ND EPSCoR
Established Program to Stimulate Competitive Research

News & Notes

May 2019

Collaborations

We live in a culture that often admires the "rugged individualist" and in times past, they have frequently been credited as the pioneers that challenged conventional thought, and brought new insights to our world, including, the world isn't flat; there is something smaller than an atom; diseases can spread when you don't wash your hands.

In today's research world, individual efforts continue to be a vital part of research. But a new paradigm has evolved that most researchers find more productive as projects have expanded in scope and effort: a collaborative, unified team working together toward a common goal. The collaborative efforts allow the individual researcher or team to focus their efforts in an area of specialty, while others add their expertise to create a larger, more complete picture.

Effective paradigm

We have seen the second paradigm in successful operation for years within ND EPSCoR-funded research, especially through the Track-1 cooperative agreement. Individual researchers, sometimes hundreds of miles apart, contribute information and insight around a central theme. The unified effort brings added energy and resources to a subject area, supplying perception and building connections that would be beyond the scope of a single individual.

The unified efforts of the Center for Regional Climate Studies (CRCS) team brings together atmospheric scientists, economists, climatology, biologists, engineers, earth science and policy, natural resources, environmental science, counseling, and computer science researchers to look at the impact to North Dakota regarding our changing climate. The information now becoming available to ND's agriculturally related industries and consumers has taken a significant step forward because the collaborative efforts have resulted in better models regarding crop production as well as more accurate hydrology and weather forecasting tools.

With the Center for Sustainable Materials Science (CSMS) research, the research focus has been on finding alternative, sustainable materials using North Dakota crops as the feedstock, rather than traditional petrochemical components. That central theme incorporates the efforts of scientists in coatings and polymeric materials, chemistry, plant science, science and math, engineering, agriculture science, and life cycle analysis to develop novel monomers, polymers, composites, resins, and other materials that can compete with traditional materials, but without the harmful environmental impacts. The benefits to ND's agriculture and related industries is just beginning to be explored.

As we look ahead, there are major challenges for our state, region, and nation, but there is the potential for solving many of these challenges—some by the work of individuals, but most likely from the concerted efforts of collaborating researchers. In the days and years ahead, continue to look for strong cross-disciplinary and collaborative efforts to find creative and innovative answers to the questions that perplex.

A new addition to State Steering

Adding to the collaborative efforts is a new voice on the ND EPSCoR State Steering Committee: **Brian Kalk**. He is the new executive director of the NDSU Research and Technology Park, replacing **Chuck Hoge**. We thank Chuck for his contributions, and look forward to Brian's input.

Regards,

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

Transforming wheat bran

Wheat bran is usually considered by farmers as a less desirable byproduct of wheat. But researchers at Mayville State University have identified alternative uses for wheat bran, potentially creating benefits for wheat farmers as well as providing materials that could be used throughout society.

Khwaja Hossain, CSMS researcher and professor of Biology, was a keynote presenter at the 7th International Conference on Smart Materials and Sustainable Technologies held April 8 - 9, 2019, in Toronto, Canada. His presentation was titled *Wheat Bran Fiber as Resources for Industries*.

Hossain leads a research project to identify possible alternative uses for wheat bran. Hossain and Atikur Rahman, a research associate, conducted their research with assistance from undergraduate students like **Creighton Pfau** (Research Experience for Undergraduates awardee), in collaboration with **Chad Ulven**, CSMS researcher and Mechanical Engineering professor at NDSU.

Hossain (left) with Pfau (right) in the lab. (Photo credit: Mayville State University)

Through their research, supported by ND EPSCoR, the team analyzed characteristics of wheat bran. It has cellulosic fiber compounds, along with starch, protein, and a little fat. Like all plant material with cellulose, it also has mechanical strength properties. The high percentage of water-insoluble fiber constituted by cellulose, hemicellulose, and lignin in wheat bran offers mechanical strength.

The team determined that wheat bran could be an appropriate reinforcement in polymers, creating a new biobased thermoplastic. Although the initial testing is very positive, they are continuing to analyze the biodegradability of the prepared thermoplastic. Wheat bran has the potential to be an effective and economical reinforcing material because of its low density, non-abrasive nature, availability, low cost, and renewability, according to Hossain. Initial uses would involve processing and densifying into bio-composite pellets, which could be handled in rural areas prior to being transported to an end molder that would ship to industrial users.

The Mayville State research team illustrates one of the many ND resources which is inexpensive to find as a raw product, but has industrial uses that would benefit agricultural producers in the state.

Nature returns

The first two weeks of June are reserved for days of exploration, research, new ideas, tours, and building a network. And fun. As part of the NATURE [Nurturing American Tribal Undergraduate Research and Education] program, students from five tribal colleges (TC) in ND come to NDSU and UND for a different kind of learning experience: the University Summer camp.

Started in 1998, the NATURE program continues to encourage and inspire potential STEM students to consider taking the next step in their educational journey. This year's University Summer camp will begin at NDSU on June 3, and conclude at UND on June 14. During those two weeks, students tour each campus, interact with student mentors, and learn from research faculty about topics they choose, and have the chance to build connections with other students and career mentors.

***Marlaysia Haskell** (left), former NATURE student and recent mentor at Sitting Bull College.*

"The goal of NATURE is to help create new or strengthen existing pathways for American Indian students to successfully pursue a STEM education," noted **Scott Hanson**, ND EPSCoR tribal colleges liaison manager and NATURE coordinator. "By encouraging young students to consider further education in STEM, it helps open doors for them to seek careers in those fields."

Each year, the University Summer camp is open to 25 students, and Hanson said there are still a few slots available this year. If a student is interested, they should contact the NATURE coordinator at their TC for more information.

Journey from student to faculty

"I was a poor student in high school, and barely graduated. My poor work ethic stayed with me in my early college. A lot of times, teachers said I could do it, but I just didn't apply myself," recalled **Jody DeLong**, now the Developmental Math instructor at Turtle Mountain Community College.

After high school DeLong looked at the teaching programs at TMCC, but he wasn't interested in elementary education. "What finally got me interested was a secondary science program with native ways of knowing," he said. In addition, DeLong's wife was pregnant. "Some of my GPA wasn't the greatest, and I'd had some personal tragedies in my life around that time too," he recalled. "But when she got pregnant, I knew it was time to grow up, buckle down, and that's when I started focusing on my grades."

The first time he attended the two-week NATURE University Summer camp, he was in his 20s. At first it felt a little weird to be an older student, he said, but he was with a couple other older students from TMCC, so it worked. The lab he chose was on alternative uses of beet pulp, such as making ethanol. It was a little more advanced as a lab, DeLong recalled, because they got to make enzymes and have a "real" lab experience.

"I was really nervous about presenting the research at the end of NATURE," he recalled. "I had never made a presentation in front of a group before, but it taught me that I could do that. NATURE didn't increase my interest in STEM, but it helped give me confidence that I could succeed."

For DeLong, NATURE opened important doors. "I learned how important networking can be. It's not something that underprivileged kids think about," he said. "But having people like **Miles Pfahl** (former TMCC NATURE program director) and **Bob Pieri** (NDSU professor in Mechanical Engineering and former NATURE University Summer Camp coordinator), talking and connecting with them, it opened up other opportunities for me."

Now as a math instructor, DeLong has a new appreciation for NATURE programming, including its Sunday Academies and Tribal College summer camps where he helps mentor. "From my observation, sometimes the students who need it the most, aren't the ones signing up," he said. "But I want to tell them that these programs do work, if the students will allow them to open their eyes. NATURE and the other programs aren't just for 'nerds'—it's for them too."

For DeLong, the NATURE experience helped confirm that he could succeed in his new career choice, and make a difference. Today, he's finished his bachelor's degree, and has applied to a master's program. "It will be a lot of work," he admits, "but now I know I can do it."

Building bridges

We've all known someone who says they're ready to go to college, but when the time comes, they don't "find the time" to sign up or show up.

ND EPSCoR is piloting a fourth element of the well-known NATURE program this summer. Inspired by the needs identified in the *ND EPSCoR White Paper: A partnership to build STEM capacity*, the goal is to help American Indian high school seniors stay motivated and inspired to continue in their educational journey. **Scott Hanson**, ND EPSCoR tribal colleges liaison manager and NATURE coordinator said, "Many seniors graduate from high school with plans for college, but never make the transition."

The concept of this pilot project has been amplified with the help of **Robert Pieri**, professor in Mechanical Engineering at NDSU, who has helped mentor many students through NATURE and the Pre-Engineering Education Collaboration (PEEC) program.

Pieri (left), converses with Tyson Jeannotte (center), Native American Success in Science and Engineering (NASSE) mentor at UND, and Hanson (right) at NATURE camp closing ceremonies in 2018.

The pilot program, entitled Bridges, is a summer intensive course, which begins late May with added sessions in June and July. This year's theme focuses on sustainability. STEM professionals will share their career paths, and highlight concepts that can help students succeed.

Those themes have also been woven into the curriculum, from learning communication, basic research, math, and science skills to exploring careers, creating presentations, and conducting research. The students will have class time and independent study assignments to complete, both important skills for success in college.

NATURE Bridges will be piloted at Turtle Mountain Community College, with students recruited from three local high schools: Turtle Mountain Community, Dunseith and St. John. It's a limited opportunity, since there's only room for 15 students. The goal? To create a program that could be used by other communities who

wish to help their students make a successful transition from high school to STEM disciplines in college.

For more information, please contact: Scott Hanson at scott.martin.hanson@ndsu.edu or by calling 701-231-8606.

Water resources and hydrologic modeling

Water is a critical issue for ND: farmers want precipitation and snowpack information; people living along rivers want data on snowmelt and flood potential; and everyone is affected when a drought hits. That's why **Xuefeng Chu**, CRCS researcher and professor in Civil and Environmental Engineering at NDSU, has focused his attention on the unique cold-climate hydrology of North Dakota.

"We've been able to develop specialized models that incorporate three levels of detail, from micro (at an individual pothole) to macro (for an entire river basin like the Missouri)," he said. "The models consider all aspects of hydrology, from precipitation to snowpack, snowmelt, and runoff, to the extremes of floods and droughts."

The models are built, and then calibrated and verified against historical data from extensive field observations at sites in ND. "There are many hydrology models," Chu said, "but most models don't account for the hydrologic dynamics of the prairie potholes in our region." Another major improvement in our models, according to Chu, is the impact of the cold climate. "For example, the Corps models used for the FM diversion don't account for the detailed processes associated with snowpack or snowmelt," he said. "Both have a significant impact on flooding potential for the Red River Basin."

The "real-world" emphasis is incorporated into the research by Chu's graduate students. **Ning Wang** is modeling at the meso scale, tracking hydrology by event, day and hour. His focus has been how potholes influence the hydrologic processes, adding in temporal scales and different spatial resolutions to refine the models.

Mohammad Hadi Bazrkar is developing a drought index that integrates the impacts of snow, surface runoff, soil moisture, and precipitation. He's hoping to create a new drought prediction method that addresses the current limitations, especially for cold climate regions.

Bazrkar (left), and Wang (right), assemble recording equipment on one of the survey sites.

Mohsen Tahmasebi Nasab, who has been supported by ND EPSCoR throughout his Ph.D. program, has focused his research on macro-scale models, looking at how climate changes impact the snowpack and surface runoff, for example, in the Missouri River Basin. "If the climate predictions are accurate," he said, "the Northern Great Plains may experience an average temperature increase of 7° F during the next 100 years. That will change the water resources available in the state, and impact the state's agriculture as well."

Lan Zeng's emphasis is on improving the current Soil Water Assessment Tool (SWAT) by incorporating new algorithms to account for the influence of depressions (or potholes) on hydrologic processes in watersheds.

This summer, the students and Chu will be heading out to collect more data from the various sites around the region. Each site, powered by a small solar array, provides a wealth of information on precipitation, temperature, and snow depth. A river surveyor system is used to measure the topography/bathymetry of a lake or pothole, as well as flow velocity profiles of rivers. In addition, soil sensors at different depths installed in crop fields provide insight into the moisture content and temperature fluctuations.

"Our research goes beyond the theoretical," Chu said. "Our goal is to develop hydrologic models that provide better answers for our state water challenges, and that can be useful for many watershed areas, especially those in cold climates." As the models are refined, they can not only inform people throughout ND, but researchers across the country.

Graduate student survey

Part of the mission of ND EPSCoR is to ensure that graduate students in the current Track-1 INSPIRE-ND award have access to professional development opportunities. ND EPSCoR has developed a *Graduate Student Professional Development Survey*, to discover how your graduate experience provides both research and professional development experiences.

To better serve the graduate students supported by the NSF Track-1, ND EPSCoR has developed a short three-minute survey to better assess what professional development programs INSPIRE-ND graduate students currently have access to, and suggestions for programs that could be developed.

The following link will take you to the survey: https://ndstate.co1.qualtrics.com/jfe/form/SV_0ugGyngFs87lTDL or you can use the QR code (right).

All graduate students that have been involved or funded by ND EPSCoR are invited to participate in the survey.

Posters on the Hill

Mikhail Bobylev (left), CSMS researcher and professor in Chemistry at Minot State University, **Tess Skinner** (center), undergraduate student presenter at the *Poster on the Hill* event in Washington, DC on April 29 - 30, 2019, along with **Jessica Molesworth** (right), executive director of the EPSCoR IDeA Foundation.

Finding collaborators in research

How does a researcher find a collaborator? Sometimes there's another individual in the department or across campus that might fit the bill, but what about at a different institution? In past NSF meetings, ND EPSCoR has been told that jurisdictions have been successful in competing on the Intellectual Merit portion of award proposals, however, many jurisdictions are not doing justice to what NSF describes as the "Broader Impacts" portion.

Thanks to the efforts of the EMPOWERED-ND Corps, chaired by ND EPSCoR's tribal colleges liaison manager **Scott Hanson**, there is a document that can assist ND researchers in finding collaborators at the other ND EPSCoR institutions, including one master's college university, three primarily undergraduate institutions and five tribal colleges. The paper includes information for researchers so they can expand diversity, enhance educational and workforce development outreach, and increase partnerships, collaborations and communication. Knowing the name and interest area of an individual on another campus offers the opportunity to see if there is a potential for collaboration.

At a recent seminar, Hanson presented the *ND EPSCoR White Paper: A Partnership to Build STEM Capacity*, which outlines some of the needs expressed by the TCs, MCU, and PUIs, and research interests of many individuals. Currently Hanson is also working on assembling similar research-interest grids for NDSU and UND researchers. The goal? To increase the access for collaborative efforts of researchers across the state.

Has it worked in the past? At the recent ND EPSCoR Annual Conference, there were two examples of successful collaborative efforts: 1) emerging seed recipients: **Dilpreet Bajwa**, professor in NDSU's Mechanical Engineering and **Kerry Hartman**, academic dean and Environmental Science instructor at Nueta Hidatsa Sahnish College (NHSC), continue to work on a project that improves the performance characteristics of poly(lactic acid); and 2) CRCS researchers: **Paul Barnhart**, assistant professor in Biology at Dickinson State, **Erin Gillam**, associate professor in Biological Sciences at NDSU, and **Mandy Guinn**, chair/ instructor in Environmental Science and Research at UTTC presented their joint research on 11 species of ND bats and threats to their wellbeing.

To enhance the impact of your next proposal, it may be worthwhile to consider a new collaborative effort.

For more information:

- The white paper: https://www.ndepscor.ndus.edu/fileadmin/ndus/ndepscor/EMPOWERED-ND/STEM_capacity_white_paper_-_Dec_2018_edited.pdf
- The video of the NDSU presentation: https://youtu.be/3Vbjyg_7AEA

Activities of note

Congratulations to all the 2019 graduates! Best wishes from everyone at ND EPSCoR!

Detection of Shelterbelt Density Change Using Historic APFO and NAIP Aerial Imagery by graduate student CRCS researcher **Morgen Burke** (UND) at a Science Café presentation on March 20, 2019.

Impact of Various Organic Solvent Ratios in Water on Solubility of Alkali Lignin poster presentation by **Lacy Lilleboe** and **Jessica Emond** with advisor and co-author **Alena Kubátová**, CSMS researcher and professor in Chemistry (all UND) at the ND Academy of Science on March 8, 2019.

Several researchers presented posters at the recent American Chemical Society Meeting and Expo, March 31 - April 4, 2019:

- *QSAR Model to Predict Properties of Amphiphilic Polymeric Micells* by graduate student researcher **Kweeni Iduoku** and co-author, **Bakhtiyor Rasulev**, CSMS researcher and assistant professor in Coatings and Polymeric Materials (both NDSU).
- *Thermal Desorption-pyrolysis with Gas Chromatography-mass Spectrometry: An Approach to Speciation and Closing Carbon Mass Balance* by **Alena Kubátová** and graduate student co-authors **Tyson Berg, Audrey LaVallie**, and **Brett Nespor** (all UND).
- *Alkali Lignin Solubilization and Characterization using Lignomics Analytical Toolset* by **Bin Yao,** post doctoral research fellow in Chemistry with co-authors **Lacy Lilleboe, Jessica Emond**, and **Surojit Gupta**, Emerging Areas Seed awardee and associate professor in Mechanical Engineering (all UND).
- Minot State University Student Chapter of the American Chemical Society members pictured below with Tess Skinner, the MSU Chapter president, holding their Honorable Mention award are, from left to right**: Alexandria Hamm, Kaytlyn Heick, Amelia Hamman, Benjamin Wilson, Tess Skinner, Stephanie Sundhagen, Erin Winterton** and MSU Chemistry professor **Mikhail Bobylev**.

(photo credit, Minot State University)

- *A Lignomics Toolkit Analysis of Subcritical Water Treated Alkali* by graduate student **Audrey LaVallie** with co-authors **Jan Bilek** and **Alena Kubátová** (all UND).
- *Thermal Carbon Analysis as a Novel Tool for Examination of Transparent Polyimide Aerogel Properties* by graduate student **Tyson Berg** with co-authors **Brett Nespor** and **Alena Kubátová** (all UND).

Exploring Students' Intentions to Engage with Science: A Side-by-side Comparison of Two Theoretical Models presented by **Ryan Summers,** assistant professor in Teaching and Leadership at UND, **Ashley Hutchison** (formerly UND) both Track-1 researchers in Education and Workforce Development (EWD) and Shuai Wang (SRI International), given at the National Association for Research in Science Teaching 92nd Annual International Conference March 31 - April 3, 2019.

Center for Regional Climate Studies (CRCS) publications

An Investigation of Severe Weather Environments in Atmospheric Reanalyses thesis by **Austin King** (UND), published April 2019. Advisor: Aaron Kennedy, assistant professor, Atmospheric Sciences, UND.

New Model for Simulating Hydrologic Processes under Influence of Surface Depressions by **Ning Wang** (NDSU), **Xiaodong Zhang** (formerly UND), and **Xuefeng Chu** (NDSU), was selected as the Editor's Choice in the Journal of Hydrologic Engineering, 2019, 24 (5). DOI: 10.1061/(ASCE)HE.1943-5584.0001772

Center for Sustainable Materials (CSMS) publications

PEG-b-poly(carbonate)-derived Nanocarrier Platform with pH-responsive Properties for Pancreatic Cancer Combination Therapy by **Mohiuddin Quadir** (NDSU), in Colloids and Surfaces B: Biointerfaces, 2019, 174, 126-135. DOI: 10.1016/j.colsurfb.2018.10.069

Emerging Areas Seed publications

Mechanical Techniques for Enhanced Dispersion of Cellulose Nanocrystals in Polymer Matrices book chapter by **Dilpreet Bajwa**, **Jamileh Shojaeiarani** (both NDSU), and **Kerry Hartman** (NHSC), in Sustainable

Polymer Composites and Nanocomposites, Thomas Inamuddin, Mishra Kumar, A.M. Asiri (eds), Springer Nature, 2019, 437-449. DOI: 10.1007/978-3-030-05399-4_16.

Doctoral Dissertation Assistantship (DDA) publications, presentations

A Network Pharmacology Approach for the Identification of Common Mechanisms of Drug-induced Peripheral Neuropathy by **Brett McGregor**, **Junguk Hur** (both UND), Guillermo de Anda-Jauregui, and Kai Guo in CPT: Pharmacometrics & Systems Pharmacology, 2019, 8 (4), 211-219. DOI: 10.1002/psp4.12383

Model Systems for Analysis of Dopamine Transporter Function and Regulation by **Moriah Hovde**, **James Foster**, Roxanne Vaughan, and Garret Larson (all UND) in Neurochemistry International, 2019, 123, 13-21. DOI: 10.1016/j.neuint.2018.08.015

Transcriptional Memory following an EMT Response DDA poster presentation by **Atrayee Bhattacharya**, with co-authors **Archana Dhasarathy**, Adam Scheidegger, Danielle Perley, and Maria Privratsky (all UND) at the Keystone Symposium on Molecular and Cellular Biology Conference on Epigenetics and Human Disease, March 17, 2019.

Upcoming events

- **CRCS and CSMS monthly meetings:** Hosted via IVN to all campuses. Dates are posted for each on their respective websites.
- **NATURE Bridges camp at TMCC**, May 28 - 31, 2019.
- **NATURE University Summer camp at NDSU and UND**, June 3 - 14, 2019.

Stay in touch

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- To submit a story or idea by the end of the month to joyce.eisenbraun@ndus.edu, please complete: https://www.ndepscor.ndus.edu/fileadmin/ndus/ndepscor/documents/NewsTemplateFillable_2018-10.pdf
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