

Welcome back!

Summers often provide a different learning experience for faculty and students, allowing time for concentrated focus on research projects, internships, and work experiences; catching up with a summer class; or taking much-needed time to relax. Now, crisp nights and sunny days usher in another academic year as students and faculty across the state embark on new classes, tackle the next step in research efforts, and reconnect with peers.

Broaden and diversify ND's workforce

ND EPSCoR faculty, students, and staff also had a busy and productive summer. For many students, it was an opportunity to discover and apply research techniques, which fulfills a part of the EPSCoR mission to broaden and diversify ND's STEM workforce pipeline. In the Nurturing American Tribal Undergraduate Research and Education (NATURE) program, students toured labs and conducted research at the University Summer Camps at NDSU and UND. Dozens more participated in several Tribal College Summer Camps, where they studied and learned about STEM disciplines from experienced faculty in their own communities.

STTAR (Students in Technology Transfer and Research) interns discovered how their classroom theories applied in work experiences with various STEM industries throughout the state. By expanding student skills, the economy is strengthened through a well-equipped workforce. It's an important example of how ND EPSCoR helps build a skilled workforce since many of the STTAR companies indicated they frequently hire past interns to fill permanent positions.

Other students explored research areas of interest within the Center for Regional Climate Studies (CRCS) or the Center for Sustainable Materials Science (CSMS), helping faculty with research projects that will impact the state now and in future years.

Growing research competitiveness

Another part of EPSCoR's mission is to help support and grow research efforts and competitiveness at

participating institutions across the state. Some of ND EPSCoR's funded research is at the forefront of scientific endeavor, resulting in hundreds of research papers published and posters presented, as well as patent applications and interest from industry partners.

However, there is another aspect to EPSCoR's support that is often overlooked; research activities that build foundational knowledge and expertise to enhance future competitiveness of faculty and students. One example in this issue highlights the work of three students at United Tribes Technical College (UTTC) who spent the summer on CRCS-related research projects that are in very early stages, providing future research opportunities for study. Another example is a student at UND who is helping create new kinds of "building blocks" for bio-based polymers. The innovative research creates a foundational step that will enhance and expand CSMS efforts and provide important insights for future investigation.

Foundational research or trailblazing exploration: they are both essential to helping build a stronger research environment within North Dakota. An added value of expanding faculty expertise is that ND benefits from new funding brought into the state from federal and industry sources. EPSCoR funded researchers have been awarded \$7.72 in external funding for each \$1 they received—an excellent return on the research investment. Reaching beyond the university setting, funded research has created new opportunities for startup and established companies. It's part of helping support a more vibrant economy in the state.

It's going to be a great year!
Welcome back!

Regards,

Kelly A. Rusch, Ph.D., P.E., BCEE
ND EPSCoR Executive Director

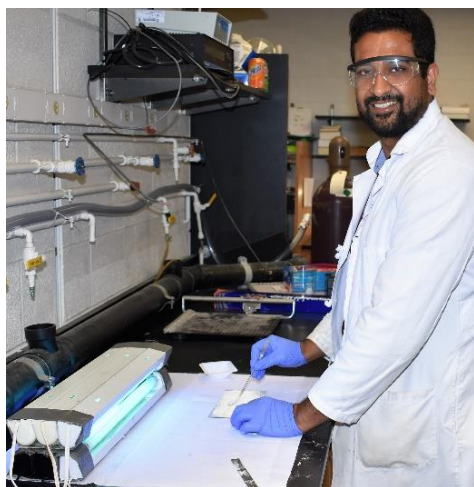


Turning on the light

Light is a tool people use every day to accomplish daily tasks, but a few researchers at UND are using light as a mechanism to synthesize and construct new sustainable materials. “This research is the interface between organic chemistry and materials chemistry,” said UND doctoral student and CSMS researcher **Rahul Shahni**. The research is a quest for sustainable answers to traditional petrochemical or BPA (bisphenol A) based materials that have been commonly used in plastics and resins.

Shahni, as part of **Qianli (Rick) Chu**’s (CSMS researcher and associate professor in Chemistry) research group, looked at ways to eliminate the BPA and create synthetic polymers that could be used in everyday products. “BPA has good characteristics—very stable at high temperatures, good mechanical strength, etc.—but it has also been found to have negative health properties. We wanted to develop a different monomer (or building block) that had the positive properties, but was made from sustainable biomass.”

Their research focused on biomass from ND beetroot and corn to create organic “building blocks” such as furfural and glycerol that could be used to create new sustainable materials. What this research team found was a potential alternative to BPA in cyclobutane building blocks (CBs), that when combined with a photosynthetic process, incorporated many desired properties. Previous research, Shahni said, focused on the 5 and 6-cyclic rings, but there was very little with a 4-ring cyclobutane monomer. Using blacklight, Shahni (below) has found a 4-cyclic ring that makes a new biomass monomer at less cost and with



little waste, and it has the positive characteristics needed to potentially make a bio-based replacement for BPA.

The research process, using photoreaction, has allowed this research team to develop a “family” or library of useful cyclobutane building blocks. “It has opened a door to develop different functionalities in the monomers,” Shahni said. “They are a promising and

safe alternative to BPA because they don’t contain a phenyl group, which enables BPA to trigger estrogenic pathways in the body.” His research has resulted in creating two different monomers, which will soon be the subject of a publication.

“I’ve learned so much from my research and Dr. Chu,” Shahni said. “Being a part of a team that is helping to open new avenues of research in recyclable/degradable monomers and polymers is very important in our research and to society.”

Foundational research

Hands-on research is often a key to helping students become aware of and persevere in STEM fields. At UTTC, three students (stories below) wanted to pursue environmental science questions, many of which began because of personal history. Under the mentorship of **Mandy Guinn**, chair/instructor of Environmental Science and Research, CRCS researcher and UTTC NATURE coordinator, the students learned appropriate research methods, how to conduct field experiments, and how to analyze data in order to take the next step in their research.

Energy from soil microbes

“I grew up in a home without electricity or running water, so I have a strong interest in trying to find clean and available sources of energy,” said **Owen Smith**, an Environmental Science student now in his second year at UTTC. Smith’s research project is to determine if microbes in various types of soil can produce electricity from their activities of eating and releasing nutrients.



Smith (left) set up a tracking board that measures the electrical activity of microbes in four different materials: river bottom, soil from campus, vermicompost, and Churo sheep manure from near the Navajo reservation in Arizona. “Sheep manure shows the most productive electrical activity,”

Smith said. “That’s an interesting result for me because Navajo people raise a lot of sheep in Arizona.”

This early stage research is interesting, but needs additional work to develop the concept. “I’m hoping to keep researching and connect the smaller cells into a larger grid. Someday I hope to find a way to power something larger,” he said. “My goal is to find a way to produce electricity from natural resources so I can share the information.”

What about onions?

Muriel Friday, a sophomore in UTTC’s Environmental Science program, was curious to know if her grandmother’s habit of eating wild onions helped her grandmother avoid getting diabetes. “My grandfather had diabetes and never ate them, but my grandmother ate them for lunch and dinner,” Friday said. “So, my research is to test wild onions and compare with other plants to see if they have the alpha glucosidase enzyme.” The enzyme and its inhibitors regulate the amount of glucose (sugar) that is absorbed into the bloodstream during digestion by increasing or decreasing the digestion of carbohydrates.



The wild onions, which are very prolific in this region according to Friday (left), grow best in slightly sandy soil and are usually found around sagebrush and grassy areas. In her field work, she picked the wild onions, but also tested organic and cultivated onions for the alpha glucosidase enzyme.

As she learned research techniques, Friday set up a control group using sugar snap peas since they also contain higher amounts of alpha glucosidase. By testing the nutritional values of each, she is hoping to better understand the potential benefit of onions and to see if her grandmother might have found a natural remedy for diabetes.

“Doing this research has really encouraged me to continue doing research,” she said. “Once I finish my degree, I’d like to go home to Wyoming and work with youth outreach, especially to encourage some of our young people to consider becoming scientists.”

Land cover effect on tornado path

An EF4 tornado from May 2019 is the subject of research by **Abby DeCoteau**, a second-year student in Environmental Science at UTTC. “I’ve always been fascinated by thunderstorms,” she explained. This past spring she had the opportunity to join UND Atmospheric Science students, mentored by **Aaron Kennedy** (CRCS researcher and assistant professor in Atmospheric Sciences) and Matthew Gilmore, (associate professor in Atmospheric Sciences), for two weeks of stormchasing in Texas, Oklahoma, and Kansas. “I didn’t see this particular storm,” she said, “but we were talking about it on the trip because the tornado path was 31 miles long and one mile wide.”



DeCoteau’s (above) research is now looking at the path of the Linwood, Kansas storm, studying the land cover and the “debris balls” that were created by the high winds of up to 170 mph. “The debris balls are picked up on radar, and we can measure how much was picked up and how far it was thrown,” she said. The key question in her research is about the impact of land cover—pasture, field, plowed—on the path or intensity of the storm, from how the radar registered the debris.

The initial radar coordinate information was provided by NOAA (National Oceanic and Atmospheric Administration) in 12 x 12 kilometer blocks. From that data, DeCoteau has assigned land cover values to each block, and she is working to correlate the debris information with the land cover.

“Research has made a difference for me,” she said. “I started in a culinary program, but following my passion in science has been amazing.” Although this was a first research experience, DeCoteau said she is ready to continue and is exploring institutions for her master’s degree.

Never giving up

He was interested in science and tech as a child, but had no idea where that would take him for a future. When his friends were working “fun” jobs, he remembered trying to make it through school while piling up debt. “I had people who pushed me to succeed and I knew that as long as I was stepping forward, I wouldn’t fail,” said **Jordan Syverson**, full-time employee at Uniqarta, a young company housed in Research 2 in the NDSU Research and Technology Park.

“My mom worked in IT at Belcourt before Turtle Mountain Community College started, and then we moved to Fort Berthold,” he recalled. “I started attending NATURE when **Kerry Hartman** (academic dean, CRCS researcher, and NATURE coordinator at NHSC) started the program on campus. I would hang out in his office and do the activities along with the rest of the kids.”

From that modest beginning, Syverson explored game design and simulation programming in college, but eventually moved home. Back at Fort Berthold, Syverson started working for Hartman as a facilitator for the NATURE Tribal College Summer Camps, and helping with a few summer research projects. He took a break to work at a dental lab in Minot, working on specialized equipment, before deciding to go to Northwest Indian College (NIC) in Washington. “It was interesting to see how they implemented culture into the science,” he said. “We studied hard sciences through the lens of the Native American beliefs. It helped me connect with my history in ways I hadn’t before.”

Once he graduated from NIC, he heard about the Pre-Engineering Education Collaboration (PEEC) program being offered at Fort Berthold Community College (now NHSC) funded by NSF. He came home, started the PEEC program, helped with summer NATURE programs, and was introduced to “Dr. Bob” (**Robert Pieri**, NDSU professor in Mechanical Engineering and PEEC coordinator). “In high school and early college, I had excelled,” he recalled. “When I got into engineering, I wasn’t getting all A’s. I thought I wasn’t good enough. Dr. Bob talked to me and helped me learn to push through and move on.”

In May 2018, Syverson became the first member of his family to graduate from college, with a degree in electrical engineering from NDSU. “My family was there and pretty proud,” he recalled. “I was the first and only one in my extended family who got a four-year degree.”

Today, Syverson is using his degree as a process engineer with an innovative ND organization, Uniqarta Inc., which is commercializing breakthrough

manufacturing processes that are up to ten thousand times faster than existing solutions for placing integrated circuits in assemblies. “I’ve worked in different jobs that were enjoyable for the moment, but



it wasn’t until this job that I found something that I could do the rest of my life,” Syverson (left) said.

“In an earlier internship, I learned

that engineering can be more group problem solving to find the right answer. At Uniqarta, it’s all about searching for the right answer, not being afraid of failure, being willing to brainstorm and keep moving forward. Now I’m able to extrapolate what I learned from school into work.”

Encouraging early interest in science, finding ways to engage a young student in learning, being willing to support, invest, and mentor - ND EPSCoR is opening the STEM pathway for students who want to make a difference in ND.

NATURE Sunday Academy sessions

Fall is often the start of new classes, and it’s also true for one NATURE program. Sunday Academy sessions began September 15, and the topics rotate to all TC campuses.

For information about NATURE programs, please contact **Scott Hanson**, NATURE Coordinator at scott.martin.hanson@ndsu.edu. The remaining topics for the 2019-2020 year will be:

Water is Life led by Ali Alshami (UND – ND EPSCoR Emerging and Translational Seed Awardee)

October 6, 2019 Nueta Hidatsa Sahnish College (NHSC)

November 17, 2019 United Tribes Technical College (UTTC)

December 8, 2019 Turtle Mountain Community College (TMCC)

March 1, 2020 Sitting Bull College (SBC)

What Lives in Wetlands? led by **Jon Sweetman** (NDSU)
October 6, 2019 Cankdeska Cikana Community College (CCCC)

November 17, 2019 (NHSC)

December 8, 2019 (UTTC)

March 1, 2020 (TMCC)

Winter Weather led by **Aaron Kennedy** (UND-CRCS co-lead/researcher)

October 6, 2019 (SBC)

November 17, 2019 (CCCC)

December 8, 2019 (NHSC)

March 1, 2020 (UTTC)

Oxygen Sensing in Water led by **Julia Zhao** and **Xu (Steve) Wu** (both UND)

October 6, 2019 (UTTC)

November 17, 2019 (TMCC)

December 8, 2019 (SBC)

March 1, 2020 (CCCC)



Synthesis of Gold Nanoparticles led by **Alex Parent** (left, NDSU-CSMS researcher)

October 6, 2019 (TMCC)

November 17, 2019 (SBC)

December 8, 2019 (CCCC)

March 1, 2020 (NHSC)

Senses and Perception in Nature developed by **Mafany Ndiva Mongoh** (SBC – CSMS researcher and NATURE coordinator)

January 12, 2020 Topic for all sites

Native Achievements in STEM developed and led by **Charles Okigbo** and team (NDSU)

February 9, 2020 Topic for all sites

Enhancing the weather forecast

One of UND's CRCS researchers is looking at the influence of smoke in a weather model. When forecasting weather on a state or regional basis, the impact of particulates in the atmosphere may have an impact. **Brittany Carson**, graduate student in

Atmospheric Sciences at UND, has joined the worldwide community of users accessing data from the Weather Research and Forecasting (WRF) Model. WRF helps modelers with forecasting needs, and includes modeling scales that range from a few meters to thousands of kilometers.

"I'm learning how to run the WRF model with my data, showing how meteorology and aerosols can interact in the atmosphere," Carson said. As part of **Jianglong Zhang's** (CRCS lead and professor in Atmospheric Sciences) research team, she is also learning a new high-performance computing software, known as Python, to run her experiments.



Carson (left) noted that doing this research is important to North Dakota since it is foundational to understanding the effects of aerosols and chemical reactions in the atmosphere, and their effect on the weather forecast. "It's especially important in a key agricultural state like North Dakota because it is well known that aerosols can enhance or suppress meteorological variables like precipitation—including hail," she said.

The WRF is a collaborative partnership of the National Center for Atmospheric Research, the National Oceanic and Atmospheric Administration, the U.S. Air Force, the Naval Research Laboratory, the University of Oklahoma, and the Federal Aviation Administration. It can provide simulations based on actual atmospheric conditions or simulated data for researchers like Carson as well as weather forecasters across the country.

Activities of note

Assessing Economic Value of Honeybee Pollination in Increasing Sunflower Oil Yield and Oil Quality was awarded \$10,000 by UND's Aerospace School to **Haochi Zheng**, along with Paul Snyder (both UND), to investigate how farmers can increase crop productivity by using "beeDar," a mapping technology performed by UAS flights.

Updates from ND EPSCoR State Office

What's an "allowable" expense?



(Article submitted by **Janelle Smith**, left, ND EPSCoR Business Manager.)

As Year Five of the INSPIRE-ND NSF RII Track-1 award wraps up and we head into the No-Cost Extension (NCE) period, there have been questions on cost allowability principles. Before incurring an expense, please note that costs must meet all of the following criteria for reimbursement under this federal award:

Costs must be allowable. Is the expense allowed under the award, either by federal regulation, limitations, or PI decision? Examples of expenses that are not allowed during the INSPIRE-ND NCE include international travel, post-docs, and visiting scholars/researchers. If in doubt, please check before you buy.

Costs must be reasonable. Costs are considered reasonable if they reflect the actions a prudent person would have made under the same circumstances – both in nature and amount. Costs must also be necessary for the performance of the award. For example: expenses for a rental car would not be considered reasonable when less expensive services are available (unless a cost savings is evident); expenses for lab glassware should match standard pricing, not custom glassware, unless there is a specific or unusual purpose.

Costs must be allocable. Costs are deemed allocable if they benefit the project or award to which they are charged. Allocable charges are either:

- solely for the benefit of the charged award; or
- benefit both the award and other work performed at the institution (costs would then be divided proportionately to appropriately reflect effort).

Costs must be given consistent treatment. Similar costs in similar situations must be treated consistently by applying generally accepted accounting principles.

Please work with your department or institution's Grant or Accounting staff, NDSU Grant and Contract Accounting (Ann Young, since NDSU is the prime), or the ND EPSCoR Business Manager (Janelle Smith), if you have any questions regarding cost criteria on this ND EPSCoR NSF Track-1 award. We are happy to help!

Calling research collaborators!

(Article by **Scott Hanson**, right, ND EPSCoR Tribal Colleges Liaison and NATURE Coordinator)



One area of emphasis within recent requests for proposals is about collaborative efforts: Can research efforts of one individual be expanded via collaborations across departments/institutions?

To help support more collaborative efforts, the EMerging Programs for Workforce Evelopment, OutReach, Education, and Diversity-North Dakota (EMPOWERED-ND) Corps began an important task a few years ago. Composed of 17 individuals from across the state, EMPOWERED-ND efforts expand diversity, enhance educational and workforce development outreach, and increase partnerships, collaborations, and communication within the NSF RII Track-1 research.

The group created an initial Broader Impacts White Paper, retitled last year to *ND EPSCoR White Paper: A Partnership to Build STEM Capacity*, to reflect the changing needs of ND EPSCoR institutions. Updated annually, the white paper lists basic demographics of the tribal college, primarily undergraduate institutions, and master's college/university (TC/PUI/MCU) institutions and their STEM needs. The goal is to help researchers prepare broader impacts sections of proposals. To foster research collaborations among STEM faculty, the document includes tables that list all faculty at TC/PUI/MCUs, their area of research interest, and indicates who is doing or interested in research. This overview shows a wide variety of research interests across the state. For a copy of the white paper, please see <http://bit.ly/NodakSTEMneeds>.

Find collaborators—sign up!

To support joint projects and assist TC/PUI/MCU researchers in finding potential collaborators at NDSU and UND, ND EPSCoR would like to build a list of STEM researchers at NDSU and UND (along with their area of research) who are interested in collaborating with TC/PUI/MCU researchers. **NDSU or UND researchers who wish to be included in the next edition of this white paper are asked to** complete the short survey at: <http://bit.ly/2NB6t50>.

Funding opportunities

Reminder Notice: The ND EPSCoR State Office has a mission to support the efforts of EPSCoR-participating institutions in increasing STEM faculty capacity and competitiveness and building a stronger STEM pipeline for our workforce.

To support faculty and students engaged in STEM research and education, the ND EPSCoR State Office is requesting proposals in the following categories:

- equipment,
- student travel to present at national conferences,
- faculty seed awards,
- awards to support K-12 outreach activities,
- awards to fund external peer review of large collaborative/interdisciplinary proposals prior to submission to a federal agency, and
- undergraduate research.

The link to the RFP and necessary forms can be found at: http://bit.ly/EPSCoR_RFP

For full consideration, proposals must be submitted by **noon, September 20, 2019**.

RFP for Workshops: The EPSCoR Workshop Opportunities (EPS-WO) Program Solicitation **NSF 19-588**.

To promote scientific progress nationwide, NSF EPSCoR establishes partnerships that are designed to effect sustainable improvements in a jurisdiction's research infrastructure, research and development capacity, and hence, its R&D competitiveness. EPSCoR welcomes proposals for workshops from institutions within EPSCoR-eligible jurisdictions. These workshops will focus on innovative ways to address multi-jurisdictional efforts on themes of regional to national importance with relevance to EPSCoR's goals and NSF's mission.

For information about this RFP, please see: <https://www.nsf.gov/pubs/2019/nsf19588/nsf19588.pdf>

Upcoming events

- **CRCS and CSMS monthly meetings:** Hosted via IVN to all campuses, with dates posted on the websites.
 - <https://csms-ndsu.org/>
 - <https://und-crcs.org/>
- **ND EPSCoR State Steering Committee:** October 16, 2019
- **ND EPSCoR Annual State Conference:** April 21, 2020 at Alerus Center, Grand Forks, ND

Stay in touch

Our mailing address is:

ND EPSCoR
1805 NDSU Research Park Drive N
Fargo, ND 58102
701-231-8400

www.ndepscor.ndus.edu

email: ndepscor@ndus.edu

twitter: @NDEPSCoR

- For a link to ND EPSCoR's prior newsletters, http://bit.ly/EPSCoR_Newsletters
- To submit a story or idea by the end of the month to joyce.eisenbraun@ndus.edu, please complete: <http://bit.ly/2m43Eh7>
- To be added to the newsletter mailing list, please email ndepscor@ndus.edu, subject line: newsletter.

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