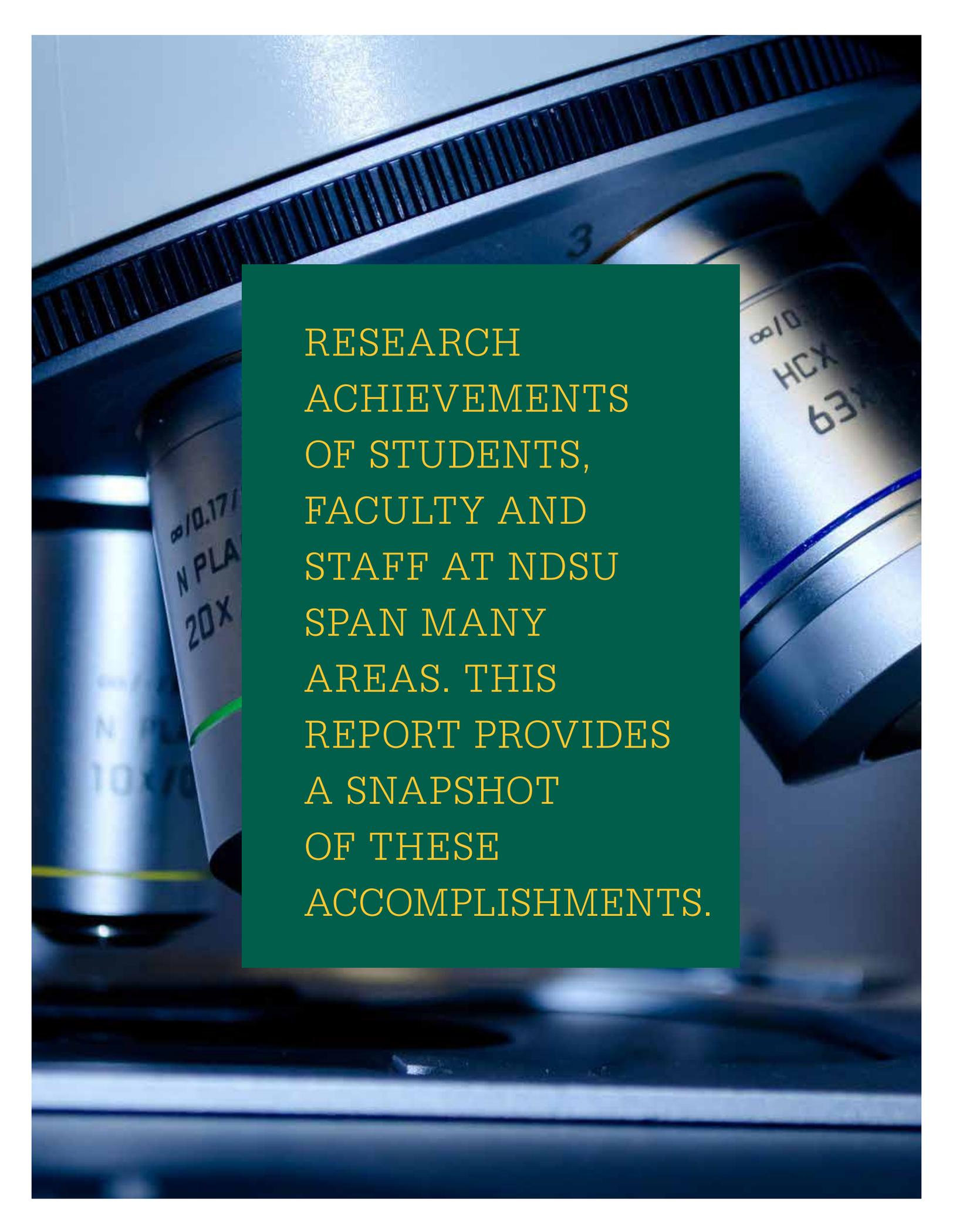




FISCAL YEAR 2016 // ANNUAL REPORT

NDSU OFFICE OF RESEARCH
AND CREATIVE ACTIVITY

NDSU NORTH DAKOTA
STATE UNIVERSITY

A close-up photograph of a microscope's objective lenses. The lenses are metallic and have various markings, including "20X", "10X", "HCX", and "63X". The background is a soft, out-of-focus blue light.

RESEARCH
ACHIEVEMENTS
OF STUDENTS,
FACULTY AND
STAFF AT NDSU
SPAN MANY
AREAS. THIS
REPORT PROVIDES
A SNAPSHOT
OF THESE
ACCOMPLISHMENTS.

NDSU ENGAGES IN IMPACTFUL RESEARCH AND CREATIVE ACTIVITY TO MEET THE NEEDS OF OUR CITIZENS

NDSU provides an environment where scholarship thrives. This growing enterprise allows faculty, students and staff to engage in research that expands the boundaries of scientific discovery, develop solutions to global challenges and create new dialogues, performances and exhibits that connect our vibrant communities.

NDSU is committed to making a difference in the lives of our citizens. When the campus crafted its latest strategic vision, we honed our research priorities to focus on three “Grand Challenge” areas that are reflective both of our current faculty strengths and the needs of our state: food systems and security; healthy populations and vital communities; and sustainable energy, environment and societal infrastructure. This year we launched a grand challenge initiative by providing funding for proposals from two faculty teams. One team is creating the Center for Engineered Test Beds, focused on shifting the paradigm in cancer studies and reducing the time and cost of new drug and drug delivery system testing. This highly interdisciplinary team spans six departments and five colleges. The other team, the Population Health Research Initiative, spans six colleges and emphasizes food systems, food security and indigenous health disparities with a strong focus on American Indian public health. Each team is in its initial formative stages, and we look forward to communicating progress in the upcoming year.

NDSU researchers are participating in the statewide effort to keep North Dakota on the forefront of unmanned aerial vehicle, or UAV, research and its applications. An example of NDSU’s exemplary work in this area is the use of UAVs for precision agriculture. This past year, NDSU collaborated with a commercial partner, Elbit Systems of America, in the country’s first use of large UAVs for precision agriculture research. This effort was made possible by a Research ND grant from the state.

There is global recognition that data generation, collection, analysis and visualization are needed in almost every scholarly discipline today. NDSU is currently expanding its high-performance and advanced-research computing capabilities with upgrades to our research computing facility infrastructure to ensure it can meet the future data analytic needs of our faculty, staff, students and the state.

Our students and faculty also reach out in ways that impact the broader North Dakota community, through projects aimed at the well-being of returning war veterans, revitalizing cultural centers, updating our understanding of what education means in the modern world and developing models for decreasing energy consumption. This community involvement is vital to our role as a land-grant university, and our artists, historians, architects and sociologists are making a significant impact.

NDSU continues to grow opportunities for our dedicated and bright undergraduate and graduate students and encourage their engagement in meaningful research and creative activity. Our second annual NDSU EXPLORE symposium was held to celebrate the achievements and accomplishments of our undergraduate students. Award winners presented their research at the National Conference on Undergraduate Research in April 2016; where 4,000 undergraduate students from around the country participated.

NDSU students continue to be competitive on a national basis. In 2016, four NDSU students were awarded National Science Foundation Graduate Research Fellowships. These prestigious awards recognize and support graduate students who are pursuing research-based master’s and doctoral degrees.

North Dakota EPSCoR, a program of the North Dakota University System, continues to invest in the research infrastructure of the state. Successful partnerships with the five tribal colleges in North Dakota have continued and this year we developed research connections with the state’s four primarily undergraduate institutions. This network of funding and collaboration is vitally important to educating and retaining our brightest minds to continue the growth of North Dakota’s economic prosperity.

While my message highlights examples of activities on campus, it is not exhaustive of all of the contributions that make NDSU successful. I thank the campus community for its efforts over this past year. I also thank our external constituents for their interest and overall support in making NDSU successful.

Please take a moment to read more about highlights and successes from the past year.



Dr. Kelly A. Rusch
Vice President
Office of Research
and Creative Activity

TRANSFORMING STEM TEACHING AND STUDENT LEARNING

A five-year, \$2.63 million grant from the National Science Foundation is changing how science, technology, engineering and mathematics (STEM) courses are taught at the university. The ultimate goal is to help more students succeed in challenging STEM courses. The grant is being used to train faculty members on a set of student-centered teaching approaches called active-learning. Rather than attending a lecture and passively taking notes, students in active-learning classrooms participate in discussion and problem solving, often working in small groups. Some NDSU faculty members already use active-learning teaching strategies, and expanding the practice across STEM disciplines will make NDSU a national leader in this area. It is expected to benefit more than 10,000 NDSU students in the short term and many more in the future.

Research shows students do better when they interact with the instructor and other students. Active-learning teaching strategies create the interactions that lead to better outcomes. Students are more likely to complete classes, earn good grades, develop good study habits and have positive attitudes toward learning – all of which contribute to overall success in college.

Paul Kelter, professor and director of NDSU's new Office of Teaching and Learning, working together with a team of NDSU faculty and staff, is leading the project, providing training and ongoing professional development for cohorts of faculty called faculty learning communities. Faculty engage in ongoing discussion and exchange tools, resources and methods to support student learning. With this training, faculty are expected to increase use of high-impact teaching practices appropriate to their discipline.



The training also prepares faculty members for teaching in the A. Glenn Hill Center, the new STEM classroom and lab building that opened in January 2016. The building is designed for active-learning-based instruction, with SCALE-UP rooms, an environment created to facilitate active, collaborative learning in a studio-like setting. Several rooms have moveable tables and chairs and other large rooms have lecture-style chairs that can rotate to face other chairs. Approximately 34 NDSU faculty and instructional staff participated as the first cohort to be trained, and these faculty get priority for room assignments to teach in the new building. Plans are to train even larger groups of faculty in future cohorts.

The grant-funded project also has a research component. Project leaders collect and analyze student and teacher data, with the goal of enhancing best practices in active learning. The research has the potential to influence STEM educational training programs throughout the United States and the world.

RESEARCH EXPERIENCES FOR RURAL STEM TEACHERS

A comprehensive professional development initiative is being implemented at NDSU in engineering, research and design focused on providing knowledge, skills and resources to middle and high school rural educators in science, mathematics and technology education.

Led by Alan Kallmeyer, professor and chair of mechanical engineering, and funded by the National Science Foundation through the Research Experiences for Teachers (RET) program, this project focuses on small, rural schools where there is often only one math or science teacher for the entire school. The objective is to improve the abilities of these teachers to deliver engineering-based lessons and content to their students.

The program's theme, Precision Agriculture and Sustainability, is the focus of a six-week summer research experience coupled with professional development workshops throughout the year. Research is conducted in teams with an in-service teacher being paired with a pre-service teacher. Research topics have included bio-based

resins and composites, 3-D printing test platforms for antennas, and analyzing soil sensors. Teams are supervised by faculty and graduate students in the departments of mechanical engineering and electrical and computer engineering.

After completing the program, teachers have critical resources for delivering course content with a renewed outlook on innovative teaching techniques, with the goal of creating increased student engagement and achievement in STEM fields. Lesson plans developed also are shared via the website "Teach Engineering," which provides standards-aligned engineering lessons and hands-on activities for K-12 teachers to use in science, engineering and math classrooms.

Ten rural and pre-service teachers participated in the first year of the three-year program. Teachers were from the North Dakota and Minnesota communities of Kulm, Fessenden Bowdon, Ulen-Hitterdahl, Cavalier and Northern Cass.



CAPTURING THE EXPERIENCES OF RETURNING WAR VETERANS



photo credit: Angela J. Smith

A yearlong project is underway to help Fargo-Moorhead and North Dakota better understand what happens when soldiers return home from war. Christina Weber, associate dean for the College of Arts, Humanities and Social Sciences and associate professor of sociology, received a \$201,104 grant from the National Endowment for the Humanities for the project “Telling Stories, Creating Community: Understanding the Legacies of War at Home.” The goal is to create a space for veterans, their family members and the larger community to talk freely about complex topics such as life in the military, experiences of war, the return home and readjusting to life as a civilian.

To achieve the program objectives, Weber and her colleagues from the departments of English, women and gender studies, public history and visual arts have developed community events that foster multidimensional approaches to storytelling.

ORAL HISTORIES

The team is collecting oral histories from veterans and their families to capture their experiences regarding the effects of American wars. Led by Angela Smith, assistant professor of public history, the oral histories will be used to establish an archive for the public and researchers to use, and will be a resource to better understand veterans’ needs in North Dakota, the Midwest and the United States.

BOOK DISCUSSIONS

A communitywide reading program has been implemented using books like Tim O’Brien’s “The Things They Carried,” which addresses questions about how to articulate the trauma of war to those who have not experienced war directly, and to create a platform for discussion about the legacies of war through the eyes of a war veteran. Alison Graham-Bertolini, assistant professor of English and women and gender studies, led a book discussion and writing workshop based on the model and focus of O’Brien’s book.

CRAFT DIALOGUES

Programming for the project allows a variety of formats to tell these stories, including writing and ceramics workshops for veterans and their families. An heirloom workshop, led by Fargo veteran and artist Josh Zeis, along with Fargo artist and NDSU faculty member Michael Strand, allowed participants to explore different ways to tell their stories, such as through the creation of heirloom cups commemorating or remembering military service.

PUBLIC FORUMS AND PROGRAMS

Public forums and programs allow veterans and families to share their stories and creative work with the community.

This program was one of only 21 projects funded by the National Endowment for the Humanities in the new “Humanities in the Public Square” grant program.

RESEARCHER STUDIES CHANGING VIEWS ON PURPOSE OF COLLEGE EDUCATION

Carrie Anne Platt, NDSU associate professor of communication, received a \$21,987 National Endowment for the Humanities Enduring Questions grant to research changing views on the purpose of a college education. The grant program supports a faculty member's development of a new course that will foster intellectual community through the study of an enduring question.

Her research will result in a new undergraduate course designed to help current students maximize the value of their own education. The research will focus on how our understanding of the "educated person" has changed over time, the history of the liberal arts and vocational training in higher education and how the tension between the two has shaped debates over college curricula. Platt's interest in the subject came in part from her experience as an undergraduate advisor. Undergraduates are sometimes unsure how to select their general education courses, how the courses might be connected to their major or why they are required to take general education courses at all. The project will allow Platt to integrate her research, teaching and advising by helping students find answers to these questions.



A CITYWIDE EFFORT TOWARD SUSTAINABILITY

Fargo's energy consumption is down, thanks to the efforts of the eFargo partnership, which includes the city of Fargo, NDSU, Cass County Electric Cooperative and Xcel Energy. The collaborative community effort has been so successful that Fargo is in third place in the Georgetown University Energy Prize (GUEP) competition, which challenges cities throughout the country to find innovative ways to improve energy efficiency and offers a \$5 million prize. Major eFargo strategies include the eFargo game, a K-12 challenge, high energy-efficiency houses and experiential learning for college students.



The initiatives paid off. According to the GUEP dashboard, Fargo residents and organizations have saved more than \$4.8 million in utility bills and prevented 21.6 million kg of carbon dioxide from entering the atmosphere by lowering electricity usage by more than 60 million kWh and lowering gas use by more than 4 million therms since January 2015.

Malini Srivastava, project lead for eFargo and assistant professor of architecture and landscape architecture, secured a Bush Fellowship to implement and test innovative strategies to educate and engage people in energy-efficiency practices that are being tracked by the competition. Her research on Fargo's strategies could inform how other cities approach the issue in the future.

USING COVER
CROPS TO
IMPROVE
AGRICULTURAL
PRACTICES IN
THE NORTHERN
GREAT PLAINS





The use of cover crops, common in the eastern and central Corn Belt of the U.S., are uncommon in the Upper Midwest and northern Great Plains due to the short growing season and extreme fluctuations in temperature and precipitation within and across growing seasons. Lack of winter soil cover means the loss of soil organic matter and nutrients in the soil, resulting in decreased crop productivity and resiliency. For these reasons, larger amounts of fertilizer are required to maintain or increase crop yields. Therefore, there is a critical need to alter current agricultural practices in the Upper Midwest and northern Great Plains by incorporating technologies to improve long-term productivity while enhancing the ecosystem.

In an effort to help farmers to achieve long-term productivity, Marisol Berti, professor in NDSU's Department of Plant Sciences, is collaborating with a team of 12 researchers from four institutions, including the University of Minnesota, Iowa State University and the USDA's Agriculture Research Service laboratory in Morris, Minnesota. They were awarded a \$2.15 million grant from the USDA for the first two years of a four-year project. The USDA will provide an additional \$1.6 million for the last two years of the project. The Coordinated Agricultural Program (CAP) project started in April 2016, and several field experiments were conducted in North Dakota, Minnesota and Iowa during the 2016 growing season.

The research project involves seeding four cover crops – rye, forage radish, camelina and a legume – into standing corn and soybeans at different growth stages in trial plots. The scientists will modify or design seeding equipment and improve seeding strategies to establish the cover crops. Scientists also will estimate the nutrients that the cover crops provided in the soil and the increased nutrient use by subsequent crops. In addition, the scientists will conduct an economic analysis of the costs and benefits of using cover crops.

Extension Services in the three states will use the data the scientists collect to conduct educational activities for producers such as research farm demonstrations, field days and regional- and county-based workshops. They also will develop educational materials and web-based information and hold one-on-one consultations with producers.



TARGETING DISEASE

CENTER FOR PANCREATIC CANCER RESEARCH ESTABLISHED

A research center aimed at early diagnosis and treatment of pancreatic cancer has been established under the direction of Sanku Mallik, professor of pharmaceutical sciences in the College of Health Professions, and D. K. Srivastava, a James A. Meier Professor of chemistry and biochemistry in the College of Science and Mathematics. The first disease-specific research center at NDSU, the Center for Diagnostic and Therapeutic Strategies for Pancreatic Cancer is being funded by a \$9.62M Phase I grant through the National Institutes of Health (NIH) Institutional Development Award Center for Biomedical Research Excellence (COBRE) program. The center can become eligible for up to two five-year renewals.

The center will conduct fundamental research with a focus on diagnostic and therapeutic tools for controlling the onset and proliferation of pancreatic cancer. The grant also will fulfill the NIH's mission of mentoring junior faculty and expanding research infrastructure. Researchers will collaborate with colleagues at the University of Nebraska Medical Center. Four junior investigators and up to 12 graduate students will conduct fundamental studies on diagnostics, drug delivery and treatment of pancreatic cancer.

SANFORD HEALTH SEED GRANTS

Sanford Health launched a program with NDSU to develop faculty research collaborations in human nutrition, weight management and other dietary-related areas. Sanford is providing \$250,000 annually for five years for the seed-grant program. Three faculty were awarded grants in the first year.



Kyle Hackney, assistant professor of human nutrition and exercise science: “Protein and Muscular Health with Aging.” Hackney’s research will explore how dietary protein and key amino acids are related to optimal muscular health with aging.



Leah Irish, assistant professor of psychology: “Temporal Dynamics of Sleep and Energy Consumption and Expenditure.” Irish’s research will examine the interplay of sleep, physical activity and diet and explore the potential role of sleep in weight management.



Katie Reindl, associate professor of biological sciences: “Dietary Flaxseed to Prevent Inflammation and Oxidative Stress in American Indian Smoker.” Reindl’s research will evaluate how the use of dietary flaxseed may be used as a chemopreventative strategy. The research will examine the effects of flaxseed on pro-inflammatory and anti-oxidant biomarkers.

DEVELOPING A NOVEL INSULIN DELIVERY SYSTEM FOR DIABETES PATIENTS

Jagdish Singh, professor and chair of pharmaceutical sciences, received a \$348,000 grant from the National Institute of General Medical Sciences of the National Institutes of Health for a project to develop a new insulin delivery system to combat type 1 diabetes.

Singh’s work will explore a “controlled delivery” that provides insulin to the patient continuously between meals and throughout the night. The proposed system would sidestep problems associated with insulin burst release by reducing the diffusion of zinc-insulin-chitosan complex from the polymeric hydrogel matrix. The aim is to stabilize the protein inside the delivery system while providing a controlled release of insulin. Singh’s goal is to develop novel controlled release delivery systems that can deliver insulin at the basal level in a chemically stable and biologically active form for up to three months after a single injection in patients with type 1 diabetes.

CARDIOVASCULAR RESEARCH

Stephen O’Rourke, professor of pharmaceutical sciences, has received a \$435,000 grant from the National Heart, Lung and Blood Institute of the National Institutes of Health to conduct cardiovascular research.

O’Rourke will investigate a naturally occurring biological molecule known as a peptide. Specifically, he’ll study a peptide called apelin that is produced by adipose tissue, which has been linked to obesity, and as research suggests, might be linked to stroke.

O’Rourke is working to understand how the peptide regulates cerebral artery vasomotor tone, or how it alters the blood vessel’s diameter. While some studies indicate that apelin may have beneficial effects on parts of the cardiovascular system, O’Rourke’s previous work showed it can inhibit certain vasodilator responses in cerebral arteries, which could increase the risk of cerebral vascular dysfunction. The objective of the project is two-fold, according to Rourke. The project will determine why and how apelin constricts cerebral arteries and compare that with its commonly regarded beneficial effects in coronary arteries.

RECOGNIZING STUDENT ACHIEVEMENTS

SCHOLARS PROGRAM

STUDENT CONDUCTS RESEARCH AT NATIONAL INSTITUTES OF HEALTH

Angel Mfon, a student in the psychology program, was selected for the prestigious Amgen Scholars Program. Through this program, Mfon spent 10 weeks during the summer of 2015 conducting hands-on research at the National Institute of Mental Health. She was among 340 students selected globally from about 5,000 applicants.

\$17,600 GRANT

NDSU STUDENT RECEIVES GRANT TO BENEFIT ELEMENTARY SCHOOL

Graduate student Michelle Crary received a \$17,600 grant to improve fitness curriculum and equipment at a Fargo elementary school. The Project Fit America grant benefitted Kennedy Elementary School and surrounding neighborhoods. In addition, NDSU researchers will study the effects of the added equipment and curriculum. Project Fit America works to create and administer fitness education programming in elementary and middle schools.

HONOR AWARD

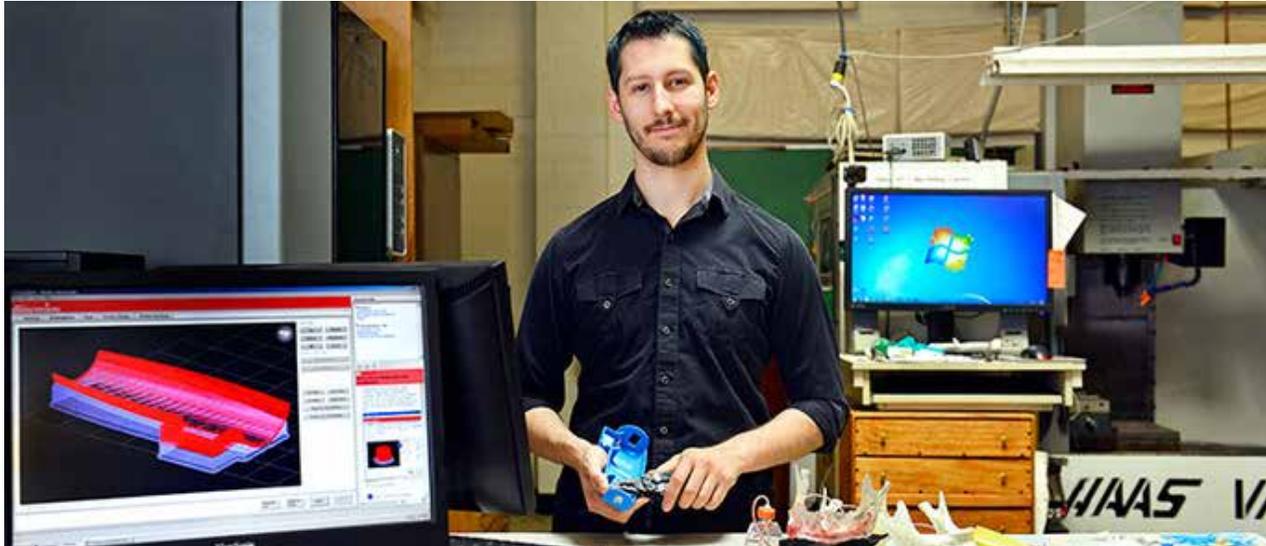
LANDSCAPE ARCHITECTURE STUDENT RECEIVES AWARD

Matt Ellingson, a fifth-year landscape architecture student under the supervision of Dominic Fischer, assistant professor in the Department of Architecture and Landscape Architecture, received an honor award from Central States American Society of Landscape Architects for his design project "Healing Waters Cultural Centre" located at Ross, North Dakota, site of the first dedicated mosque built in the United States. The award is regionally significant, with the eight-state competition including North Dakota, South Dakota, Nebraska, Iowa, Kansas, Missouri, Oklahoma and Arkansas.

STUDENT RECEIVES ASTRONAUT SCHOLARSHIP

Katie Gisi, a senior majoring in agricultural and biosystems engineering, was selected to receive the prestigious Astronaut Foundation Scholarship for the 2016-17 academic year. The program is actively supported by 73 former astronauts and has a mission to help the United States retain its world leadership in science and technology through scholarships for outstanding students who are pursuing degrees in science, technology, engineering or mathematics.





CULTIVATING PROMISING STUDENT INVENTIONS

Advanced Bone Technology was one of 21 student teams awarded a \$20,000 grant as part of VentureWell's E-Team Program. VentureWell, a non-profit organization that supports an emerging generation of science and technology innovators, focuses on inventions that have the potential for positive social and environmental impact.

The project is directed by David Wells, professor of industrial and manufacturing engineering and mentor to Bison Microventure, an undergraduate innovation initiative. The CEO of the research project is Andy Dalman, a mechanical engineering graduate student. Other project founders are Joel Hedlof and Ben Ferguson, NDSU mechanical engineering undergraduate students.

NSF GRADUATE RESEARCH FELLOWSHIP AWARDS

Four NDSU students were awarded fellowships from the National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP). Only 2,000 fellowships are chosen from almost 17,000 applicants and awarded to individuals through a peer-reviewed, competitive process. Awardees have demonstrated their potential to do cutting-edge research in their field of study. The GRFP provides three years of financial support within a five-year fellowship period for graduate study that leads to a research-based master's or doctoral degree in science or engineering.

NDSU GRFPs awarded:

Loren Anderson, mathematics
Jessica Bair, psychology alumni
Liz Cambron, cellular and molecular biology
Cody Ritt, civil and environmental engineering

Honorable mentions:

Steven Giesler, civil and environmental engineering
Krystal Kalliokoski, chemistry
Rachel Salter, biological sciences/STEM education

NSF provides fellowships to individuals selected early in their careers based on their demonstrated potential for significant achievements in science and engineering. GRFP is vital to NSF's overall strategy of developing the globally engaged workforce necessary to ensure the nation's leadership in advancing science and engineering research and innovation.

CELEBRATING UNDERGRADUATE RESEARCH AND SCHOLARLY ACTIVITY

NDSU EXPLORE

From research on bones to Superbowl commercials, nearly 100 undergraduates at NDSU shared their research and creative activity during the second annual NDSU EXPLORE event held Nov. 3, 2015, in the Memorial Union. Whether majoring in the sciences, engineering, business, arts or humanities, students showcased their scholarly projects.

Research shows undergraduates benefit from research experiences. Benefits include enhanced leadership and communication skills, as well as skills that employers seek such as problem-solving, innovation, communication, critical thinking, analytical reasoning and collaboration.

First place winners in the poster and oral presentation sessions at the NDSU EXPLORE showcase traveled to present their research at the National Conference on Undergraduate Research in Asheville, North Carolina, April 7-9, 2016.



THE STUDENTS, THEIR ADVISORS AND PRESENTATION TITLES ARE:

Cooper Bierscheid – industrial and manufacturing engineering, graduated December 2015

Faculty advisor: David Wells

Utilizing Additive Manufacturing Processes for Medical Devices: Protosthesis

Mariom Carvajal – microbiology

Faculty advisor: David Rider

Revision of the Genus *Bebaeus* Dallas, 1851

(*Insecta: Hemiptera: Heteroptera*) with

Comments on Its Natural History

Torie Jones, Luke Koran,

Typhanie Schafer, John Wells – public history

Faculty advisor: Angela Smith

Ellendale Public History Field School Project

Lauren Singelmann – electrical and computer engineering

Faculty advisor: Dan Ewert

Graphical User Interface That Analyzes

RNA Sequencing Data

NDSU HAS BEEN
AWARDED MORE
THAN \$1.6 MILLION
FOR UAS-RELATED
PROJECTS INVOLVING
PRECISION
AGRICULTURE,
SENSOR SYSTEMS
AND SOFTWARE
DEVELOPMENT.



TESTING LARGE UNMANNED AIRCRAFT SYSTEMS FOR PRECISION AGRICULTURE

A group of North Dakota Agricultural Experiment Station scientists and NDSU Extension Service specialists collaborated with the Hillsboro Airport Authority, some Traill and Steele County producers and Fort Worth, Texas-based Elbit Systems of America on a research project to test the role of large unmanned aircraft systems (UAS) in precision agriculture.

The project used the Hermes 450, small rotocopters and small fixed-wing UAS to collect imagery from a four by 40-mile corridor in east-central North Dakota during the 2016 crop-growing season. The Hermes 450's flight was approved by the Federal Aviation Administration as part of the Northern Plains UAS Test Site in North Dakota. The UAS-collected image data were used to estimate stand counts in corn and sugar beets; the effectiveness of nitrogen applied to corn and wheat; iron deficiency chlorosis in soybeans; and yield predictions for corn, soybeans and wheat. The intent is to compare the data collected from the air at various altitudes with data collected through satellite imagery, in-field observations and on-the-ground sensors, detailed soil analyses and harvest yield information. NDSU's Center for Computationally Assisted Science and Technology stores the large amount of image data.

Researchers are assessing the costs associated with collecting UAS imagery, including personnel, transportation, the number of flights required to gather sufficient data, the time required to collect the information, area of coverage

per flight and maintenance costs per hour of flight to determine whether using UAS for agricultural purposes is economical.

Persons involved in the project say this kind of information will help companies such as Elbit decide whether to consider expanding to North Dakota.

A Research ND grant from the North Dakota Department of Commerce is partly funding the project. The NDSU Department of Agriculture and Biosystems Engineering investigators on the project included Sreekala Bajwa, department chair, and John Nowatzki, agriculture machine systems specialist.

The projects are the latest in NDSU's efforts to determine the role of UAS in agricultural production and to help strengthen the state's economy. Those efforts began in 2014 with a project using thermal infrared sensors and cameras mounted on UAS to gather data from crop and livestock research projects at NDSU's Carrington Research Extension Center.

A Research ND grant was also awarded to the NDSU Department of Electrical and Computer Engineering, in partnership with Cyclops Technologies Inc., to develop and miniaturize a Through-the-Wall Sensor payload that can be operated from a small UAS that can be used by law enforcement and search and rescue teams.

HIGH-PERFORMANCE COMPUTING

KEEPING IT COOL

The NDSU Center for Computationally Assisted Science and Technology (CCAST) is expanding its server room footprint by fitting out a 1,123 square-foot computer room in the Research and Technology Park Research 2 building. The fit-out includes space for 24 high-performance computer racks and associated equipment powered by up to 500 kW of electricity and chilled by a temperature-neutral system that includes rear-door heat exchangers. The state-of-the-art power and cooling technology used at CCAST will allow it to provide a very high-density computing and data storage environment necessary to support the increasing demands of NDSU computational scientists, their collaborators and other research partners. The design of the room includes an extension path to 1 MW of chilled IT power.



BOOT CAMPS

High-Performance Computing (HPC) has become an indispensable discovery tool for researchers, students and businesses. HPC applications can now be found in almost any field, from science and engineering to business, agriculture and arts.

The Center for Computationally Assisted Science and Technology (CCAST) has conducted a series of boot camps to introduce the basics of HPC to students, staff and faculty who are interested in the field. During the four-day event, participants received information via lectures and demonstrations with Raspberry Pi – a computer cluster model built by CCAST for its outreach activities. Training included hands-on sessions where participants could run simple and complex computer programs on CCAST's clusters and learn about parallel computing.

Participants included NDSU faculty, staff and students and their counterparts from Valley City State University (VCSU). The boot camps were delivered to VCSU remotely via the SAGE-2 web-based data intensive collaboration tool.



BIOINFORMATICS SEED GRANT PROGRAM

Through the North Dakota National Institutes of Health IDeA Networks of Biomedical Research Excellence (INBRE) program, NDSU has implemented a \$400,000 seed-grant initiative intended to launch promising new research projects in bioinformatics. Four projects were awarded in 2015.

Xuehui Li, assistant professor of plant sciences
Changhui Yan, associate professor of computer science
Gang Shen, associate professor of statistics

“Development of bioinformatics tools for next-generation sequence data analysis for polyploid crops”

Peter Bergholz, assistant professor of microbiological sciences
Brian Slator, professor of computer science
Anne Denton, associate professor of computer science

“Laying a foundation of bioinformatics methods for integrated structure and function analysis in microbiome studies”

Shaobin Zhong, assistant professor of plant pathology
Changhui Yan, associate professor of computer science
Gang Shen, associate professor of statistics

“Develop bioinformatics pipelines for dual RNA-seq analysis of plant-pathogen interactions”

Lauren Hanna, assistant professor of animal sciences

“Building a bioinformatics infrastructure by genetically characterizing a commercial beef cow herd for longevity and efficiency attributes”

NSF DAY COMES TO NORTH DAKOTA

NDSU hosted North Dakota’s first ever National Science Foundation (NSF) Day on May 18, 2016. More than 200 faculty and staff from 20 regional higher education institutions attended. The daylong event was an opportunity for the NSF to promote programs and activities while giving faculty an opportunity to interact with NSF program officers and learn how to become more competitive for NSF grants. Twelve NSF program officers came to NDSU to present information on a range of programs representing science, engineering, technology, mathematics and education. Faculty researchers received tips regarding proposal writing, NSF’s merit review process and programs that fall within their seven directorates, as well as funding opportunities that cross disciplinary boundaries.

NDSU HOSTS PRESTIGIOUS MATHEMATICS CONFERENCE

Mathematicians from around the world gathered on the NDSU campus July 27-31, 2015, for the National Science Foundation-Conference Board of the Mathematical Sciences Regional Conference. The event, part of a series of three regional conferences funded by the National Science Foundation through a competitive process, was organized by María Alfonseca-Cubero, associate professor of mathematics. The conference was aimed at mathematics faculty, graduate students and post-docs and was technical in nature. The goal was to ensure that participants, especially new researchers, gain an understanding of the latest developments in specified areas of mathematics. Sessions focused on new developments related to the David-Semmes conjecture, which aims to provide a geometric description of the measures that have bounded singular potentials for Calderón-Zygmund kernels.



**NDSU'S STRATEGIC VISION
DEFINES GOALS OF
SUPPORTING RESEARCH
EFFORTS THROUGH
THE IMPROVEMENT OF
INFRASTRUCTURE AND
PROVIDING CENTRALIZED
FUNDING IN SUPPORT OF
RESEARCH, INCLUDING
THE DEVELOPMENT OF
INTERDISCIPLINARY EFFORTS
TO ADDRESS SOCIETAL
GRAND CHALLENGES.**

MEETING SOCIETY'S GRAND CHALLENGES

The grand challenge areas, including “Food Systems and Security,” “Healthy Populations and Vital Communities” and “Sustainable Energy, Environment and Societal Infrastructure,” leverage current and emerging strengths of NDSU researchers and align the university with the needs of the state, nation and world. In 2016, two grand challenge projects received seed funding, as described below.

POPULATION HEALTH RESEARCH INITIATIVE

Led by Don Warne, chair of the Department of Public Health, and Kalidas Shetty, associate vice president for international partnerships and collaborations, the Population Health Research Initiative (PHRI) includes developing a Doctor of Public Health degree program and several additional interdisciplinary collaborations. The PHRI partnership includes six of the seven academic colleges at NDSU. PHRI will significantly increase NDSU's population health research capacity by building on existing strengths and developing new graduate education programming through expansion of public health faculty in several key areas.

CENTER FOR ENGINEERED CANCER TEST BEDS

Led by Kalpana Katti, University Distinguished Professor of civil and environmental engineering, the Center for Engineered Cancer Test-Beds (CECT) seeks to design a test bed at the interface of biology and engineering with controlled properties using a synergistic application of in silico design. Specifically, the center proposes to develop novel, life-like biomimetic environments through use of 3D scaffolds that enable humanoid testing of novel anti-cancer drugs and drug delivery systems. The goal is to reduce the time and cost of new drugs and drug delivery systems being made available to populations. The biomimetic environments also will allow for transformative study of cancer biology; specifically, the metastasis to bone.

BOOK PUBLICATIONS



TEACHING DESIGN TECHNOLOGIES

Mike Christenson, associate professor of architecture, has written a book that introduces how design technologies work together, including tools, materials and software such as Adobe Photoshop, Adobe Illustrator, Autodesk AutoCAD and others. “Beginning Design Technology” teaches how to think about each design tool, whether a software program or physical model making, so that a tool can be selected based on its strengths for a specific task, as well as discussing when and how to combine it with other tools for better results.



THE SCIENCE OF NOSTALGIA

Clay Routledge, professor of psychology, has written a new book examining nostalgia. “Nostalgia: A Psychological Resource (Essays in Social Psychology)” looks at how views of nostalgia have changed and how social scientists have studied the complex phenomenon. It explains in detail what nostalgia is, what causes one to feel nostalgic, the complex emotional nature of nostalgia and how engaging in nostalgic reflection influences social and psychological health.



FOCUSING ON AMERICAN INDIAN HEALTH

Donna Grandbois, associate professor of nursing, is one of the authors of “American Indian Health and Nursing,” the first nursing textbook focusing on American Indian health. Grandbois, who wrote a chapter on American Indians in the Northern Great Plains, is one of 12 contributing authors for the book, most of whom have American Indian ancestry. The textbook addresses American Indian history, current American Indian issues and disparities in Native health and health care.



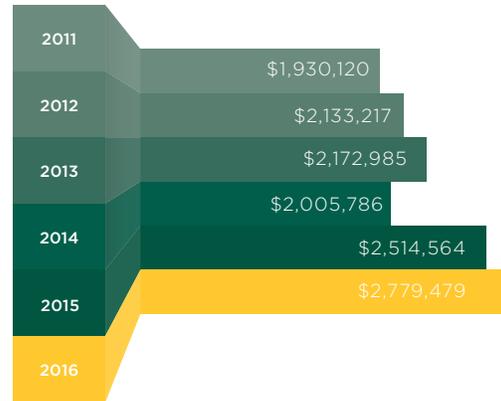
REGIONAL PERSPECTIVE ON CRIMINAL JUSTICE

Jeffrey Bumgarner, professor and chair of criminal justice and political science, is the lead author of “Minnesota’s Criminal Justice System,” part of the State-Specific Criminal Justice series published by Carolina Academic Press. The book covers a range of criminal justice topics, such as crime levels, law enforcement, corrections, the judiciary, juvenile justice, punishment and other key subject matter—all within the geographic, cultural, historical and political contexts of Minnesota.

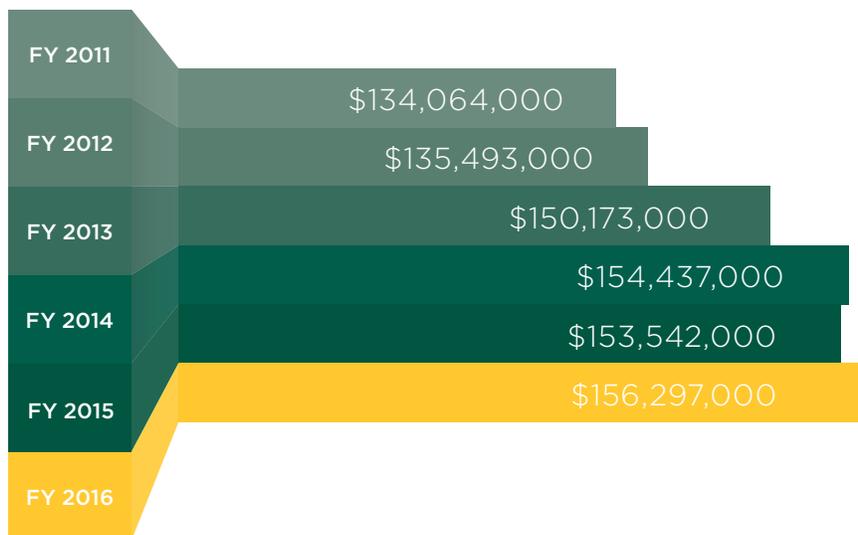
INVENTION DISCLOSURES



LICENSING INCOME

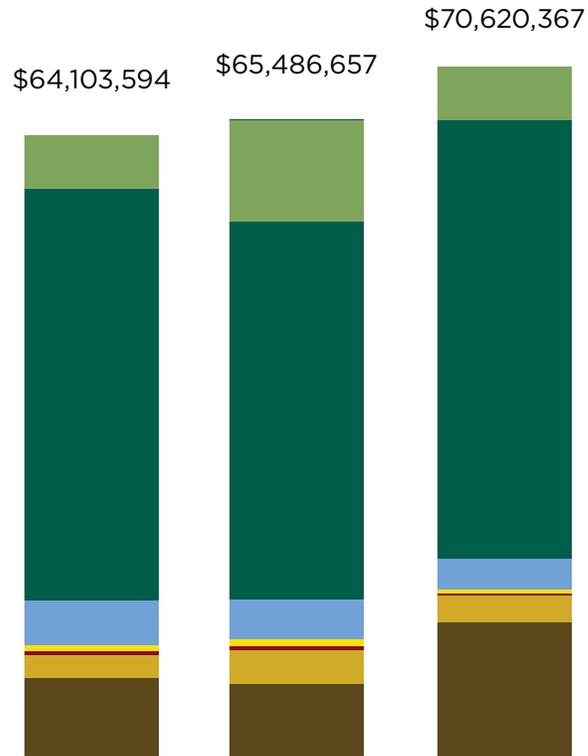


NDSU HIGHER EDUCATION R&D EXPENDITURES



FY11-FY15 data available from NSF at www.nsf.gov/statistics/srvyherd/#tabs-2.
 FY16 data based on information provided to, but not yet published, by NSF.

EXTERNAL AWARDS BY SOURCE



	FY 2014	FY 2015	FY 2016
Commodity	\$6,213,329	\$8,021,977	\$6,327,352
Federal	\$43,545,478	\$43,828,337	\$48,693,023
Foundation/Non-Profit	\$4,115,664	\$3,943,861	\$3,064,819
Other	\$358,114	\$408,479	\$156,230
Other Government Office	\$353,463	\$332,013	\$272,052
Private	\$1,880,835	\$2,856,041	\$2,331,270
State	\$7,636,711	\$6,095,949	\$9,775,621

An adjustment was made to the previously published FY 2015 External Awards total. The adjusted award total is included here.



NDSU ECOLOGIST RECEIVES INTERNATIONAL AWARD

Ned Dochtermann, an evolutionary ecologist and assistant professor of biological sciences, received the 2016 Animal Behavior Society's Outstanding New Investigator Award. The international award recognizes early career scientists for outstanding contributions to the body of knowledge in the field. Dochtermann was selected for his influential role in the field's move toward using new statistical approaches for analyzing animal behavior.



PROFESSOR NAMED AMERICAN CHEMICAL SOCIETY FELLOW

Dean C. Webster, professor and chair of coatings and polymeric materials, was named to the 2016 class of American Chemical Society (ACS) fellows. The group includes 57 distinguished scientists who have demonstrated outstanding accomplishments in chemistry and given important contributions to ACS, the world's largest scientific society.



NDSU PROFESSOR RECEIVES DISTINGUISHED CHAIR FULBRIGHT AWARD

Cheryl Wachenheim, professor of agribusiness and applied economics, was awarded a Distinguished Chair Fulbright Scholar grant to teach courses in agribusiness at Renmin University in Beijing, China, during the 2015-16 academic year. Wachenheim joined approximately 1,100 U.S. faculty and professionals who travelled abroad through the Fulbright U.S. Scholar Program in 2015-16. She is one of roughly 40 scholars to receive the Distinguished Chair Award, which is viewed as among the most prestigious appointments in the Fulbright Scholar Program.



ENDOWED CHAIR ESTABLISHED IN RISK MANAGEMENT AND TRADING

William Wilson, University Distinguished Professor of agribusiness and applied economics, was awarded the new CHS Endowed Chair in Risk Management and Trading. The CHS Foundation, the major giving entity of CHS Inc., the nation's leading farmer-owned cooperative, awarded a \$2.5 million grant to NDSU to create the endowed chair position. The endowment, and related programs funded by it, will better prepare more students entering the regional and national commodity marketing business; create a state-of-the-art teaching and training platform for students pursuing careers in risk and trading; expand the research capabilities for faculty and students in risk, commodities and portfolios; and expand and upgrade the university's producer outreach and extension programs. The CHS Chair in Risk Management and Trading is part of the Department of Agribusiness and Applied Economics in the College of Agriculture, Food Systems, and Natural Resources.

ND EPSCoR

North Dakota colleges and universities collectively seek research opportunities by participating in the North Dakota Experimental Program to Stimulate Competitive Research (ND EPSCoR). Funded by the National Science Foundation and by support from the North Dakota legislature, ND EPSCoR also supports education, diversity and workforce development.

In 2016, ND EPSCoR piloted a Research Experience for Undergraduates (REU) program. Students from five North Dakota universities received awards. Students work with faculty on leading-edge research projects in chemistry, materials science, engineering, hydrology, agribusiness and applied economics and atmospheric sciences, while learning scientific research and communication skills.

The REU program is geared toward undergraduate students in the STEM disciplines and provides the opportunity to work in the Center for Regional Climate Studies (CRCS) or the Center for Sustainable Materials Science (CSMS). Students must be enrolled at NDSU, University of North Dakota, one of the five tribal colleges located in North Dakota or one of four North Dakota University System primarily undergraduate institutions.

STUDENT RECIPIENTS, THEIR INSTITUTIONS, CENTER OF RESEARCH AND ADVISORS ARE:

Levi Bassett
Dickinson State University, CRCS, Joshua Steffan

Quintin Elliott
University of North Dakota, CSMS, Qianli Chu

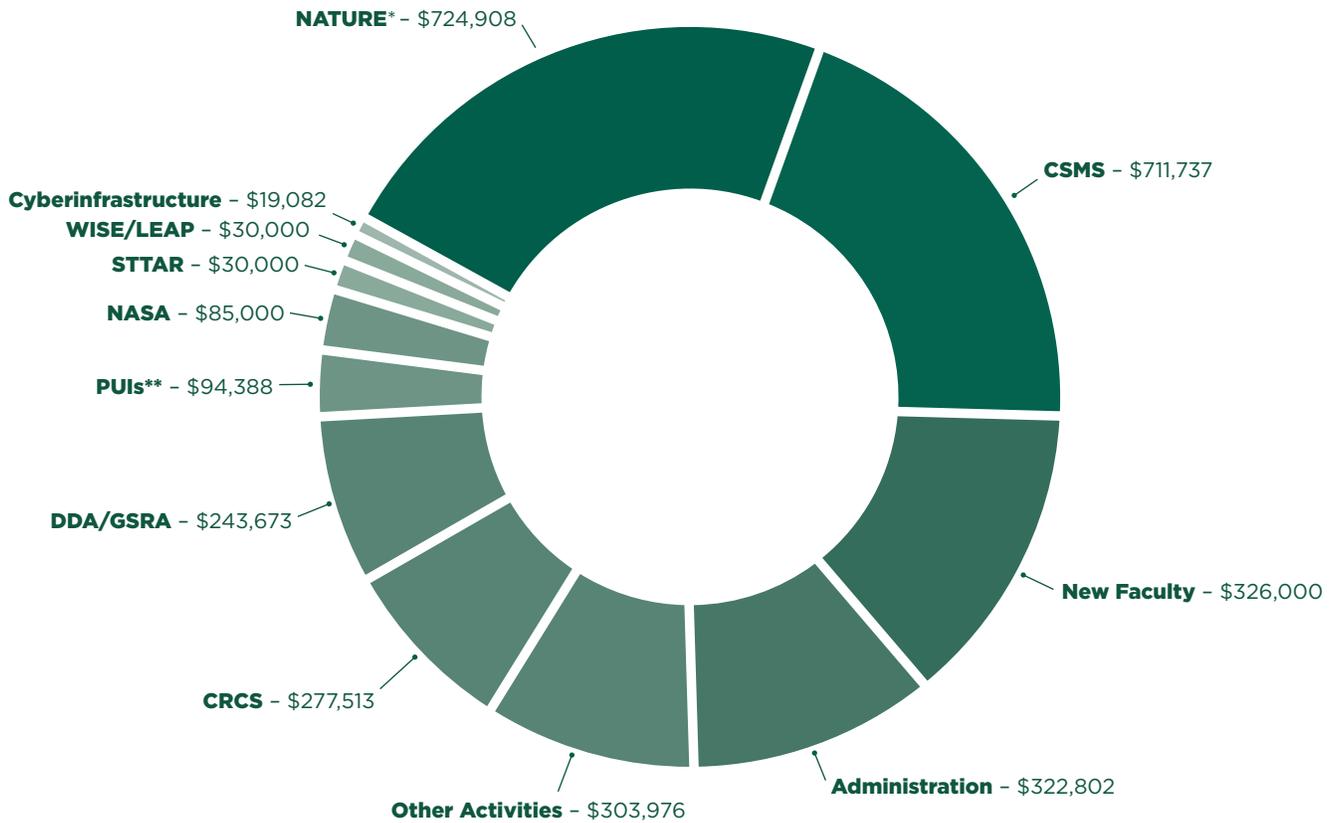
Breanne Hatfield
Minot State University, CSMS, Mikhail Bobylev

Billi Petermann
Dickinson State University, CRCS, Eric Brevik

Hayden Zander
Valley City State University, CRCS, Andre DeLorme

*To learn more about NDEPSCoR programs, visit www.ndepscor.ndus.edu.

FY16 ND EPSCoR FUNDED PROJECTS – NDSU CAMPUS



TOTAL - \$3,169,079

DDA - Doctoral Dissertation Assistantship
GSRA - Graduate Student Research Assistantship
CSMS - Sustainable Materials Science Research Cluster
UG STEM - Undergraduate STEM program
NATURE - Nurturing American Tribal Undergraduate Research and Education

WISE - Women in Science and Engineering
STTAR - Students in Technology Transfer and Research
CRCS - Regional Climate Studies Cluster
PUI - Primarily Undergraduate Institution
*includes funds spent directly at the five Tribal Colleges
 **Includes funds spent at PUIs

www.ndsu.edu/research

NDSU NORTH DAKOTA
STATE UNIVERSITY

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