfect, given the messy state of the students' gloves, work areas,

Pamela Pena Martin prepares for the Destroy-a-Toy activity with Franklin students.

and even clothes, following the hands-on activity.

“I think that's sort of a theme with me as a teacher. I definitely like messy projects and things where there isn't necessarily always this beautiful defined end, but maybe a kind of like gross mess that then you patch together and then you find out something different than maybe what you were expecting.”

She definitely found the activity rewarding:

“So I like doing that, but yeah, this was really fun. And just seeing how excited the students were and even just putting on the gloves and goggles here and seeing them light up, that was nice. But my favorite part of any of these days is just interacting with the students and getting to know them, and it's really fun.”

For Kisung Kang, a 4th year PhD student, the outreach is right up his alley as well; his research is magnetic simulation. He explains why he volunteered to be involved with Musical Magnetism.

Indicating that his research is too complicated for the general public, he reports that this kind of outreach can give the students some simple ideas about their research. He also claims that by participating in hands-on activities about each magnetic principle, the students can learn how these simple principles are related to more complicated research.

Kang’s favorite aspect of this particular hands-on activity was the kids getting to break down the magnetic drawing board to see what's going on inside of it, which was the main emphasis of this particular activity. He was excited that they were getting to learn about the physics of the mechanism: “doing something with the real parts and seeing what’s going on inside of this stuff and learning the real physics inside of this stuff.”

What's the benefit for Kang? Why put his important research on hold and get out of

his lab for a few hours to come spend time with the Franklin kids? “For me it's kind of like refreshing myself. So sticking in the laboratory is kind of a boring job, but when I meet students like these, doing this kind of stuff, then I can remind myself I was once a kid in middle school, who was eager to study about the sciences. So it's kind of reminding myself.”

Physics’ Secondary Education Partnership Coordinator, Maggie Mahmood interacts with a Franklin STEAM Studio student.

Regarding the benefits for the students, Kang reports: “Well, they usually spend most of their time with science teachers, but not real researchers like us or a professor. This kind of gives them some chance to communicate with the real scientific experts. They can meet and then discuss what's going on in the real word. I think this is kind of a valuable experience for the students.”

For Pamela Pena Martin, I-MRSEC’s outreach coordinator, her favorite part of the Musical Magnetism program is seeing the students get turned on to science. “Just getting to know the students that are in the program,” she says, “and seeing how excited they are about science, and watching them engage and be curious, and find an opportunity to just interact with science and feel positive about it.”

Regarding what she finds the most challenging about Musical Magnetism, she admits that organizing and administrating it is quite a challenge.

“It's a lot of work to organize the program, to think about the order of things, to make sure that there's a lot of engaging activity. We have things that we do in our center, and things that we hope students will learn.”

However, the biggest challenge, according to Pena Martin, is making sure it engages the students.

“But we also want to make sure that it's, first and foremost, about the students. So, putting ourselves in their shoes and thinking about what will be engaging and interesting and encouraging at that age.”

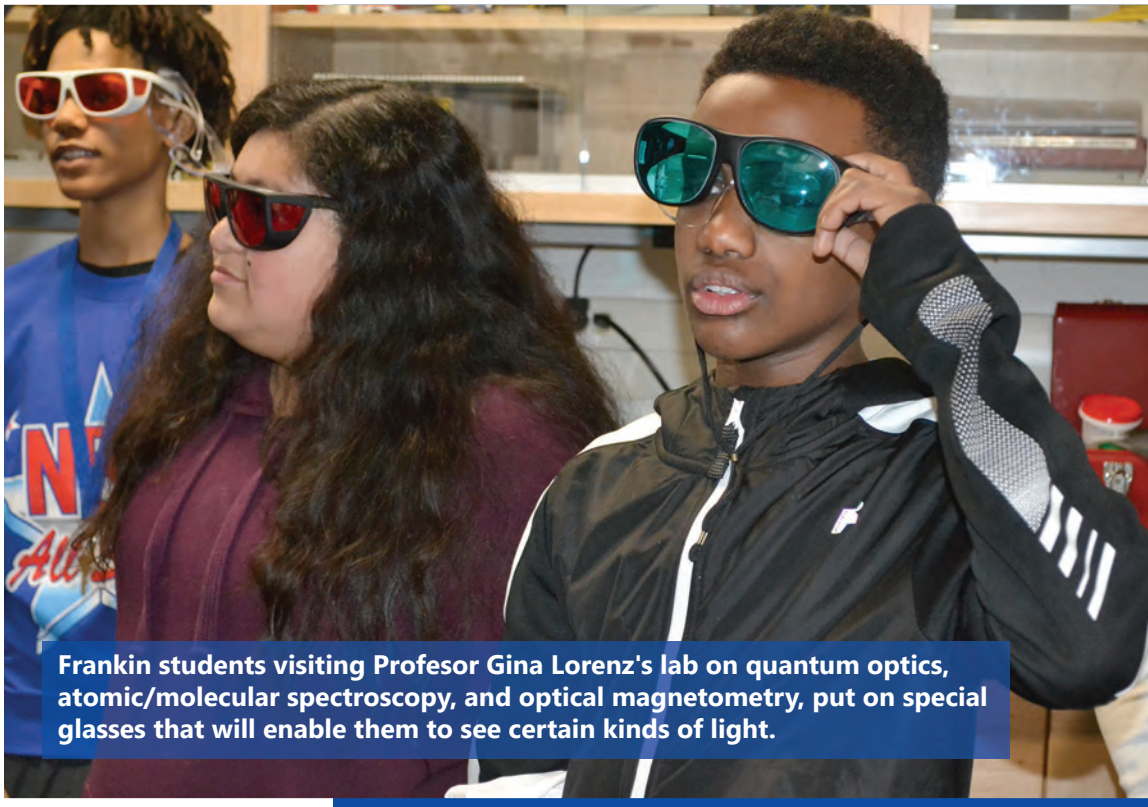
Maggie Mahmood and Pamela Pena Martin (standing) interact with Franklin students who have finished "destroying" their Magnadoodles.

Regarding the impact Pena Martin feels it’s having on the kids, she reports: “I feel like they've been more readily participating in the activities. I think they're taking challenges more. They seem to be really interested.”

MRL's Jade Wang encourages a Franklin seventh grader who's about to look through a microscope during Franklin's visit to an MRL lab.

FRANKLIN STEAM ACADEMY STUDENTS EXPERIENCE CUTTING-EDGE SCIENCE AT MRL

February 27, 2020



Frankin students visiting Profesor Gina Lorenz's lab on quantum optics, atomic/molecular spectroscopy, and optical magnetometry, put on special glasses that will enable them to see certain kinds of light.

Explore a different reality via VR. Cover up from head to toe in a strange suit, safety glasses, and gloves and experience a cleanroom. See firsthand what equipment like a 3D Optical Profilometer and a Contact Angle Goniometer do. These are just some of the cool things Franklin STEAM Academy students got to experience during their field trip to the Materials Research Lab (MRL) on February 20th (the 7th graders) and 21st (the 8th graders). During their brief hiatus from the classroom, the students not only got to see, but get their hands on, some real-world, high-tech stuff MRL scientists use every day in their research.

The MRL tour was part of “Musical Magnetism,” a multi-disciplinary curriculum that uses rap and music to expose students to materials science and magnetism. Created by I-MRSEC (the Illinois Materials Research Science and Engineering Center), the program was designed to fulfill a couple of the center’s main goals: scientific communication and exposing folks, especially youngsters, to materials science and magnetism.

I-MRSEC Education and Outreach Coordinator Pamela Pena Martin explains why the curriculum included a visit to MRL. "We spend most of the 8-week program visiting Franklin. We love having the chance to welcome these students, whom we've been getting to know over the last several weeks, to our "home" at Materials Research Lab! Here we don't just show them research spaces but let them actually don a cleanroom suit, operate a scanning electron microscope, and do other activities that help promote the image of themselves as scientists, in hopes that this will encourage many of them to pursue STEM studies.”

Having Franklin students visit MRL isn’t just beneficial for the students; according to Pena Martin, it’s rewarding for the MRL scientists too. “Their presence also brings energy and enthusiasm that is truly inspiring to those of us doing research,” she claims. “We were each that age at one time, and it is fun to remember the experiences that sparked our own interest in science.”

Following a brief welcome by Professor Gina Lorenz, who earlier in the eight-week program had done an activity about invisible light at Franklin, MRL safety engineer Maisie Kingren briefly chatted about lab safety…and provided the groups with safety goggles. Seventh graders were then divided into six smaller groups, and eighth graders into four groups, which then rotated through different activities to experience what some of MRL’s different instruments and scientists do.

Scientists in charge of the different activities scheduled were delighted to welcome the students to MRL, giving them brief tours of their labs and exposing them to some of what they do, day in day out. For example, I-MRSEC’s Kising Kang introducted the Franklin students to Virtual Reality (VR), always popular with kids. At MRL, scientists actual-

Tao Shang explains how MRL's cleanroom works to several Franklin students who are suited up and enjoying the experience.

ly use VR in their research; for instance, some use it to study molecules. So, donning the VR headset and equipped with a controller, students got a 3D look at molecules and other structures, and even got to move them around to see what the insides of the material looks like.

Tao Shang explains how MRL's cleanroom works to several Franklin students who are suited up and enjoying the experience.Tao Shang explains how MRL's cleanroom works to several Franklin students who are suited up and enjoying the experience. A Franklin seventh grader learns how to do dynamical mechanical analysis of a snack food.

A Franklin seventh grader learns how to do dynamical mechanical analysis of a snack food with the help of MRL scientist Roddel Remy.

In another lab, MRL Research Scientist Kathy Walsh demonstrated a 3D Optical Profiler for the students. This tool uses light to make finely detailed images of objects. During her presentation to the Franklin students, Walsh and the kids had fun looking at objects, which the students chose from a variety of samples she had on hand, then measured them using the profilometer.

For instance, they looked at coins (a penny, and a quarter) that happened to be a Harpers Ferry quarter. “So I got to give them a pop quiz on history,” she explains.

They also looked at a myriad of other interesting things: a surgical mask with Hello Kitty printed on it, paper and ink, a $5 bill one of the students had, and a couple of hairs (one from Walsh’s head, and one from Julio Soares' beard). They also checked out some snacks (Cheetos and Chester's Hot Fries), and some insects (a stink bug and a bumblebee [to the right below is an image of its eyes). Walsh clearly enjoys showing off what her 3D Optical Profilometer can do:

“I love this instrument—you can put almost anything into it and get interesting images," she boasts, "so it's great for looking at real-world materials!”

According to Walsh, getting out of the classroom and into a real research setting like MRL can be beneficial for youth: “Classroom science tends to be aimed towards getting a specific result. All the experiments have been done already, so classroom science isn't about discovering something new but

Image of a bumblebee's face that the Franklin 7th grade students took.

rather about seeing it for yourself." But she says visiting an environment like her MRL lab gives the students a greater ability to explore. "What are the odds that any other human being before you has looked at a Hello Kitty facemask with a 3D optical profiler?" she continues. "This open-endedness showcases the joy of exploratory science in contrast to the common experience of getting bogged down in trying to get "the right answer" for a lab report." And the Franklin students appeared to have experienced the joy of exploratory science. "Some of the students were really into it," Walsh reports.

A seventh grader looks through a microscope during Franklin's visit to an MRL lab.

Via another instrument, a Contact Angle Goniometer demonstrated by MRL senior research scientist Julio Soares, STEAM Academy students discovered how the instrument analyzes the shape of drops of liquid. The Goniometer allowed students to look at drops of liquid, such as water, up close to see the various shapes they can take on, from very flat to sphere-shaped, based on how the liquid interacts with the surfaces of various materials.

A tour of MRL's cleanroom was another fun and unique activity for students. Because anyone who enters this special lab must completely cover their body in order to prevent the lab from being contaminated by dust, skin cells, or hairs, students had to suit up in cleanroom suits, safety glasses, and gloves. In addition to understanding what scientists who work in a cleanroom must do every day just to enter their lab, they also saw what's inside the clean room and heard about experiments conducted there. Following their tour, students even got to take their cleanroom suits home!

One more instrument Franklin students learned about was a piece of equipment that performs Dynamical Mechanical Analysis (DMA). DMA analyzes how much force it takes to break different materials. MRL scientist Roddel Remy led students in several activities which allowed them to see the equipment in action as they studied different materials, including snacks, to see how strong they are.

During another activity, MRL staff scientist Jade Wang, who operates the Scanning Electron Microscope (SEM), worked with Franklin students who examined a butterfly wing using a small optical microscope, then through the SEM's much higher magnification. They even got to run the SEM and control which parts of the sample to look at. In fact, 7th graders captured images of a butterfly wing and bee's up close which was imaged in the SEM.

Concerning the impact the field trip had on the students, Pena Martin shares an anecdote:

"We noticed them asking questions—some REALLY great and insightful questions!—and seeking connections between the research happening at MRL and their world. One student, as she was leaving at the end of the tour, told me she wants to come back again sometime. To illustrate her level of enthusiasm, the very next day, when we visited Franklin, the first thing she asked me was, 'When can I come back to MRL?'"

CENA Y CIENCIAS—SCIENCE DEMONSTRATED IN SPANISH BY HISPANIC ROLE MODELS

March 11, 2020

"We use language as a powerful tool to connect with the communities and provide an example for the children." – Felipe Menanteau

Paul Ruess has fun with a youngster who's reading the temperature on a digital thermometer during a Cena y Ciencias activity.

Pizza. Exciting demos (including one featuring a blowtorch!). Hands-on activities related to temperature. These are some of the fun things a group of Kindergarten through 5th graders from two Urbana elementary schools, Dr. Preston Williams and Leal, experienced at Cena y Ciencias (Supper and Science) on March 2nd. The evening at Williams was comprised of supper (pizza) followed by science, of course. The night's theme was: "Put to the Test of Fire: Materials That Protect Us." However—probably most important of all—the night's activities were all conducted in Spanish by scientists of Hispanic heritage.

Cena y Ciencias (CyC) is a Spanish-language science outreach program for the two dual language schools held monthly at Williams throughout the fall and spring semesters. CyC partners include the Illinois Materials Research Science and Engineering Center (I-MRSEC), the Center for the Physics of Living Cells (CPLC), the Illinois chapter of the Society of the Advancement of Chicanos and Native American Scientists (SACNAS); and Urbana School District employees and parents. Moreover, the National Science Foundation has supported the program since its inception.

Luis De Jesus discusses a thermometer reading with young children during Cena y Ciencias.

I-MRSEC faculty and researchers from a variety of disciplines, including Astronomy, Chemistry, Materials Research, and Engineering, help with lesson content, developing ideas and concepts to be communicated, plus demos and hands-on activities to underscore principles being taught. Spanish-speak-

An Illinois student has placed hand santitizer on the hands of young visitors during Cena y Ciencias.

ing students who are passionate about science outreach help with activities and serve as role models.

One driving force behind CyC, both in curriculum planning and implementing the program, is Chemistry Associate Professor Joaquín Rodríguez López, who characterizes CyC as a community.

"CyC is truly a group activity, and it works so well because of the engagement of all involved, from the student volunteers from the SACNAS chapter, to the university staff, the teachers and staff at participating schools, the PI's that learn how to better explain their science, and all the members and invited scientists that design and test the experiments. It's strength in community. We are also extremely grateful to the institutions that allow this to happen, these are manifold, and in the specific case of my laboratory, support from NSF is crucial."

Serving as the supervisor for Cena y Ciencias since August 2019 is Lina Florez, a senior in astronomy and physics, who is also part of the BESO (Bilingual Engineering and Science Outreach) program at CPLC. According to Florez, the CyC theme for the 2019–2020 school year was Salvar El Mundo (saving the planet). The idea behind the March 2nd lesson was to help the kids understand the difference between temperature and heat. It addressed the thermal properties of materials, flame resistant materials, and new ways to apply materials to protect people.

Starting the evening off with a bang was Felipe Menanteau, an NCSA research scientist and Astronomy Research Associate Professor. Menanteau's eye-catching demos addressed the difference between heat and temperature, and how different materials react to/behave with heat.

Usually, an adult leader presents CyC demos, with children seated a safe distance away and not necessarily interacting with or touching anything. I-MRSEC outreach coordinator Pamela Pena Martin claims the goal of the demos is to be "very showy" and to "WOW" the kids. Filling the bill on March 2 was a demo performed by Menanteau and

Two Illinois students, Damián Castañeda and Deirdre Stone, show young visitors two bottles of liquid, hand sanitizer and water, in preparation for a hands-on activity with them during Cena y Ciencias.

Pena Martin: he wielded a blowtorch, aiming it at some heatproof, fire-resistant materials she held in front of her. This demo was demonstrating heat-resistant properties in materials, such as those used to shield space shuttles to protect them on reentry into earth's atmosphere, for instance.

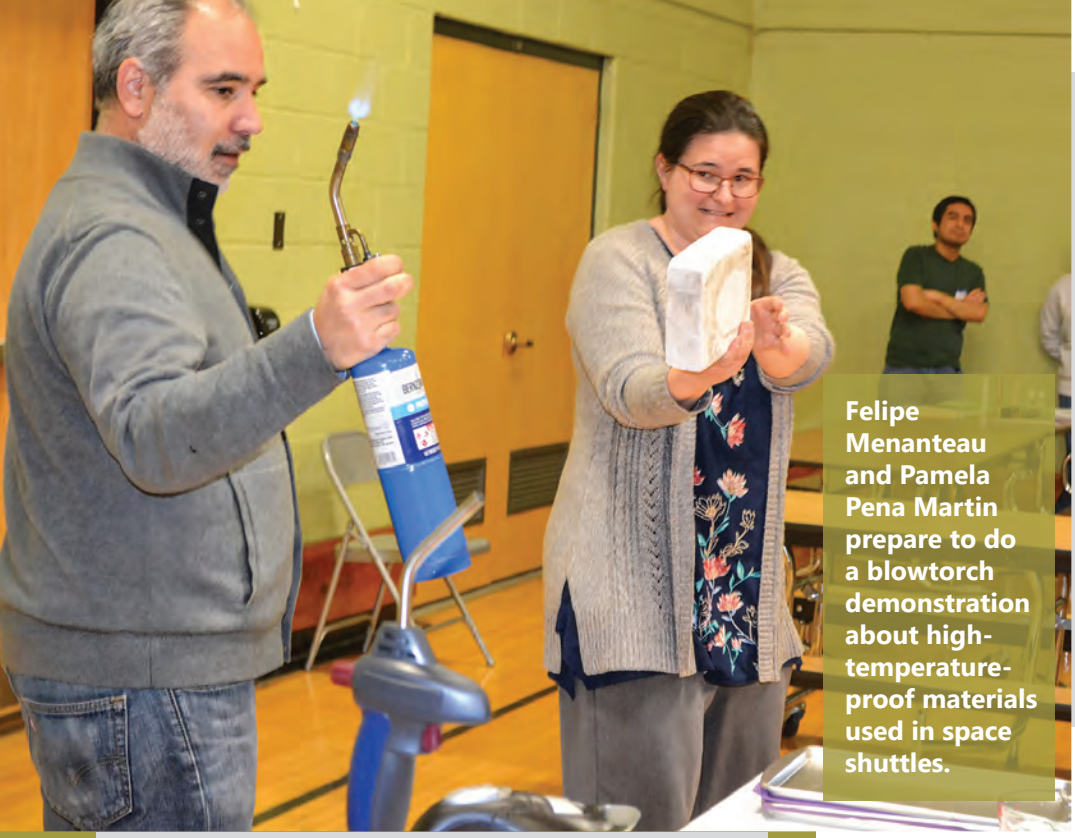
Next, youngsters participated in several hands-on activities addressing the theme of the night. These were geared toward different age groups: younger kids (K–2nd graders, 5–8 year olds), older kids (grades 3–5, ages 8–11), or the whole K–5 range. In the first hands-on activity, the kids used different tools (their hands/senses, an aquarium thermometer, and a digital thermometer) to measure the temperature of three different rods, made of copper, plastic, and wood. The second activity involved kids rubbing some liquid from two different bottles on their hands: one bottle contained hand sanitizer, the second, water. After having a little liquid placed in their hands, they were to either blow on them or wave them around. Blowing on their hands after applying the hand sanitizer was supposed to make them seem colder than after using the water. But in reality, both liquids were at room temperature. Regarding the phenomenon, Florez says:

"So the kids were touching things, and they were feeling maybe one thing is hotter, or cooler. But we were trying to show them that overall, the temperature was the same. Our bodies can be deceiving, and so that's why scientists develop instruments to specifically test everything, just so that we know that we're a little faulty or misguided in how we perceive things. That's why we develop tools to help us in the bigger picture."

Florez, who believes the kids were receptive to the lessons, admits that it's sometimes hard to get their attention, but adds:

Lina Florez shows children a digital thermometer reading during a Cena y Ciencias activity.

Children at the March 2nd Cena y Ciencias watch Felipe Menanteau perform a demonstration about heat and temperature.



Felipe Menanteau and Pamela Pena Martin prepare to do a blowtorch demonstration about high-temperature-proof materials used in space shuttles.

"When they sit down, they're very receptive. They definitely want to play, and they definitely want to learn. It's a great environment."

Florez likes participating in outreach events like CyC because of the impact similar events had on her as a child.

"I personally benefited from outreach, so I definitely want to help and make sure everybody has access to science and learning, and having the opportunities to explore what is out there: that's what I do. I've benefited so I want to give back."

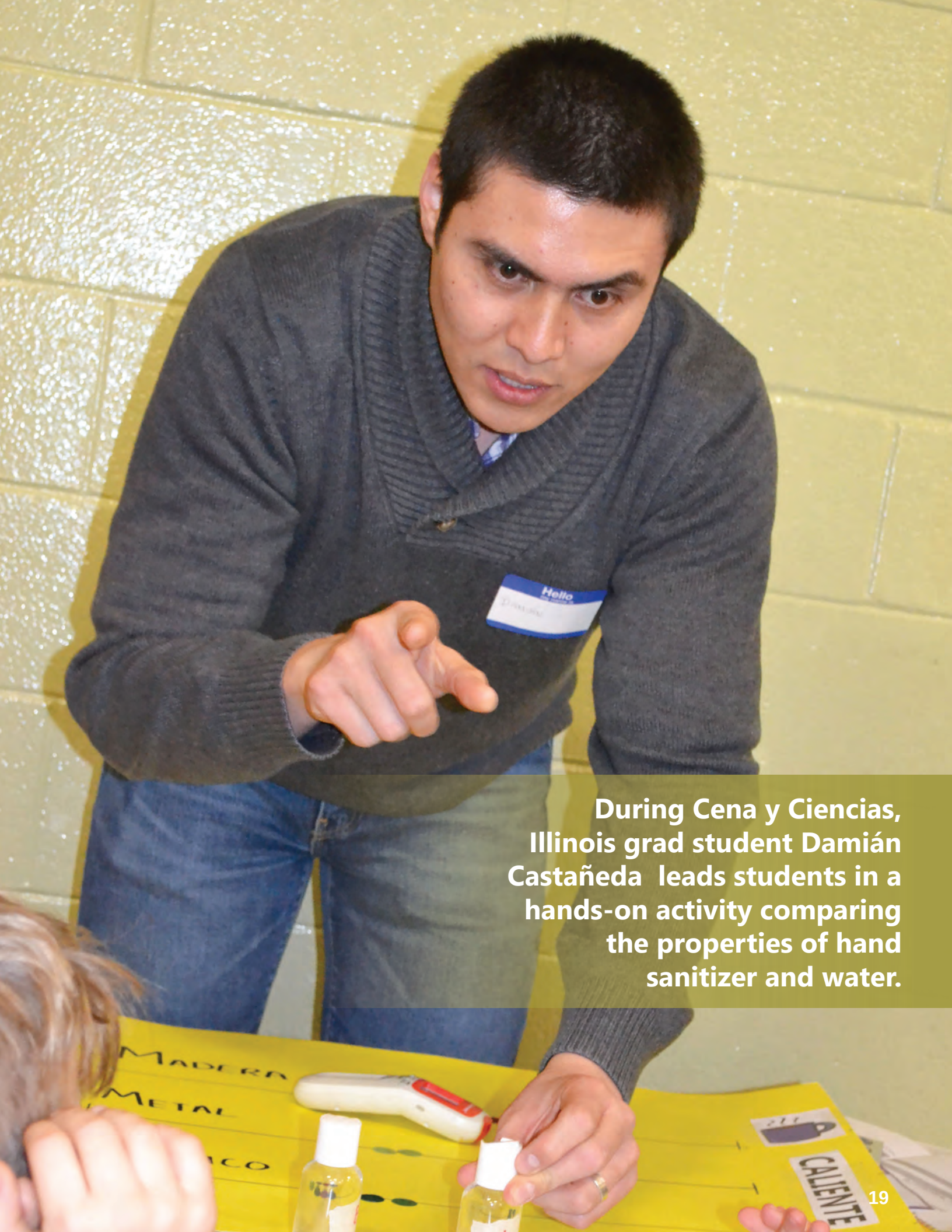
CyC planners also seek to provide something purchased or that kids can make during the lesson to take home to continue learning about the night's topic. Addressing this idea of something youngsters can repeat at home was third-year Physics PhD student and CPLC BESO student Luis Miguel de Jesus Astacio.

"Usually we try to design the activity in a way that it can be easily transported to their house, so if they are still curious after Cena y Ciencias, they can just go through their house, play with stuff they find around their house, and they can just keep on learning. We try to use materials that can be found anywhere. It doesn't have to be here or in a lab to be able to do these kind of things."

Another theme taught earlier in the semester included: "Today's Technology for Tomorrow's Humankind." The February 3rd activities were designed to give kids an appreciation of size scale, from atoms to galaxies, vacuum science, and materials for space travel, such as high pressure, temperature, etc. Later in the spring, CyC will address "Clean energy for all and everything" (May's theme), which will deal with renewable energy, solar energy, batteries, etc.

However, while monthly lessons are related to science those who suggest the various topics are studying, carefully prepared according current pedagogy, and designed to engage various age groups, Menanteau says there's an over-arching

Two youngsters listen while a lesson about heat and temperature is presented.



During Cena y Ciencias, Illinois grad student Damián Castañeda leads students in a hands-on activity comparing the properties of hand sanitizer and water.

Children at the March 2nd Cena y Ciencias watch Felipe Menanteau perform a demonstration about heat and temperature.

goal that's even more important than communicating science content. "The principle of these sessions is not to create scientific literacy with the Latino kids," but to "inspire potential scientists." He explains that CyC's main goal is Latino PhD, Master's, even undergrad student volunteers serving as role models for Hispanic youngsters. Menanteau says CyC addresses a much-needed niche in the community.

"I think this program has the biggest depth that the University of Illinois has with the community. We are one of the best universities in the world," he continues, "and we interact very little with our communities, which suffer from poverty, immigrants, and the disadvantaged. Some of them rarely see themselves as potential scientists."

So one goal of doing sessions in Spanish, according to Menanteau, is to inspire youngsters, many from Guatemala, Panama, or from Mexico, "who would otherwise never assume that they could be scientists. We don't expect them to become scientists, but we want to give them the opportunity and role models, so that they can potentially see themselves, not just as landscapers or bus drivers. They can see themselves in the faces and skin tones of grad students or scientists who speak the same languages."

Agreeing with Menanteau about CYC's providing Hispanic role models is Luis De Jesus. "I think it's very important for the kids to get involved with science beyond classrooms. And specifically, in my case, I think it's really important for the kids to see other Hispanics in scientific roles, so that they can predict themselves in that context as well. I don't think every single kids has to be a scientist in the future, but I think it's very healthy for people to have a scientific intuition and just to be curious in general. I think activities like this one encourage both curiosity and help with scientific thinking."

Regarding the impact of the March 2nd activities, De Jesus reports, "I think it helped them see the concept they might have been studying in their classrooms in a more practical setting."

De Jesus, who got involved with CyC three years ago, has never met an outreach program he didn't like. He's involved in a number of others, such as CPLC's BESO program: "I think events like these are very important. Right now, we are doing our best to expand and have many more schools [that]

have similar programs. Last semester, we started a similar program at IPA (International Prep Academy). I think it's important just to keep going, and see that there's more to science than just learning and exams."

Like De Jesus, Joaquín Rodríguez López is also committed to outreach. "I decided to become a professor because I love to teach and help others pursue questions about the world and how to better it through science. CyC allows me to do that with children that are starting to marvel and ask questions about the world."

López also agrees with exposing young Hispanic children to the idea that there are scientists of color and that they, too, could become one.

" I think it's important to be a role model, and to let children know that it is great to explore all these questions growing in their minds, and that if you pursue these, you may discover something new. Then, they realize they are scientists – in fact, when I am on stage with them, I call them "the scientists" – and that age, or skin color, or language has nothing to do with becoming accomplished scientists."

He also believes another benefit of CyC is that students get to share the science they learned with parents and other family members.

"CyC is also about creating a supporting community around them, that helps them nurture their scientific interests," he explains. "They see happy and accomplished graduate student volunteers, and professors, and university staff enjoying scientific activities. Pizza dinner is the catalyst to get them all engaged, but the real reward is getting the families involved and building the notion that exploring scientific curiosity is a great life choice."

Felipe Menanteau teaches the youngsters at Cena y Ciencias about heat and temperature.

VIRTUAL CENA Y CIENCIAS PROVIDES HISPANIC/LATINX ROLE MODELS, ENCOURAGES HANDS-ON “KITCHEN SCIENCE”—ALL DONE IN SPANISH

Virtual Cena y Ciencias Provides Hispanic/Latinx Role Models, Encourages Hands-on “Kitchen Science”—All Done in Spanish

November 12, 2020

Why does holding your nose when taking medicine help it to not taste so bad? What is surface tension on liquids? What do scientists do in labs? What are crystals and how do they form?

Noted above are just some of the questions the Virtual Cena y Ciencias (CyC) hopes to answer during its Spanish-language, science outreach events for local Hispanic/Latinx and dual-language-program school children. But, to adhere to COVID-19 social distancing mandates, CyC, scheduled for the first Monday of the month throughout the fall 2020 and spring 2021 semesters, is being held online until further notice. Despite the change of venue, the COVID-19-friendly events, like their no-social-distancing-required predecessors, feature lectures and/or demonstrations followed by hands-on science—with a caveat. The "kitchen science" activities featurescience that can be done with materials available in most homes. Plus, in addition to the exposure to science, the youngsters will experience it in Spanish, offered by Hispanic and Latinx scientists who serve as role models.

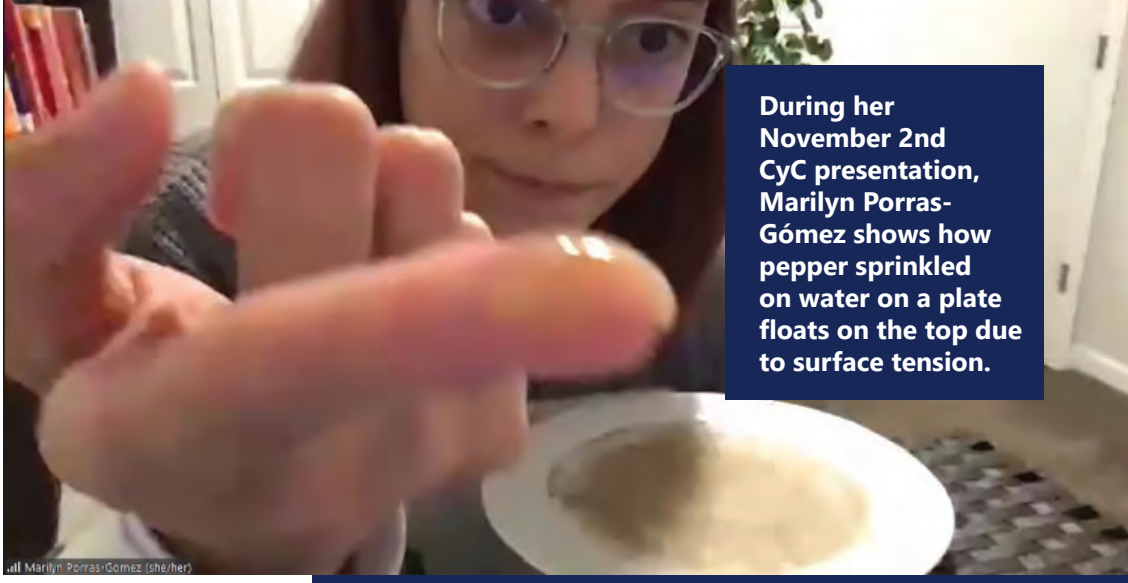
Participating in the program are students from Urbana’s Dual Language programs at Dr. Preston Williams Elementary and Leal Elementary schools, Also involved, mainly in the science and interview parts, are science students from Urbana Middle School.

Supporting CyC are a number of partners, including I-MRSEC (the Illinois Materials Research Science and Engineering Center); the state 4-H program; Urbana Unit 116 and Champaign Unit 4 School Districts, along with parents of children in these districts; the Illinois chapter of SACNAS (the Society of the Advancement of Chicanos/Hispanics and Native American Scientists); CPLC (the Center for the Physics of Living Cells); and Grainger College of Engineering. Furthermore, the National Science Foundation (NSF) is providing funding support through the NSF-funded I-MRSEC and CPLC Centers.

A slide Marilyn Porras-Gómez presented about surface tension during her Zoom talk.

A steering committee plans and administrates CyC. Regarding this group, the phrase, “It takes a village,” comes to mind.

“I think the model of how the group functions is really important here," claims I-MRSEC Outreach Coordinator Pamela Pena Martin. "Because we have people from the school district, parents, 4H, people from University programs, campus student organizations, etc. working together, this allows us to do several things. School district representation and parents help us to stay in tune to any special considerations and needs of the families we wish to reach. Scientists from campus bring the connection to cutting-edge scientific research. Many identify as Latinx/ Hispanic, providing role models for attendees that broaden their perspective of who is a scientist.”



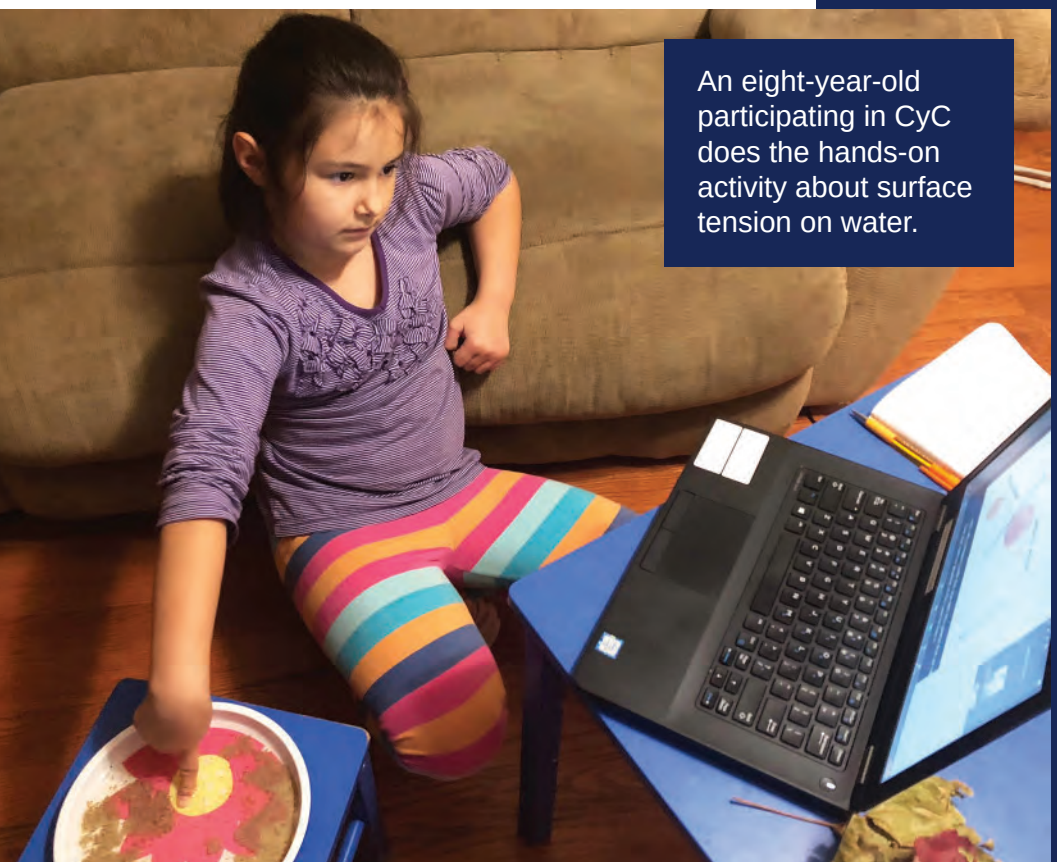
During her November 2nd CyC presentation, Marilyn Porras-Gómez shows how pepper sprinkled on water on a plate floats on the top due to surface tension.

As an example of the group's role, in preparation for leading the November lesson, Marilyn Porras-Gómez, after coming up with possible activities, presented them to the steering committee, so the group could contribute ideas and suggestions for adapting them to the CyC audience.

The 2020 CyC program covers a range of topics that all have some connection to COVID-19 and the related science, with all activities falling under the umbrella of "kitchen science" such that they are easily done at home with common household items. For instance, in October, the lesson focused on one of our five senses: taste. Led by Professor Yanina Pepino, whose research lab looks at individual differences in human taste perception and preferences, and who is a member of an international team studying the impacts of COVID on taste and smell, her lesson's activities illustrated the importance of smell on how we sense taste.

Presenting activities at the November 2nd CyC was Marilyn Porras-Gómez, a third-year Ph.D. student in the Department of Materials Science and Engineering. Somewhat related to her research, the hands-on activity she led was about surface tension **"and how soap and our lungs have something in common: they both are capable of reducing the surface tension of liquids,"** she explains, adding that she'd planned "a very cool and simple experiment at home to demonstrate how soap does this."

In addition, Porras-Gómez presented a short 1–2-minute video she'd made called, "Un Día en el Lab" (A Day in the Lab). Entirely in Spanish, the video exposed youngsters to things she might do in her lab on a given day. Geared toward kids, her video included some fast-forwards while she was suiting up in her lab gear and removing it. Plus, a cartoon-esque animated video segment of her in the lab introduced the kids to several procedures she does on a regular basis.



An eight-year-old participating in CyC does the hands-on activity about surface tension on water.

Part of I-MRSEC, Porras-Gómez works in Professor Cecilia Leal's lab, where her research focuses on understanding fundamental properties of lipid membranes (the material cell membranes are mainly made of), in particular, healthy and diseased lung membranes.

Particularly excited about serving as a role model to Hispanic and Latinx youngsters as part of the Cena y Ciencias outreach, Porras-Gómez admits: "Ever since I heard about CyC, I resonated with the cause; therefore, as soon as I became part of the I-MRSEC at the beginning of this year, I let Pam know that I wanted to contribute." The native Spanish speaker from Costa Rica found the experience quite rewarding.

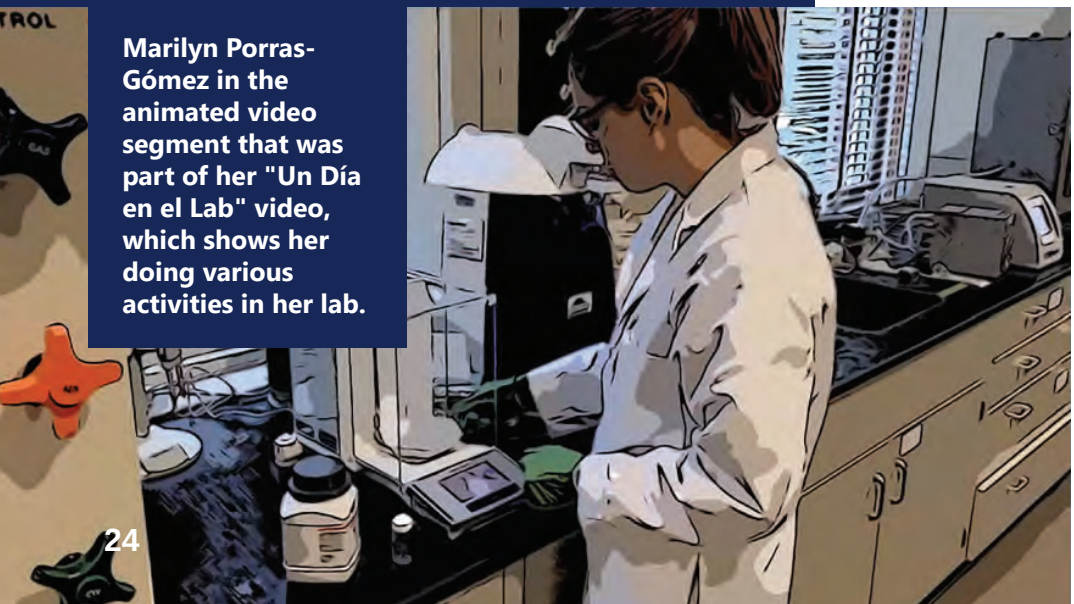
“I am very passionate about Science and Outreach,” she continues. “I believe that encouragement, representation, and role models are essential tools to bridge the gap of untapped minorities in STEM, and that is what CyC does—making science accessible to Hispanic and Latinx children in the community.”

As the title suggests, the December lesson, Cristales Escondidos en tu Cocina (Hidden Crystals in your Kitchen), which will be led by Gonzalo Campillo-Alvarado, will seek to unveil many of the crystals that we use in our kitchen (sugar and salt, perhaps?). Plus, he intends to discuss how crystals grow and their applications in our world, including their important role in the fight against COVID-19. Two activities he has planned are to "show the properties of chocolate (some of them faster than others) and how we can freeze molecules and create seeds for ice cream formation." Campillo-Alvarado is an I-MRSEC postdoctoral researcher in Professor Ying Diao’s research group in Chemical and Biomolecular Engineering.

Integral to the success of CyC is a lengthy list of committed folks who regularly attend weekly planning meetings or contribute toward the mission of the group in other ways. These include: Ricardo Diaz: 4H, parent; Joaquín Rodríguez López: University; Rachel Whitaker: University; Sharlene Denos: University, parent, Champaign International Prep Academy PTA; Luisana Hernandez: Urbana School District, parent; Amy Leman: University, evaluation and assessments; Andrea Marroquin: Urbana School District; Luis de Jesus Astacio: University, SACNAS; Mitzy Castillo Maldonado: Urbana School District; Pam Pena Martin: University, parent; Felipe Menanteau: University, parent; Roxana Cejeda: University, 4H; Marilyn Porras-Gómez: University; Gonzalo Campillo Alvarado: University; William Hernandez: University, SACNAS; Vanessa Blas: University, SACNAS; Victor Cervantes: University, Grainger College of Engineering.

Post doc researcher Gonzalo Campillo-Alvarado with a hands-on activity from Cristales Escondidos en tu Cocina (Hidden Crystals in your Kitchen).

So why did all of these folks get involved with CyC? What do they personally find rewarding about it? What kind of impact do they believe CyC is having on youngsters? Several of the folks above share what CyC means to them personally and how they believe it’s impacting the kids/families who are participating.



Marilyn Porras-Gómez in the animated video segment that was part of her "Un Día en el Lab" video, which shows her doing various activities in her lab.

For example, Illinois grad student Luis M. de Jesus Astacio, who has lived in Puerto Rico most of his life, reports: **“I wasn’t aware of the unproportionally low presence of Latinxs and Hispanics in STEM until I moved to Illinois for graduate school. Back home, my commitment towards inclusivity in academia sometimes involved participating in initiatives similar to CyC.”**

So, once he arrived in Urbana, he joined CyC, explaining that **“It seemed to me as one of the most direct and impactful ways to help alleviate the socio-economic disparity in STEM across the USA.”**

In terms of the impact CyC is having on the youngsters, Luisana Hernandez, an Urbana School District parent, states: **“Cena y Ciencias has a great impact on students! As a parent, I enjoy listening to my kids talk about the activities as they apply them in different scenarios. In October, we had a lesson on taste, and since then, my children continue to test the experiment, especially with medicine!”**

Mitzy Castillo Maldonado of the Urbana School District recalls that when she was in elementary school, she was invited to participate in an after-school science program run by Illinois students.

> **“It was such an amazing and unique experience that my fellow ESL students and I would not have had if not for the University,” she recollects. “I believe this is the same for the current students that now participate in CyC, especially those who are recent arrivals and are still learning English.”**

Andrea Marroquin from the Urbana School District, who has served as a TA at Leal for the past several years, reports hearing conversations students were having about Cena y Ciencias. “They would be so excited to attend the event!” she exclaims, saying things like “‘I wonder what we will be doing tonight?’ and ‘The pizza is so good!’ She then goes on to cite several positive impacts of the program:

> **“Even just them being excited to be around their peers, and learning from the U of I students, and learning from experience, and seeing ‘young’ kids with this knowledgeable background on science—it showed them how attainable science really is.”**

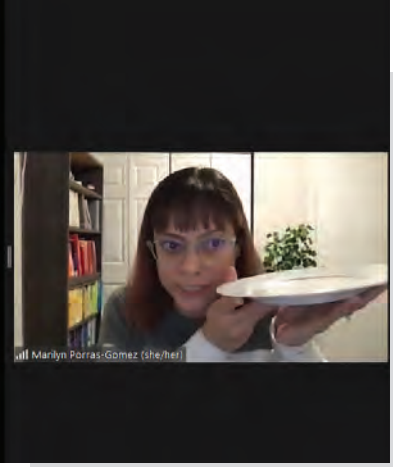
In addition, the fact that C&C is presented in Spanish, largely by folks of Hispanic and Latinx origin, is quite important to those who are integrally involved.

Illinois grad student Luis M. de Jesus Astacio works with youngsters during a February 2020 Cena y Ciencias at Dr. Preston Williams School.

According to Ricardo Diaz from 4H, who is also a parent, “Parents, volunteers, and presenters serve as models in both language and career. Spanish thus becomes a viable language for career and communication.”

Grad student Luis M. de Jesus Astacio says that by presenting the science lessons and demons in Spanish:

> **“We are showing the kids that science is a field accessible to all members of society. Similarly, by hearing these lessons from other Hispanics, we are setting an example for them.” About whether he considers CyC’s main goal to be teaching the kids science or showing them that they too can be scientists, de Jesus Astacio adds, “As scientists, we think that scientific literacy is important and necessary. However, at the end of the day, what we are after is for the kids to allow themselves to dream and to pursue such dreams. This is especially important when societal pressures tend to tell otherwise.”**



Vis-à-vis CyC's Spanish language component, Luisana Hernandez reports asking her children, "Who can be a scientist?" and being taken aback when they replied, "Anyone!"

"Their answer surprised me," she admits, "but I know that it wouldn't have been the same answer if they didn't participate in CyC. We live in a community with many learning opportunities, but rarely are any in Spanish. The opportunity of my kids participating in CyC in Spanish gives them a chance to identify themselves with the language, students, and scientists."

Citing a further benefit of CyC, another participant says, "Building community connections with the University of Illinois has ongoing impact even beyond the specific goals of CyC."

In hopes that others doing outreach in our social-distancing new normal might find it useful, Pamela Pena Martin shares a bit about how CyC adapted to the virtual world after knowing in the summer that it wouldn't be possible to run CyC in its typical format.

"We have been able to maintain much of what makes the CyC program special, and more importantly, effective," she acknowledges. "We still encourage the whole family to participate in the lesson. We still present great science, with content led by scientists at the leading edge of their respective fields, many who also serve as role models through shared identities with kids attending. Kids are still being introduced to these science concepts and activities entirely in Spanish. The aim is still for activities to be fun—that students would enjoy it and 'learn by doing.' With the first lesson, we could already see how engaged many kids were by the great questions they asked during the session."

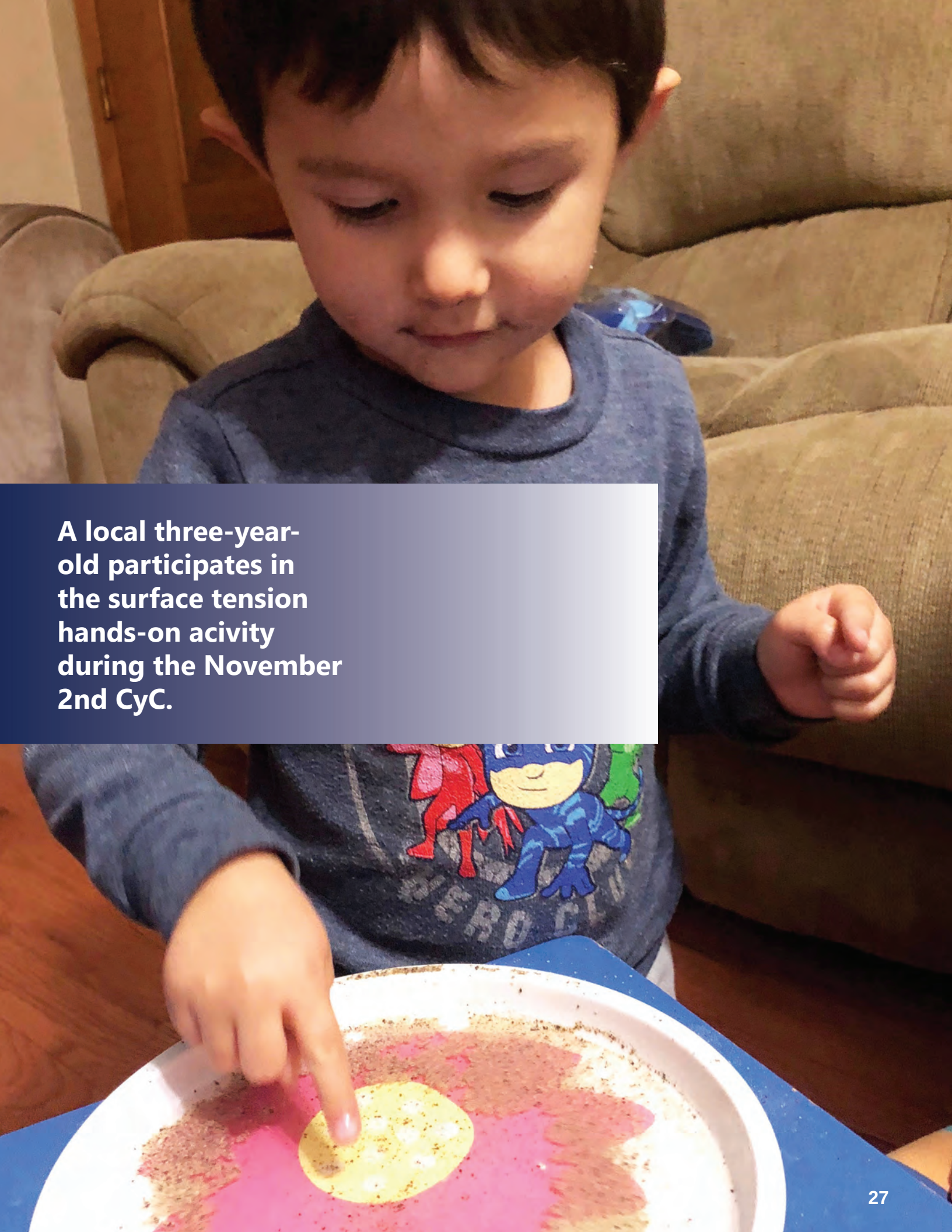
Despite the glowing assessment, Pena Martin admits that they a have faced a few difficulties related to the virtual format. For one, while they have funds to purchase materials for activities, safely distributing those has proved challenging. Thus, for hands-on activities, they rely on common household items, the key word being "common" and easily accessible for everyone. She acknowledges that having school district representatives who know the families really helps.

To describe another challenge they have encountered, Pena Martin coins a new COVID-19-related phrase—"Zoom fatigue!"

"Kids are doing much of their learning via screens as it is," she admits, "so we keep lessons to less than an hour, a bit shorter than the normal in-person lesson."

Another really important challenge they haven't figured out how to address? They haven't yet found a way to provide the "Cena" (normally pizza) part of Cena y Ciencias (Spanish for Supper and Science.)

Finally, Pena Martin reports that they had to adapt between the first and second lesson, adjusting content to make more time for questions. "Participation was higher than anticipated—a good thing!" she explains. Plus, they added English subtitles "which PowerPoint can do reasonably well from spoken Spanish," she claims, in order to help Spanish-learners follow in a space where audio interruptions can leave them struggling more than in the in-person program.

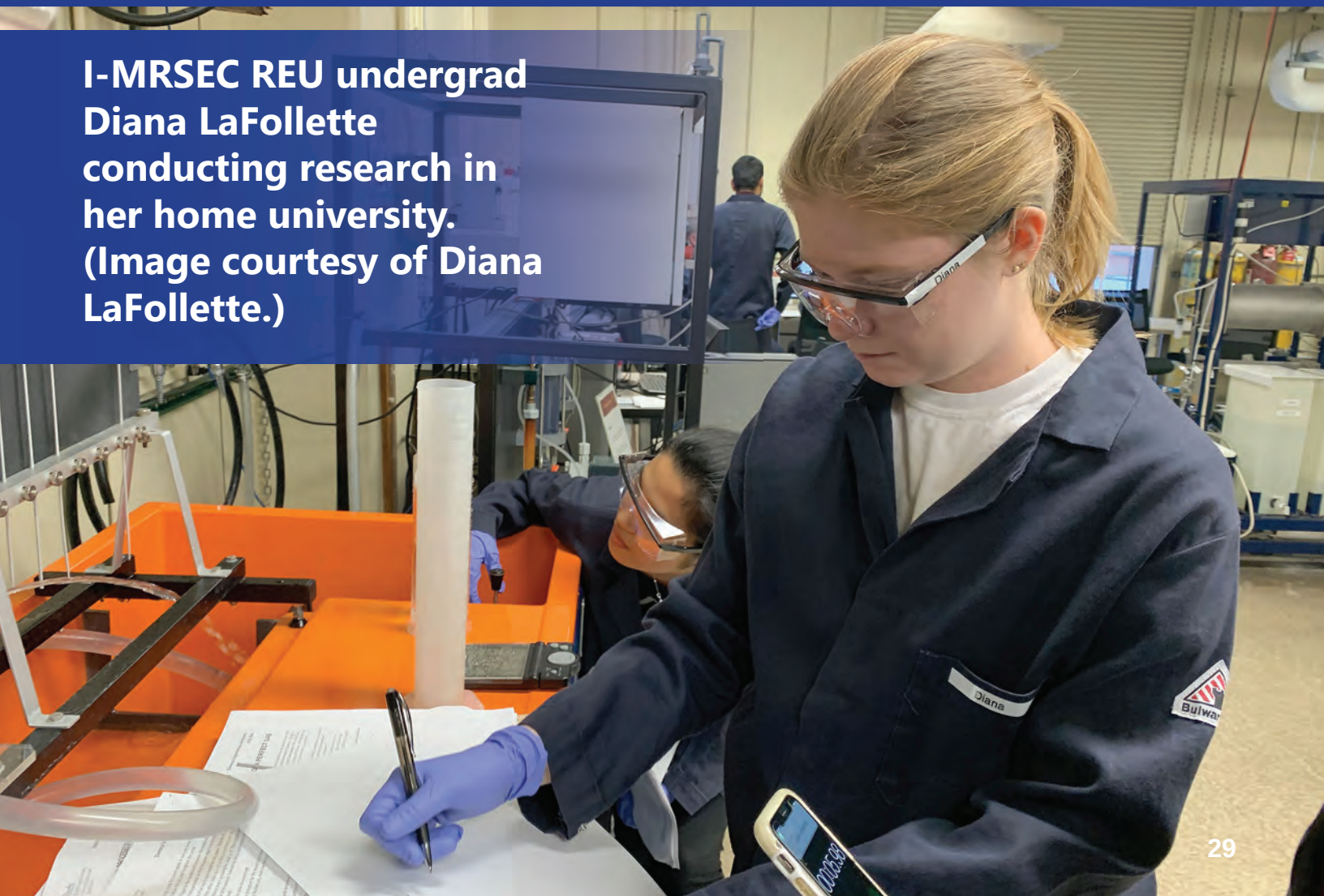


A local three-year-old participates in the surface tension hands-on acivity during the November 2nd CyC.

Tarik Simpson learns how to use a scientific instrument while doing a research project at his home institution. (Image courtesy of Tarik Simpson.)

I-MRSEC undergrad Austin Redington, a Chemical Engineering senior at the University of Minnesota. (Image courtesy of Austin Redington.)

STEM RESEARCH EXPERIENCES AND OPPORTUNITIES

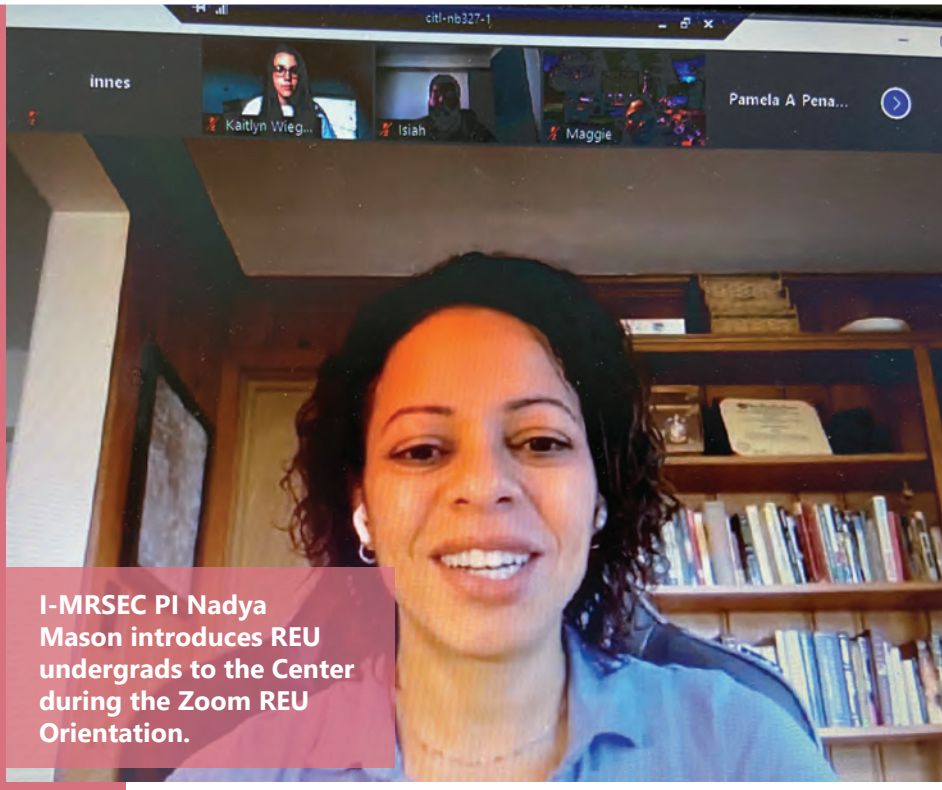


I-MRSEC REU undergrad Diana LaFollette conducting research in her home university. (Image courtesy of Diana LaFollette.)

I-MRSEC'S VIRTUAL REU TO EXPOSE UNDERGRADS TO RESEARCH, PROVIDE TRAINING IN NEEDED SKILLS

May 29, 2020

Eleven undergraduate students participated in the I-MRSEC (Illinois Materials Research Science and Engineering Center) virtual REU this summer from May 27th through July 31st, 2020. Due to the COVID-19 pandemic, the REU wasn't business as usual (in-person interactions with researchers while conducting research in one of Illinois' state-of-the-art labs). However, the students participating still carried out research and gained valuable experiences while earning a stipend, just like the in-person program. For example, they still had face-to-face interactions with researchers (via Zoom?) while conducting research; they still collected and analyzed their data and presented their results. And just like last year's program, they still did networking, plus gained other useful information and skills related to research and preparing for a career in STEM… all done virtually!



I-MRSEC PI Nadya Mason introduces REU undergrads to the Center during the Zoom REU Orientation.

When offered the chance to either defer until next summer or participate this summer, most undergrads who had signed up for the summer 2020 REU wanted to go ahead and participate virtually.

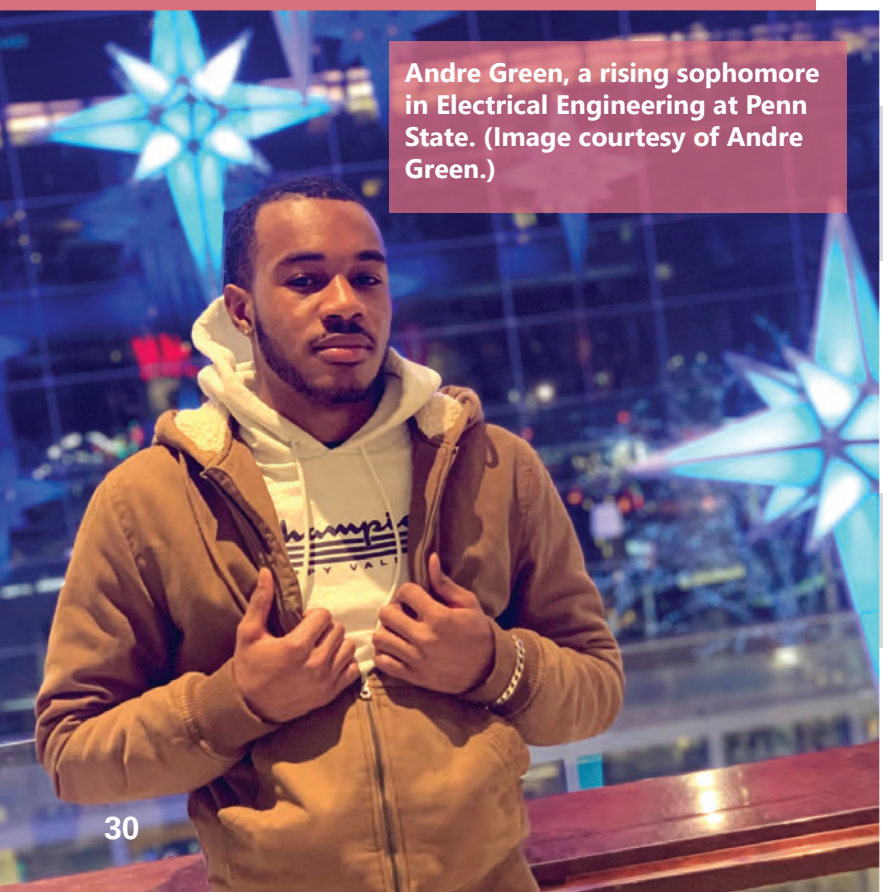
According to Pamela Pena Martin, I-MRSEC's Outreach Coordinator, a number of their students were going into their senior year,

> **"so this research experience, even if it's not quite the same as in person, it's still really valuable to them."**

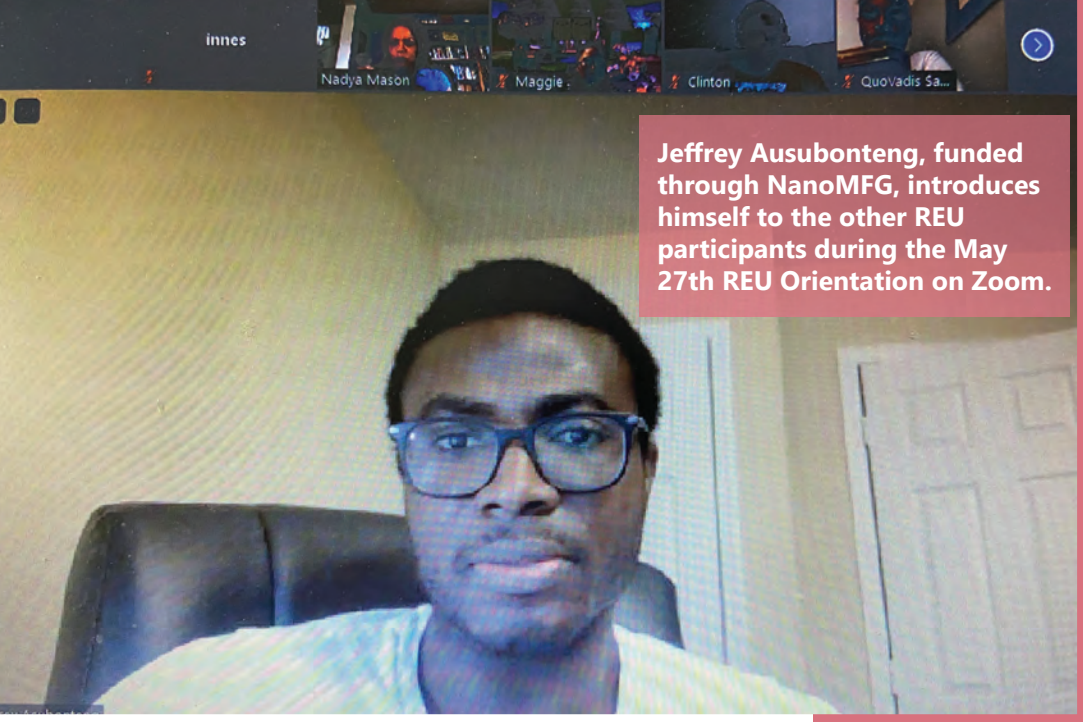
She reports that those who are planning to enter graduate programs would need to not only have the experience of participating, but be able to add it to their resume, build their network, plus learn skills that they would need in the future.

> **"We realized, if we could manage to do it, it'd be probably very worthwhile to those students," she reports.**

There were eleven students in the program. Seven were funded directly through I-MRSEC; plus, the REU also partnered with other groups/



Andre Green, a rising sophomore in Electrical Engineering at Penn State. (Image courtesy of Andre Green.)



Jeffrey Ausubonteng, funded through NanoMFG, introduces himself to the other REU participants during the May 27th REU Orientation on Zoom.

professors on campus. In these cases, the others provided funding for their undergrads, but found them through I-MRSEC's applicant pool and also took advantage of I-MRSEC's programming. For example, Materials Science and Engineering Professor John Abelson, who's not involved with the Center but does NSF-funded materials research, received an REU supplement to fund a student. Also, two students were being funded through another NSF center, the Nanomanufacturing Node (NanoMFG) at NCSA, directed by I-MRSEC professor Elif Ertekin. The eleventh undergrad was funded through a research grant of Ertekin's.

The REU undergrads carried out research related to that done by their different mentors. However, although in last year's REU, students used analysis equipment housed in the Materials Research Lab (MRL, home of I-MRSEC), because this year's students didn't work on-site in campus labs, they didn't have access to that equipment. So how were they able to conduct research? Most did computational projects. Although some I-MRSEC faculty do computational research normally (in other words, all of their research is computer based), Pena Martin claims, "It still is a challenge to mentor somebody remotely on those types of projects; it's still different when you're mentoring someone remotely." Plus, in addition to computational projects, many faculty who do experimental projects also have side projects that must be done on the computer, like data analysis, data mining, doing literature searches to get a better idea of the status of different materials, getting different materials' parameters and gathering that information. These are the types of projects this year's students did.

As part of their summer research experience, students also learned what research is like. They were expected to answer research questions, learn new research tools, obtain and analyze data, then interpret and share their results. Plus, this summer, in lieu of giving a live talk before an audience of peers, mentors, and other interested persons, students gave virtual presentations both midway through the program and a final presentation at the end of the summer; they also wrote a final paper.

In addition to the research itself, the REU provided quite a bit of training and other professional development. For example, because so many of the projects were computational, the REU partnered with NCSA to provide a Python workshop to give students the

Angela Pak, a rising senior majoring in biomedical engineering. (Image courtesy of Angela Pak.)

Kaitlyn Wiegand. (Image courtesy of Kaitlyn Wiegand.

opportunity to learn that computer language. Not only undergrads participated in the workshop; it was being opened up to current graduate students, as a lot of them were working remotely and might have been doing more computational projects as well, but might not have had training in this area.

Plus, every other week, the REU held meetings related to I-MRSEC's two main research areas. Students attended one of two IRG meetings—whichever the research they are conducting most closely aligned with. For instance, some meetings were related to IRG1: Metallic Antiferromagnetic Materials: Utrafast Charge, Lattice, and Magnetization Dynamics, or the Center's IRG2 area: Active interfaces between highly deformable nanomaterials.

Another training opportunity the REU provided undergrads was a Professional Development Series whose seminars highlighted critical skills needed by a scientist or engineer. Some PD sessions focused on research and communication skills, addressing data management, research ethics, scientific writing, and how to give effective scientific and/or poster presentations. Other sessions tackled professional and job skills, including sexual harassment, how to apply for a job or to grad school, how to write an effective resume or CV, and combatting the imposter syndrome.

Pena Martin indicates that they also strove to foster extra networking and mentoring. Characterizing REU participants as "emerging scientists," she claims that because they'd been trained in science and sought out a research experience,

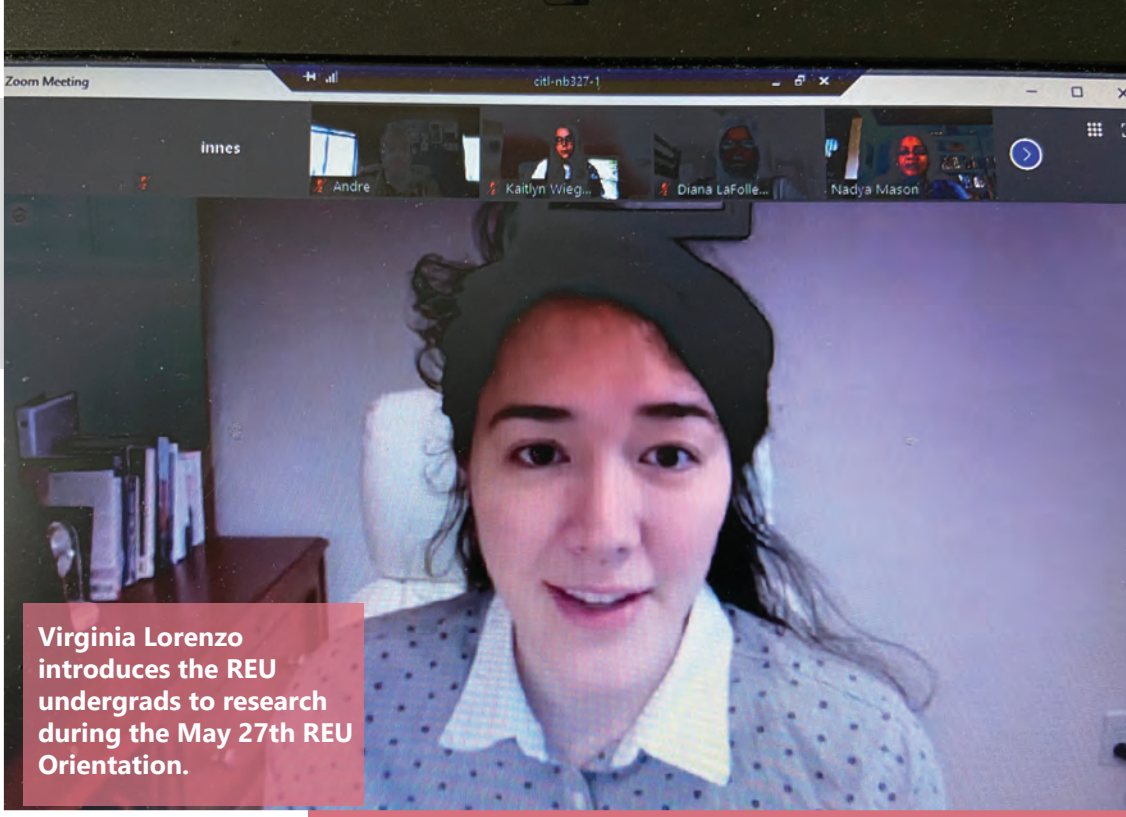
> **"It's very possible that some of them will want to stay in research, and they will be our colleagues. And so I think it's important to give them a chance to network with each other and also others on campus. So we'll be doing a little bit of extra effort to have some additional mentoring from other faculty as well, just to create some opportunities to meet and get to learn about other scientists' paths and get some advice from them."**

To provide this additional component, the REU scheduled a faculty seminar series for the students. I-MRSEC faculty and other Illinois professors, including Daniel Schoemaker, SungWoo Nam, Axel Hoffmann, Cathy Murphy, John Abelson, Elif Ertekin, Andre Schleife, Fahad Mahmood, and Nenad Miljkovic, shared about their research and how they ended up choosing their fields.

Pena Martin acknowledges that one of the challenges they faced in doing a virtual program was addressing the social/relationship-building aspect. Normally, REU students would have been living with or near each other, going out for lunch together, even sharing offices. "So this time," she admits, "we had to be a little bit more intentional creating spaces for them to get to know each other, because we think that's a really important part of the program."

For instance, prior to the REU, Pena Martin held a get-acquainted Zoom meeting with the students, reporting, "It was really cool to see their faces and get to chat with them." She says they used an icebreaker, talking about their favorite foods,

“trying to create some opportunities for us to get to know each other virtually, which is a little different than being in person.”



Virginia Lorenzo introduces the REU undergrads to research during the May 27th REU Orientation.

Also off this year’s agenda was everybody’s favorite—the ice cream social—done the second week of the program last summer. “So this year, of course, we couldn't do that,” Pena Martin lamented. Instead, they planned a virtual web social in June, which included some fun icebreaker activities.

One final component of the program was an educational outreach activity. Last year's activity was a table about science at the Urbana Farmer's Market. Since that won't be possible this year, the team did some brainstorming about what might be possible virtually.

On May 27, the first day of the program, program coordinators held an Orientation session via Zoom. During the session, participants met some key players. I-MRSEC PI Nadya Mason shared an overview of I-MRSEC, introduced I-MRSEC faculty, and explained about the center's IRGs (research areas) and educational programs. Professor Virginia Lorenzo, I-MRSEC's Associate Director of Education, introduced the undergrads to what research is; finally, Pamela Pena Martin, I-MRSEC's Outreach Coordinator, shared about the specifics and expectations of the program. During the session, the undergrads also introduced themselves.

Since mentorship is a key program component, during a segment about mentoring, undergrads shared about previous experiences with mentors, then Pena Martin closed the session by explaining that, as their experiences illustrated, there are different mentoring styles. She urged them to indicate what would be more helpful should their mentor's particular style not be meeting their needs.

Following are introductions to a number of this year’s undergrads, the researchers they are working with, and what they hope to accomplish through the REU. For instance, Angela Pak, a rising senior majoring in biomedical engineering at the University of Texas at Austin, was assigned to Dr. Rashid Bashir's group, and was working on biomarker detection on transistor-based biosensors.

Pak indicates that before this REU, she had only done maybe 10–15 hours of research a week, in addition to schoolwork.

“I applied to this REU to understand what it was like to do research full-time,” she says. “I wanted to try and prepare myself a little better for the graduate school experience.”

Pak reports that after graduation, she hopes to go to graduate school to pursue a PhD in BME.

“My dream job would be anything that allows me to continue doing research/development in engineering with a humanitarian focus!” declares Pak.

Also funded through I-MRSEC was Kaitlyn Wiegand, a rising senior in Chemistry at Southern Illinois University (Carbondale), who indicates that she signed up for this REU in order to explore her interest in materials research as a possible course of study/research in graduate school.

“I hoped to gain experience in the process of conducting research,

Tarik Simpson presents a poster about his research during the BMES (Biomedical Engineering Society annual meeting in Philadelphia in 2019. (Image courtesy of Tarik Simpson.)

including working collaboratively with others, collecting and analyzing data, and presenting scientific findings," she explains.

Funded by I-MRSEC, she was in Professor Nadya Mason's research group, mentored by Mason and Narendra Jaggi while doing micro magnetics simulations.

Her goal after graduation is to attend graduate school in chemistry or chemical engineering. Regarding her dream job, she doesn't have one,

"but rather a dream to help others with whatever my job ends up being," she says.

Another REU participant was Isiah Ramos, a rising junior from Parkland Community College, who's transferring to Illinois in fall 2020 in Agricultural and Biological Engineering (ABE) with a focus on nanotechnology. Ramos worked with I-MRSEC Prof. Narayana Aluru, whose research in IRG2 involves active interfaces between highly deformable nanomaterials.

Ramos shares why he applied to I-MRSEC's REU:

"I'm considering pursuing my PhD at U of I, so I wanted to start scouting for prospective mentors as well as learn what kind of research is being done in my area of interest."

Ramos hopes to run his own lab someday.

Tarik Simpson, a rising senior in biomedical engineering at Alabama State University, worked with Professor Sungwoo Nam this summer on image analysis and processing wrinkle structures. Funded through I-MRSEC, Simpson worked closely with grad student mentor Jin Myung Kim.

While he calls the research he conducted at his school last summer 'very nice," Simpson says he applied for I-MRSEC's REU in order to be challenged a bit more.

"This summer, I wanted to be pushed outside of my comfort zone, and I was advised to apply here because I was told that the University of Illinois Champaign-Urbana had one of the best materials programs," he explains.

His goal was to understand the research process better and broaden his horizons, gaining knowledge that would help him during this upcoming year.

After graduation, Simpson plans to work until he gets accepted into a graduate program. His dream job? Doing biomedical research for the FBI, DOF, or at Yale, Princeton, or MIT.

Also funded through I-MRSEC was Austin Redington, a rising senior studying Chemical Engineering at the University of Minnesota. He worked with Professor Daniel Shoemaker doing data mining and computational work regarding known and unknown Antiferromagnetic materials (AFM).

Redington says he signed up for the REU in order to experience university research in order to prepare for graduate school. He adds that he's worked in a lab as an undergraduate, but that experience was limited to around 10 hours a week.

Redington's long-term goals are to attend grad school. His dream job? Become a college professor and teach either chemistry or chemical engineering.

Another participant was QuoVadis Renae' Savoy, a rising senior at Southern University A&M at Baton Rouge, Louisiana. An Electrical Engineering major minoring in mathematics, Savoy was funded through NanoMFG and mentored by Elif Ertekin on a research project called Gr-ResQ ("Graphene Rescue").

"The research will be related to training neural networks to analyze people's facemask-wearing habits from public images and analysis of testing methods," she explains, "— all related to the recent COVID pandemic."

Savoy shares why she signed up for the I-MRSEC REU: "Because I wanted to gain knowledge on research topics dealing with engineering analysis and to renew my passion for STEM field. I hope to improve in variety of skills while using new equipment, written and oral communication."

After graduation, Savoy hopes for a career that will allow her to "promote innovation in the design, research, and implementation of products and services. To utilize my knowledge and skills attained to convey that I am a complex problem solver."

Andre Green is a rising sophomore in Electrical Engineering at Pennsylvania State University. Funded by Dr. Elif Ertekin, he worked in an IRG-2 research area under Ertekin and graduate researcher Emil Annevelink. His task was to develop a Python script capable of autonomously determining whether the Nudged Elastic Band (NEB) method being observed is completed correctly. "I will first research those determinants to find the finish condition and then implement this condition into a Python function," he says.

One of the main reasons Green wanted to join the I-MRSEC REU was to gain the necessary research experience for his future. He believes receiving a solid foundation after his first year in college is crucial towards his development and STEM interests.

"When looking at this program, I knew I would gain exactly that through the research that was being conducted and the highly qualified mentors who would guide me along the way," reports Green. "I hope to gain a better understanding regarding what type of research I want to pursue in the future and become more comfortable conducting research independently."

After he receives his BS in Electrical Engineering degree, Green plans to attend grad school to work towards either an MS or PhD in Electrical Engineering. His dream job?

"To utilize the skills in my field to obtain occupation in which I can work towards the next big technological breakthrough," he admits.

Diana LaFollette is a rising senior at the University of Southern California, where she's majoring in chemical engineering with a focus on sustainable energy and a minor in environmental studies. After graduation, she plans to obtain a PhD, possibly in materials science engineering. Acknowledging, "I love both teaching and research!" she claims her dream job is to be a professor.

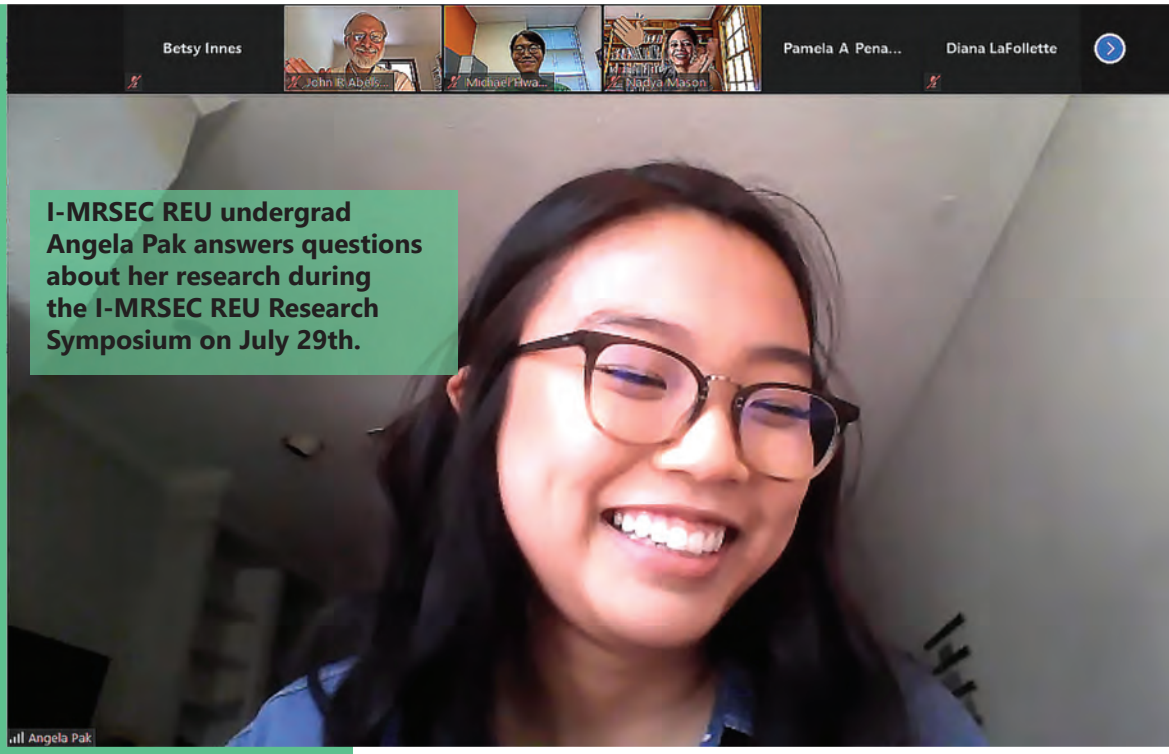
Diana LaFollette at work in a lab in her home institution. (Image courtesy of Diana LaFollette.)

LaFollette indicates that she applied to the I-MRSEC REU in order to "gain research experience, learn more about materials science, and to spend a summer working full-time in a lab to help narrow down my specific interests before applying to graduate school." She was working with Dr. John Abelson this summer, in the area of model simulations of thin film nucleation.

I-MRSEC'S VIRTUAL REU UNDERGRADS GAIN KNOWLEDGE, SKILLS, AND INSIGHTS INTO THEIR FUTURE CAREERS

August 7, 2020

Although the COVID-19 pandemic precluded I-MRSEC (the Illinois Materials Research Science and Engineering Center) from hosting the residential REU (Research Experience for Undergraduates) intended for summer 2020——undergraduate students physically conducting research in Illinois labs—the eleven undergrads from all across the U.S. who participated appeared to have benefitted immensely. What kind of impact did participating in the I-MRSEC REU's virtual counterpart have on the undergrads? In addition to conducting cutting-edge research in one of Illinois' labs—virtually—mentored by an I-MRSEC faculty member and/or a Ph.D or post-doc researcher, they presented their results at I-MRSEC's Undergraduate Symposium. Plus, students also gained other benefits from the REU: some became adept at using new software; others gained confidence; still others gained a clearer understanding of the direction they plan to go careerwise—including materials science research—all thanks to I-MRSEC's Virtual REU.



I-MRSEC REU undergrad Angela Pak answers questions about her research during the I-MRSEC REU Research Symposium on July 29th.

After collecting and analyzing data related to their individual projects, the participants got to experience presenting the results of their research during the two sessions of the I-MRSEC REU Research Symposium held on July 29th and 30th, giving students the chance to share what they'd learned, demonstrate new skills they'd acquired, and answer audience questions.These final presentations took place via Zoom, similar to the bulk of their interactions as part of the NSF-funded REU.

Regarding I-MRSEC leadership's decision to continue the previously planned residential REU virtually, PI Nadya Mason says they did it for the students.

"Despite our disappointment at having to cancel the in-person program," she admits, "we quickly realized that students now, more than ever, wanted and needed the REU experience."

She claims that holding the virutal REU was especially important for the rising seniors.

Via Zoom, I-MRSEC PI Nadya Mason interacts with undergrads presenting during the I-MRSEC REU Research Symposium on July 29th.

“The research experience and professional development would likely be crucial to their decisions about graduate school and professional choices next year,” she continues. “So, we decided to go ahead with the program, confident that we could rise to the challenge of putting together a strong virtual program for students.”

Jeffrey Ausbonteng.

Mason admits that they put a great deal of effort into trying to compensate for the lack of in-person, face-to-face interaction

“A lot of the in-person learning happens informally,” she admits, “through hallway conversations, watching over shoulders, etc. So we had to think of ways of re-creating that experience virtually—which in this case involved more personal and group virtual meetings.”

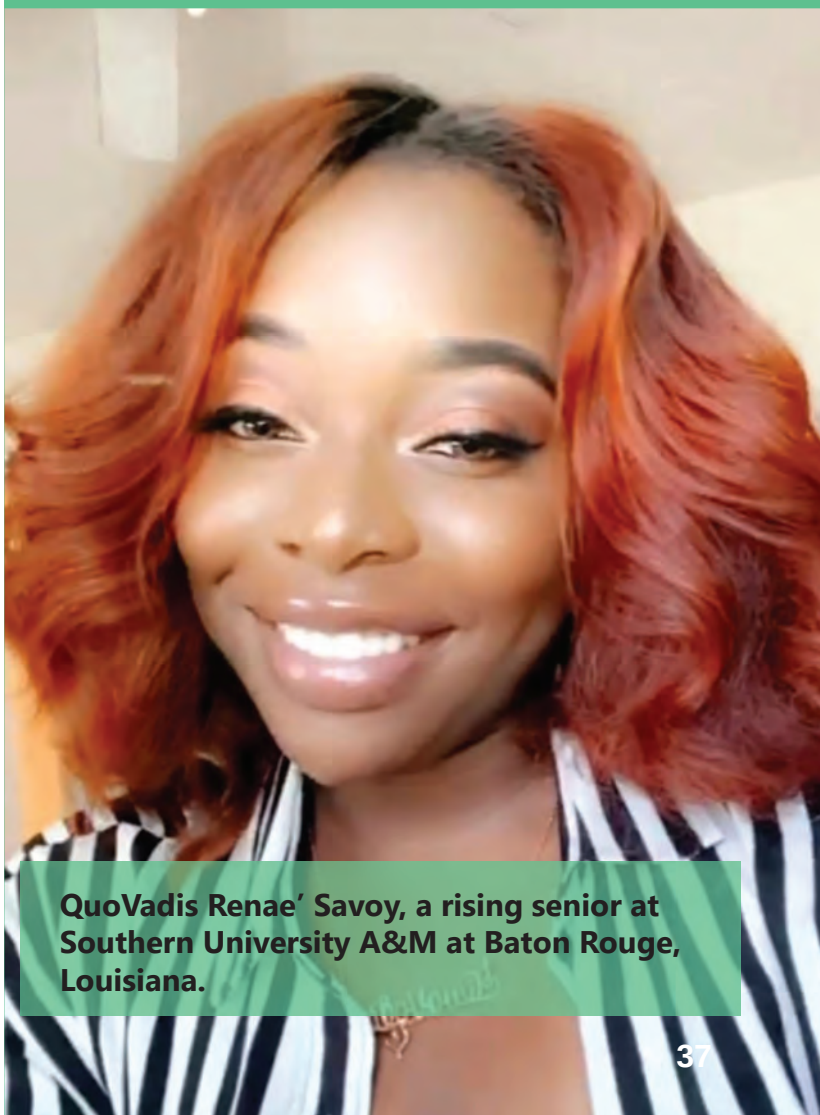
Indicating that she was sad that the REU students couldn’t experience I-MRSEC’s fun and collaborative research environment in person, she adds, “Though I hope they got at least a taste of that in their virtual experience.”

Mason, who mentored one of the REU participants, further explains that for her research group, the virtual requirement was particularly difficult.

“Finally, my group typically does experimental research, so we had to come up with an all-virtual project. I was fortunate to have a visiting professor working with me who figured out a great project related to our research.”

According to Mason, all of the REU students she spoke with said they had had a great experience and were extremely grateful that they could participate.

“I think the students got a real taste of research and of being in a research environment, even virtually, which will help train them and inform their choices about their future careers,” she explains, adding: “I also think they were happy to have some ‘normalcy’ during an otherwise abnormal summer.”



QuoVadis Renae’ Savoy, a rising senior at Southern University A&M at Baton Rouge, Louisiana.

Olivia Gordon.

Agreeing with Mason's appraisal of their experience, several of the undergrads discuss their research, their results, and some of the things they gained through the REU.

For instance, Jeffrey Ausbonteng will be a rising senior this fall at North Carolina Central University in Durham, NC, majoring in mathematics and biology. His research this past summer focused on using a neural network to generate a mathematical model with 99% validation accuracy in order to develop a face mask analytic tool.

According to Ausbonteng, the most challenging part of his research was

"getting used to GitHub, which is something new that I have learned. This program has improved my understanding of developing mathematical models using python and some other software."

Regarding this summer's impact on his career plans for the future, Ausbonteng acknowledges,

"This experience has cemented what I have planned to do in the future."

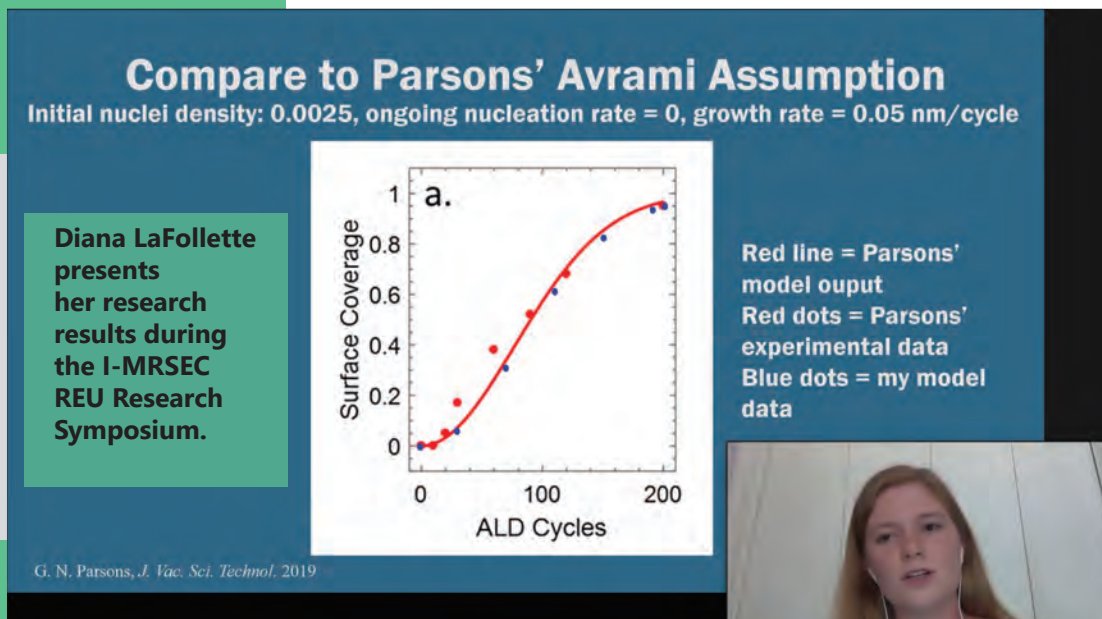
Olivia Gordon will be a rising junior this fall at Grand Valley State University in Allendale, Michigan. She is majoring in chemistry and minoring in environmental and sustainability studies. Gordon reports that her research this summer in Elif Ertekin's lab resulted in a nearly fully automated system written in Python to analyze Stone-wales-type bond rotation energy barriers in graphene.

Gordon reports that the most challenging thing for her was

"going from absolutely zero knowledge about coding and writing in Python, to being able to write fully functional scripts 100s of lines long. For me it was an impressive jump and something I didn't think was possible in 10 weeks. Certainly it was a challenging experience, with lots and lots of trial and error, but a rewarding one nonetheless."

Gordon indicates that one way she grew personally this summer was learning to collaborate with others and to appreciate the benefits of interdisciplinary collaboration.

"Prior to the summer," she reports, "I had never worked with other students



Diana LaFollette presents her research results during the I-MRSEC REU Research Symposium.

Isiah Ramos. (Image courtesy of Isiah Ramos.)

on a research project—never mind it being interdisciplinary. This taught me to be more collaborative and to keep an open mind about how someone else with a completely different background would approach the same problem. As a student, this experience impacted the ways in which I am able to analyze and approach a problem. It has opened my eyes to embracing more interdisciplinary collaborative work in the future."

Gordon indicates that the experience this summer has significantly influenced her future career plans and goals.

"I had never really given much thought to graduate school or doctorate programs," she admits, "but all the presentations and resources given to me through this program have really pushed me to realize I want more out of my education."

Admitting that she always knew she wanted to continue to do research, she adds,

"but I never realized that in order to accomplish that I should continue and go for my own PhD. I've proudly decided that is what I want to do thanks to the I-MRSEC this summer."

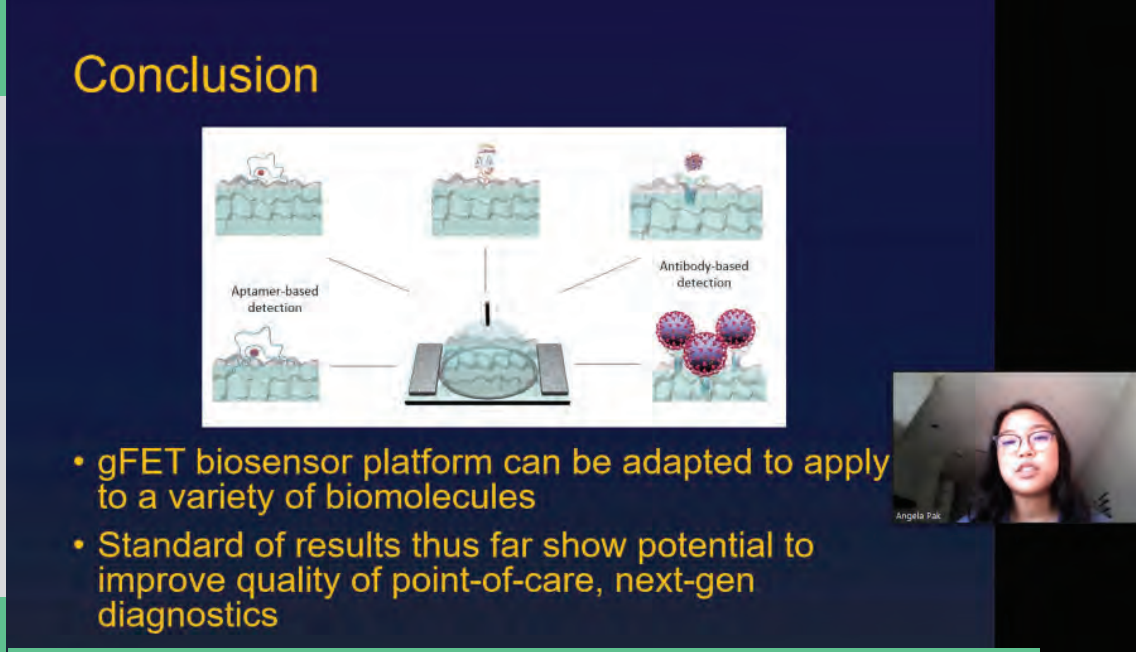
Another I-MRSEC REU undergrad was Diana LaFollette, a rising senior at the University of Southern California who is majoring in chemical engineering with a focus on sustainable energy and a minor in environmental studies. Working with Dr. John Abelson this summer in the area of model simulations of thin film nucleation, LaFollette created a model that she says will predict the physical morphology of a thin film based on certain growth parameters, specifically the nucleation rate and the growth rate.

According to LaFollette, the most challenging parts of her experience were learning Python and adapting to a virtual environment.

"When you're working from home," she admits, "you don't have anyone you can turn to to talk through your

Kaitlyn Wiegand presenting her research via Zoom. (Image courtesy of Kaitlyn Wiegand.)

ideas with someone right next to you." Conversely, she adds that "The challenge of working virtually definitely made me more confident in working independently and figuring out solutions to problems without assistance."



I-MRSEC REU undergrad Angela Pak shares her conclusions during her final presentation at the I-MRSEC REU Research Symposium on July 29th.

LaFollette acknowledges that prior to this summer, she knew very little about thin films or Python.

"After developing this model," she asserts, "I feel I have a much better grasp on thin films as a whole, computer modeling techniques, and Python as a programming language."

Regarding the impact that participating in I-MRSEC REU has had on her personally and as a student, LaFollette reports that the experience made her much more confident in both her research abilities and her abilities as a programmer. "Previously," she admits, "I did not view coding as one of my strengths, but over the summer, I grew a lot in that area." In addition, her previous research experiences had all involved a lot of hands-on supervision from graduate students, but as a result of this summer, she claims:

"The virtual environment made my project much more independent, which made me feel much more prepared for going into graduate school where I'd be doing research independently."

Did the experience impact her career plans? She acknowledges that before this summer, she was planning on going to graduate school and eventually becoming a professor. This summer definitely confirmed her intended career path and that she still wants to pursue a role in academia.

Isiah Ramos is a rising junior who's transferring from Parkland Community College to Illinois in fall 2020; he intends to major in Agricultural and Biological Engineering (ABE) with a focus on

nanotechnology. Ramos, who worked with I-MRSEC Prof. Narayana Aluru on a project that involved active interfaces between highly deformable nanomaterials, reports that because he did a literature review, he didn't really have any results. However, he does insist, "Biosensors are neat though!"

Regarding the most challenging part of his experience, Ramos admits, "Easily the fact that everything was online. There are certain things that are better explained in person."

What were some of the positive impacts of his experience? Ramos admits that prior to the summer, he "knew next to nothing about 2D graphene and its applications, I guess you could say it was something I took for granted before knowing how much it can do."

Not only that, but he acknowledges that the summer had an even bigger impact on his future career plans.

"I started the summer curious about materials research," he says, "and I'm ending it knowing full well that I want to go into biomaterials research for grad school, with U of I being at the top of that list of schools."

Further, he also figured out what he wants do career-wise.

"I intend to go into research as my career much further down the road. This program just helped me narrow down the options; I'm interested in various fields of research, and the MRSEC combines all of those aspects into one. Going into biomaterial research just seems like a no brainer at this point."

Kaitlyn Wiegand, a rising senior in Chemistry at Southern Illinois University-Carbondale, spent the summer in Professor Nadya Mason's group researching micro magnetics simulations. Regarding her results, she reports that coupled magnetic islands at very close distances were found to have significantly smaller switching fields than isolated nano-spheres and nano-discs—similar to the results of the literature proposal she modeled her simulations after.

According to Wiegand, the most challenging thing about her research experience was trying to accomplish all of the goals in a 10-week period. "As the research progressed," she admits, "we were always learning and figuring out new ways to simulate each system."

Wiegand reports that she learned a great deal this summer, including information about graduate school at Illinois, the research process, and specific science related to her research. She claims that "One major thing that I learned was how to use OOMMF, a micromagnetics simulation software."

How did the research experience impact her personally and as a student?

"This experience has taught me to have confidence in my ideas and results," she asserts, "and to always be actively thinking of how a certain problem could be carefully and systematically studied. It has also taught me to accept results which don't necessarily fit my expectations, as a beneficial and crucial step in the research process."

Regarding the impact her experience might have on her future career, she says,

"This experience provided me with a lot of motivation and helpful skills to use moving forward in my academic career as I apply to graduate school, especially when it comes to the type of research I am interested in. I-MRSEC faculty really put an emphasis on the idea of pursuing what you enjoy, which changed my outlook in a very positive way."

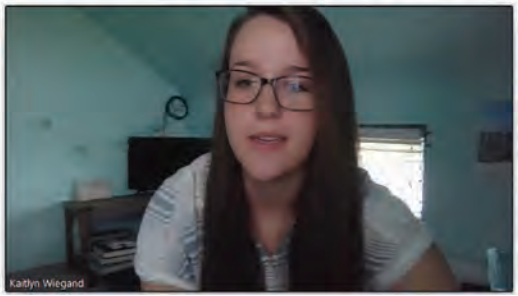
Testing Simulation Parameters: PERP Nano-Discs

Damping constant (α)

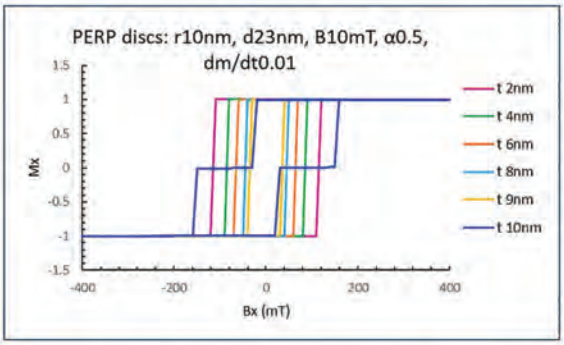
- Question: is α too large to achieve a true energy minimum?
- Answer: α = 0.5 seems appropriate for larger step sizes (10mT), but the switching field (Bsw) varies slightly with small step size (1mT)

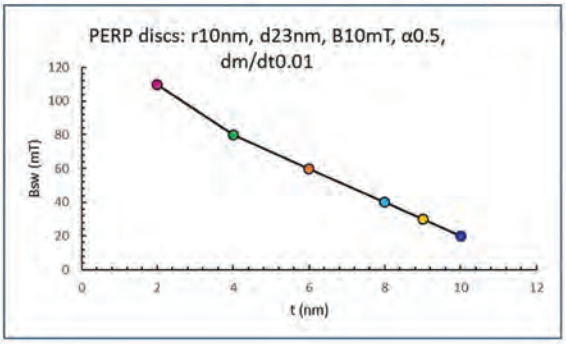
Nano-disc thickness (t)

- Question: how does t impact switching behavior?
- Answer: linear relation between Bsw and t; when t = r, there appears to be a third stable state (M=0)

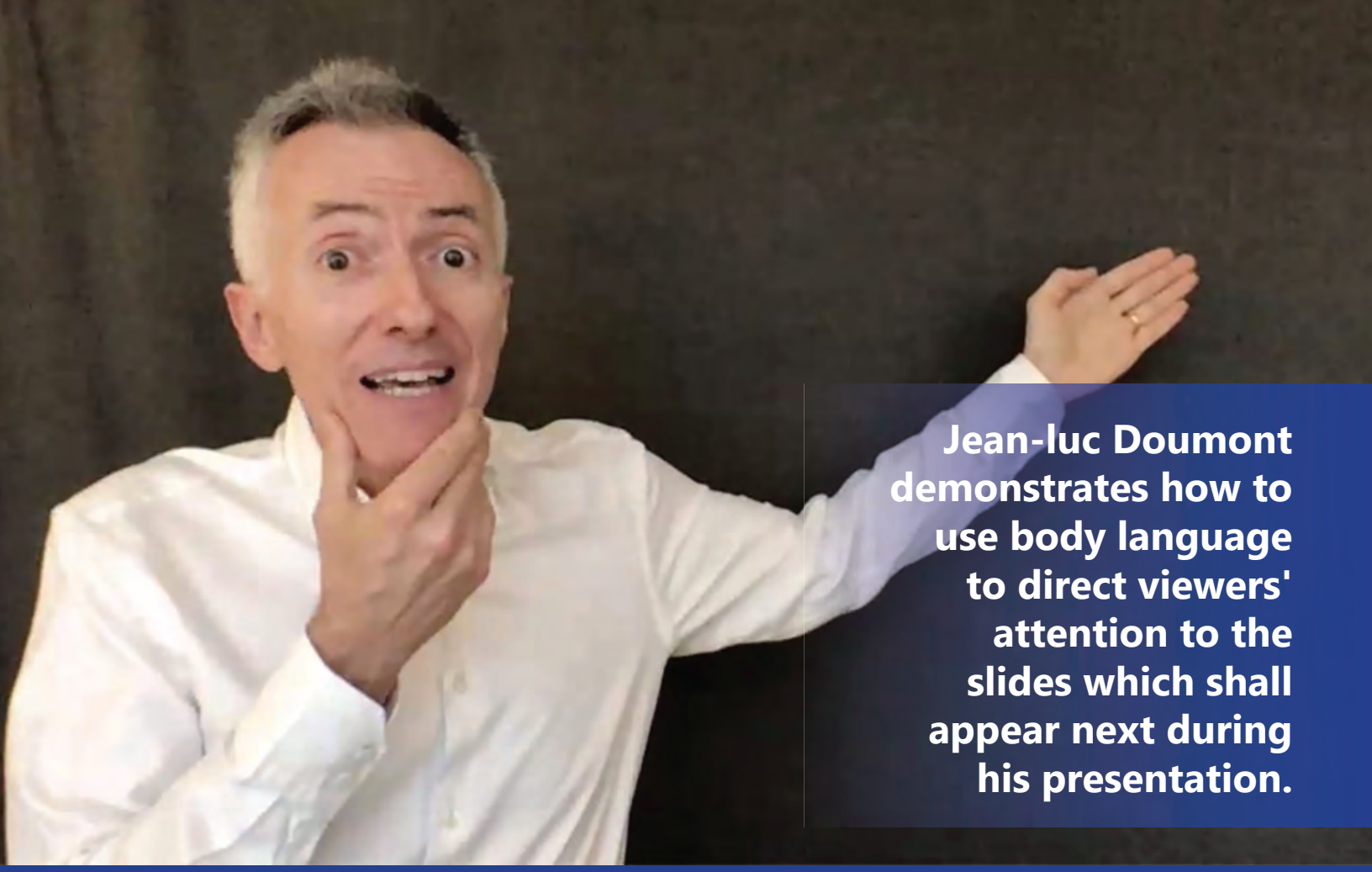


Kaitlyn Wiegand presenting her research via Zoom. (Image courtesy of Kaitlyn Wiegand.)





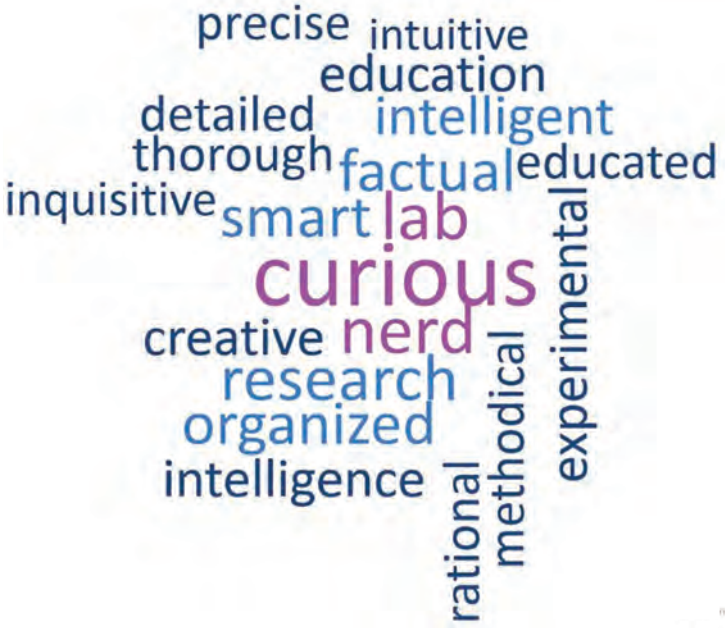
PhD student Preethah Sarkar with the baked representation of her research for I-MRSEC's Bake-Your-Research Contest. (Image courtesy of Preethah Sarkar.)



Jean-luc Doumont demonstrates how to use body language to direct viewers' attention to the slides which shall appear next during his presentation.

SCIENTIFIC & COLLEGIAL COMMUNICATION PROFESSIONAL DEVELOPMENT

A Word cloud comprised of words participants used to describe, "What is a Scientist?" during I-MRSEC's virtual Science Communication & Public Engagement Fundamentals workshop.



PRINCIPIAE'S JEAN-LUC DOUMONT TEACHES I-MRSEC RESEARCHERS HOW TO DELIVER REMOTE PRESENTATIONS…REMOTELY

July 13, 2020

Jean-luc Doumont of Principiae uses body language to express an idea during I-MRSEC's Remote Presentations workshop in 2020.

Do what you can with what you have where you are." "You must focus their attention where you want it to be." "Everything you need—nothing you don't." "Invest time in your setup, not money in accessories." These were some of the pithy pieces of advice shared by Principiae's Jean-luc Doumont in a June 30th workshop sponsored by the Illinois Materials Research Science and Engineering Center (I-MRSEC). In keeping with I-MRSEC's commitment to improve scientific communication, the topic of this latest workshop was quite timely and extremely apropos: "Delivering Your Presentation Remotely.

Based on the popularity of the workshop he had taught on campus last fall about improving oral presentations—and given the current prevalence of Zoom meetings, etc., that most of us have now in lieu of face-to-face, in-person meetings due to COVID-19 quarantine restrictions—Doumont was invited to impart his wisdom about making remote presentations by doing just that…presenting a Zoom workshop remotely from his upstairs study in Brussels, Belgium.

Doumont listens to a question from a member of the audience during the Q&A session at the end of the workshop.

The two-hour workshop was well attended: around 88 University of Illinois folk participated via Zoom, including around 10–15 undergrads (including I-MRSEC REU participants), 40–50 grad students, 10–15 postdocs, 10–15 faculty, and around 15 staff/scientists.

Doumont began by acknowledging the two things he missed most about giving in-person presentations in front of a live audience: laughter…and, of course, the applause at the end. He next shared a couple of remote presentation issues members of the audience most hoped he would address during the workshop: 1) how to gauge audience interaction, and 2) how to keep one's audience engaged.

Doumont stresses that keeping the audience engaged is one of the major challenges of online presentations. Picture this scenario, which he alludes to. You're in a Zoom meeting; the current speaker is droning on and on; you see the brief notification that the important email you've been waiting for has finally arrived. What do you do? You momentarily blow off the meeting, navigate over to your email, read that message, plus briefly scan for other new messages in your in box. While this is something that might possibly happen in an in-person presentation, even more

challenging in online presentations is the need to get the message across—to get your audience to pay attention…to understand. In order to help the audience to "Be able to act upon a message," Doumont explains, the speaker must "Make them care!"

According to Doumont, someone making remote, online presentation communicates with his/her audience using not just verbal (vocal), but nonverbal/visual communication. He says what the audience sees is critical.

At one point during his talk, Doumont asks the audience,

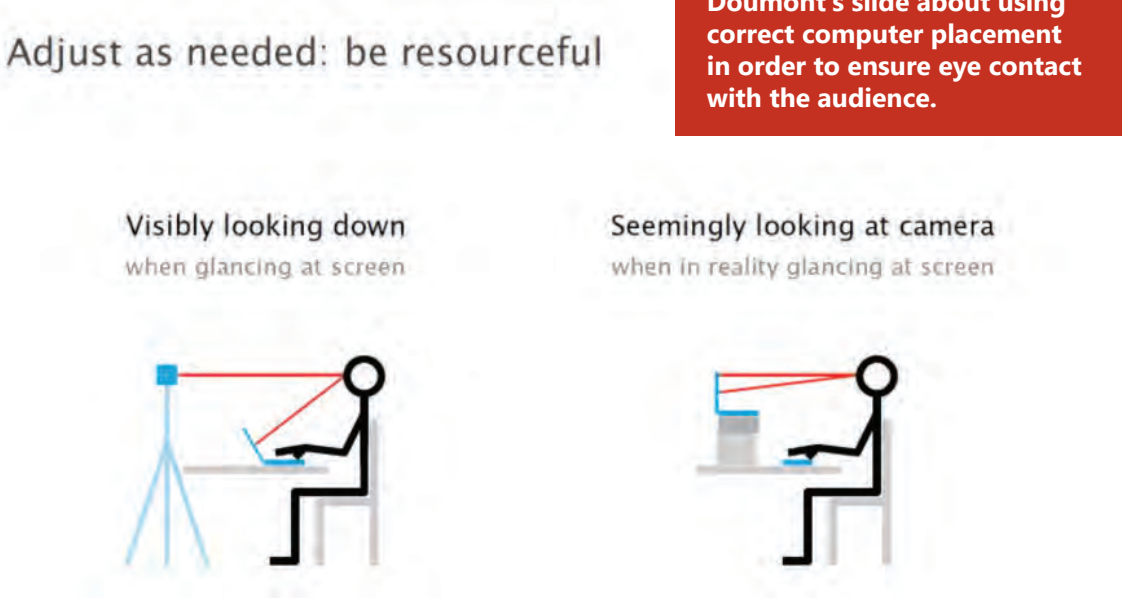
Doumont demonstrates the challenge of showing the presenter and the slides simultaneously.

"Why are we even giving remote presentations? They are harder for the speakers to deliver. They are harder for the audience to listen to. Why are we doing that? And don't tell me it's because we are no longer allowed to be together in the same place at the same time."

He cites a form of remote communication that has been around for a long time—the research paper. "You cannot say nearly as much in a research talk as you would be able to say in a research paper," he qualifies. "In fact, even face-to-face, even in person, why are we having this?" He refutes the idea that it's to give the listener the opportunity to ask the presenter questions afterwards, saying, "Strictly speaking, you could be asking questions by email to the authors."

"If you ask me," he submits, "talks have got something essentially human that papers don't have…and that is precisely non-verbal communication. Right?...Then there is what you cannot put in writing easily. And that is how the speaker says it using his or her voice…And then there is everything you can see, the language, facial expressions, all the way to dress code."

Something else a paper doesn't have is the ability of the speaker to establish credibility using nonverbal communication. "What makes you believe a speaker?" Doumont asks. "The projected confidence of the speaker." He also insists that the speaker should optimize the experience of the audience…with constraints. "I decide what they pay attention to at every single moment," he claims, directing their attention to the PowerPoint by pointing to it, or by turning to look at it, then looking back at the audience. He compares it to what one sees on a news cast, where the watcher first focuses on the newscaster, then a film spot comes up, underdubbed by the newscaster's voice, then the visual goes back to the newscaster.



Doumont's slide about using correct computer placement in order to ensure eye contact with the audience.

David Cahill listens to Doumont's presentation during the November 2019 workshop.

To optimize communications, Doumont recommends that presenters use what he calls his "three laws." These are: 1) adapt to your audience; 2) maximize the signal-to-noise ratio, and to 3) use redundancy.

In regards to maximizing signal to noise ratio, he is not just referring to the technological aspect of the presentation. He considers noise to be anything that distracts…saying "Uh," or "Ummm"; poor lighting; and one's background, such as a busy library, which watchers will examine, possibly telling themselves, "Hey, I know that book!"

Regarding background, Dounmont confirmed something we all have discovered during this protracted period of seeing everyone, even news commentators or President Obama, in their homes—backgrounds matter! How often have we been watching someone and commented that the items on their shelves are poorly balanced behind them. And contrary to public opinion, Doumont says showing off one's library can be distracting—noise.

In fact, Zoom has backgrounds one can attach in lieu of one's messy living room. (This writer has actually used Zoom's Golden Gate Bridge background.) Doumont refers to one he tried, "a background with a palm tree moving in the wind behind me. That would be very distracting," he acknowledges.

"Focus attention to your message," he instructs the audience. "Don't give them anything else to look at!"

Doumont even considers too-busy slides to be noise. Regarding maximizing the signal-to-noise ratio, he cited an ad he saw at the Brussels airport for the new Volvo XC 40. It said:

"Everything you need—nothing you don't. That's maximizing the signal to noise ratio content," he insists. "And it applies to slides too."

Indicating that in-person presentation slides typically contain too much information and in particular, too much text in a very small font, he says, "Now, when you move to remote presentation, the temptation is to think that your audience is going to see your slides full screen on their laptop, so you can use more text," he admits.

Regarding his third law, redundancy, Doumont claims one can compensate for loss of communication during a presentation, such as a person getting distracted by visual noise in the background, actual physical noise in their space, or a glitch in the technology where a voice or the visual is lost, by using redundancy—stressing a point using one's voice, plus slides.

"You can try to minimize those losses with an extremely high signal-to-noise ratio," he insists. "That's a good idea." While he claims, "You cannot realistically bring the losses down to zero," he submits that employing redundancy is key.

"Right now, I'm talking to you. When you hear me, and I'm using slides, and you hopefully read that, I've got two chances. If for some reason you can actually not hear me, then you would have the main messages on the slides that compensate. If for some reason,

Doumont demonstrates the result of not giving oneself enough space for hand gestures.

you don't get the image, you can only hear my voice, but hopefully that will be enough. Get my point? Now that's redundancy."

What were some of the challenges of online presentations that Doumont addressed? One, it's difficult to show both the speaker and their slides simultaneously. For instance, if one makes the slides large enough to be seen, then the speaker is distant; if the speaker is large and center front, then the slides are too small. Thus, Doumont recommends that the speaker control what is presented, and when to do so, by alternating between periods of just the speaker, then just the slides. Doumont demonstrated this quite effectively during his presentation. This was a rather common-sense method several members of the audience hadn't considered and reported that they planned to implement.

Another solution to the presenter-slides dilemma is this: Doumont posits that the presenter could record oneself presenting on a smartphone, then use a video-editing application to mix in slides. (The photo to the right illustrates the challenge of this method of presentation.)

A further challenge to presenting online is this: if the presenter is using a laptop on a desk, it will always appear as if they are looking down. Doumont recommends rearranging the space to be used to optimize the speaker's appearance–to make it appear that they're standing, even though they're not. He illustrates his journey in how he optimized his upstairs office for online presentations by using a backdrop to eliminate the distraction of his personal library; stacking up boxes to bring his laptop up to eye level; slanting the laptop so he wouldn't look down; even creating a side table of sorts. Regarding the optimization of his office, Doumont exhorts workshop participants to,

"Do what you can with what you have where you are," and to "Invest time in your setup, not money in accessories."

Regarding setup for remote presentations, Doumont urges presenters to consider using a neutral backdrop and to beware of backlight and sidelight. He also suggests giving yourself space for hand gestures, since, as the photos to the right illustrate, they can appear "in your face" if you're too close to the camera.

The workshop ended with members of the audience asking a number of questions, such as a tactful way of having a discussion with participants about recording presentations; whether there is more of a lag or if the video quality of QuickTime is different than using the zoom video; and the usefulness of having a co-host when someone all

I-MRSEC REU undergrad Diana LaFollette. (Image courtesy of Diana LaFollette.)

of a sudden turns on their video, so someone will be able to close that without distracting the speaker; and another about compatibility of animations in Power-Point.

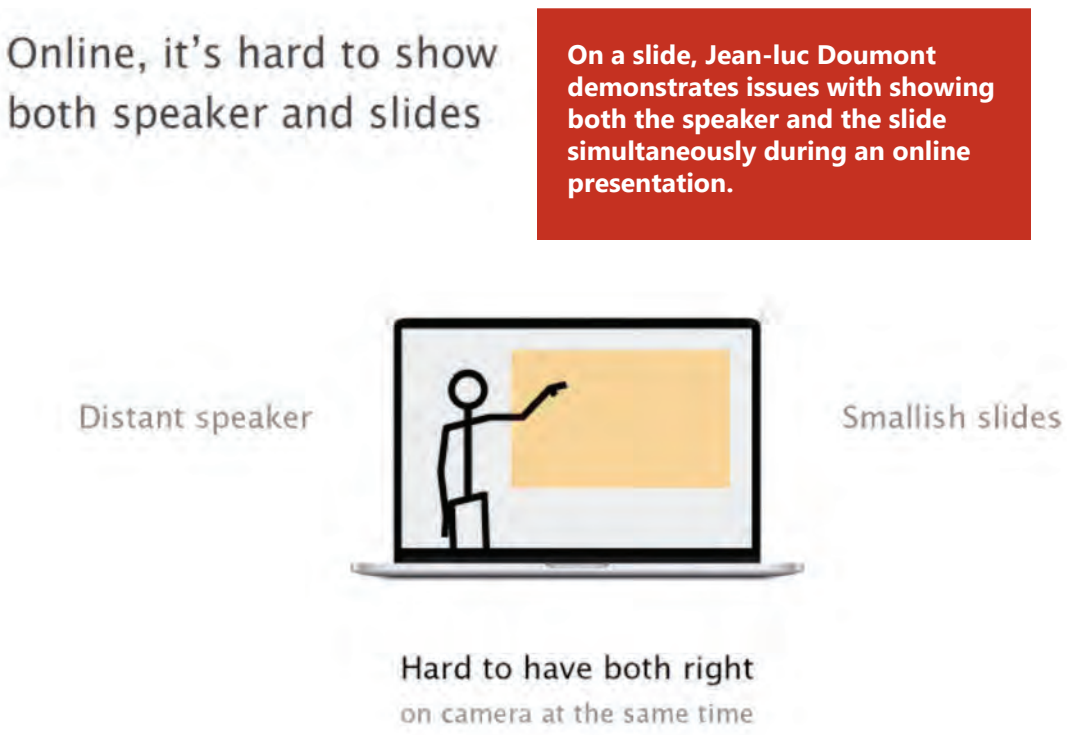
Several members of the workshop's Zoom audience shared why they participated, what they felt were the highlights of the workshop, and things they believed they would implement down the road. For instance, Materials Science and Engineering Professor and I-MRSEC researcher David Cahill participated because he "wanted to learn how to lecture more effectively on line." He indicates that his favorite part was

"the zoom-hack of always using screen share and switching between applications that show the video feed and the slides."

He says he intends to use the above, and will also use Doumont's advice about backgrounds, lighting, and posture."

Another participant, Kathleen Brooke Oolman, who's working on a PhD in physics in the area of antiferromagnetic metals, had attended Jean-luc Doumont's in-person workshop last fall. She recalls that she had found it "incredibly enlightening" and says she had learned a lot about giving engaging presentations. She shares why she attended the remote presentations workshop:

"With the recent transition to an all-online-platform," she acknowledges, "I found it challenging to give talks virtually and was hoping to glean just as much knowledge (and more) about giving presentations in this new format."



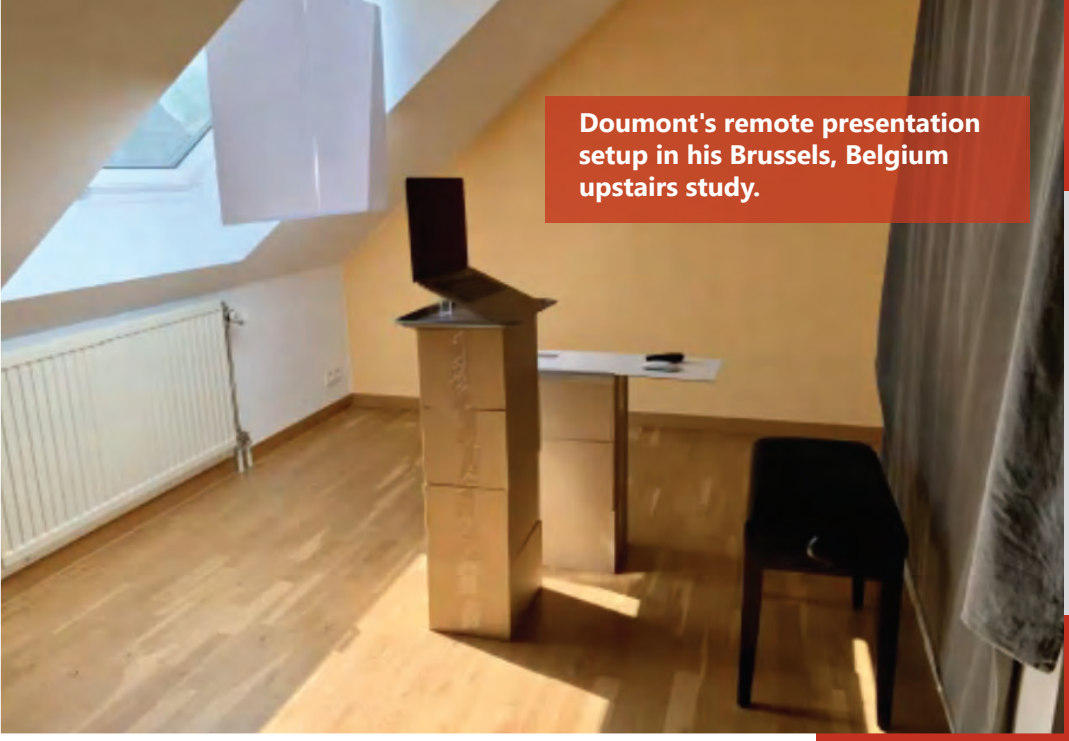
On a slide, Jean-luc Doumont demonstrates issues with showing both the speaker and the slide simultaneously during an online presentation.

Regarding the workshop, she admits that her goal was to "memorize everything that Jean-luc said during his workshop so I can use everything he said in all my presentations." In fact, she and her husband, who also attended the workshop, intend to implement his idea of creating a presentation-giving workspace in their home

"by setting up a backdrop and computer stand with nice lighting to lower the "noise" in the presentation and have the capability of giving "eye contact" to the audience."

Also participating in the workshop were several undergraduate students participating in I-MRSEC's REU, including Diana LaFollette, a rising senior at the University of Southern California studying chemical engineering. Working with Dr. Abelson and with Kinsey Canova, her research here on campus involves working on modeling thin film growth using Monte Carlo modeling. LaFollette participated in the workshop

"to gain new skills and tips that I think will be directly applicable for a long time, considering the current state of the world and how things are changing in response to COVID."



Doumont's remote presentation setup in his Brussels, Belgium upstairs study.

According to Pak, her favorite part of the workshop was

"seeing how creative Jean-Luc is with giving online presentations." She adds: "I had always associated giving online presentations with a lower quality than in-person presentations, but he so clearly showed that that doesn't have to be the case."

Can she see herself using some of his tips? Definitely. She reports:

"I can definitely see myself using Jean-Luc's tip to share your screen from two sources–one a video feed and another your actual presentation slides. Seeing him doing this and so seamlessly transitioning between his face and

She particularly appreciated tips she gleaned concerning how to adjust for virtual presentations, which ranged from changing one's set-up, including elevating the computer screen, to learning how to alternate between showing video and slides on screen and retaining people's attention.

"I used the tips on how to set up your computer and background for my midprogram presentation for the MRSEC REU yesterday," she acknowledges, "and they worked well! I think I will continue doing so in the future."

Another I-MRSEC REU undergrad, Angela Pak, a rising senior majoring in Biomedical Engineering at University of Texas at Austin, who's researching the use of graphene field effect transistors for biomolecule detection, shares why she attended the workshop.

"Because being able to give online presentations is a skill that is going to be relevant likely for the rest of my career–especially in this current season with the global pandemic. That being said, I have rather limited experience giving online presentations, as I have only done so once before this program at the end of my last semester—so it was rather unexpected."

I-MRSEC REU undergrad Angela Pak. (Image courtesy of Angela Pak.)

his slides made the online presentation feel almost in-person."

Doumont demonstrates the result of not giving oneself enough space for hand gestures.

A third I-MRSEC REU undergrad who particularly appreciated Doumont's presentation was Kaitlyn Wiegand, a rising senior at Southern Illinois University (Carbondale), who's majoring in Chemistry. Her current research here on campus includes simulating nanomagnets with various shapes, orientations, and dimensions to determine their potential applicability to experimental work in magnetic information storage.

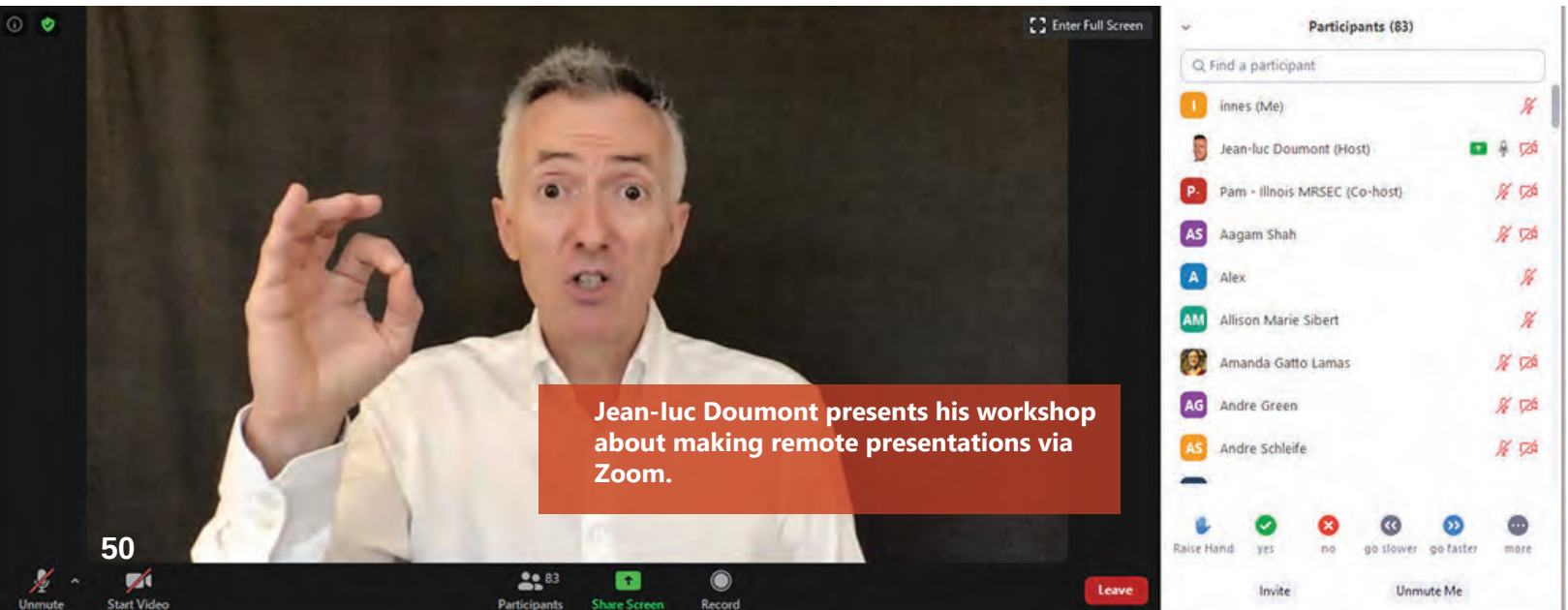
Wiegand "wanted to learn how to give interesting and engaging presentations, not only face-to-face but also via platforms like Zoom." She notes, "His talk was highly recommended by a number of faculty that had attended his previous workshop, and he certainly did not disappoint."

Wiegand's favorite part of the workshop was when Doumont:

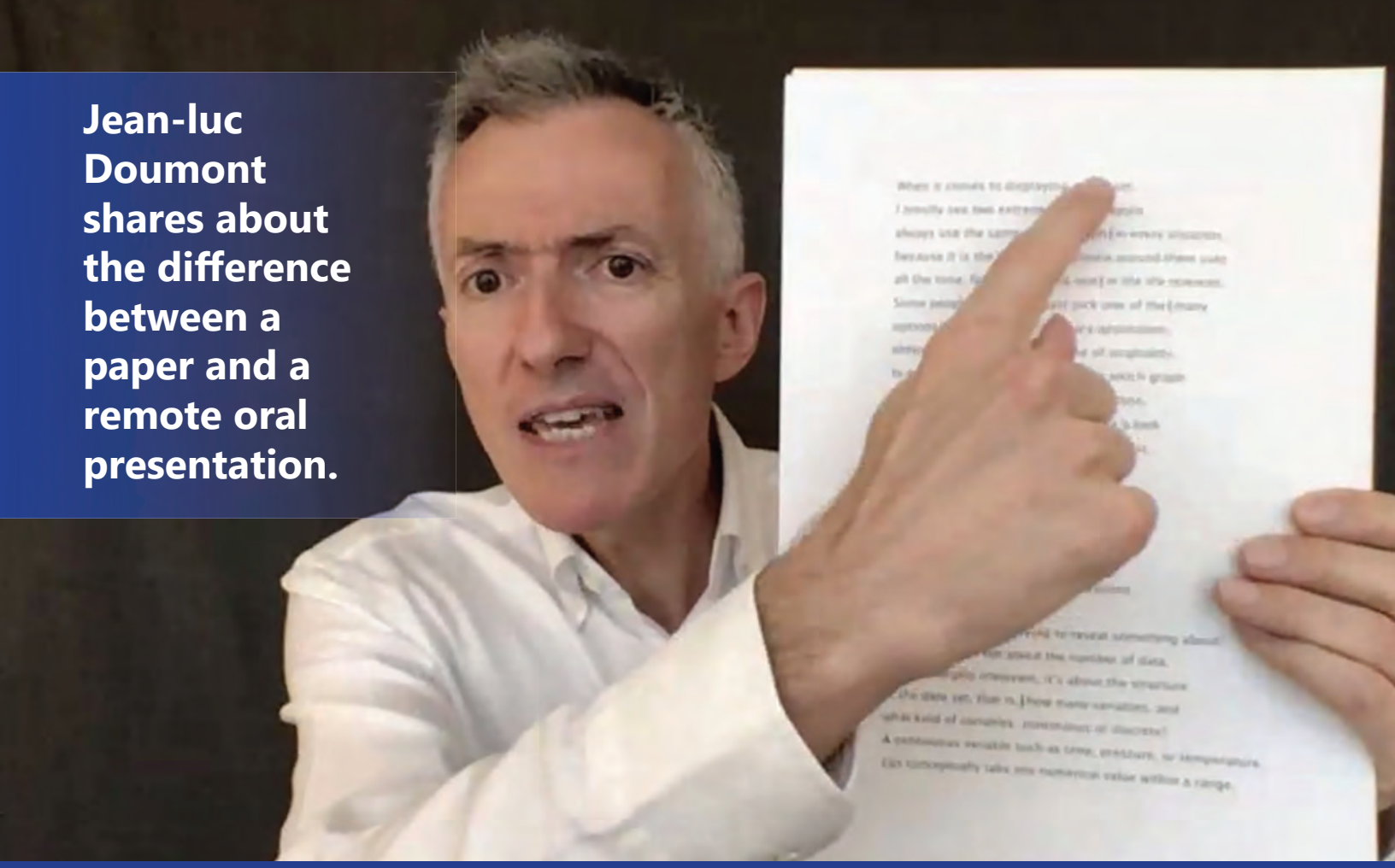
"showed images of his office setup for video meetings, and gave tips for utilizing this setup, like placing a sticky note with a drawn-on smiley face by the camera to help make eye contact with the audience during presentations."

She shares one thing she gained from the workshop that she intends to use down the road:

"His method of directing the audience's attention to certain parts of your presentation by use of body language, such as clearly motioning with your arm and turning your face to what you would like them to focus on."



Jean-luc Doumont presents his workshop about making remote presentations via Zoom.



Jean-luc Doumont shares about the difference between a paper and a remote oral presentation.

To optimize communication, apply Jean-luc's "three laws"

Jean-luc Doumont's three laws about communication.

verbal

Me ⇉ Audience

nonverbal

Adapt to your audience

Maximize $\frac{\text{signal}}{\text{noise}}$

3 Use redundancy

I-MRSEC'S VIRTUAL COFFEE & COOKIES HOUR ENCOURAGES COLLEGIAL COMMUNICATION AMONG RESEARCHERS; BAKE-YOUR-RESEARCH CONTEST FOSTERS FUN!

October 6, 2020

A sign of the times? To encourage collegial collaboration and facilitate socialization among researchers, yet abide by COVID-19 social distancing mandates, on Friday, October 2, from 4:30–5:30 PM, I-MRSEC (Illinois Materials Research Science and Engineering Center) held its first-ever virtual MRSEC Coffee and Cookies Hour. For the 16 or so participants hunkered down behind their computers at home (or their office) to video chat with colleagues, ostensibly, it was BYO coffee and cookies (C&C).

Why a virtual Coffee and Cookies Hour? Prior to the pandemic, I-MRSEC hosted monthly coffee hours, in addition to other, more structured meetings and workshops. According to Pamela Pena Martin, I-MRSEC's Outreach Coordinator,

> **"The MRSEC has always had a desire to foster community. It's good for science—informal discussions can sometimes be the starting point of a new research idea. It's good for the scientists—we are human beings and need connections with others for our own wellbeing."**

Thus, in order to "give opportunities for these valuable interactions," planners cooked up a Coffee and Cookies Hour. Pena Martin shares how it came about.

> **"When the reality finally sank in that we would be unlikely to have in-person coffee hours for quite some time," she admits, "we started exploring virtual ways to get together.**

> **We wanted to find something that would mimic the feeling of being in a real space—being able to form small groups to chat, move between groups easily, meander along to suddenly meet a colleague you haven't seen in a while...the sort of thing that I think we took for granted until it was no longer possible."**

C&C Hour planners eschewed Zoom, with its lineup of video faces where everyone hears everyone else

Azel Murzabekova, a Physics PhD student in Fahad Mahmood's lab shows off the Intercalcated cake she created for the Bake-Your-Research Contest. (Image courtesy of Azel Murzabekova.)

speak, in favor of the Gather Town web-browser-based platform, which, according to its website, is

> **"a video-calling space that lets multiple people hold separate conversations in parallel, and walk in, out, and around those conversations just as easily."**

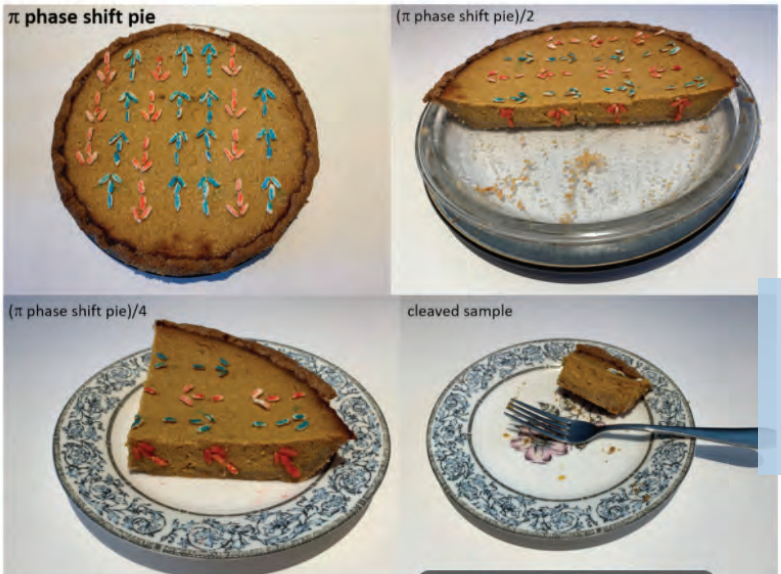
Professor Andre Schleife had suggested Gather Town as a possible platform, plus Professor Gina Lorenz had already set up a Gather Town space that Physics has been using for their coffee hours. So I-MRSEC planners decided to give it a try.

Preethah Sarkar, a PhD student in Professor Nadya Mason's group, with the baked representation of her research for I-MRSEC's Bake-Your-Research Contest. (Image courtesy of Preethah Sarkar.)

One benefit of Gather Town is that attendees aren't required to set up an account or download anything. Folks just need a web browser and their camera/microphone already on hand for Zoom meetings. Another fun component of the platform is that users choose an avatar that looks somewhat like themselves, which can be seen going from place to place. To converse with others, however, one's avatar must be in fairly close proximity to theirs. To "find" someone, a user clicks on the person's name, and the program draws a line to the person's avatar. Then, using direction arrows, the user moves their avatar fairly close to the person, which causes their face (and voice) to appear in a small video window.

So Lorenz and Pena Martin set up the C&C Hour's Gather Town space, which looks a lot like the MRL 2nd floor conference room and lounge areas (slightly widened to make space for groups to congregate, and with a much, much longer table.). True to the name of the event, they even included a virtual coffee and cookies table! (As mentioned above, BYO!) Thus, using the program, attendees were able to easily navigate the virtual conference room area and, as Pena Martin points out, "meander between groups of colleagues to video chat."

Scattered throughout the virtual meeting space were entries to I-MRSEC's first-ever "Bake Your Research Contest," held in conjunction with the C&C Hour. All in the name of fun, the challenge of the contest, open to all levels of I-MRSEC folk, including students, postdocs, and faculty,



Virginia Lorenz's Pi Phase Shift Pie. (Photo courtesy of Gina Lorenz.)

I-MRSEC

was to cook or bake something that in some way represented one's research. Pena Martin came up with the Bake-Your-Research idea while trying to devise an activity for I-MRSEC students and postdocs.

"Intercalated cake"- Cake layered with condensed matter (condensed milk) represent NbS2 layers, each third layer is filled with strawberry to represent chemical intercalants, with bowtie antennas on top to enhance THz field

Intercalcated cake baked by Azel Murzabekova, a Physics PhD student in Fahad Mahmood's lab, for the Bake-Your-Research contest. (Image courtesy of Azel Murzabekova.)

"I thought it would be a good opportunity to practice the science communication skills that the MRSEC focuses on," she explains, "plus put to use the quarantine baking skills everyone has developed!"

When Pena Martin suggested the contest at a meeting, participants expressed enthusiasm for it, so they proceeded. And since it just so happened that plans for the October 2nd Coffee & Cookie Hour were already in the works, it occurred to her that they could put the two together and end up with a really fun social event.

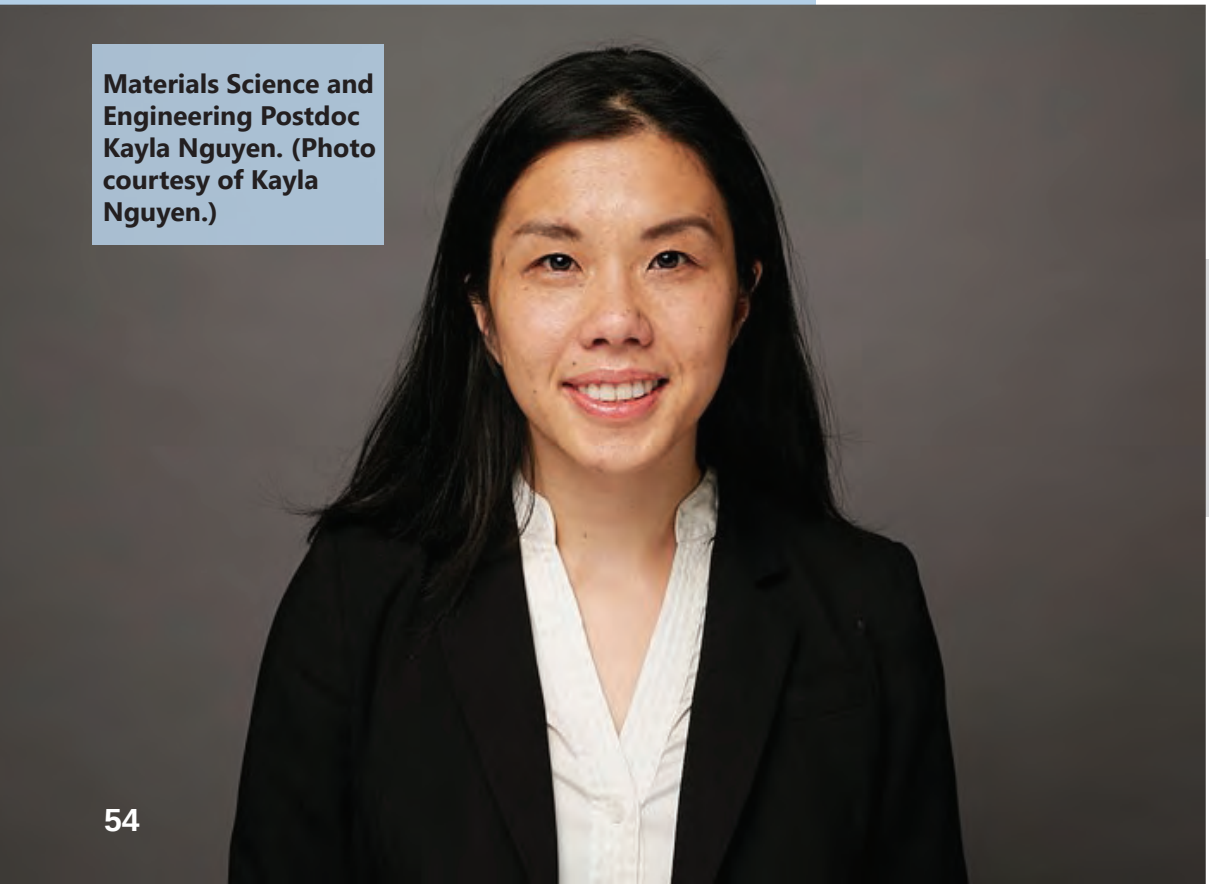
"I also think that baking/cooking is one of those things that pretty much everyone, both inside and outside of the scientific community, can relate to," she admits. "Finding ways to connect our research with it could help make it feel as if it's as familiar and accessible as the kitchen."

So those who wished to compete baked their items and sent photos to Pena Martin by October 1 at noon. Photos of the innovative creations were unveiled during the C&C Hour, with participants voting on their favorites. Pena Martin boasts that, as a reward, the winner would receive

"glorious accolades, the utmost of bragging rights, and a MRSEC mug"

(plus, possibly have a non-virtual treat to consume during the C&C Hour).

Several I-MRSEC folks shared why they



Materials Science and Engineering Postdoc Kayla Nguyen. (Photo courtesy of Kayla Nguyen.)

attended the Coffee & Cookies Hour. For instance, Materials Science and Engineering Postdoc Kayla Nguyen says she attended the coffee hour, and participated in and advocated for the Bake-Your-Research contest because she

"wanted an event that would utilize skills that some scientists have picked up during the quarantine. Also, baking, art, and science are fun things to do and if we can combine them together, it would produce something exciting."

Nguyen believes the event had its intended results. Not only did she find the baking submissions to be "creative and very delicious (looking)," she says the event fostered community.

"I am glad that this event provided a way to connect the MRSEC community together even though we are all currently in isolation. Social interactions, whether virtually or in-person, are important when it comes to building a strong community, especially for young scientists so that they could foster relationships with senior faculty members."

Physics Associate Professor and I-MRSEC researcher Gina Lorenz, who studies metallic antiferromagnets in which domains manifest as phase shifts in the antiferromagnetic ordering, submitted a "Pi Phase Shift Pie" entry to the Bake-Your-Research Contest. Lorenz baked her "Pi Phase Shift Pie" with divisions by 2 and 4, and a "cleaved" sample. The pie represents an antiferromagnet with a pi phase shift, corresponding to adjacent spins pointing in the same direction. As the pie was cut, the phase shift changed to pi/2, corresponding to a 90-degree spin rotation within the pie; to pi/4, a 45-degree spin rotation.

Kathleen Brooke Oolman displays her Bake-Your-Research Contest entry. (Image courtesy of Kathleen brooke Oolman.)

Onur Tosun shows off his winning entry: "Graphene on Nanosphers in a Hall Bar."(Photo courtesy of Onur Tosun.)

spontaneous meetings, having a chance to meet informally and chat about whatever is on our minds is refreshing. Interacting as part of a game environment where faces are not the only thing you see helps make it a more relaxing setting."

According to the Bake-Your-Research Contest winner, Onur Tosun, an I-MRSEC postdoc whose research is in the area of Condensed Matter Physics, the following saying—

"What you eat is what you research!"

—inspired him to bake his research, which focuses on the electronic transport properties of strained two-dimensional materials on nanopatterned substrates. He goes on to explain strain in some everyday situations:

"We see the macroscopic effects of strain on three-dimensional materials in our daily lives," he explains. "For example, when you bend/deform a piece of plastic, its color and temperature change. In the kitchen, for example, you see a similar effect when you put a slice of cheese on your burger and microwave it; the cheese melts and strains. The causes and effects of the nanoscale and macroscopic-strain-related phenomena might be different, but they are similar."

Tosun expresses some of the difficulties encountered while preparing his entry: "The challenge for me was the choice of materials to bake my research, such that my entry could totally reflect

"The cleaved sample shows that sometimes you don't get a good cut and disorder sets in," she explains.

Lorenz, who helped Pena Martin set up the Gather Town area for the event, claims "Pam did an amazing job making the space 'comfortable' and reflective of the real-life MRSEC space." Lorenz, who attended the C&C Hour for some "fun and social interaction," believes the event was a great success.

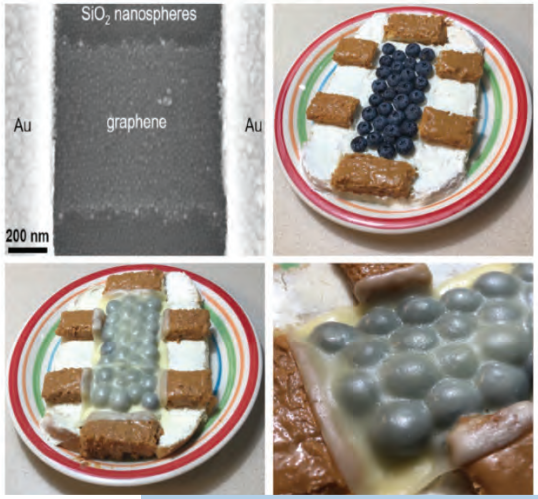
"We had some good laughs," she admits, "and that was the main point. During this time of limited

my research. In my entry, I aimed to show how graphene strains on silica nanospheres. Therefore, I needed something which was transparent or semi-transparent and was supposed to be strained on the periodically located blueberries. I realized a slice of cheese was the best option for my purpose."

Downplaying his hard-won victory, Tosun is quick to applaud his opponents. "All the participants showed their creativity and enthusiasm to make this competition enjoyable. I am so happy to be in an environment where there are incredibly creative people. What I won is not a competition, it is the honor of sharing the same atmosphere with those amazing people."

For Tosun, who started as a postdoc at Illinois in August 2020, which is after COVID-19 pandemic began, the event was particularly significant.

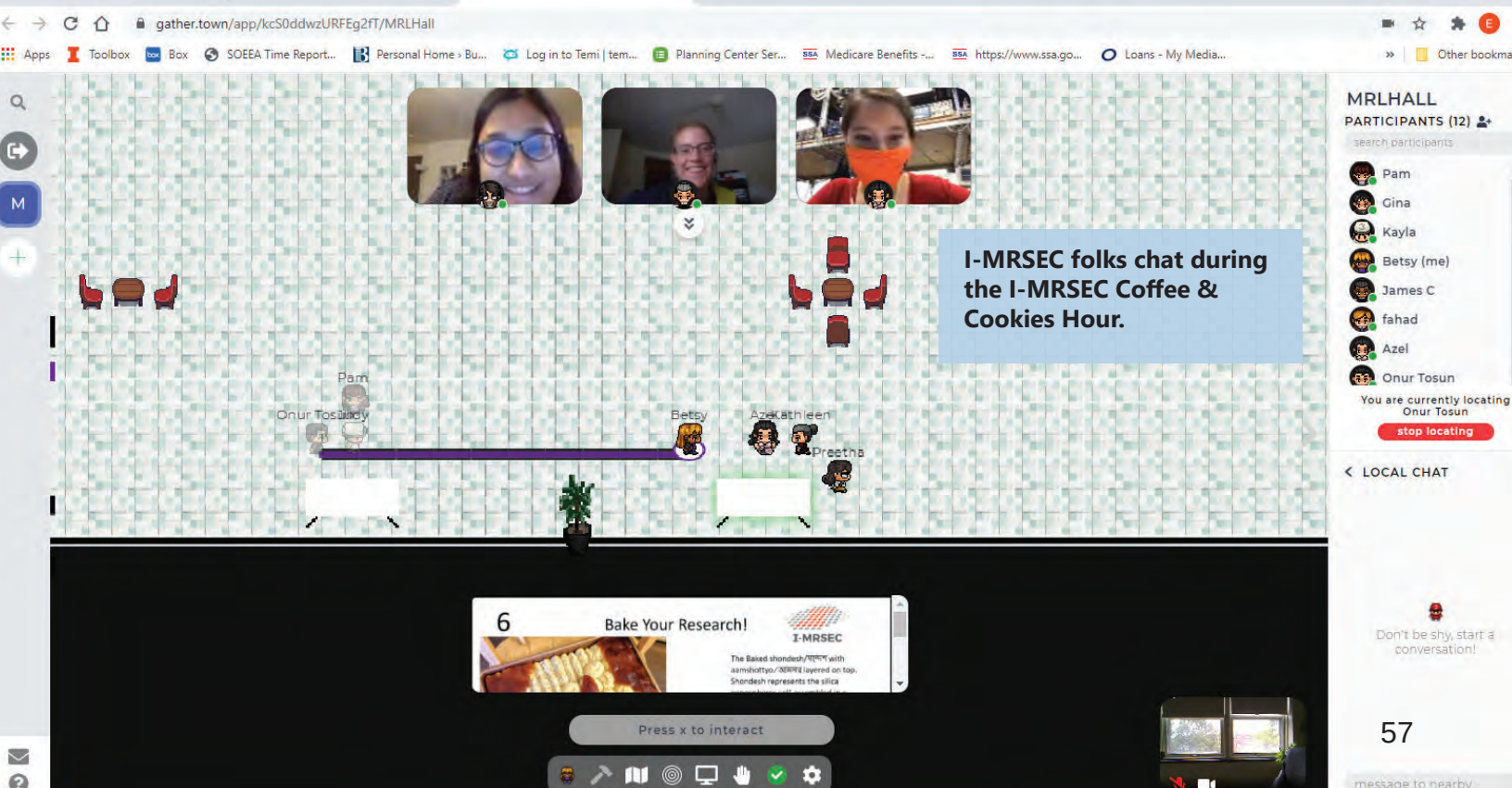
"I never got a chance to meet most of the postdocs and professors in person," he explains. "The Coffee & Cookies hour was an amazing opportunity for me to meet people in an 'almost-real' world where we used our avatars and cameras to communicate in a simulation of a conference room."



Bake-Your-Reserch Contest winner Onur Tosun's submission.

Regarding the importance of I-MRSEC events, both personally and professionally, Tosun indicates:

"Our life completely changed due to COVID-19. If it was not for the MRSEC virtual gatherings, I would feel a complete isolation, and I would be less productive in both my research and social life. The event made me feel like everything was 'normal'."



I-MRSEC folks chat during the I-MRSEC Coffee & Cookies Hour.

I-MRSEC WORKSHOP SEEKS TO HELP RESEARCHERS IMPROVE THEIR PUBLIC ENGAGEMENT

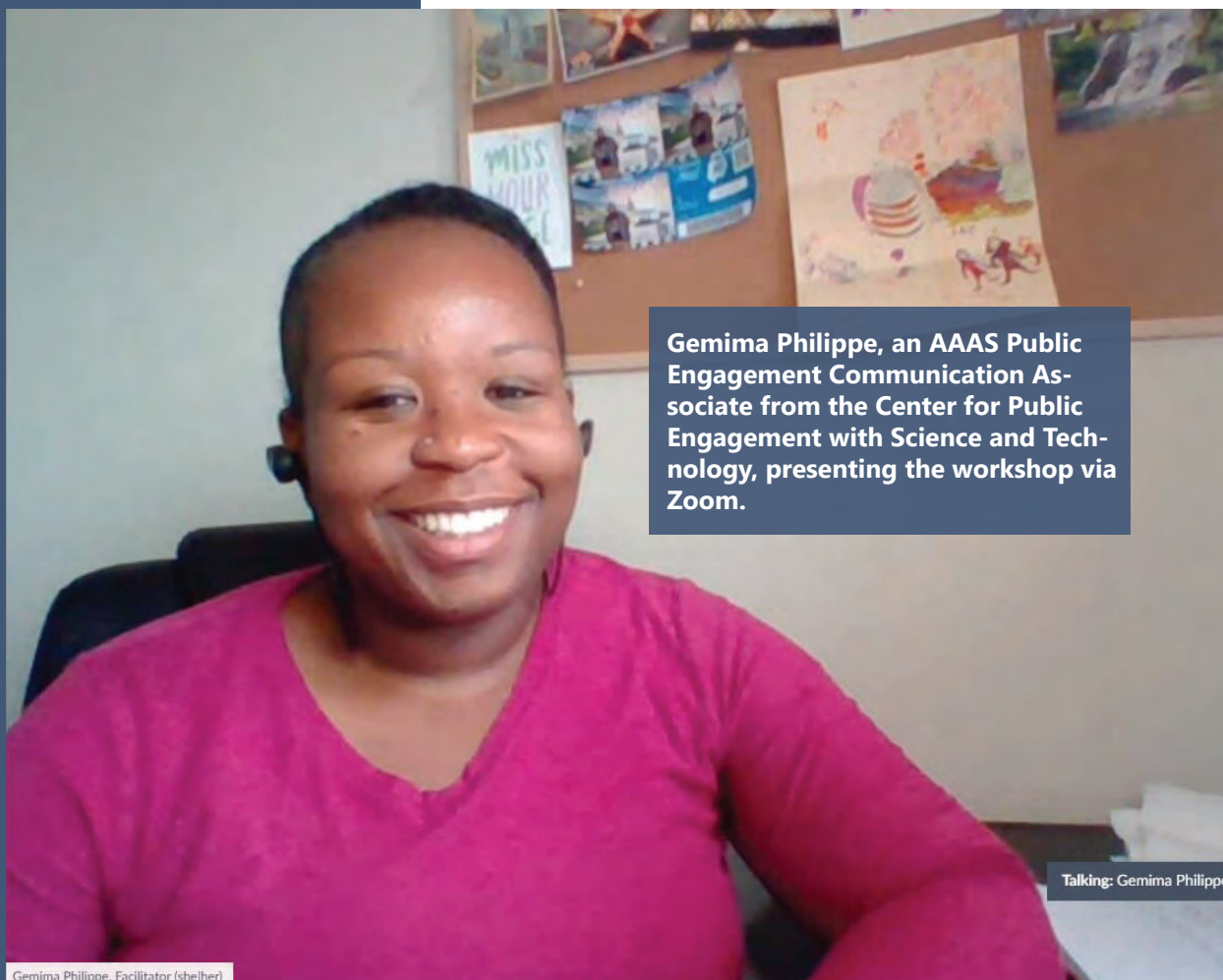
The program addresses the needs of scientists who are motivated to engage but lack the resources to develop their skills and create plans for action." – Gemima Philippe

October 23, 2020

Intent on improving their scientific communication, particularly public engagement, 22 folks, mostly researchers from I-MRSEC (the Illinois Materials Research Science and Engineering Center) participated in the Center's Science Communication and Public Engagement Fundamentals workshop on October 16, 2020. Presented by Gemima Philippe, a Public Engagement Communication Associate from the Center for Public Engagement with Science and Technology at the AAAS (American Association for the Advancement of Science), the online workshop addressed the importance of Science Communication, then tackled key areas participants should focus on in order to improve their own.

An interactive experience, the workshop, held via "Go to Meeting," was comprised of brief lectures by Philippe, whose video was prominently displayed at the top, followed by opportunities for participants to use the "chat" component of the web platform (similar to a group text) to communicate with each other about themselves, their personal experiences, goals, etc. Periodically, Philippe even invited participants onto the "platform" to share—meaning the entire group could both see and hear them displayed next to Philippe. Otherwise, small videos of participants' faces were ranged in rows below, similar to an audience.

Workshop content involved Philippe first delving into the value of public engagement about science, citing the importance of key elements she'd identified: identify your goal, define your audience, develop your message, determine your public engagement type, even evaluate then refine your message. After each topic, participants had the opportunity to contribute via chat. Plus, near the end, one participant even got to briefly practice their presentation then receive helpful critique. In addition, at the close, Philippe armed participants with tools and resources they could draw on to further improve their public engagement.



Gemima Philippe, an AAAS Public Engagement Communication Associate from the Center for Public Engagement with Science and Technology, presenting the workshop via Zoom.

According to Philippe, her workshop gives scientists and engineers opportunities to

"reflect on their public engagement interests and experience and think critically about what they want to accomplish and how to achieve it. The program addresses the needs of scientists who are motivated to engage but lack the resources to develop their skills and create plans for action."

Similar to that of I-MRSEC, her center's vision is "for science and society to engage in conversations and learn from one another."

One challenge Philippe believes most scientists face in communicating science is that they don't necessarily

"feel trained in a specific area before they are comfortable venturing out on their own. This can be a paralyzing obstacle," she continues, "but we can help them overcome it. People communicate about things that are important to them every single day—and having conversations about science should be no different."

She says in addition to providing basic communications training, their workshops help to "demystify the process a bit and help scientists to recognize their innate ability to effectively share their research."

Why did the workshop participants attend, and what did they hope to gain? Kathy Walsh, an MRL (Materials Research Lab) senior research scientist specializing in scanning probe microscopy and profilometry shares why she participated:

"I'm looking to improve my fluency in talking about science at a range of accessible levels," she explains. "Some of what I do is very easy to relate to. Other aspects of my work are harder to identify with since they deal with submicroscopic size scales beyond the realm of everyday experience."

A faculty member, Andre Schleife, Associate Professor in Materials Science and Engineering (MatSE), attended the workshop to

"build a framework for how to think about public engagement." He reports "The workshop definitely accomplished that. I have a better idea now of what questions to ask and how to approach a new public engagement activity."

MatSE Associate Professor Andre Schleife. (Image courtesy of Andre Schleife.)

Also participating in the workshop was Kisung Kang, a grad student who works in Schleife's lab researching the simulation of magnetic materials. Kang shares why he got involved: Before the pandemic, he had participated in various I-MRSEC outreach programs. Mostly involved K–12 students, he had visited Franklin STEAM Academy, a local middle school, to help with the lecture and hands-on activities in an outreach about batteries. He also participated in a virtual reality experience about materials visualization during a tour of MRL. "Whenever I met diverse people and students," Kang admits, "I felt a small obstacle that might distract us from effective communication. I am curious about what causes this feeling, but I couldn't find the answer." When he learned about the AAAS workshop, he signed up, hoping to "find the clue and improve my communication skill."

Illinois grad student Kisung Kang. (Image courtesy of Kisung Kang.)

Philippe maintains that one key to understanding how to communicate with non-scientists is to grasp their perception of who/what a scientist is. Consequently, after asking participants to briefly describe a scientist, they came up with this list. Responses ranged from a scientist's exceptional characteristics (curious, examiner, expert, investigator, smart); their role (experiments, explore interesting problems, nature); and, of course, their stereotypical accoutrements (flask and goggles, lab coat, and specialized equipment. Thankfully, no one suggested the general public's epitome of a scientist—an older white man with crazy hair…the Einstein-esque mad scientist.)

So, why does Philippe insist science communication is important? She contends that science and society converge on several issues, like healthcare, the economy, and climate change.

"Scientific evidence can inform these issues," she maintains, "but evidence alone cannot answer value questions—the 'whether' or 'why' questions—related to these issues. Scientists need the tools to be able to effectively discuss these issues with other members of society."

She says that's where their workshops come in. Imparting why they feel science communication/public engagement is important, several workshop participants, including I-MRSEC's PI, Nadya Mason, shared slightly different views. Mason says:

"I think science communication and public engagement are integral parts of our jobs as scientists. For one, much of our research is federally

funded—the I-MRSEC is supported by the National Science Foundation, for example—so the public and policy-makers should have a sense of where their tax dollars are going," she says.

According to Mason, that leads to an even more important point:

"We need to better communicate our science so that the public and policy makers can make better choices – about whether to support the science, about the implications of the science, and even about the use of science and technology in their daily lives."

dding that public engagement even goes beyond voters and policy makers, Mason mentions a key emphasis of I-MRSEC:

"We also want to educate and inspire the next generation of scientists."

MRL scientists Kathy Walsh feels it allows non-scientists, even scientists in other disciplines, to keep on learning. Indicating that she does physics for her day job, but reads history for fun, she continues,

“If it had been the other way around, I would have loved the opportunity to continue to engage with science as an adult. Not everyone who loves science does it as their day job, and not everyone who has a day job as a scientist does what I do. I love to learn new things, and I know others do, too.”

Underscoring what he perceives as a general a lack of communication or agreement between scientists and the public, Andre Schleife feels strongly about the need for better communication. In fact, that’s why he attended the workshop:

“I am very concerned about a seemingly growing disconnect of ‘the public’ and scientific results,”

Kathy Walsh teaches Franklin STEAM Academy middle schoolers about scanning probe microscopy during a Franklin tour of MRL.

Andre Schleife (right) enjoys exposing a student to virtual reality during a visit to MRL. (Image courtesy of Andre Schleife.)

he reports, citing why he was motivated to become more active in public engagement.

> **"I am also concerned about an apparent lack of understanding of 'the scientific method' in the general public and the increasingly common misconception that a personal opinion is of equal merit to a scientifically proven, evidence-based result that contradicts that opinion."**

Inserting a caveat about his above statements, Schleife indicates that he's not sure if this disconnect is actually happening and is based on actual data, or if this is just his impression. "But it seems to be what is happening a lot on social media these days," he maintains.)

Continuing in this vein regarding the disconnect between scientists and the general public, Kisung Kang uses creative metaphors comparing science to the air and science communication to the wind.

"I think science is something like air," Kang claims. "It is always around us," but adds that sometimes, it's not easy to prove its existence and understand its detailed information.

> **"Scientific public engagement is the chance for people to face the science around them. Whenever people learn the importance of science, they become willing to support scientists and engineers."**

Based on public support, Kang thinks scientists could feel more confident to continue their research and scientific discovery.

Continuing in a closely related analogy, Kang compares science communication to wind, indicating that the degree of science included might contribute to the disconnect.

> **"As the wind might be a good way to feel the air, I think science**

Kisung Kang interacts with a Franklin STEAM Studio student who's experienceing Virtual Reality during one of the school's field trips to MRL.

communication works like the wind. If I deliver heavy scientific knowledge with professional terminologies, the public cannot enjoy the communication—like feeling strong wind or a hurricane."

He adds that this too strong delivery might even cause people to back away from science. He then compares somewhat superficial science communication to a paltry breeze which people can barely feel on a hot summer day, describing it as:

"If I deliver too little scientific information, the students are barely inspired, and they don't realize the importance of science."

Finally, he completes the analogy by describing a balanced presentation:

"If I could deliver the appropriate science level with fun and important scientific messages, the students and people can enjoy the communication like the cool wind during hot summer. Therefore, effective communication is a key point for public engagement to draw and inspire the public and students."

One key emphasis of the workshop was understanding one's audience—figuring out their interests, level of understanding, attitudes, beliefs, etc. To help participants understand who their audience is, Philippe recommends that scientists do some research about them, then consider overlapping goals—interests they and those they'll be presenting to both have in common. She also encourages participants to consider what their audience will do with the info they receive. In fact, helping participants discern who their audience is so they can then adapt their public engagement accordingly is one of Philippe's favorite parts of her workshop.

"Personally, I love to really dig in to discussions about audiences during our workshops," she states. "It's important that scientists recognize the many facets of an audience's identity and critically assess what they think they know about that audience."

Adding that addressing community and representation are also important, she hopes one takeaway her participants internalize is this:

"the importance of seeing their audience's perspective when interacting with them."

Striving to understand and see from her audience's perspective is Kathy Walsh, who describes her outreach as mainly tours and instrument demonstrations for groups and individuals, at levels ranging from schoolchildren through experienced professionals in different fields. She asserts that her target audience, in addition to kids who visit MRL on field trips, is comprised of parents, families, and chaperones, who share a common interest in helping their kids succeed.

“Some may not really be into science,” she admits. “Some have strong, hobby-level scientific interests themselves but have few opportunities to engage with labs in person, and some are scientists or engineers (so there are a wide range of backgrounds).”

Walsh’s goal for her public engagement is to connect scientific tools to common experience.

“I've always loved science,” she says, “but almost went into non-science. I want to engage with people like me who took a different path. I hope they will see themselves as able to understand active scientific research (not to be put off by specialist terminology) and that they will feel welcome in labs. It would be nice to have more non-scientists (community collaborators) participating in research."

While Walsh mainly targets parents, one audience Schleife works with is high schoolers, such as periodically making presentations to summer camp participants who visit MatSE. Passionate about informing various audiences about the benefits of using computer simulations for materials research, Schleife’s research involves computational materials science/first principles simulations.

Kisung Kang’s outreach efforts thus far have also involved programs for K–12 students, including serving as a guide during field trips, along with the public. Describing what he perceives as characteristics of a K–12 audience, Kang believes their interests originate from a “natural curiosity about the world,” but acknowledges that they might have difficulty “understanding difficult knowledge.” He also suspects they might need help in grasping “simple and straightforward scientific logic.”

Kang’s public engagement goals involve the interface between the public and scientists.

Kisung Kang teaches Franklin STEAM Studio students about Virtual Virtual Reality during one of the school's field trips to MRL.

“I hope the scientific interest of the public is promoted by this interface,” he says, adding that ‘Especially for K–12 students, I want to give positive insights to scientific careers as one of the choices.’”

What did participants glean from the workshop? One takeaway Schleife hopes to implement is the structured approach Philippe shared about how to plan, implement, then characterize a public engagement opportunity. “That was very helpful,” he admits, “and gives me a way to think about how I can approach this.”

Re Walsh's favorite part of the workshop, she acknowledges that she benefitted from talking shop with two professors who do outreach activities with different scope from one another.

"It's nice to see that even highly experienced science communicators still critically analyze their style, learn from each other, and try new strategies," she says. "For me, the most helpful advice was Nadya Mason's comment in a break-out session about how many themes or points one can practically expect to communicate effectively in a given amount of time."

Kang's favorite part of the workshop was the message refinement. Upon learning that one's message should be memorable and meaningful, he did an exercise in the breakout room. Having set his audience as K–12 students, he reports,

"My original goal was to let the students learn that 'Supercomputer calculations can be used for the research of antiferromagnetic materials.'"

However, he realized that his message included professional terminology he'd need to explain—antiferromagnetic materials. After discovering that the info he had originally wanted to deliver was "Simulation can be used for the research," he reports:

"I truncated some information and made it more straightforward. Finally, my goal became to let the students learn that 'Simulation can be a part of materials researches.'"

Equally rewarding for Kang was contributing to the message of a colleague who wanted to share about her virus study and DNA analysis, but was finding it difficult to explain to the public about DNA, which delivers specific information about individuals.

"I suggested using the barcode as an analogy," he reports, "since people commonly know how the barcode works."

Gemima Philippe. (Image courtesy of Gemima Philippe.)

To his delight, his colleague liked his suggestion and planned to use it in the future.

What Philippe finds most rewarding about teaching science communication workshops is the lightbulb moments. Although as a facilitator, she leads discussions about the same communication and engagement practices during each workshop, she never tires of it.

"The amazing scientists we work with make each workshop unique," she claims. "I really enjoy those moments when a participant internalizes one of our concepts and a noticeable shift begins in how they talk about engagement."

Indicating that this lightbulb moment might happen at various points throughout each workshop, she calls it "super rewarding to witness."

A Franklin seventh grader learns how to do dynamical mechanical analysis of a snack food with the help of MRL scientist Roddel Remy.

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