ND EPSCoR
Established Program to Stimulate Competitive Research

News & Notes

March 2020

Connecting research to community

Research is the backbone of innovation and economic development. Research also serves the citizens of ND by helping them solve complex problems and discover new solutions to the challenges facing communities, industries, and businesses across the region. ND EPSCoR's interconnected institutions contain great innovators of educators, researchers, and students who are ready to roll up their sleeves to help your business and community.

Over just the past few years, collaborative efforts across the state have resulted in useful research that offered opportunities to new faculty and undergraduate and graduate student researchers across the state, as well as to experienced researchers from 11 campuses. The collaborative efforts at one master's college/university (Minot State University), three primarily undergraduate universities (Dickinson State University, Mayville State University, and Valley City State University), five tribal college/universities (Cankdeska Cikana Community College, Nueta Hidatsa Sahnish College, Sitting Bull College, Turtle Mountain Community College, and United Tribes Technical College), and two research universities (North Dakota State University and University of North Dakota) have resulted in new information in several important program areas.

One of ND EPSCoR's primary programs is the National Science Foundation (NSF) Research Infrastructure Improvement (RII) Track-1. The collaborative work done since 2014 through this program provides a useful illustration of the importance of collaborative research to ND. Under this program, two Centers— Regional Climate Studies (CRCS) and Sustainable Materials Science (CSMS)—have produced valuable knowledge, which has been made available to others through journal articles, translational workshops, stakeholder meetings, annual conferences, and industrial engagements.

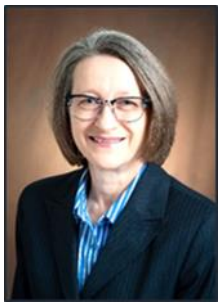
Thanks to CRCS, updated information is now available to those interested in more accurate weather models, air and water quality, ND crop economics, and soil health, or the impact of climate and weather events on native grasses, bats, aquatic species, or fertilizer recommendations.

The benefit to the state? Putting information into the hands of ND's citizens, who will use CRCS' research to make informed decisions that will impact our economy. Research on changing climate conditions benefits ND's farmers, ag industries, land use planners, and many other stakeholders. For more information about CRCS, see their website at https://und-crcs.org/.

CSMS researchers created a variety of new biobased building blocks (monomers) that are useful in resins, coatings, materials, and other composite products. Much of the collaborative research that developed from the creation of these monomers use agricultural byproducts that are renewable. The ultimate product will have biodegradable properties that will allow for the replacement of some petroleum-based products. Several of the CSMS researchers have applied and/or received patents, which will allow these new discoveries to enter the marketplace.

The benefit to the state? Expanded emphasis on bio-based, sustainable products gives increased consideration to our environment and contributes to our economy. For more information about CSMS, see their website at https://csms-ndsu.org/.

The research done through the NSF RII Track-1 is just one avenue of ND EPSCoR's programming, which illustrates the important collaborative work being done across the state at each of the 11 campuses. The 2020 ND EPSCoR Annual Conference on April 21 in Grand Forks will showcase ND EPSCoR's faculty and student researchers' achievements and give us the opportunity to celebrate their great work. We hope to see you there!



Regards,

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

STTAR business applications open

There are 19 spots remaining in ND EPSCoR's Students in Technology Transfer and Research (STTAR) program, which will continue to accept applications from ND-based businesses that are interested in hiring summer 2020 interns and having ND EPSCoR cost-share their salary. STTAR cost-share is $5/hour. Companies must provide a minimum 2:1 match.

STTAR is administered through the combined efforts of ND EPSCoR and academic Career Offices in ND. Although related to the more general cooperative education and internship programs offered throughout the state, STTAR's primary emphasis is on research and development.

The ND business enterprise does NOT have to be a technology company to be eligible for assistance. However, the research effort or specific problem to be addressed must have its foundation in science, technology, engineering, and/or mathematics.

For more information about the 2020 program, please see the STTAR brochure here http://bit.ly/32YHbmX

Businesses interested in participating with ND EPSCoR should download the business application at: https://www.ndepscor.ndus.edu/programs/sttar-program/. Businesses can send their completed application to **Shireen Alemadi**, ND EPSCoR STEM Manager, at shireen.alemadi@ndus.edu.

STEM needs survey for K-12

To facilitate bridges between K-12 and higher education, ND EPSCoR is working to produce an in-depth report on K-12 STEM needs. The goal: to better prepare our students for careers in STEM fields.

Shireen Alemadi, ND EPSCoR STEM manager, is looking to K-12 teachers for information, and she is asking teachers to complete an anonymous survey, either through this QR code (left) or by completing the survey at http://bit.ly/K12STEMSurvey.

By gathering this important information, ND EPSCoR will be able to compile a comprehensive report of what ND K-12 is doing in STEM and reviewing how higher education can support these STEM efforts.

For more information, please contact Shireen Alemadi at shireen.alemadi@ndus.edu.

Prairie Waters at VCSU

The Prairie Waters Education and Research Center provides environmental education opportunities on water issues for K-12 students, college students, teachers, and natural resource professionals in North Dakota. In addition, it provides research opportunities for VCSU students. The center is located in the former Kathryn School in Kathryn, ND, approximately 20 miles south of Valley City.

School group activities include: point/nonpoint pollution, aquatic macroinvertebrates, water chemistry/ quality, watersheds, mussels and fish of ND, water cycle, wetlands, streamflow, and geocaching.

For more information on Prairie Waters, please contact: Bonita Roswick, Education specialist at bonita.roswick@vcsu.edu or prairie.waters@vcsu.edu.

Upcoming research activities

In its sixth year, the NSF RII Track-1 project continues to produce amazing research in sustainable materials and climate studies. To highlight some of the work done around the state, this article features the CSMS research occurring at Minot State and Mayville State and the CRCS research occurring at Dickinson State and Valley City State.

CSMS CENTER FOR SUSTAINABLE MATERIALS SCIENCE

CRCS Center for Regional Climate Studies

Minot State University:

Mikhail Bobylev, CSMS researcher and professor in Chemistry, focuses on optimizing the syntheses of substituted benzylamines as model reactions for a new type of polymerization. Work by a previous undergraduate student resulted in the discovery of new biologically active compounds that were faster and created fewer waste products. Two undergraduate students **Taylor Simons** (top right) and **Benjamin Wilson** (middle right) continue to examine the full potential of these efforts.

Undergraduate student **Alexandria Hamm** (bottom right) will continue to work on improving the selectivity of the synthesis of monobenzyl formamides. Hamm has also been selected to present the results of her work to the members of Congress at the *2020 Posters on the Hill* event on April 21, 2020, in Washington, DC.

Mayville State University:

Khwaja Hossain, CSMS researcher and professor in Biology, will continue two CSMS-related research projects: a project about wheat bran-PLA biocomposite and a project about wheat bran reinforced cement concrete.

- *Wheat bran-PLA bio-composites*.

The main objective of this research is to prepare a wheat bran-based thermoplastic poly-latic acid (PLA) bio-composite of increased stiffness and toughness.

So far, sodium hydroxide (NaOH)-treated wheat bran has been compounded with PLA polymer at varying loading rates of wheat bran (such as 10%, 20%, and 30%). To increase the fiber compatibility with the matrices, maleic anhydrate was added as a compatibilizer to the previously treated wheat bran to PLA ratios and was reinvestigated to find whether using the compatibilizer made a difference in = tensile strength, tensile modulus, flexural strength, flexural modulus, and other mechanical properties.

Currently, Hossain and his students, **Creighton Pfau** and **Aaron Reistad**, are milling raw wheat bran (no pretreatment) with a goal of compounding 10%, 20%, and 30% of raw wheat bran with the PLA polymer. Compounded raw wheat bran-PLA will be injection molded to make specimens for mechanical characterization. The team is also working on preparation and characterization of the specimen from the net polymer to compare its properties to prior bio-composites.

(Khwaja Hossain, above)

- *Wheat bran reinforced cement concrete*

The objective of this project is to explore the impact of wheat bran and wheat bran biochar as a partial replacement of traditional cement.

So far, wheat bran biochar has been produced through a process of pyrolyzing with and without carbon dioxide at 300°C, 500°C, and 700°C for two, three, and four hours to find the difference. Concrete mixtures were prepared in the laboratory with a cement to wheat bran ratio at 2% and 10% for this initial research. Control concrete specimens using traditional sand, cement, and water were also prepared to compare the properties with the wheat bran biochar concrete. Each of the treatment type concrete blocks were cured and tested for load bearing properties.

Future work will investigate self-healing concrete preparations in which self-healing bacteria will be incorporated with the concrete specimens. Based on previous literature, Hossain and his students will conduct research with bacteria and nutrients incorporated in a mortar mix and then poured into a mold to form a concrete specimen. Control concrete specimens will also be prepared following the same procedures. A series of tests will be performed at different curing times to determine the effects of the added bacteria and organic compounds on strength characteristics of cement mortar.

Dickinson State University:

The goals for the Dickinson State research group, which includes **Eric Brevik**, professor of Geology & Soils, **Joshua Steffan**, associate professor of Agriculture, Microbiology, & Soil Biology, and **Paul Barnhart**, assistant professor of Biology, include the task of finishing the processing of all soil samples collected for fundamental characteristics (bulk density, pH, organic matter content). The project compares the soil

(Steffan, left, and Barnhart, right, show one group from the hundreds of collected soil samples.)

microbes in various land plots from long-term CRP land to land that has been used for no-till crop production. The comparison includes the complete microbial sequencing and nitrogen cycle functioning analysis. **Karissa Bohn** has been working with the team under ND EPSCoR's distributed Research Experience for Undergraduates (REU) program.

Barnhart has been part of a three-campus collaborative project (with fellow CRCS researchers at NDSU and UTTC), collecting data on the presence, habitat, and habits of bats in his part of the state. The remainder of his research will focus on finishing the acoustic analysis of bat presence.

Once these laboratory analyses are complete, Brevik said the next steps will involve data analysis and manuscript preparation. The team intends to have at least two papers completed by the end of summer 2020, one focused on soil properties/microbial communities and one focused on this portion of the bat study.

Valley City State University:

Andre DeLorme, professor of Science, has been actively charting the distribution of the different species of Predaceous Diving Beetles (Order Coleoptera; Family Dytiscidae) in North Dakota. Climate variations are expected to cause changes in both the thermal and hydrological properties of aquatic systems, which affects the organisms living in those systems. As a result, responses to these changes may cause shifts in species distributions. DeLorme chose this group of aquatic insects because both larval and adult forms living in northern aquatic habitats. The adults are strong fliers and can move from one water body to another, making them an excellent model for distribution changes due to climate variations. Two of DeLorme's undergraduate students, **Katherine Gehrig** and **Morgan Ohm**, will continue the collection of species around the state and prepare distribution maps of their current ranges. The team will also search for and compile historical distribution data on these species.

Lauren Dennhardt, assistant professor in Science, has focused her research on the migration of cool season grasses. Her aim is to make prairie restorations more resilient in a changing climate. Research efforts this year will include running statistics and writing a manuscript on assisted migration with cool season grasses. Her team finished collecting data last year at various plots and has begun analyzing data. This information is important for planning land restorations as climate variations continue. She is planning to present this research at the 2020 Ecological Society of America.

Additionally, Dennhardt is assessing the transcriptional responses in cool season grasses. This analysis could add a mechanism to explain some of the effects seen in the field.

(DeLorme, left, and Dennhardt, right, at the 2019 ND EPSCoR Annual Conference.)

Students present at regional conference

Greg Gust, CRCS Stakeholder and National Weather Service Warning Coordination Meteorologist, provided some feedback on the Red River Basin Commission Land & Water International Summit Conference, which was held in Fargo, ND, January 14-16, 2020. There were about 350 representatives from local, state and federal government agencies, engineering companies, and jurisdictions spanning Minnesota, North Dakota, South Dakota and Manitoba portions of the Red River Basin, and three commissioners from the International Joint Commission, which prevents and resolves disputes between the U.S. and Canada under the 1909 Boundary Waters Treaty.

CRCS researcher and graduate student in Civil and Environmental Engineering (CEE), **Mohammad Hadi Bazrkar**, presented on *Macro-scale Grid-based Hydrologic Modeling and Drought Identification in the Red River of the North Basin*. Another CRCS colleague and CEE graduate student, **Ning Wang**, presented on the *Roles of Surface Depressions in Hydrologic Processes of the Devils Lake Watershed*. Both Ning and Hadi are students of **Xuefeng Chu**, CRCS researcher and professor in CEE at NDSU.

(Bazrkar, left, and Wang, right, doing field work in late summer 2019.)

Gust noted that this was the first year that students presented during the main conference session, and they were very well received by the conference attendees, especially the operational hydro-meteorologists from the National Weather Service Office in Grand Forks, the North Central River Forecast Center in Chanhassen, MN, and the Manitoba Infrastructure in Winnipeg, MB.

2020 NATURE University Summer Camp Associate Coordinators

ND EPSCoR is pleased to announce the 2020 NATURE associate coordinators for the NATURE University Summer Camp to be held at NDSU and UND, June 1-12, 2020. Both have a long history of participating in NATURE programming and the NATURE University Summer Camp.

Uwe Burghaus, associate professor in Chemistry and Biochemistry at NDSU, will be the associate coordinator of NATURE University Summer Camp activities at NDSU. This is Uwe's first year in this role.

Tyson Jeannotte, environmental engineer at Quentin N. Burdick Memorial Health Care Facility, Belcourt, will be the associate coordinator of NATURE University Summer Camp activities at UND. Tyson has served in this role for multiple years.

Funding opportunities

DEPSCoR Regional DoD Day

Congress recently re-established the Defense Established Program to Stimulate Competitive Research (DEPSCoR) Program. The Department of Defense (DoD) has asked the University of South Dakota to host a regional DEPSCoR DoD Day on **April 21, 2020**, in Vermillion, SD. For more information or to register for the event, see https://www.usd.edu/research/depscor-dod-day.

Program officers from the Army, Navy, Air Force, and other DoD representatives will participate in the meeting, which will cover the following topics:

- How to work with the DoD, especially Army Research Office (ARO), Office of Naval Research (ONR), Air Force Office of Scientific Research (AFOSR).
- How to make connections with DoD program officers.
- How to pursue funding opportunities specific to DEPSCoR.
- How to pursue other programs within the Basic Research Office.

NSF Track-4 Research Fellows Solicitation

The RII Track-4 Fellows program **NSF 20-543** provides an opportunity for non-tenured faculty to spend extended time at premier research facilities. The fellowship period may be used to initiate new or expand

existing collaborative relationships, or to make use of unique equipment not available at the PI's home institution. Any research topic eligible for consideration under NSF's policies will be considered for support. The fellowship host site may be an academic, government, commercial or non-profit facility in the US or territories.

Deadline: May 12, 2020. There is a limit of three proposals per institution, so please work with your sponsored programs office in advance of this deadline.

Eligible PIs employed by degree-granting institutions of higher education must hold a non-tenured faculty appointment. RII Track-4 awards will be made as standard grants. The award amount will not exceed $300,000 and the project duration will not exceed 24 months. Only single-PI proposals will be considered. For more details, please see the program solicitation: PDF download: https://www.nsf.gov/pubs/2020/nsf20543/nsf20543.pdf

Center for Sustainable Materials Science (CSMS) publications

Formation of Three-Dimensional Polymer Structures Through Radical and Ionic Reactions of Peroxychitosan by **Andriy Voronov** (professor, Coatings and Polymeric Materials and CSMS researcher, NDSU) with Olga Budishevska, Nadiya Popadyuk, Anna Musyanovych, Ananiy Kohut, Volodymyr Donchak, and Stanislav Voronov in Studies in Natural Product Chemistry (Bioactive Natural Products)
2020, 64, 365-390. DOI: 10.1016/B978-0-12-817903-1.00012-7.

A Comprehensive Cheminformatics Analysis of Structural Features Affecting the Binding Activity of Fullerene Derivatives by **Bakhtiyor Rasulev** (assistant professor, Coatings and Polymeric Materials and CSMS researcher, NDSU) with Natalja Fjodorova, Marjana Novic, and Katja Venko in Nanomaterials, 2020, 10(1), 90.
DOI: 10.3390/nano10010090.

Spatial Distribution and Solvent Polarity-Triggered Release of Polypeptide Incorporated into Invertible Micellar Assemblies by **Andriy Voronov** (NDSU) with Yanxiong Pan, Oksana Zholobko, Hui Li, Jing Jin, Jinlian Hu, Bingcan Chen, and Zhongyu Yang in ACS Applied Materials and Interfaces, 2020. DOI: 10.1021/acsami.9b22435

Doctoral Dissertation Assistantship (DDA) publications

Standardized Protocol for Reporting Methods When Using Drones for Wildlife Research by **Andrew Barnas** and his advisor, **Susan Ellis-Felege** (both Biology, UND) with Dominique Chabot, Amanda Hodgson, David William Johnston, and David M. Bird in Journal of Unmanned Vehicle Systems, 2020. DOI: 10.1139/juvs-2019-0011.

Activities of note

NATURE: A 20-year Journey Cultivating STEM Among Tribal Youth in North Dakota, an article written by **Scott Hanson** (Tribal Colleges Liaison and NATURE Manager), **Jean Ostrom-Blonigen** (Project Administrator), and **Kelly Rusch** (Executive Director) on the history and impact of ND EPSCoR NATURE programming, was featured in the *Tribal College Journal of American Indian Higher Education*. For the complete article, see: https://tribalcollegejournal.org/nature-a-20-year-journey-cultivating-stem-among-tribal-youth-in-north-dakota/.

Mohammad Hadi Bazrkar, CRCS researcher and NDSU doctoral student in Civil and Environmental Engineering, was inducted into the Tapestry of Inclusion on March 4. The Tapestry of Inclusion is a pictorial mosaic that recognizes students, faculty, staff, and alumni for the contributions to diversity they bring to NDSU. Inductees contribute to supporting and advocating for diversity on the basis of age, color, gender expression/identity, mental and physical ability, race, socioeconomic status, religion, sex, sexual orientation, and veteran status of the University community.

John Wilkinson, who received ND EPSCoR New Faculty Start-Up award funding in 2013-2015, was recently featured as the February 2020 NDSU Research and Creative Activity (RCA) Researcher of the Month. Wilkinson, associate professor in Chemistry and Biochemistry, recalled becoming curious about how cells work at a young age, which led him to biology and science classes in high school, a BS in biochemistry and a Ph.D. in molecular biology from Vanderbilt University. Following postdoctoral training at the University of Michigan, he started his faculty career at Wake Forest before coming to NDSU, where studies cancer.

Muneer Shaik, CSMS graduate student researcher, Chemistry, UND, was awarded a $250 travel award at the Red River Valley ACS Young Investigator Award competition held at Mayville State University February 1, 2020.

Updates from ND EPSCoR State Office

NATURE Sunday Academy strikes gold
*By **Scott Hanson** (left)*
Tribal Colleges Liaison Manager and NATURE Coordinator

Although the temperature was -3 degrees outside, a dozen participants showed up on a Sunday morning in December at Cankdeska Cikana Community College (CCCC) for the monthly NATURE Sunday Academy activity, a key program element of ND EPSCoR's NATURE programming for middle and high school students.

The activity "Synthesis of Gold Nanoparticles" presented by Alex Parent, CSMS researcher at NDSU and assistant professor in Chemistry and Biochemistry, is a title that attracted the students' attention. Combining the word "gold" with "nano" suggested a cutting-edge technology with a rare material.

To study the gold nanoparticles, it was necessary to create a tool to measure the light from different sources, so the participants built their own spectrometer. When everyone began constructing the papercraft spectrometer, **Lori Gourneau**, a CCCC life science instructor, told the group that few of the spectrometers created by the instructors during last June's Sunday Academy workshop proved to be operational. *[Each June, as part of the NATURE University Summer Camp, **Britt Heidinger** and **Julia Bowsher** (NATURE Sunday Academy co-coordinators and associate professors in Biological Sciences at NDSU) host university faculty, Tribal college/university (TCU) faculty, and many of the high school teachers involved in Sunday Academies at the TCUs for a few days at NDSU to choose Sunday Academy activities for the upcoming school year.]*

The participants seemed undaunted by the difficulties the instructors encountered while making the spectrometers, and they set about making their own. To everyone's delight, four out of the five papercraft spectrometers constructed by participants formed an image, although image quality varied.

Producing the gold nanoparticles provided an opportunity to see how light could be used in creative ways and to better understand how light waves can be reflected, absorbed or transmitted.

Grant vs cooperative agreement
By Janelle Smith (right) Business Manager

You may be aware that ND EPSCoR works with both grants and cooperative agreements, but do you understand the difference between them? According to the National Science Foundation (NSF), "a grant is to be used when ***no substantial involvement is anticipated*** between the Government and the recipient during performance of the contemplated activity;" whereas, "a cooperative agreement is to be used when ***substantial involvement is anticipated*** between the Government and the recipient during performance of the contemplated activity" https://www.nsf.gov/bfa/dcca/contracts/faq.jsp#difference.

The NSF EPSCoR RII Track-1 award is a cooperative agreement. This award is typically comprised of five distinct reporting years. Under these agreements, the prior year's annual report must be approved by the program officer before the next year's funding is released by NSF. This requirement ensures that each year's funds are used in a way that directly benefit that year's efforts. NSF involvement also extends to budget adjustments, which must be pre-approved to ensure the award remains within scope and budget.

Additionally, under this cooperative agreement, there are several required meetings with NSF, including a Strategic Planning meeting (in Year 1) to set project metrics and progress meetings in Year 2 (Reverse Site Visit at NSF) and Year 3 (Site Visit in ND). Throughout the agreement, NSF has the right to require changes to ND EPSCoR's planned activities, objectives, or key performance metrics - and has made significant adjustments in past projects—including the elimination of research components and the addition of new activities.

In contrast, grants typically allow greater flexibility in scope and changes to budgeted activities. While there are reporting requirements with grants, the Principal Investigator generally has more freedom to adjust project activities with fewer restrictions on achieving specific results.

Upcoming events

- **ND EPSCoR Annual State Conference:** April 21, 2020 Alerus Center, Grand Forks, ND; Registration now closed.
- **NATURE University Summer Camp**: June 1-12, 2020, at both NDSU and UND.
  - **NATURE University Summer Camp Opening Ceremony:** 11 a.m. to 1 p.m. June 1, Gorecki Center, UND.
  - **NATURE University Summer Camp Closing Ceremony:** Research presentations from 9 to 10:45 a.m.; ceremony from 11 a.m. to 1 p.m., McGovern Alumni Center, NDSU.
- **Nueta Hidatsa Sahnish College NATURE Tribal College Summer Camp**: July 13-17, 2020.

ND EPSCoR support for ND K-12 instructors

The STEAM Energy Teacher Professional Development Module, an enroll-anytime self-paced online course remains available: https://register.und.edu/learning/jsp/session.jsp?sessionId=PDE.20.0522&courseId=TL.ONL.SE&categoryId=10062

Under this program, 25 Science teachers in ND who complete the course will be reimbursed for the total cost. **Ryan Summers**, EWD researcher and assistant professor of Science Education at UND said **ND EPSCoR sponsorships are still available.**

Once enrolled, participants have 60 days to complete the modules. **To qualify for reimbursement, the modules must be completed by July 31, 2020.** These modules were developed with funding from North Dakota's current NSF RII Track-1 cooperative agreement (INSPIRE-ND).

This three-module course explores aspects of STEAM (science, technology, engineering, arts, and mathematics) instruction through an integrated investigation of sustainable cities. Participants will imagine, research, design, and build their own sustainable city. Each module of the integrated curriculum has a specific content focus that engages through both a learner and teacher lens.

For more information, please contact Summers at ryan.summers@und.edu or call 701-777-3144.

Goodbye to Joyce Eisenbraun, ND EPSCoR Communication Manager

ND EPSCoR wishes Joyce Eisenbraun a fond farewell and an exciting retirement plan. Thank you Joyce for serving as ND EPSCoR's first Communication Manager.

Stay in touch

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