



# NDSU OFFICE OF RESEARCH AND CREATIVE ACTIVITY

FISCAL YEAR 2013 ANNUAL REPORT

**NDSU** NORTH DAKOTA  
STATE UNIVERSITY

# FOCUSING ON THE FUTURE

Some research and creative activity take decades to develop. Other types of research and creative activity are fast-track springboards that help solve immediate challenges or add context and texture to knowledge. Regardless of the path, research and creative activity have an impact on everyday life—through products used, challenges met, or improvements made. Most importantly, opportunities in research and creative activity can have an impact on students' lives—either in choosing their life's work, gaining experience that can be used on the job, or helping their communities.

The research and creative activity enterprise at North Dakota State University continues to evolve and develop. In the Higher Education Research and Development Survey by the National Science Foundation, NDSU reported research expenditures of \$150M for fiscal year 2013. NDSU is poised to continue providing research opportunities for students, faculty, and staff. We know that future challenges await. Continued shrinking of competitive federal and other funding, market forces, and other variables can impact the future.

Amidst a continually changing environment, we will work to maximize innovative opportunities. Interdisciplinary research teams that work to solve grand challenges important to the United States are among the opportunities going forward. The NDSU Research and Technology Park is engaged in strategic planning for the future. The operation, but not the mission of research, is changing to one that is a vital component of a vibrant community and one that is engaged in the two-way transfer of thought, innovation, and culture. Research partnerships will continue to play significant roles in future research endeavors.

NDSU remains the only North Dakota university notably listed among the top 108 U.S. public and private universities in the Carnegie Commission on Higher Education's category of "Research Universities/Very High Research Activity." NDSU is listed in the top 100 research universities in the U.S. for research and development in agricultural sciences, chemistry, physical sciences, psychology, and social sciences, based on research expenditures reported to the National Science Foundation. A previous study by Economic Modeling Specialists International showed the economic impact of NDSU research at \$74.8M annually. Licensing and royalties based on NDSU research discoveries reached more than \$2.17M in fiscal year 2013.

Individual researchers, scholars, and research teams routinely receive accolades and competitive funding for outstanding work. Students at NDSU do, indeed, learn from the best. As a student-focused, land-grant, research institution, we are dedicated to fulfilling our mission to provide opportunities for students and the state we serve.



Thank you for your interest in our research and creative activity enterprise.

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



**Research and creative activity on the campus of North Dakota State University spans the alphabet from asthma to zoology. This report provides a snapshot of the achievements by students, faculty, and staff.**

#### **NANO AND ITS IMPACT— UNDERGRAD STUDENTS RESEARCH ANSWERS**

Something extremely small can pack a powerful punch. With more than 1,600 products using nanotechnology on the market, a multidisciplinary team of NDSU student researchers examines how people perceive such products, and their potential environmental impact. The Nanoenvirology Research Group, led by Achintya Bezbaruah, assistant professor of civil and environmental engineering, determines if industrial products and byproducts containing nanoparticles will affect the environment. They investigate how to use nanomaterials to clean the environment; examine how plants and microorganisms are affected by nanomaterials; and study consumers' perceptions of nano-based products. The research team's work has led to three patented inventions for groundwater remediation, surface water phosphate removal, and slow-release phosphate and iron fertilizers. Students say working in research increases their critical thinking skills and provides future job skills. Team members included undergraduates: Amanda Grosz, a senior in civil engineering, Bismarck, N.D.; James Tibbles, a freshman in mechanical engineering, Shoreview, Minn.; Cody Ritt, a sophomore in civil engineering, Hamel, Minn.; Hannah Hood, a sophomore in psychology, North Saint Paul, Minn.; Neal Dittrich, a senior in business administration, Champlin, Minn., and Sanjivni Sinha, a senior in biotechnology, New Delhi, India. Students are mentored by graduate researchers: Mary Pate, Wadena, Minn.; Mohammad Hossain, Dhaka, Bangladesh; Achintyamugdha Sharma and Priyanka Deka, Guwahati, India.



#### **FLYING HIGH**

The Federal Aviation Administration has named North Dakota one of six test sites to conduct research and testing to safely integrate unmanned aircraft systems (UAS) into the National Airspace System. North Dakota's team approach between government, industry and education provides an unparalleled UAS research environment, combining the expertise of North Dakota State University and the University of North Dakota Aerospace. Scientific capabilities at NDSU span the UAS market space and are coupled with powerful data facilities at its Center for Computationally Assisted Science and Technology. NDSU's focus includes precision agriculture, transportation, coatings, microelectronics and informatics. Functional test flights and operational research flights were completed at NDSU's Carrington Research Extension Center. The tests flown by University of North Dakota pilots used the Draganflyer X4ES, with additional research planned to check soil and crops in precision agriculture activities.





### **GROWING RUST-RESISTANT WHEAT**

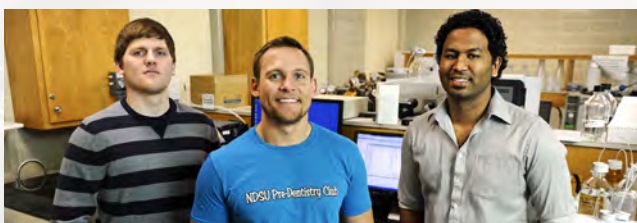
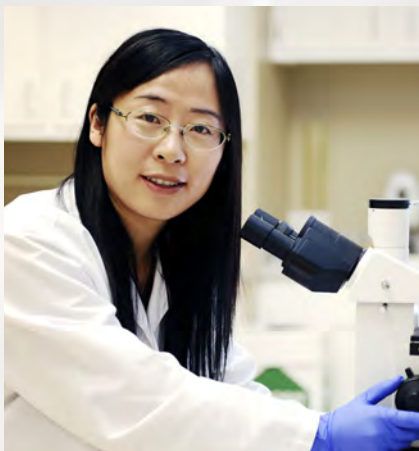
Called the polio of agriculture in some parts of the world, rust disease in wheat is a fungal infection that can have devastating impacts on crops. Maricelis Acevedo, assistant professor of plant pathology, specializes in leading research on rust disease in wheat. Her research emphasizes genetics to build resistance to leaf and stem rust in wheat. She was one of 16 scientists invited to the Melinda and Bill Gates Foundation in Seattle to brainstorm future needs in wheat research and also received a 2013 Leap Research Award from NDSU's FORWARD program, which works for the advancement of women in higher education. Acevedo's research has implications for the agricultural economy. More than 19,000 farms in North Dakota grow wheat, according to the State Wheat Commission. North Dakota typically ranks second only to Kansas in total wheat production each year.



### **RESEARCH ADDRESSES OIL BOOM NEEDS**

From the New York Times to Bloomberg News, and the BBC to Aljazeera, North Dakota's oil boom is making headlines across the globe. NDSU researchers are uniquely positioned to help the state as it addresses the population and economic boom. Faculty research on population projections, school enrollments, infrastructure, law enforcement needs, workforce characteristics, and soil conservation provides community and business leaders with planning tools amidst unprecedented growth. Faculty members Nancy Hodur and Dean Bangsund in agribusiness and applied economics, Carol Archbold in criminal justice, and others such as the Upper Great Plains Transportation Institute, contribute to oil-boom-related research. Additional scientists offer expertise in sensors that can monitor equipment and expertise in corrosion that can lead to pipeline degradation. Other opportunities are on the horizon for unmanned aerial vehicle research to monitor pipelines. NDSU's Dickinson Research Extension Center and faculty researchers comprise the group called A Commitment to Continue, with a goal to cooperatively produce significant scientific research and education to assist the agricultural and energy industries.





## GROWING ENTREPRENEURS

Good ideas that work are one thing. Good ideas with market potential are another. NDSU's Research and Technology Park, NDSU's Provost, and a host of partners provide innovative students with tools to become future entrepreneurs. The annual Innovation Week gives students the opportunity to develop and present their ideas to business leaders and compete for prizes to continue refining their inventions. Recent first-place Innovation Week winners are:

- a. Team NewCure developed a new therapeutic agent for neuroblastoma, a cancer that most commonly affects children and infants. Shuang Zhou, a graduate student in pharmaceutical sciences from China, along with graduate student Ying Zhang and adviser Erxi Wu, assistant professor of pharmaceutical sciences, focused on salinomycin. This common antibiotic for animals emerged as a promising cancer-fighting compound several years ago. They also studied salinomycin's effects on medulloblastoma, brain cancer cells and pancreatic cancer cells. They discovered the agent markedly inhibited cell proliferation and the formation of tumorsphere, a spheroid composed of cancer stem cells. The next steps for Zhou's salinomycin research are to proceed to animal studies and develop a screening kit.
- b. Aqua Motion International fostered an entrepreneurial focus to provide free swimming lessons to children in high-risk drowning areas around the world. Team members are Jonathon McCarthy, a senior majoring in management from Coon Rapids, Minn., and Andrew Moe, a sophomore majoring in accounting from Pequot Lakes, Minn. Paul Brown, senior lecturer in management and marketing, serves as adviser.
- c. Hum-HealthyPlus developed a recipe for nutritious and cost-effective hummus that is gluten-free. The recipe uses corn flour and lentils, both produced in North Dakota. The team includes senior zoology majors Tyler Lewandowski, Foley, Minn.; Dwight Anderson, Hankinson, N.D.; and cereal science graduate student Lukshman Ekanayake, Kurunegala, Sri Lanka. Team adviser is Dilrukshi Thavarajah, assistant professor of cereal science.
- d. Other teams that placed in the competition are working on bio-based sports equipment, a laser tool for hunters to practice accuracy, a textbook exchange program, mobile health platforms, cake that promotes growth of beneficial intestinal microorganisms, and food using corn-based distillers grains and the powdered food substitute Soy lent, to produce food with the aid of a 3-D printer.



## NDSU RESEARCH LEADS TO BUSINESS STARTUPS

Bringing research discoveries out of the lab and into the marketplace is another way to measure results. Through the NDSU Research Foundation, faculty and students patent inventions from wide-ranging research and license them to companies to develop the technology. Six startup companies have been created in industries such as electronics, computer systems, coatings, biomedical and bioscience technology since 2003. The direct and indirect economic impact of startup companies stemming from NDSU-related research totals \$3M.

Fargo-based Elinor Specialty Coatings, for example, licensed technologies for a breakthrough hexavalent chromium-free, magnesium-rich coatings technology that protects aluminum alloys. NDSU researcher Dante Battocchi was part of the team that developed the primers being marketed by Elinor Specialty Coatings to military and civilian auto and shipbuilding industries. Known as Aluma45MgRP, the company's product earned a TechConnect National Innovation Award for the potential positive impact that the product will have on specific industries. The company also licensed a removable protective coating developed at NDSU for outdoor bronze monuments and statues.

Another startup company, c2renew, arose from NDSU research focused on turning agricultural waste into biocomposite plastics. Based in Colfax, N.D., c2renew licensed the green technology. Developed by Chad Ulven, associate professor of mechanical engineering and his research team at NDSU, the technology could be used anywhere commodity thermoplastics are typically used and has been focused on agricultural equipment applications.

A biotech startup company, HQC Biosciences, stems from the research of NDSU graduate Erin Nyren-Erickson, who licensed a technology she helped create while at NDSU. The tool she developed provides a faster, more sensitive and cost-effective method to test the blood-thinning drug heparin for contaminants. Her biotech business and lab are now launched in NDSU's Research and Technology Park. The company uses nanoscale technologies to develop novel analytical and quality control tools for biological sciences.



## UNDERSTANDING ASTHMA

Imagine what it would be like to breathe through a straw. That's sometimes what it can feel like for an estimated 18.9 million people in the U.S. who are affected by allergic asthma, both at home and on the job. While at NDSU, T.J. Peterson, Brooklyn Park, Minn., researched agricultural pulmonary exposure to grain dust, chemicals, and toxins that can trigger asthmatic reactions. His faculty research advisers included Glenn Dorsam and Jane Schuh, who are both associate professors of veterinary and microbiological sciences. The researchers induce asthma in mice to understand what happens to the animals' lungs after exposure to the particulates. The project is funded through the National Institutes of Health. Peterson says he thinks the hands-on research in the lab equates to three years in the classroom. He is beginning medical school at Uniformed Services University of Health Sciences in Washington, D.C., which trains doctors for all branches of the military.





### CONNECT THE DOTS TO RENEWABLE ENERGY'S FUTURE

Quantum dots are nanocrystals ranging in size from two to 10 nanometers—billions of them could fit on the head of a pin. Svetlana Kilina studies how quantum dots could maximize conversion of solar energy in new-generation solar cells and fuel cells. Quantum dots have the potential to convert light to electric energy – or vice versa – much more efficiently than conventional energy materials such as silicon. Her findings could help dramatically optimize solar cells, sensors, optoelectronic devices, and bio-imaging technology. Kilina, an associate professor of chemistry and biochemistry, was named one of 126 U.S. and Canadian researchers to receive the Sloan Research Fellowship, making her the first scientist in North Dakota to be given this prestigious honor. The fellowship is given to early-career scientists and scholars whose potential and achievements identify them as the next generation of scientific leaders. She had previously received a \$750,000 five-year award from the U.S. Department of Energy Office of Science Early Career Research Program. Kilina uses supercomputers to conduct computer-simulated experiments, investigate, and advance her research in this field, including the NDSU Center for Computationally Assisted Science and Technology, in addition to the National Energy Research Scientific Computing Center, governed by the Department of Energy and Los Alamos National Laboratory.



### NEXT GENERATION RESEARCHERS RECOGNIZED

Two major national awards received by NDSU professors totaled a combined \$1.6M to biochemistry and to plant pathology research programs, providing additional research opportunities for students. Stuart Haring, assistant professor of biochemistry, and Robert Brueggeman, assistant professor of plant pathology, received five-year Faculty Early Career Development awards from the National Science Foundation. Living cells are the focus of Haring's research, for which he received \$992,429. It is the largest single CAREER award received at NDSU since 1996. Haring's research involves understanding molecular mechanisms of DNA metabolism, which are important in preventing mutations from occurring. Brueggeman was awarded \$623,363 for research that examines mechanisms of disease resistance in cereal crops. Understanding how disease resistance operates against important cereal crop pathogens will enhance food security and keep the production of diverse crops an economically viable option for producers. Eighteen faculty members at NDSU have received prestigious National Science Foundation CAREER awards across a variety of disciplines since 1996. The program recognizes and supports the early career-development activities of scholars who are likely to become the academic leaders of the 21st century.



## RESEARCH ON RENEWABLES SPANS STATES

From detergents to paint to cosmetics and computers, thousands of everyday products are made from petrochemicals. A multi-state research group is collaborating to produce viable renewable replacements for existing petrochemicals. Dakota Bioprocessing Consortium began with a \$6M grant to the North Dakota and the South Dakota Experimental Program to Stimulate Competitive Research programs. This multi-state, multi-institutional research collaboration includes NDSU, the University of North Dakota, South Dakota State University and the South Dakota School of Mines and Technology. Researchers evaluate agricultural and urban waste as potential sources of renewables. Initial research centers on using lignin, which binds plants and wood, as a raw material for renewable chemical and polymeric alternatives. Isolating molecules from wastes may serve as building blocks to renewable replacements. NDSU's team includes Mukund Sibi, University Distinguished Professor of chemistry and biochemistry; Dean Webster, chair of coatings and polymeric materials; Pinjing Zhao, assistant professor of agricultural and biosystems engineering/Ag Extension Service; and Bret Chisholm, senior research scientist, Center for Nanoscale Science and Engineering.

## STRATEGIES TO ADDRESS 21ST CENTURY CLASSROOMS

Preparing teachers who have tools for multicultural educational settings is one of the goals of Kelly Sassi, assistant professor of English and education. Her action research done in classrooms in the state helps teachers develop strategies that address achievement gaps between multicultural students and majority white students in the United States. Her research collaborations at Sitting Bull College, Fort Yates, N.D., and with secondary school teachers from the Standing Rock Sioux Reservation, focuses on enhancing students' writing skills and test scores, while evaluating standardized test methodologies. Sassi's work at Standing Rock was funded by a U.S. Department of Education's Supporting Effective Educator Development grant from the National Writing Project for professional development of teachers at high-needs schools. NDSU is the home of the Red River Valley Writing Project—one of 183 sites of the National Writing Project nationwide. The mission of the National Writing Project is to improve the teaching of writing and improve learning in the nation's schools.

## DEALING WITH WORKPLACE BULLIES

Bullying doesn't stop on the playground. From the workplace to the boardroom, research shows that adult bullying takes many forms. Almost 30 percent of people are targeted at some time during their work histories, according to Pamela Lutgen-Sandvik, associate professor of communication at NDSU. She points out that it's not always just one aggressive person, but can come from a climate of hostility and aggression where bullying is the norm. When adding people who see workplace bullying, but aren't directly bullied, to those who directly experience abuse, Lutgen-Sandvik's research consistently estimates that nearly half of U.S. workers are affected, making it a problem of epidemic proportion. She translated her peer-reviewed social science research into a book for the public, "Adult Bullying – A Nasty Piece of Work: Translating a Decade of Research on Non-Sexual Harassment, Psychological Terror, Mobbing and Emotional Abuse on the Job." The book also outlines reversing the effects of adult bullying, but Lutgen-Sandvik says more research is needed on how organizations have ended bullying, why upper-managers and decision-makers fail to take action or take action that worsens abuse, and what organizational pressures or interpersonal beliefs drive bullies' behavior.



## BRINGING LIFE TO PERFORMING ARTS

Students and faculty in Performing Arts at NDSU present their work to audiences around the globe, providing wellsprings of opportunity, serving as arts ambassadors. Congratulations to the School of Music for their yearlong series of events to commemorate their significant achievement to be designated as a nationally recognized School of Music. Their festivities included residencies by noted musical artists and gala concerts, as well as a number of commissions. In addition, Theatre Arts students learn their craft from professors and visiting artists through a variety of performance opportunities. The centennial of theatre at NDSU included a televised documentary, and guest artists, allowing students to work with professionals from throughout the nation.

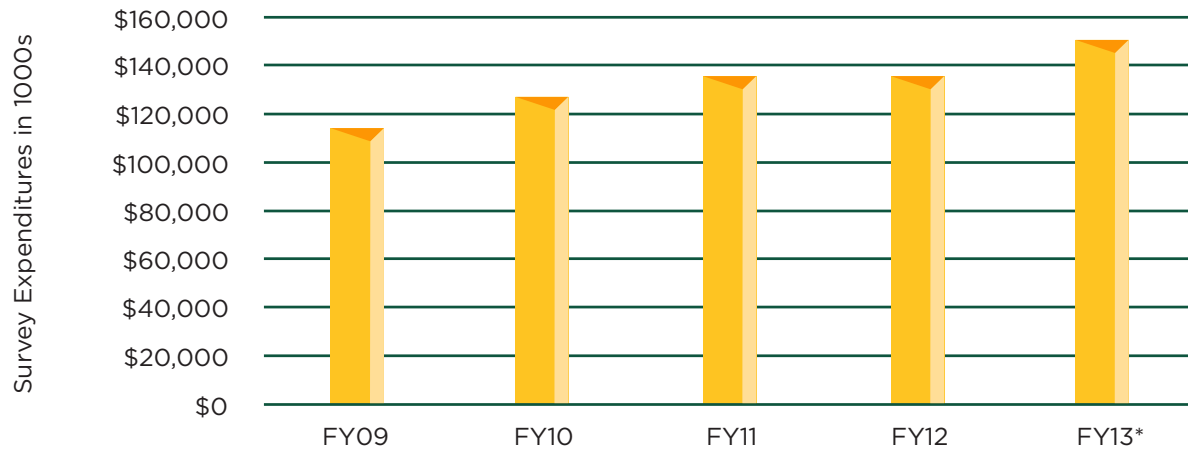


## ART IN UNEXPECTED PLACES

The Department of Visual Arts provides an inspiring, diverse, and relevant artistic learning environment where students exhibit their work in many different settings. From the “Misfit Cup Liberation Project” to ArtStimulus, artist Michael J. Strand, visual arts department head at NDSU, works to build community through art, craft, and design by making objects that extend beyond the walls of museums or the confines of galleries. Strand takes particular interest in strengthening rural communities with his projects. A Bush Fellowship recipient, he intends to expand the depth of his artistic practice by working to connect rural North Dakota communities with international cultures. He has presented at international and national venues, including the Smithsonian American Art Museum, and presented a TEDx Talk in Fargo titled “The Spaces Between: Art, Craft and Humanity.” Strand also has been featured in the magazine “American Craft,” with an article about his work in social practice and craft.

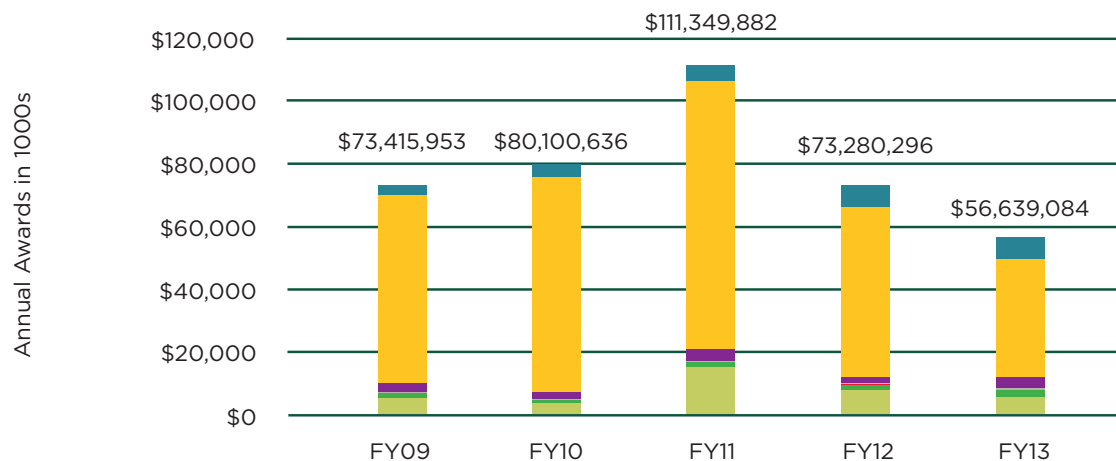


## NDSU HIGHER EDUCATION R&D EXPENDITURES (HERD)



FY09 - FY12 data from National Science Foundation (NSF): Table 20 Higher Education Research and Development Survey expenditures, ranked by FY 2012 R&D expenditures: FY 03-12. [http://ncesdata.nsf.gov/herd/2012/html/HERD2012\\_DST\\_20.html](http://ncesdata.nsf.gov/herd/2012/html/HERD2012_DST_20.html).  
 \*FY13 data reported to, but not yet published by, NSF.

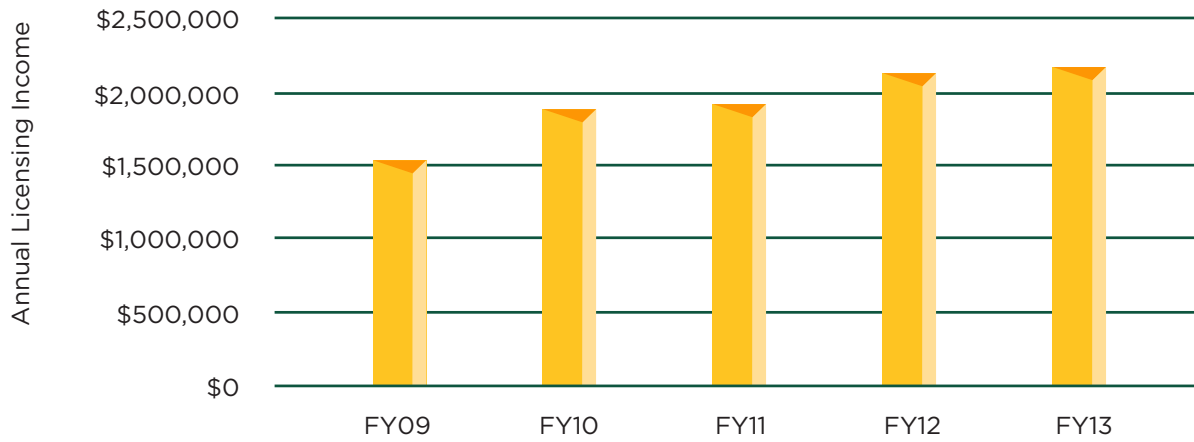
## EXTERNAL AWARDS BY SOURCE



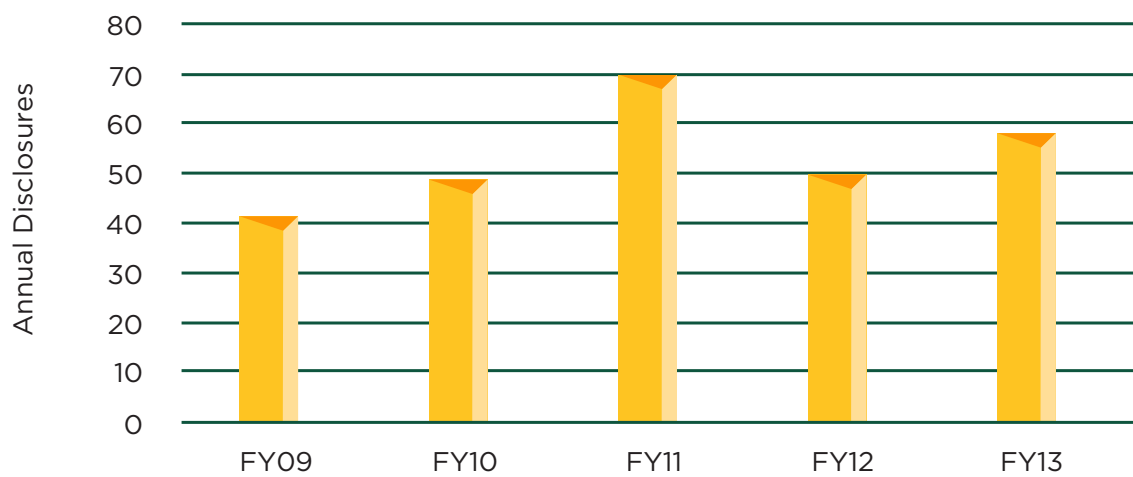
Commodity	\$3,726,611	\$4,507,847	\$5,692,514	\$7,732,125	\$7,590,644
Federal	\$60,049,334	\$68,732,665	\$84,972,845	\$53,898,413	\$37,507,434
Foundation/Non-Profit	\$2,684,819	\$1,986,513	\$3,804,059	\$1,904,028	\$3,384,938
Other	\$66,283	\$131,154	\$259,769	\$64,770	\$390,571
Other Government Office	\$90,655	\$199,546	\$134,493	\$412,536	\$231,850
Private	\$1,793,283	\$1,007,048	\$1,510,575	\$1,890,399	\$2,307,909
State	\$5,004,937	\$3,535,863	\$14,975,627	\$7,378,025	\$5,225,739



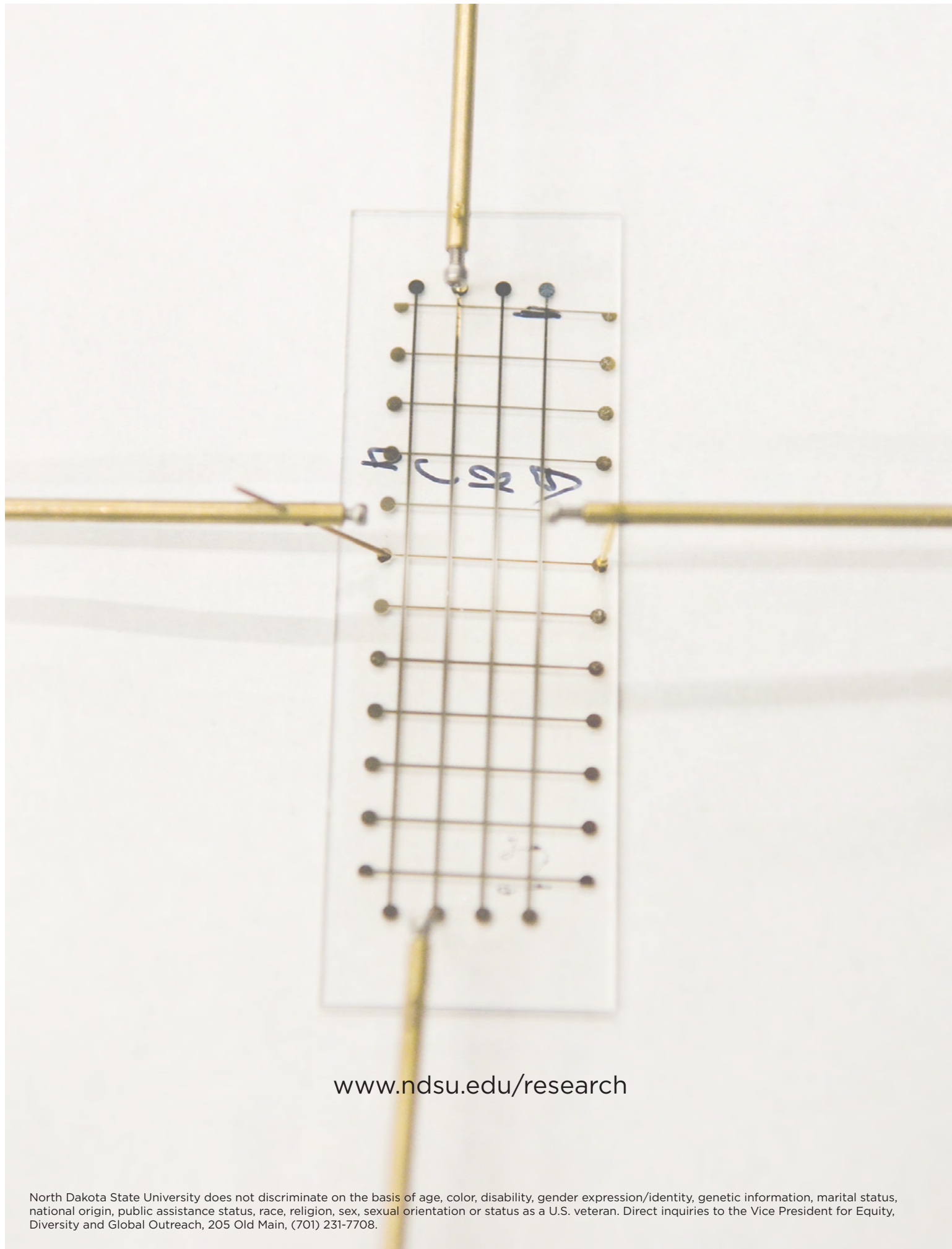
### LICENSING INCOME



### INVENTION DISCLOSURES







[www.ndsu.edu/research](http://www.ndsu.edu/research)