Welcome to the first issue of CeMaST Connections, a rebranded re-issue of our newsletter. 2020 has been a truly unique year for everyone, and we strive to maintain connection with you so that we can continue empower, conduct, and support STEM education and scholarship across the K–16 continuum.

Thank you to our newsletter contributors, listed in order of article appearance:

Dr. Rebekka Darner • Olesya Courier • Leslie Reyes-Hernandez • Hannah Alperstein
Dr. George Rutherford • Dr. May Jadallah • Todd Eddy • Dr. Chris Merrill • Matthew Hagaman
Dr. Tanya Josek • Dr. Brad Christianson • Christine Salinas

Edited by Amanda Fein • Designed by Courtney Ossola

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Dear STEM enthusiasts,

I would like to start off this director’s message by introducing myself. My name is Rebekka Darner (most call me Bekky), and I began as the Director of CeMaST in 2019, coming from 7 years as a faculty member in ISU’s School of Biological Sciences. I hold a doctoral degree in mathematics and science education and master’s and bachelor’s degrees in the biological sciences. I have committed my career to research and teaching that fosters a scientifically literate general public, and I am excited to continue this work as the CeMaST’s director.

The CeMaST leadership team and I have decided to resurrect the CeMaST newsletter, so keep an eye out for an issue each fall, spring, and summer. The leadership team, students, and staff will collaboratively contribute to each newsletter’s contents to share with you the varied ways in which we are striving toward CeMaST’s goals. We always welcome your responses to our newsletter articles, so please drop us an email!

I also hope that our newsletter serves to contextualize CeMaST’s activities within national and global trends relevant to STEM. In this respect, 2020 has thus far taught us many lessons. The COVID-19 pandemic has demonstrated to us why we must continue to help learners of all ages understand scientific topics such as the basics of microbiology, disease transmission, and how our bodies fight off infections. The pandemic has also demonstrated the importance of fostering quantitative literacy among the general public and educational experiences that demonstrate the tentative, yet reliable, nature of scientific knowledge. Somehow, our collective health has become politicized, but I want to offer this reminder—just because some people choose to politicize scientific topics does not mean that science is political. As STEM educators, we must maintain the courage to look to the evidence and teach our students to do so as well.

This year has also been a time of racial reckoning in which we have been forced to acknowledge that discrimination and oppression still exist for many people in our country. In STEM, this discrimination and oppression manifests itself as the longstanding underrepresentation of some minority groups in STEM disciplines. For example, although Blacks/African Americans make up about 12% of the national population, only 9% of science bachelor’s degrees and 3% of engineering degrees were earned by Black people in 2016. To address issues of underrepresentation, I hope STEM educators can turn toward culturally relevant pedagogies that position students as knowledge generators rather than passive recipients of facts; elicit, value, and leverage students’ funds of knowledge; encourage students’ language; value students’ lived experiences as evidence; and promote students’ critical lens to solve problems (Kolonich et al., 2019). Furthermore, I hope that we can join many of our professional organizations who are showing leadership in addressing the minoritization of some identity groups in the STEM fields, such as the American Association for the Advancement of Science’s (AAAS) draft plan, Addressing Systematic Racism in the Sciences, which they welcome comments on via email (suggestionsforaaas@aaas.org).

Finally, I want to acknowledge the lessons that educators have learned as we have been forced to move our teaching online. The pandemic has caused us to rethink online learning. It was once (and, by many, still is) assumed to always be less-than face-to-face learning, but being forced to teach online has led many instructors to discover innovative ways of doing so. The ones who have embraced the online learning space as an opportunity rather than a problem are the ones who will be the educational leaders after the pandemic. Of course, many things are best taught face-to-face, but there are also many instances in which online learning is superior because it provides more opportunity for self-paced learning, reduces the social anxiety of trying out new ideas, and, overall, opens up educational opportunity to those who cannot afford to live away from home to go to college. Rather than simply trying to replicate what we do in face-to-face classrooms in the online space, I hope that we will come to embrace the online learning space for all that it offers, even post pandemic.

As I close this letter, I wish you and your loved ones good health and happiness. Please feel welcome to drop me an email anytime to collaborate, discuss anything you read in this newsletter, or just chat about STEM with a fellow enthusiast.

Take care,

Rebekka Darner, PhD
ISU’s Noyce Scholarship provides $20,000 scholarships to aspiring STEM teachers over their junior and senior years, in addition to a summer-long internship that engages them in integrated STEM teaching and mentored research in their major. We are happy to highlight two new Noyce Scholars, Hannah Alperstein and Leslie Reyes-Hernandez, who completed their Noyce internship this past summer. Hannah, a physics major, was mentored by Dr. Matt Caplan, Assistant Professor of Physics, as she conducted a research project examining multidimensional diffusion in crystalline solids. Leslie, a mathematics major, was mentored by Dr. Edward Mooney, Professor of Mathematics, as she conducted a research project examining middle school students’ mathematical justifications. Together, Hannah and Leslie wrote and taught a 2-hour virtual STEM 4-H workshop, “Catapulting Math & Science to New Heights,” in partnership with Illinois Extension. In their workshop, 10–14-year-olds explored conservation of energy, forces, and parabolas. Joining Hannah and Leslie in the 2020 cohort of Noyce Scholars are Noah Fabris (technology), Gary Derwin (technology), Kevin Diaz (chemistry), and Riley Fortune (technology).

The Noyce internship program provided me the opportunity to teach what I love to kids and hopefully inspire them to be curious about science and the world around them. This program also gave me access to the research and educational worlds of STEM! I learned invaluable information about what it means to be an effective, caring teacher and how to promote inquiry in my classroom.

-Leslie Reyes-Hernandez

Participating in the Noyce program throughout the summer was an eye-opening, life-changing experience for which I am greatly thankful. I learned of innovative and efficacious STEM teaching methods in which

-Hannah Alperstein
Anyone familiar with undergraduate STEM education knows that getting a degree in a STEM discipline is challenging by nature and that the challenge increases for students from economically disadvantaged backgrounds. Colleagues from Illinois Wesleyan University, Illinois State University, and Heartland Community College were recently awarded a $4.6 million grant from the National Science Foundation to provide scholarships and other help for such students. The program, called NexSTEM, awards up to $10,000 per year for STEM students from central Illinois who have significant financial need and who meet the program’s academic requirements. The first cohort of students entered the three institutions in Fall 2019, and the second cohort followed in Fall 2020. The 39 students in the program represent 11 different STEM majors. However, financial assistance is only the beginning.

In the first 2 years, each NexSTEM scholar participates in a research project chosen to highlight the real-world applications of the major they chose. Current projects include the ecological restoration of a savannah, actuarial investigation of life insurance trends, the creation of geological maps, the effects of antibiotics on bacteria, and the development of a media player for dementia patients, among many others. Scholars present their progress and results in a poster or oral presentation at the end of each semester. After this initial research project is finished, the students’ research mentors become their professional mentors, helping them to finish strong and plan for life beyond college.

NexSTEM scholars build a sense of community through service projects, student clubs, and regular contact with peer mentors, professional mentors, and the NexSTEM leadership team. The campus coordinators and project director keep close tabs on all the students, arranging tutors when necessary and generally providing stable points of support for the scholars. The success of the NexSTEM program will provide useful, concrete examples of things that help STEM students become STEM graduates, even in the face of challenges.

A group of ISU student environmental activists started a campaign in 2020 to demand that the ISU Foundation Board of Directors pull all university investments out of fossil fuels to reinvest those assets into renewable energies. The students designed and distributed a petition to garner support from ISU students, faculty, staff, and RSOs. Last September 2019, the students held a Climate Strike in support of the global climate movement that was led by Greta Thunberg. This September 2020, the Student Government Association (SGA) unanimously supported a resolution to support divesting ISU from all investments in fossil fuel industries. The students are building their arguments around ISU’s mission, vision, and value statement, and they are focusing on serving their university, region, state, nation, and world through “commitments to responsible stewardship, meaningful civic engagement, cultural enrichment, and the development of global citizens” (ISU Strategic Plan). To learn more about their work, visit Fossil Free ISU.
ILCTE and CeMaST: A Collaborative Grant Project Impacting Illinois CTE Teachers

Dr. Chris Merrill

The Illinois Career and Technical Education Innovative Curriculum Resources (ILCTE) project is a federally funded project from the Perkins Act that is disseminated through the Illinois State Board of Education. The project is led by Dr. Chris Merrill, who is a Professor in the Department of Technology and a CeMaST Associate Director, along with Dr. Brad Christensen of CeMaST, who serves as the project’s STEM and CTE Curriculum Specialist. The mission of ILCTE is to facilitate and coordinate Career and Technical Education (CTE) programs in public secondary schools, primarily for Grades 6–12. ILCTE project personnel focus on providing current, relevant, and innovative curricula; professional teaching and learning development; technical assistance; and resources to CTE teachers and career counselors.

ILCTE believes that innovation is the key to successful CTE education, which should ultimately enhance, inspire, and transform CTE programs in Illinois. Although ILCTE is currently in its final year of this funding cycle, the team hopes that this project will be renewed for another 5 years starting in July 2021.

All ILCTE developed curricula, professional development, and other resources are free to Illinois teachers. All materials can be accessed on the ILCTE website.

IPREFER: The Wonder Weed

Matthew Hagaman

IPREFER (the Integrated Pennycess Research Enabling Farm & Energy Resilience Project) is exploring how field pennycess (Thlaspi arvense L.) can be leveraged as an oilseed cover crop throughout the Midwestern United States.

Although most cover crops can be planted for many reasons (including erosion control, improved soil structure, moisture and nutrient retention, and weed prevention), pennycess can serve all these roles while also serving as a source of food to early-season pollinators and serving humankind as a source of biofuels and livestock feed. Pennycess grows during the off-season, germinating in the fall and maturing just before corn or soybeans are planted in the spring.

IPREFER is a collaboration between ISU and other academic and commercial partners. CeMaST supports the education, outreach, and extension objectives of the project by providing educational opportunities to Illinois youth as well as making connections between farmers, researchers, and other stakeholders throughout the state. In October, CeMaST used a cover crops game to familiarize legislators and other members of the public with the variety of careers supported by the project.

At present, the CeMaST-led team is finishing a Cover Crops Science project book for youth in state and national 4-H programs. Peer review is ongoing, and the book is expected to be completed in 2021. The project book teaches youth about plant science, agricultural practices, ecosystem interactions, and biofuel production using pennycess as an exemplar. Pennycess has not traditionally been used as a cover crop; however, because this research is taking place right now, students completing cover crops projects are able to learn alongside researchers across the Midwest!

In 2014, Illinois adopted a new set of K–12 science standards, the Next Generation Science Standards (NGSS). These standards focus on bringing genuine science experiences into the classroom fueled by students’ natural curiosities, questioning, and knowledge. Although Illinois adopted these standards 6 years ago, standardized testing for K–12 students remains reflective of the previous science standards rather than the NGSS. Recently, Dr. Harvey Henson at Southern Illinois University – Carbondale secured funding to have teams of teachers across different grade bands come together to write new items for the Illinois Science Assessment that reflect the NGSS. Each of these teams is formed and led by faculty across Illinois, and some have already started writing items!
the items. After the items are written, they will also undergo external review, be revised, and finally be ready for the state to use. We are all looking forward to working with teachers to write these science assessment items so that K–12 students can have standardized testing that is more reflective of their experiences in the classroom.

What’s Happening with Smart Grid?
Dr. Brad Christianson

The Smart Grid for Schools program conducted by CeMaST has proven to be very popular with teachers and students over the past several years. Hundreds of teachers and tens of thousands of students have learned about electricity, the electrical grid, and “smart” technology through the hands-on program. Each year, the SGFS program is enhanced through additional hardware, software changes, curriculum revisions, and other updates. During the summer of 2020 the program was enhanced further with the design of the Solar Farm Simulator, a wind turbine and interchangeable appliances in the Smart Homes, and digital simulations for the grid and homes suitable for on-line use.

The Smart Grid for Schools program has consisted primarily of two components, the construction grid and the Smart Home. The Construction grid provides students with table-top models of the components necessary to design and build their own electrical grid. Models include four different power plants (nuclear, coal, gas, and renewable), high voltage transmission towers, substation transformers, and low voltage distribution poles, some with bucket transformers. Several “customers” are also included such as houses, a café, barn, school, gas station, ice cream shop, and factories. After placing the components in line, students connect red, black, and/or blue “hot” wires and white “common” wires to complete the circuit, illuminating the LEDs and starting the machinery in the factory. Students add switches to control current flow. They can then make their grid “smart” by connecting gray wires between the customers and the Smart Grid Monitor. Green LEDs on the monitor indicate that the customer is receiving power. By reviewing the monitor lights, power outages can quickly be found, immediately bypassed, and then resolved.

New for Fall 2020 is a revised curriculum that identifies over 40 educational standards in mathematics, science, social studies, and language arts throughout the K-12 grade levels. Where and how each standard is addressed is clearly stated in the teacher edition.

The Smart Home is a two-story doll house with a roof panel that opens to allow access to the kitchen/dining room and laundry area. Each Smart Home is filled with home automation technology including WiFi, a water and light sensor, security system, lights that change color, and a programmable thermostat. The smart meter measures the electricity used by the home and what is used by any electrical device connected to the outlets on the back of the home. Students control the home through a tablet. They can conduct several challenge activities and experiments that introduce them to the operation of the home. Also, they can program the home to do certain tasks when events occur. For example, when the electric car returns to the garage, the lights can be programmed to turn on automatically.

New for 2020 is the wind turbine. The wind turbine mounts on the roof of the home and can be spun manually to produce up to a simulated 400 watts. This output is displayed on the tablet. Also new is the ability to replace the refrigerator and washer/dryer unit with more efficient models. The energy use of each appliance can be monitored. The Smart Home curriculum is now fully customizable by the teacher. After selecting the grade level, the teacher can include or delete individual instructions or sections of the curriculum depending on the educational goals for the project. The customized curriculum automatically shows up on the student’s tablet.

The Solar Farm Simulator is new for Fall 2020. It allows students to explore how solar farms produce electricity and how they can be designed to get the maximum energy from the sun. It consists of 20” square base with a four-foot-long arm that has a bright LED work light attached to one end. The other end pivots on a large protractor so that the “sun” can move from before sunrise to after sunset. The large protractor pivots, changing the elevation of the sun to simulate changes throughout the year.

There are four solar arrays included with each simulator. Each array consists of three solar panels that produce about 3 VDC. The angle of the panels can be changed anywhere from vertical to horizontal. They can be placed at any orientation on the simulator. The arrays can be connected individually to a multimeter so that placement and angle can be compared. They can also be wired together in series or parallel.

Hastened by the pandemic, Smart Grid for Schools has become Smart Grid for Internet. The Smart Home simulation allows students to control a virtual home in the same manner that they controlled the doll house. The virtual home has a wind turbine where wind speed can be adjusted, and a graph drawn to analyze the output. The virtual home also has interchangeable appliances and several other challenges and experiments.

The Grid Construction set is also going virtual. Students can place factories, homes, and other customers into the grid and connect them with wires. Switches can be added to control the circuits and smart meters can be placed to monitor the grid. Also, occasionally a storm passes through that damages the grid. A timer indicates how long it takes to find and fix the problem. As students learn more
about the smart grid, they improve their system and greatly reduce the duration of power outages.

The physical models are available for shipment to schools or other educational organizations free of charge. They are usually kept for two weeks and then returned, also with free shipping. The virtual components can be accessed free of charge. Training is required for all components of SGFS and SGFI. Several sessions have been scheduled and training can be arranged once the components arrive at the school. For more information, scheduling delivery, curriculum downloads and access to the virtual simulations go to smartgridforschools.org.

This show is created for all curious minds and STEM enthusiasts. The interviews are meant to be understandable and inspiring to audience members as the researchers themselves take the time to explain and answer questions along the way. There is also always a segment of the show dedicated to sharing personal experiences with STEM and what motivated the guest to begin their career in that particular field. What is important to emphasize in the show is just how common it is researchers to experience moments of doubt, discouragement, or setbacks. Relatability and connectivity is what will help our audience feel more confident in exploring the potential that STEM has to offer.

STEAM Talk Podcast premiered its first two episodes on September 15, and its third episode on October 15. Graduate Assistant Christine Salinas hosts, and guests are all contributing members to respective STEM education fields ranging from Illinois State University faculty to grad students investing in their research. All guests are also encouraged to share their best advice for students, and explain key moments in their lives that lead them to where they are today.

This semester’s episodes feature interviews with the following: Dr. Rebekka Darner (CeMaST Director and STEM education researcher), Dr. Andres Vidal-Gadea (Illinois State University Professor of Molecular Neuroethology and Worm Lab Director), Dr. Matt Caplan (Illinois State University Physics Professor and neutron star researcher), Dr. Catherine O’Reilly (Illinois State University Professor of Geology and climate researcher), and SACNAS (Society Advancing Chicanos/Hispanics and Native Americans in Science) President Rosario Marroquin-Flores will be interviewed about the SACNAS Research Journal Spotlight along with journal contributor Ian Rines (Ph.D candidate and cricket researcher).

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We Are CeMaST

All CeMaST-affiliates are encouraged to share a STEM-related moment with us, so we may continue to celebrate what makes us CeMaST together. Email your best photos and stories to Courtney at crossol@ilstu.edu for future issues. Tell us what you love about STEM, what makes you smile, or why you are excited about being involved with CeMaST.

Pictured from L to R: Matthew Hagaman, Dr. May Jadallah, Olesya Courier (pictured with sons Chris (L) and Zach (R)), Ellie Marsan, Dr. Rebekka Darner, Todd Eddy, Dr. Brad Christiansen, Dr. George Rutherford, Amanda Fein, Dr. Tanya Josek
The CeMaST Team

CeMaST Leadership Team

Dr. Rebekka Darner, Director
Dr. Jeffrey Barrett, Associate Director (Mathematics representative), Department of Mathematics
Dr. May Jadallah, Associate Director (Education representative), Department of Teaching & Learning
Dr. Chris Merrill, Associate Director (Technology representative), Department of Technology
Dr. George Rutherford, Associate Director (Science representative), Department of Physics

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Olesya Courier, Marketing, Events, & Conference Coordinator
Todd Eddy, Administrative Aide
Kate Edler, Technical Assistant to Data Analysis
Amanda Fain, Technical Editor
Matthew Hagaman, STEM Instructional Designer
Dr. Tanya Josek, Postdoctoral Associate
RJ McHenry, Technical Assistant to Smart Grid for Schools
Courtney Ossola, Graphic Designer, STEAmtalk Manager, & Social Media Guru

CeMaST Student Employees

Sayali Ahirrao, Graduate Assistant
Daniyal Baig, Graduate Assistant
Emily Bollinger, VR Assistant
Ashley Dumas, Research Assistant
Kara Kirkus, Smart Grid for Schools Assistant
Christine Salinas, Graduate Assistant, STEAmtalk Host
Ellie Marsan, Smart Grid for Schools Assistant
CeMaST Staff Spotlight

Every issue we will highlight three outstanding members of our crew. Thank you for all that you do!

Matthew Hagaman

I am currently working as an instructional designer at CeMaST, splitting my time between the Smart Grid for Schools (SGFS) and IPREFER (Integrated Pennycress Research Enabling Farm & Energy Resilience Project) grant projects. I also teach e-Commerce in ISU’s Department of Technology.

For SGFS, I spend most of my time working with technology, wearing the hats of software developer, web designer, video editor, and industrial technologist. I am most excited about CeMaST’s recently-released virtual grid construction game and the upcoming virtual reality experience exploring jobs at a local solar farm construction site. For IPREFER, Matthew spends his time developing interactive learning experiences for youth in the areas of plant science, cover crops, and bioenergy. He is excited to host a 4-H special interest club on these topics soon.

In his free time, Matthew enjoys hiking and spending time in nature.

Dr. Tanya Josek

This is my second year as a Post-Doctoral Associate here at CeMaST. I am working with Dr. Rebekka Darner and Dr. Catherine O’Reilly (ISU Geology) as a part of the Project EDDIE Team. I have been working on developing a tool that measures the pedagogical orientation of biology, ecology, and geology professors.

Later this semester I will have the honor of teaching two ecology labs in Dr. Victoria Borowicz’s BSC 201 Ecology course. The labs I will be teaching will be modules developed by Project EDDIE community members. In June 2021, I will also be working with Dr. Darner and Dr. Sarah Boesdorfer (Assistant Professor of Chemistry Education at ISU) to lead a team of Central Illinois teachers to develop Illinois State Assessment items. Although my Ph.D. is in Entomology, I am grateful to have the opportunity to be working in science education.

Post-secondary science education is one of my passions because it is a very important field of work that helps one better understand how to reach and help their students when teaching. Outside of work I enjoy spending time with my wife and our three dogs (Scoby, Blue, and Adora) and playing boardgames with friends.

Olesya Courier

My name is Olesya Courier, I am the Marketing, Event, and Conference Coordinator. I have been working at CeMaST for about three years. Right now, I am working on a few projects:

• Smart Grid for School,
• Midwest Annual Robert Noyce Teacher Scholarship Program,
• Illinois Summer Research Academy,
• High School Research Symposium.

Outside my work, I love spending time with my family. I am a mom to two boys (5th grader and 9th grader). We love watching movies together, playing board games, and taking our dog Ozzy on walks.
THANK YOU

The next issue of CeMaST Connections will be published Spring 2021.

Follow us on Social Media for Regular Updates and Content