2024 South Dakota Student Research Poster Session

February 29, 2024
State Capitol Rotunda
Pierre, SD

SD EPSCoR
RESEARCH. EDUCATION. ECONOMIC DEVELOPMENT.

SOUTH DAKOTA BOARD of REGENTS

Co-Sponsored by the South Dakota Board of Regents and the South Dakota NSF-EPSCoR Program

Executive Summary

Welcome to the 2024 South Dakota Student Research Poster Session in the Rotunda of the State Capitol! This is the 27th annual event, which continues to display the important link between research and higher education. The undergraduate projects on display include student research and higher education in a variety of disciplines. This work speaks to the creativity and industriousness of our students and their desire to pursue a challenging education. Research involvement requires initiative that goes well beyond that of the regular classroom and the payoff is great in developing problem-solving skills and specialized expertise. It is well-known that students who have been actively involved in research make more effective professionals and more active citizens, regardless of their career choice.

This year, ten undergraduate students statewide are being honored with this special opportunity to present their research. Eight of these students have been selected by the six public universities and two were selected from other colleges and universities by the South Dakota Biomedical Research Infrastructure Network (SD BRIN) and South Dakota Established Program to Stimulate Competitive Research (SD EPSCoR) programs. In addition, eight displays from the six public universities, SD BRIN and SD EPSCoR ring the outer circumference of the Rotunda. These displays highlight the state's investments in research, as well as research collaborations among institutions.

It is important for our state policymakers to witness first-hand the outcomes of an enhanced research culture on our educational system. At the same time, it is important for students to learn more about how public policy decisions related to higher education, including support for research, are made. This event, which brings students and legislators together with the public and state agency personnel, is a positive step toward achieving the interactions needed to ensure a robust system of research in higher education for South Dakota.

Table of Contents

Streamlining Cryogenic Cooling for HPGe Detectors in Low Background Counters

Baily May
Black Hills State University
Hometown: Martin, SD
Major: Physics
Research Advisor: Dr. Brianna Mount

Biography:
Baily May is a sophomore at Black Hills State University majoring in Physics with a minor in Mathematics. During her time at Black Hills State University, she participated in Black Hills State University's National Science Foundation-funded Research Experience for Undergraduates summer program where she worked remotely with a mentor from the University of California-Berkeley. Additionally, Baily works with the Black Hills State University Underground Campus conducting physics research on the 4850L of the Sanford Underground Research Facility. Inspired by her research opportunities, Baily plans to pursue a Ph.D. in physics upon graduating in 2026. In her free time, Baily enjoys spending time with family and exploring the Black Hills.

Abstract:
At the Sanford Underground Research Facility, ongoing projects are dedicated to researching dark matter and neutrino properties. In order to detect these cosmic particles, large-scale particle detectors are constructed. In addition to detecting dark matter and neutrinos, these detectors are extremely sensitive to other radiation as well, which can overwhelm wanted signals from the rarer events. The underground location of the particle detectors protects them from cosmic-ray radiation, but radiation from the construction materials may still overwhelm the rare signals from dark matter and neutrinos. To minimize the trace amounts of radiation from the construction materials, the Black Hills State University Underground Campus assays materials for ultra-low levels of radiation before they can be used with the larger detectors, like LZ and DUNE. The assays are performed with low background counters that utilize high purity germanium (HPGe) detectors. The HPGe detectors must remain at cryogenic temperatures to reduce thermal noise and ensure effectiveness of radiation detection. The liquid nitrogen systems to keep the HPGe detectors cool require a labor-intensive process of checking and refilling the liquid nitrogen dewars. This poster details the ongoing efforts to automate the liquid nitrogen systems that maintain the temperature of the HPGes.

Natural Language Processing: Understanding Slang and Colloquial Speech

Beau Miller
Dakota State University
Hometown: Freeman, SD
Major: Computer Science
Research Advisor: Dr. Mark Spanier

Biography:
Beau (pronounced 'Bo') Miller is a Senior Honors student attending Dakota State University who is pursuing a bachelor's degree in Computer Science and writing his Honors thesis on "Natural Language Processing: Understanding Slang and Colloquial Speech". After graduating in May 2024, Beau plans to return to Dakota State University to pursue a master's degree in computer science. Beau intends to stay within South Dakota and work with the Bureau of Information and Telecommunications. Outside of academics and work, he has a love for the outdoors and South Dakota's community and natural beauty.

Abstract:
This research project explores the relationship between Natural Language Processing models and colloquial language. Colloquial speech in this context refers to informal and casual speech which is used in everyday life, such as slang and colloquialisms. These phrases and words hold an odd, transient space with public consciousness, each instance having a variable time of relevancy and popularity, amongst many other factors. This proves an issue for NLP (Natural Language Processing) models, as training them is expensive in both time and training resources, which runs anathema to new and evolving colloquial language, which may not possess extended relevancy or extensive documentation. This project focuses on how an NLP model could learn fast- moving colloquial language in a timely manner and how a model could effectively apply this language for practical applications, such as the ability to better understand new cultural trends, or improved communication between the model and a user.

Two Diagenetic Trematodes (*Platyhelminthes*) from the American Wigeon (*Mareca americana*) and their Phylogenetic Affinities

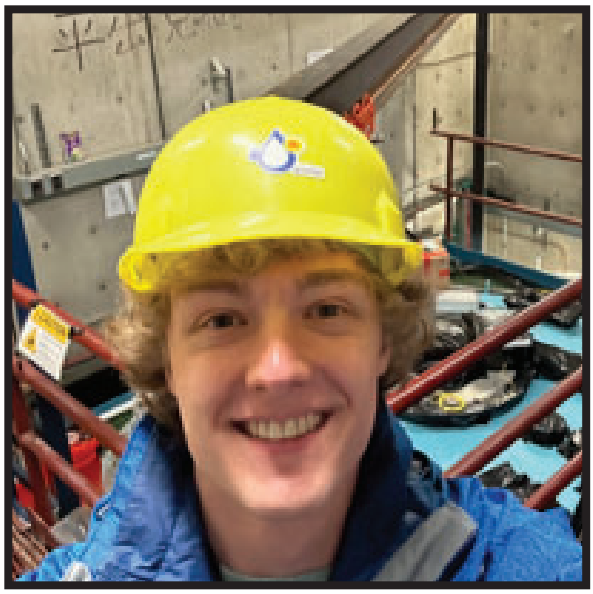
Summer Carlson
Northern State University
Hometown: Moorhead, MN
Majors: Biology and Environmental Science
Research Advisor: Dr. Eric Pulis

Biography:
Summer Carlson is a junior at Northern State University pursuing a double major in Biology and Environmental Science, with a minor in Chemistry. As an athlete, Summer competes on the Northern State women's cross country and track and field teams. Academically engaged, Summer is an active participant in the university's Honors program. Summer's current research, undertaken through this program, focuses on the trematode diversity found in the American Wigeon, a bird species local to South Dakota. Hailing from Moorhead, MN, Summer chose Northern State University to deepen her passion for biology and wildlife. Post-graduation, Summer aspires to work directly with animals, potentially in a clinical or zoological setting.

Abstract:
Many of the digenean trematodes (*Platyhelminthes*) are transmitted to their definitive hosts trophically through intermediate hosts. For trophically transmitted parasites to persist on the landscape, these species interactions must be regularly occurring in time and space, thus can help us to understand the ecological interactions of the host species parasitized by the different stages of a trematode species during its life cycle. In this study we will be identifying the trematode parasites collected from the American Wigeon (*Mareca americana*) in South Dakota. The American Wigeon is a medium sized dabbling duck with a bill structure that is specialized for grazing on aquatic and upland plants, thus it likely has less dietary overlap than most other dabbling ducks and its trematode parasites may be unique to the host or a subset of another species' parasites. Comparatively few studies on the parasites of the American Wigeon have been published compared to other abundant ducks in North America and South Dakota. Our objective is to identify the trematode species sampled from an American Wigeon using morphological and molecular methods. Two trematode species collected from an American Wigeon in South Dakota are members of the *Echinostomatidae Looss*, 1899 and *Strigeidae Railliet*, 1919 families. Both species have been stained and mounted. DNA was extracted from hologenophores and a portion of the nuclear 28S, entire ITS region, and select mitochondrial gene fragments will be sequenced. Specimens mounted will be drawn and measured to compare with original descriptions and identify the species or will be described if new. These sequences will be used to differentiate lineages and estimate relationships using phylogenetic trees. Our current and future research will allow us to document the trematode diversity of the American Wigeon in South Dakota.

Improving DUNE's Results by Studying Neutrino-Argon Events with ANNIE

Noah Everett
South Dakota Mines
Hometown: Pipestone, MN
Majors: Physics and Mathematics
Research Advisors: Dr. Jingbo Wang



Biography:
Noah Everett (pronounced 'Ever-et') is from Pipestone, MN and started attending South Dakota Mines in Fall 2020 where he is currently a senior Physics and Mathematics major with minors in Computer Science and Computational Statistics. Noah stays actively involved in the SDM and surrounding community. For example, he is currently involved in several student organizations including the Health and Fitness Club, which he founded in Spring of 2022, and the Society of Physics Students, for which he serves as the Associate Zone Councilor for Zone 11 which includes IA, MN, NE, ND, and SD. Noah is also a first-year mentor for incoming physics and mathematics students. Noah also has done a substantial amount of research, having worked with six different research groups on over nine projects spanning physics, mathematics, and computer science. Noah has spent the last two summers interning at SLAC National Accelerator Laboratory and Fermi National Accelerator Laboratory (Fermilab) working on experimental and theoretical particle physics. At SDM, he primarily works on the Accelerator Neutrino Neutron Interaction Experiment (ANNIE) which is at Fermilab. After graduating in May, Noah plans to attend graduate school for physics and then pursue a career in research.

Abstract:
The Deep Underground Neutrino Experiment (DUNE) is the flagship physics experiment in the United States, dedicated to understanding the elusive properties of neutrinos. This intricate experiment measures neutrinos sent 800 miles from Fermilab in Illinois to Lead, South Dakota where the DUNE far detector is located almost 1 mile underground in the Sanford Underground Research Facility (SURF). DUNE's success hinges on its exceptional sensitivity to neutrino interactions in ultra-pure liquid argon. However, this liquid argon is essentially invisible to neutrons produced in these interactions, which carry away vital information. This limitation can be addressed by measuring the number of neutrons produced in neutrino-argon interactions. To this end, we propose using the Accelerator Neutrino Neutron Interaction Experiment (ANNIE), which is a water detector that specializes in studying neutrons, to measure this property. We investigated the feasibility of using ANNIE to help DUNE by adding a small volume of liquid argon into ANNIE. This collaboration holds the potential to yield insights unattainable by DUNE alone, ultimately enhancing the overall efficacy of the experiment.

Production and Characterization of Magnetic Activated Carbon from Corn and Soybean Crop Residue to Estimate Efficacy for Wastewater Treatment

Magdalene Hoff
South Dakota State University

Hometown: Gillette, WY
Major: Agricultural and Biosystems Engineering
Research Advisor: Dr. Kasiviswanathan Muthukumarappan

Biography:
Magdalene (Maggie) Hoff is a senior with a major in Agricultural and Biosystems Engineering with a minor in Bioprocessing Sciences. Maggie has been working on the magnetic activated carbon project since October 2022 and had previously worked on another research project in the Agricultural Engineering department at South Dakota State University. This past summer she did a research internship at the University of Tennessee, and she also presented her research at the American Society of Agricultural and Biological Engineers (ASABE) International Meeting in Omaha, NE. After graduation she is going to work at a meat processing facility. Outside of school she enjoys spending time with her friends and family, cooking, and new starting crafting projects.

Abstract:
Corn and soybean crop residue was used as a source of carbon for producing magnetic activated carbon. The magnetic activated carbon (MAC) was produced using potassium carbonate (K2 CO3) as an activating agent, and iron III oxide (Fe3O4) to induce magnetization. After activation in a muffle furnace, the MAC was allowed to cool to room temperature and then washed with deionized water, distilled water, or left unwashed. Absorption capabilities of the MAC were tested using methylene blue and iodine number determination tests. These tests showed MAC samples washed with distilled water outperformed the others in every test. Using the values found in these tests, estimated surface area of MAC can be calculated. Based on previous research these test values were extrapolated to approximate the MAC's capability for absorbing pollutants from wastewater. These pollutants that should be tested in future work related to this study are nitrates/nitrogen, phosphorus, microorganisms and antibacterial agents, and pH value.

Not just a Pretty Face: The Importance of FORBS (Flowering Plants) for Cattle Nutrition in South Dakota

Kaitlyn Preszler
South Dakota State University

Hometown: Roscoe, SD
Major: Wildlife and Fisheries Sciences and Ecology and Environmental Sciences: Specialization in Rangeland Management
Research Advisors: Dr. Krista Ehlert, Dr. Lora Perkins, Dr. A. Joshua Leffler

Biography:
Kaitlyn Preszler grew up on a farm outside of Roscoe, SD. Kaitlyn's family has a cow-calf operation where she gained an appreciation for rangeland management and livestock production. In her free time she enjoys kayaking, hiking, horseback riding, and gardening.

Abstract:
Rangeland throughout South Dakota provide an important feed source for cattle producers. Flowering plants, or forbs, are well known for the ecosystem services they provide such as pollinator and wildlife habitat. Forbs also make up a portion of a grazing cow's diet. Little is known about the nutritional value these forbs could be offering to grazing cattle. It has been suggested that forbs have a high nutritional value, however, we are not aware of any prior studies that determine the value of individual forb species. Our study investigated the nutritional value (acid detergent fiber (ADF), neutral detergent fiber (NDF), lignin content) and dry matter digestibility of individual forb species native to South Dakota. We used our data to calculate the relative feed value (RFV) of each species. Forb species were grown in a greenhouse until an adequate amount of material could be collected for digestibility analysis. Our results indicated that forbs are a high nutritional source to grazing cattle. All species were highly digestible with NDF values of 27.7-31.8% and ADF values of 16.9-23.8%. Dry matter digestibility was 62.2-67.8%. RFV values of 215-245, indicated high value forage. Although all species tested had high nutritional value, statistical differences among species indicated that certain species may be more valuable than others. For example, Prairie Cinquefoil has statistically greater dry matter digestibility compared to other species tested. Collectively, our results demonstrate that forbs can provide important nutritional value for grazing beef cattle-which is an additional benefit for rangelands and livestock producers, that has previously been rarely discussed.

The Characterization of Neurotransmitters Following Acute Ethanol Exposure in Zebrafish with and without Embryonic Ethanol Exposure

UNIVERSITY OF SOUTH DAKOTA

Makayla Mofle
University of South Dakota
Hometown: Sioux Falls, SD
Major: Medical Biology
Research Advisors: Dr. Yohaan Fernandes and Dr. Mindy Rampersad

Biography:
Makayla Mofle is a junior at University of South Dakota majoring in Medical Biology and minoring in Interdisciplinary Science and Business Administration. Makayla plans to attend medical school after graduating in May of 2025. Makayla started in the Fernandes Lab her freshman year and this past summer she was able to immerse herself into research as a recipient of the SPURA summer program. At the University of South Dakota she is also a tutor and supplemental instruction instructor, and a member of the sorority Kappa Alpha Theta, where she has served on the Panhellenic Council.

Abstract:
The prevalence of alcohol consumption amongst women aged 18 to 44 in South Dakota is estimated to range from 59.4 to 72.7 percent marking it as one of the highest in the United States. Furthermore, 1 in 7 women in the US reported consuming alcohol during pregnancy. Prenatal alcohol exposure affects 1 in 100 children born in the US and is associated with a host of birth defects collectively known as fetal alcohol spectrum disorder (FASD). Impaired social behavior is often a devastating symptom of FASD that dramatically reduces the quality of life for patients with FASD. Additionally, FASD cost the US 4 billion dollars annually with additional costs resulting from individuals with FASD. Thus, advancing our understanding of the mechanisms responsible for ethanol-induced social defects is paramount. Zebrafish have already begun playing a role in furthering our knowledge about potential mechanisms responsible for ethanol-induced social defects. Zebrafish are social animals. Increases in dopamine levels indicate that a stimulus is rewarding. Previous work has shown that dopamine levels increase in zebrafish when shown a social stimulus. Our previous work has shown that embryonic ethanol exposure from 24 to 26 hours postfertilization (hpf) disrupts social behavior in adult zebrafish, and whole brain dopamine levels in zebrafish with embryonic ethanol exposure are lower compared to controls when shown a social stimulus, which suggests that the embryonic ethanol exposure impacts the reward system. Here we build on our previous work by using an acute ethanol exposure in adult zebrafish with and without embryonic ethanol exposure as a rewarding stimulus. Our preliminary data shows a trend in which dopamine levels are increased in the fore and midbrain of fish without embryonic ethanol exposure. However, we do not find ethanol-induced dopamine increases in fish with embryonic ethanol exposure. Our data suggest that embryonic ethanol exposure impacts the reward system and thus has the potential to provide mechanistic insights into one of the most devastating symptoms of FASD.

Monitoring Selenium Bioaccumulation and its Potential Effects in False Map Turtles (*Graptemys Pseudogeographica*)

Grant Budden
University of South Dakota
Hometown: Pipestone, MN
Major: Medical Biology
Research Advisor: Dr. Jacob Kerby

Biography:
Grant Budden (pronounced 'Boo-den') is a senior majoring in Medical Biology at the University of South Dakota. Grant will be continuing his education at the University of Minnesota School of Dentistry to attain a Doctor of Dental Surgery degree after graduating from the USD in the Spring of 2024. Currently on campus, Grant enjoys spending time as the president of the Special Olympics College Club, president of Then Feed Just One, and Vice President of Site Leader Relations for AWOL. Grant began this project as a 2022 UDISCOVER Scholar and has received scholarships from the South Dakota Space Grant Consortium and USD's Office of Research for Undergraduate Research Excellence. This research will also be presented at the National Conference of Undergraduate Research in Long Beach, California and will be the focus of his Honors Undergraduate Research Thesis.

Abstract:
Selenium is an element that becomes bioactivated in aquatic environments. Selenium bioaccumulation may threaten an already threatened South Dakota species, the False Map Turtle (*Graptemys pseudogeographica*). Invertebrate filter feeder species like zebra mussels (*Dreissena polymorpha*) are known to uptake selenium via their exposure. Previous laboratory work has found that False Map Turtles consume large amounts of zebra mussels throughout the summer months leading to selenium bioaccumulation from selenium transfer. A myriad of negative effects like selenosis, reproductive infertility, and death are associated with high selenium concentrations. Sampling was done on the False Map Turtles in the summer of 2022. Samples were taken once a month from July to September. A blood sample and several morphometric measurements were collected from each turtle. Data were collected from 15 male and 38 female False Map Turtles. The average selenium concentration present during each month appeared to peak in July with an average concentration of 0.941 ug/g and a maximum concentration of 6.24 ug/g. The relationship between sex and the average selenium concentration per month showed relatively equal concentrations among males and females with similar concentrations during August and September. Yet, during the peak month of July, male turtles had a much higher selenium concentration (1.37 ug/g) than their female counterparts (0.732 ug/g). When accounting for turtle body mass in relation to sex, males appeared to have over 600% more selenium present per gram of body weight. Further work needs to be done to determine why this difference exists. Differences in overall size might alter prey selection where males are more likely to consume the smaller zebra mussels. Additionally, detoxification systems in the turtles themselves might differ between the sexes. Regardless, these findings highlight the importance of understanding the role of invasive zebra mussels in contaminant distribution in aquatic ecosystems.

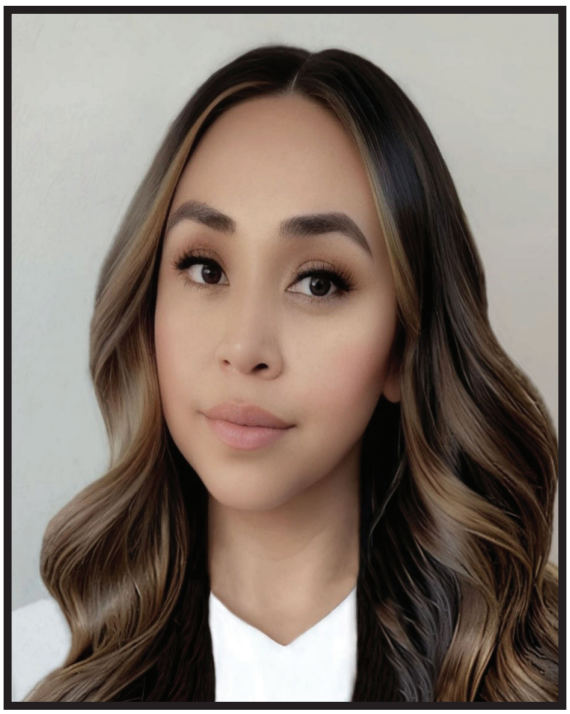
Evaluating Bioaccumulation of Heavy Metals in Tribal Bison Herds: Risk to Human Health and Bison Production

Erica Lafferty

Hometown: Eagle Butte, SD. Cheyenne River Sioux Tribe

Major: Natural Resource Management emphasis in Wildlife and Fisheries

Advisors: Dr. William Severud, Dr. Amanda Cheeseman, Dr. Jeff Martin, Dr. Xu Lan (all SDSU)



Biography:

Erica Lafferty is a tribal member of the Cheyenne River Sioux Tribe in South Dakota and is an Oglala Lakota College Alumni where she graduated with an A.A. in Life Sciences in 2020 and a B.S. in Natural Sciences with an emphasis in Conservation Biology in 2023. While pursuing her undergraduate degree she worked on several research projects that were all within her area of interest such as public health research, environmental research, community infrastructure, biochemical research, and earth science data. The majority of these projects partnered with the Cheyenne River Sioux Tribe or the OLC, and South Dakota universities. Erica is currently in her second year of graduate school at South Dakota State University majoring in Natural Resource Management, where she is currently working on her research project that is looking at how heavy metals in the soil and plants can influence bison health and determining if there is cause for concern for human health and bison production. Her personal goal is to finish her master's degree and then pursue a Ph.D. After receiving her Ph.D. she plans to work with tribal communities within South Dakota and the Great Plains region and work with improving and managing bison herds, evaluating the state of their rangelands, cultivated lands, and wildlife.

Abstract:

For tribes in the Great Plains region, bison have been integral to their survival. Because of the huge impact bison had on the way of life for the tribes, providing food, shelter, clothing, tools, and weapons, the bison were considered sacred due to their versatility. With the tribes maintaining a symbiotic relationship with their immediate surroundings and environment, they were provided with a healthy source for their dietary needs. However, with the introduction of Western philosophies and colonization many of the tribes began facing difficulties securing food for their dietary needs. Governmental policies that restricted access to traditional diet resources and incentivized/forced reliance on foods that have now been linked to high incidence of disease in tribal communities. Many of these reservations face food insecurity and food desert issues as well. The scientific communities, tribal governments, and individuals have been working to reintroduce traditional diet foods, such as bison meat, back into the communities. Many of the South Dakota tribes have commercial herds that help provide bison meat to the communities. For years many tribal lands have accumulated heavy metals within their soils from anthropogenic activities. These heavy metals may accumulate within plant and animal tissue, causing adverse health effects in those who consume them. Therefore, there is a need to investigate the health of the soil, plants, and bison tissues is needed to identify the levels of heavy metals within these areas and create baseline data for bison health. This project seeks to address this issue by collecting soil cores, samples of vegetation, and bison tissue to assess the incidence of heavy metals and map high risk areas.

Characterization of Fluorescent Protein-expressing Influenza Viruses

Caycee Schneider
Mount Marty University
Hometown: Turton, SD
Majors: Pre-Med and Biology
Research Advisor: Dr. Victor Huber

Biography:
Caycee Schneider is a junior Pre-med/Biology double major at Mount Marty University. Caycee participates in sideline cheer and is involved in the Biochemistry club. Caycee is also the vice president of the Red Cross club, which hosts 2 blood drives a year. Caycee is very passionate about healthcare and enjoys helping others, which she does through her job as a CNA and volunteer work with Mount Marty.

Abstract:
Fluorescent protein-expressing influenza viruses allow researchers to visualize where an infection is localized and how viruses interact with immune system components. This visualization can be done through flow cytometry or fluorescent microscopy. However, the characteristics of the viruses are important to understand because it determines how infective the virus is and how much virus is needed to perform certain experiments. Previously, fluorescent protein-expressing influenza viruses have been utilized in other studies, but have not yet been used in our lab. Our specific influenza viruses are WSN-based reporter viruses named WSN-PA-RFP, which produces a red fluorescent protein, and WSN-PA-GFP, which produces a green fluorescent protein. To characterize the viruses, we used 3 different types of assays. The HA titer tests the amount of virus present in a sample. The TCID50 is an infection that determines the amount of virus needed to kill 50% of cell culture. Finally, the plaque assay quantifies how much virus in a sample can successfully infect and reproduce in a sample, which is called plaque forming units or PFU. Through this characterization, a better plaque assay protocol was also developed to fit the needs of the lab as the old protocol was not effective enough for the lab needs. The new protocol is 80% effective. The characterizations are as follows, WSN-PA-RFP has a TCID50 of 106.55, PFU/ml of 107.09, and an HA titer of 1:32. WSN-PA-GFP has a TCID50 of 102.98, PFU/ml of 104.86, and an HA titer of 1:8.

Black Hills State University
Research and Student Education

Black Hills State University's close proximity to the Sanford Underground Research Facility creates unique research opportunities for BHSU students. Space is designated at the 4,850-foot-level for the BHSU Underground Campus for ongoing physics and biology research as well as flexible space for future research across a variety of disciplines.

The BHSU Underground Campus provides opportunities for faculty and students

Located nearly a mile underground, the BHSU Underground Campus creates world-class research opportunities for South Dakota faculty and students, leveraging and expanding the benefit of Sanford Lab for the state and amplifying its impact on science, technology, engineering, and mathematics (STEM) education. The research and experiential learning opportunities for students are unrivaled anywhere else in the U.S.

The Sanford Science Education Center provides science outreach

The Sanford Science Education Center (SSEC), which was made possible thanks to T. Denny Sanford's $70 million donation, draws upon and leverages the science and engineering of the Sanford Lab and capitalizes on the educational resources of BHSU.

The BHSU Underground Campus and the SSEC complement the educational offerings already underway and open up new directions.

Contributing to Workforce Development

- BHSU has provided over 100 funded undergraduate research fellowships during the last decade to students in priority areas, such as biomedical research, genomics and biotechnology, physics, environmental science, and deep underground science.
- BHSU recognizes the importance of Science, Technology, Engineering and Mathematics (STEM) education in the creation of a research enterprise and the development of a skilled workforce. The University provides scholarships to recruit students into these disciplines.
- Successful workforce development includes outreach to K-12. BHSU is actively involved in outreach, teacher preparation and education research and houses the Center for Advancement in Math and Science Education (CAMSE).
- New degrees are currently under development to address workforce needs and promote technology-based economic development.

Rob Dahlenburg (left), senior mathematics and science education major from Spearfish, gets final instructions from Spearfish Middle School students and teacher Andy Johnson before taking their robot underground during the BHSU Underground Robotics Competition at Sanford Lab.

BHSU graduate student Risten Haugen conducts research at the BHSU Underground Campus in the Sanford Underground Research Facility.

Supporting South Dakota's Research Agenda

- The Center for the Conservation of Biological Resources (CCBR) capitalizes on the strengths of the BHSU biology program to address regional problems in conservation and biodiversity management.
- The BHSU WestCore DNA facility was created to strengthen the South Dakota INBRE program.
- The innovative Master of Science in Integrative Genomics program leverages the resources of CCBR and WestCore to advance South Dakota's 2025 initiatives, primarily in biotechnology.
- BHSU is significantly involved in Sanford Lab research in two areas; neutrino physics and microbial genomics. Both of these research initiatives are supported by grant funds and collaborations with universities and government organizations, such as Princeton University, the Desert Research-Las Vegas, the University of Tennessee-Knoxville, and the Bigelow Laboratory for Ocean Sciences, among others.
- BHSU is a partner in a 2010 center in physics.
- BHSU is a partner in S.D. EPSCoR and INBRE.

RESEARCH@DSU

Transforming What's Next in Cyber

At Dakota State University, we nurture and celebrate innovation. Students, faculty and staff have opportunities and resources to engage deeply in research and development in South Dakota and beyond.

DEEP **FOCUS**

Cyber Ag

Initially supported through a State appropriation for Precision Ag Cybersecurity work at DSU and SDSU, Dakota State's Cyber Ag efforts have now expanded with support from Case New Holland and a partnership with Sweden's national center for the study of Artificial Intelligence, AI Sweden.

Cyber Health

Building on efforts in an Internet of Things (IoT) lab that has attracted generous funding and generated new intellectual properties, DSU is now home to efforts in machine learning for social determinants of health and an app development partnership that supports a proven suicide prevention peer mentoring model.

AI and Machine Learning

In addition to our work with AI Sweden and the National Institutes of Health via SDSU, DSU continues to develop AI research with direct relevance to automotive, energy, health, space, and telecom sectors.

For more information, contact DSU's Office of Research and Economic Development at 605-256-5100 or dsu.researchaffairs@dsu.edu. Or check out dsu.edu/research.

BROAD **IMPACT**

Programs like our partnership with AI Sweden ensure that professionals are prepared for the intercultural challenges of a connected world. A growing research portfolio that topped $11M in expenditures for FY23 ensures ample opportunity for students to work across 17 MadLabs®, in our Applied Research Lab, or other campus labs.

The Paulson Cyber Incubator and Entrepreneurial Center

The Paulson Center works with researchers to protect and develop their intellectual property through its programs and resources, including its membership in the National Science Foundation's Great Plains I-Corps hub.

Developing STEM Workforce to Meet Urgent Needs

In collaboration with the National Security Agency, the Department of Defense's Cyber Scholarships Program, and the National Science Foundation's CyberCorps Scholarships for Service program, and through the Governors Cyber Academy, DSU continues to develop the cyber research and education workforce to power the silicon prairie, lead regional development, and directly address national and global shortages of cyber professionals.

Innovation to Build Tomorrow's Economy Today

DSU offers faculty, students, and full-time staff researchers the tools to innovate today and scale for the technological and economic needs of tomorrow. Together, we're transforming what's next in Cyber.

NORTHERN STATE UNIVERSITY

Aberdeen, South Dakota | northern.edu

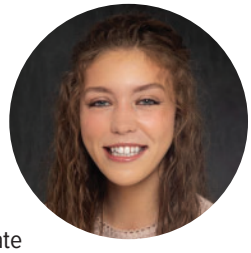
Northern State University is engaged in research throughout the year

Research at Northern State University is conducted year-round in its state-of-the-art Jewett Regional Science Education Center and across campus. Undergraduates can collaborate with faculty on projects that have a global impact, gaining a competitive edge through hands-on experience. The following are some highlights of Northern's recent and ongoing research.

Grace Kramer

Recent Northern State University graduate **Grace Kramer** transforms her Honors Program thesis on UTI genetics into a groundbreaking business. South Dakota is set to manufacture eqUTI, an over-the-counter patch preventing UTIs during intercourse. With support from community leaders like Dr. Sal Villegas and Mike Bockorny, Kramer aims to enhance science career opportunities locally. Passionate about women's health, she eyes the South Dakota Governor's Giant Vision Competition to advocate for FemTech innovations.

Alexandria Arndt



Alexandria Arndt, a criminal justice major at Northern, won first place for her honor thesis "Addicts to Advocates: How Drug Courts Are Reforming The System" at the National Collegiate Honors Conference. She is advised by Dr. Justin Gus Foote from the Department of English, Communication, and Global Language in the College of Arts and Science. Alex is also on the softball team and the vice president of Speech and Debate.

Northern Research Highlights

- **Jess Splichal**, BS biology and AS biotechnology, partners with One-Legged Pheasant owner **Dave Welling** to create a craft beer using a modified yeast strain. The collaboration provides hands-on scientific experience, relevant to Splichal's medical aspirations. Proceeds from craft beer sales support NSU scholarships.
- In a 2023 research project with **Dr. Amy Dolan**, **Mia Zagorski**, and **Calista Kocmick** investigated "Developmental Biology of Sea Urchin Embryos." They enhanced animal husbandry skills by collecting, fertilizing, and visualizing sea urchin gametes.
- **Maddie Gonzales** and **Mya Krause**, under **Dr. Amy Dolan**, contributed to ongoing research on Western Painted Turtles, extracting and amplifying turtle DNA using PCR.
- Undergraduate students **Jaeden Shaving** and **Dylan Grundstrom** presented research at conferences with NSU travel grants. Shaving explored the spiritual beliefs of the Lakota people at the 2023 Northern Great Plains History Conference, while Grundstrom delved into humor evolution in online forums at the Lighthearted Philosophers Conference.

Northern Grant Activity

Northern faculty and staff helped secure $3 million from state, federal, and private entities in FY 2023.

Northern Edge Grant: Over $11,000 was awarded to undergraduate researchers for their research and scholarship projects in 2022-2023.

In collaboration with **Dr. Eric Pulis**, **Summer Carlson** received a $2,500 Competitive Research grant for her project, “Two digenetic trematodes (Platyhelminthes) from the American Widgeon (Mareca Americana) and their phylogenetic affinities.” She will present at the 2024 Legislative Poster Session in Pierre, SD, representing Northern State University.

Susan Citrak | Coordinator of Undergraduate Research | **northern.edu**

SOUTH DAKOTA MINES

Building South Dakota Through Research & Innovation

RETURN ON INVESTMENT

98% Placement in career field

$70,036 average starting salary

39% of graduates stay in South Dakota

#7 Regional Public University *(USNWR)*

#9 Most Highly Recommended School in the Nation *(WSJ)*

#31 in the Nation for Return on Investment *(WSJ)*

RESEARCH & INNOVATION STRATEGIC GOAL

Promote an innovative and research-driven culture that discovers knowledge and creates wide-ranging partnerships that benefit society through economic growth

FISCAL YEAR 2023

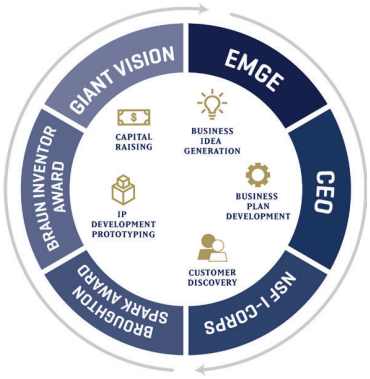
$24M in research awards
(71% increase since 2019)

$19M in research expenditures
(62% increase since 2019)

TOP FUNDING SOURCES

National Science Foundation
Department of Defense
State of SD
Department of Education
National Aeronautics & Space Administration
United States Department of Agriculture
Industry
Centers for Disease Control & Prevention

ENTREPRENEURIAL ECOSYSTEM



Governor's Giant Vision Business Plan Competition

$262,500 Awarded to students & Faculty in Governor's Giant vision Business Plan Competition

15 out of 20 First-Place Awards in student & open divisions

CURRENT RESEARCH INITIATIVES

Bioprocessing at CNAM Bio & Dakota BioWorx

Quantum Information Science

Osteoarthritis

Neutrino Research at SURF

Advanced Metals Processing

South Dakota State University

Research

LEADING RESEARCH IN BIOPROCESSING, PRECISION AGRICULTURE, REMOTE SENSING AND LIFE SCIENCES TO DRIVE ECONOMIC DEVELOPMENT, SOLVE VEXING PROBLEMS AND IMPROVE THE LIVES OF SOUTH DAKOTANS.

The POET Bioproducts Center officially opened in fall 2023. The new, state-of-the-art laboratory, located in the Research Park at South Dakota State University, will bring researchers from SDSU and South Dakota Mines together with industry partners to scale up innovative biotechnologies and diversify South Dakota's economy.

Public-private partnerships create economic value through innovation

In 2011, two SDSU professors partnered with South Dakota Innovation Partners to co-found Prairie AquaTech. Allocated research funds from the state ($2.5 million) and other sources ($100 million) was invested for the creation of bioprocessing technologies for plant-based ingredients in aquaculture feed. The technology was invented, patented and licensed to Prairie AquaTech, which then commercialized and scaled-up its product. In 2019, the company opened its $60 million food ingredient manufacturing facility in Volga.

Now, Houdek is a world leader in the production of alternative aquafeed ingredients, has opened South Dakota's first certified food ingredient manufacturing facility, is one of the state's most successful ag startups and provides a lucrative market for South Dakota's soybeans.

Graduate and undergraduate research plays an important role in a student's academic career at SDSU.

SDSU is also home to Research Experiences for Undergraduate programs, an NSF-backed program that provides undergraduate students with experience pursuing high-level research projects with guidance from faculty researchers. Undergraduate students are encouraged to get involved in research through the Undergraduate Research, Scholarship and Creative Activities Day, the South Dakota Legislative Poster Session and through the Journal of Undergraduate Research. Students in the Van D. and Barbara B. Fishback Honors College conduct original research as part of their graduation requirements.

Economic Impact Highlights

Faculty raised and deployed an average of $139,000 each to conduct research and other sponsored activities (FY23)

$1.54 return on every $1 spent on research expenditures

$140.1 million in grants and contracts secured in FY23

FY23 research expenditures at $74.1 million
22% increase from FY22

R1 Our Way

In SDSU's new strategic plan, Pathway to Premier 2030, it was announced that the university will embark on a journey that will reshape how the university, and the rest of the country, views its research enterprise. SDSU will begin a process to increase its research expenditures and doctoral research graduates, with the end goal of being recognized in the highest category of research institutions.

sdstate.edu/research

UNIVERSITY OF SOUTH DAKOTA

Fostering South Dakota's knowledge-based economy, training the state's skilled workforce, and contributing to South Dakota's high quality life.

RESEARCH FOCUS

Biomedical Engineering: Researchers at USD BME are at the intersection of science and medicine, developing tomorrow's innovative solutions for today's medical problems. Current research topics include studying the biomechanics of blood vessels and developing vascular tissue engineering scaffolding for regenerative medicine. We are also generating novel drug-delivering catheter balloons for treating artery disease. We are developing next-generation antimicrobial materials to stop the spread of pathogens, and we use bioinformatics and machine learning to analyze life sciences data ranging from basic laboratory experiments to patient clinical outcomes.

Physics: USD physics researchers are active in experiments at Sanford Underground Research Facility at the Homestake Mine in Lead, SD. The unique capabilities of the underground lab including ultra-pure germanium (Ge) crystal growth and detector development have positioned these researchers to be the global leadership and allowed them to lead an NSF PIRE consortium for developing novel Ge detectors for use in underground experiments. The Ge crystals produced as part of this research may also have commercial value in sensors, solar panels, medical imaging devices, radiation detectors, and other electronics.

Neuroscience: Researchers are investigating post-traumatic stress disorder in veterans and the effects of stress on the brain. Utilizing functional magnetic resonance imaging (fMRI), researchers are also exploring normal and abnormal brain function.

Missouri River Institute (MRI): Researchers are studying the effects of land and water use practices and climate change on the Missouri River system to better understand the impacts of these changes on the function of the system. MRI researchers partner with the National Park Service, U.S. Army Corps of Engineers, U.S. Fish &Wildlife Service, and South Dakota Game, Fish & Parks staff. They assist in providing data and expertise to help inform management and river regulation decisions to promote biodiversity and a healthy and sustainable river system.

WORKFORCE DEVELOPMENT

Undergraduate Research: USD is home to three Research Experiences for Undergraduates Programs, sponsored by the National Science Foundation. The programs offer student participants one-on-one research experiences with USD chemistry faculty members augmented by educational workshops, tours, and social activities.

Graduate Research: The University of South Dakota Neuroscience, Nanotechnology and Networks (USD-N3), National Science Foundation Research Traineeship (NRT) grant provides an interdisciplinary, team-based graduate training in the development of nanotechnology-derived tools for the study of the nervous system. The program is also aimed at preparing graduate students for training in non-STEM-specific professional skills.

TRAC: USD's research supports technology-based economic development. The Technology Readiness Acceleration Center (TRAC), established in 2020, pairs student entrepreneurs with faculty inventors to develop new technologies and evaluate their market potential. Technologies that emerge from TRAC are guided along the commercialization pathway for their business, including assistance with learning about business organizational structure and operations. USD works closely with the South Dakota Small Business Development Center, the Governor's Office of Economic Development, the Enterprise Institute, and USD's Graduate Education and Applied Research (GEAR) Center to provide services, support, and space to nurture and grow companies that will shape South Dakota's future economy.

For more information, contact **USD's Office of Research and Sponsored Programs** at **605-658-3760** or **orsp@usd.edu**

Six federal agencies for EPSCoR and NIH INBRE (IDeA Network of Biomedical Research Excellence) administer programs supporting the development of research infrastructure, STEM education and knowledge-based economic development.

EPSCoR Participating Institutions

SD EPSCoR
RESEARCH. EDUCATION. ECONOMIC DEVELOPMENT.

EPSCoR Impact on South Dakota

National Science Foundation (NSF)	National Institutes of Health (NIH)	National Aeronautics & Space Administration (NASA)
Dr. Mel Ustad, PI **Dr. Kinchel Doerner, Project Director**	**Dr. Victor Huber, Project Director**	**Dr. Ed Duke, Project Director**
NSF Track-1 Statewide research infrastructure, STEM education and economic development projects. Current 2019-23 award: $20M 1989-2023: 10 awards: $90M **NSF Track-2** Collaborative research projects 5 awards: $17.5M 3 Active awards: $14M **NSF Track-4** Early career research fellowships 10 awards: $1.8M 2022-2023 awards: $708,834 **Co-Funding** EPSCoR co-funds awards in SD. 2018 - 2023: $11.1M 2023: $3.4M **Other EPSCoR Awards** 2020-2023: $3.2M	**IDeA Network of Biomedical Research Excellence (INBRE)** Statewide core research infrastructure and summer research support. 2001-2023: $67.1M 2023: $4.7M **(Centers of Biomedical Research Excellence)** 2022: $7.4M **4 Centers (2022):** • BioSystems Networks & Translational Research-Insights into Inflammation: $2.8M • Center for Pediatric Research: $2.3M • Transdisciplinary Approaches to American Indian and Rural Population Health Research: $2.2M • Sanford Community Cancer Program of the North Central Plains: $1M	**NASA Research Infrastructure Development (RID) awards** Supporting NASA EPSCoR core activities in South Dakota 2007-2023: $3.2M 2023: $200,000 **Major Research Awards** $750,000 3-year research awards 2007-2023: 15 awards $11.25M **NASA Space Grant** Supports STEM Education 2005-2023: $14.3M 2023: $910,000

Since the establishment of the SD EPSCoR program, South Dakota continues to build upon three core pillars of research, education, and economic development.

Research Impact

SD EPSCoR completed Year 4 of its NSF RII Track-1 project in September 2023. The following helped with research impacts.

Research results have been described in 175 articles submitted for publication.

111 postdocs & graduate students participating.

STEM Education Impact

NIH INBRE supports 55 undergraduate students doing summer research annually, with a total of 1,210 students from 2001-2023.

NASA EPSCoR has supported 297 graduate students and 251 undergraduate students doing research – 2007-2023.

The SD EPSCoR education component is part of the NSF Track-1 project involving development of STEM K-12 curriculum modules and conducting teacher workshops. There have been 648 teachers participating in the workshops from 2019-2023.

(Photo on right): Fall 2023 teacher workshop at Sisseton Wahpeton College in Sisseton, SD.

Economic Development Impact

The Dakota Seeds Internship support program was launched in collaboration with the Governor's Office of Economic Development (GOED) to encourage South Dakota businesses to utilize internships to develop and identify future employees.

DAKOTA SEEDS IMPACTS:

1,917 internships

Over **30%** become full-time employees.

367 companies

The Giant Vision Competition is in partnership with the South Dakota Chamber of Commerce and Industry. 2024 will be the 20th Annual competition!

Photo: (left) first-place $20,000 business winners Elliott Zimmer, Governor Kristi Noem, and David Zimmer of My Parts Pro LLC; (right) Governor Kristi Noem with first-place $5,000 student competition winner John Barbour, a student at South Dakota Mines.

SD BRIN/INBRE

brin.usd.edu

Enhancing basic biomedical research in cell biology with a network of a research intensive institution and partner undergraduate institutions

South Dakota NIH IDeA Programs

Since 2001, SD BRIN/INBRE has received more than $56.8 million in NIH funding for the partner institutions of the University of South Dakota (USD), Augustana University, Black Hills State University, Dakota Wesleyan University, Mt. Marty College, Oglala Lakota College, Sisseton Wahpeton College, and the University of Sioux Falls.
This funding supports Bioinformatics, Nucleic Acid Sequencing and Genotyping, and Proteomics Core Facilities for all SD and regional researchers through its first goal of improving research capabilities in cell biology with special emphases on proteomics, genomics, and bioinformatics. SD BRIN's second goal is developing human resources in biomedical sciences and bioinformatics by supporting research of students and faculty from predominantly undergraduate institutions and tribal colleges.

South Dakota has three Centers of Biomedical Research Excellence (COBRE) at Sanford Research. The Center for Cancer Biology focuses on cancer research with direct translational relevance to human patients. The Center for Pediatric Research seeks to establish a foundation of basic scientists with translational research projects studying developmental mechanisms underlying pediatric diseases. The Transdisciplinary Approaches to American Indian and Rural Population Health Research Center analyzes American Indian rural health research in an ecological framework.

What is NIH INBRE?

NIH INBRE is one of the four Institutional Development Award (IDeA) programs offered by the National Institutes of Health National Institute of General Medical Sciences. INBRE stands for IDeA Networks of Biomedical Research Excellence. The INBRE program in each state is funded by $2.5 million in direct costs annually.

SD Biomedical Research Network

Supporting South Dakota

In addition to providing services from the core facilities at free or reduced rates to all SD researchers, SD BRIN invests in its undergraduate partner institutions providing summer research support for 30 science faculty, summer student research fellowships for 55 undergraduates, and over $300,000 in scientific library databases for access to journal articles.

An additional two dozen faculty at Avera Research, Sanford Research, South Dakota State University, and USD are chosen as mentors for the summer undergraduate fellows from the partner institutions. An annual convocation for both faculty and student researchers (with a student poster session and workshops on career planning) is held at the end of the summer program.

Mount Marty University

Although Mount Marty University has received many honors, the true measure of the university's achievements is the success of students as they go forth to serve others in their communities and the world. The university's faith-based learning community inspires students to develop their strengths and passions personally and professionally

Thank You

On behalf of the Research Affairs Council of the South Dakota Board of Regents, we extend our thanks to all who have participated in the 2024 Student Research Poster Session. The best and brightest undergraduate students in South Dakota were selected to present the results of their research experience. Faculty research advisors are critical to nurturing the students in carrying out the research projects. State support is essential to providing the research infrastructure at our hope that the 2024 Student Research Poster Session serves to illustrate the magnitude and diversity of research being carried out at our institutions of higher education in South Dakota.

SOUTH DAKOTA
BOARD of REGENTS