

NORTH DAKOTA SCIENCE AND TECHNOLOGY PLAN

**ND EPSCOR
ND STATE STEERING COMMITTEE
JUNE 2024**

The *North Dakota Science and Technology Plan* was adopted by the North Dakota Established Program to Stimulate Competitive Research State Steering Committee on June 6, 2024.

A handwritten signature in blue ink, reading "Curtis Biller", is positioned above a horizontal line.

Curtis Biller
Chair, ND EPSCoR State Steering Committee

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RU Research Park Representative
Fargo, ND

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VP Research and Creative Activity
North Dakota State University
Fargo, ND

Scott Snyder, Ph.D.
VP Research and Economic Development
University of North Dakota
Grand Forks, ND

Jolynne Tschetter, Ph.D.
Executive Director, ND EPSCoR
North Dakota State University
Fargo, ND

PURPOSE, MISSION, VISION, AND GOALS

PURPOSE

Current and past NSF EPSCoR and state funding has been pivotal in advancing the research capacity and competitiveness of North Dakota. The purpose of this plan is to identify North Dakota’s research and development strengths, opportunities to further develop research and development capacity, and challenges that must be overcome to take advantage of those opportunities as they relate to NSF EPSCoR funding opportunities. This work represents only the initial step of an ongoing process to compile a comprehensive and dynamic jurisdictional science and technology plan.

MISSION STATEMENT

The mission of the North Dakota Science and Technology Plan is to create a framework to foster innovation and drive economic prosperity through the advancement of science and technology while building a skilled and adaptable workforce that is aligned with the evolving needs of industries and society to address complex challenges and broaden North Dakota’s economy.

VISION STATEMENT

The vision of the North Dakota Science and Technology Plan is to create a future where science and technology are catalysts for positive change; through collaboration, creativity, and continuous learning, unlocking new frontiers of knowledge, driving economic prosperity, and fostering a culture of innovation that enables business to prosper, building a capable and resilient workforce, and enhancing North Dakota’s quality of life.

GOALS

1. Increase student enrollment in STEM postsecondary education.
2. Increase number of STEM degrees awarded at all levels and among first-generation college students, women and students of color.
3. Increase recognition that applied and basic research are needed to tackle 21st century challenges, including economic and societal challenges.
4. Increase research competitiveness through capacity-building (people, equipment, and facilities).
5. Continue to make strategic investments in the jurisdiction including ND EPSCoR to support STEM infrastructure, STEM education, targeted industry sectors, and leverage unique research facilities.

TARGETED INDUSTRIES

The State of North Dakota has identified six targeted industries to catalyze economic development efforts across the state. These target industries represent both established and emerging industries whose continued growth will increase the state's competitiveness, increase economic growth, and generate quality employment opportunities.

These targeted industries capitalize on the state's strengths, resources, and opportunities representing areas where North Dakota possesses a competitive advantage and significant growth potential. Five of the targeted industries are impacted by advances in STEM and/or rely on a STEM trained workforce.

1. **Food and Agriculture:** North Dakota's fertile soil and favorable climate make it a powerhouse in agriculture, with a strong focus on crop and livestock production plus value-added agribusiness. The state's agricultural sector contributes significantly to its economy, and North Dakota continues to invest in research, technology, and infrastructure to enhance productivity, sustainability, and market access for its agricultural products.
2. **Energy and Natural Resources:** With its abundant natural resources, particularly oil, coal, and wind energy, the energy sector remains a focal point for economic development in North Dakota. The state continues to support the expansion of conventional energy production, particularly from the Bakken Formation, while also investing in renewable energy sources like wind power. Initiatives to promote energy innovation, efficiency, and sustainability further solidify North Dakota's position as a key player in the nation's energy landscape.
3. **Advanced Manufacturing:** North Dakota aims to strengthen its advanced manufacturing sector, leveraging its skilled workforce, strategic location, and supportive business environment. The state prioritizes industries such as aerospace, machinery, value-added agricultural innovation, construction, transportation, and technology manufacturing, fostering innovation, investment, and job creation in these high-growth areas. Collaborations between industry, academia, and government entities drive advancements in manufacturing processes, materials, and technologies.
4. **Information Technology:** North Dakota is nurturing its technology and innovation ecosystem, with a focus on fostering entrepreneurship, research, and development in emerging fields such as information technology, biotechnology, and Uncrewed Aerial Systems (UAS). The state provides resources, incentives, and support programs for tech startups, small businesses, and research institutions to drive innovation, attract investment, and create high-quality jobs in the technology sector.
5. **Autonomous Systems:** North Dakota has established itself as a leading force in UAS with the federally designated Northern Plains UAS Test Site and the public private partnership of Grand Sky, the nation's first commercial UAS business and aviation park. These facilities provide testing grounds and infrastructure for research, development, and commercialization of UAS technologies. The state's expertise in autonomous systems spans various applications, including agriculture, energy, infrastructure inspection, public safety, surface transportation, and beyond.

FOOD AND AGRICULTURE

Agriculture is a leading industry in North Dakota providing 28.4% of our gross business volume and one of every five jobs in North Dakota is related to agriculture. While crop production agriculture comprises the largest sector of the agriculture economy in North Dakota, North Dakota is working to diversify and grow its economy by investing in the development of value-added agriculture and precision agriculture.

Value-added agriculture focuses on production and manufacturing processes that increase the value of a primary agricultural commodity resulting in the transformation of raw commodities to products desired by consumers.

The agricultural sector in North Dakota has also evolved with advancements in technology and sustainable farming practices. Farmers are increasingly adopting precision agriculture techniques, incorporating data-driven decision-making and innovative machinery to optimize crop yields while minimizing environmental impact. Furthermore, the state's strong agricultural research institutions, like North Dakota State University (NDSU), drive innovation in crop genetics, soil health, and agricultural engineering, bolstering the competitiveness of North Dakota's agricultural products in domestic and global markets.

Precision agriculture enables farmers to more accurately evaluate soil variability, noxious plants, disease, and other elements influencing crop quality and customize the inputs and time required for optimal yields, efficiency, and safety. As a result, food quality and attainability improve for customers and production is more cost-effective. In North Dakota, over 54% (the highest percentage nationwide) of producers use precision agriculture.

RESEARCH AND EDUCATIONAL OPPORTUNITIES

NDSU is home to one of the first precision agriculture majors at the bachelor's level in the U.S., which will be leveraged to train the next generation of workforce, including UAS. The Big Data Pipeline Unit under the auspices of the North Dakota Agricultural Experiment Station (NDAES) at NDSU. Current agricultural and natural resources/environmental research uses advanced techniques in data management, data analysis and visualization. The Unit applies data science tools like advanced statistical, AI techniques, database technologies, and software engineering applied to agricultural issues.

In addition, Lake Region State College and North Dakota State College of Science, offer in Precision Agriculture programs at the associate degrees level and Bismarck State College offers Precision Agriculture courses as part of its Agriculture programs and degrees.

All five of North Dakota's Tribal Colleges and Universities are 1994 land grant institutions, with academic offerings, research and extension in areas like sustainable food systems, reclamation of ancestral farming practices and crop varieties, Indigenous food sovereignty, to name a few.

Statewide network of research, education, and outreach through the NDSU Extension Service and ND Agricultural Experiment Station.

Center for Bioplastics and Biocomposites (CB²) is a National Science Foundation Industry & University Cooperative Research Center (I/UCRC) whose focus is to develop products for agricultural and forestry

feedstocks, plastics, coatings, adhesives and composites. This is a collaborative effort between NDSU, Iowa State University, Washington State University, University of Georgia and over 20 industry members to make commercially relevant products.

North Dakota Agricultural Weather Network (NDAWN) is a network (mesonet) consisting of over 150 weather stations distributed across North Dakota, eastern Montana, and western Minnesota which provide weather updates every five minutes that are aggregated, checked for quality control and loaded into the NDAWN database which is available to the general public at no charge. NDAWN has been supported by gifts and grants from Federal and State Agencies, Commodity Organizations, Agricultural Clubs, producers, businesses and individuals since its inception in 1989 and is operated cooperatively by the NDSU School of Natural Resource Sciences and the High Plains Regional Climate Center in Lincoln, Nebraska.

Additional Areas of Research Supporting Food and Agriculture

- ✓ Public Health and Global Nutrition (includes generating new, high-nutrition public plant varieties)
- ✓ Precision agriculture
- ✓ Pollinators
- ✓ Climate smart agriculture including decarbonization practices like carbon trading

EMERGING AND NEW RESEARCH AREAS FOR AGRICULTURE:

- | | |
|--|---|
| ✓ Cybersecurity and food systems vulnerability | ✓ Soil health/soil function |
| ✓ Controlled environment agriculture, especially greenhouse production | ✓ Plant physiology |
| ✓ Environmental research related to salt, water, and soil | ✓ Improved plant genetics |
| ✓ Digital technology to increase production | ✓ Development of new biobased materials |
| ✓ Sensors to increase farming efficiency | ✓ Regenerative agriculture |
| ✓ Precision agriculture economics | ✓ Food sovereignty |
| ✓ Remote sensing and satellite imaging technology | ✓ Hydroponics |

ENERGY AND NATURAL RESOURCES

North Dakota's energy sector is a cornerstone of its economy, with the state being a leading producer of both conventional and renewable energy resources. The primary conventional energy resource in North Dakota is oil, particularly from the Bakken Formation, one of the largest oil fields in the United States. The development of hydraulic fracturing (fracking) technology has enabled the extraction of oil and natural gas from shale formations, leading to a significant increase in production and economic activity in the region.

North Dakota is the #3 oil-producing state in the nation, transporting nearly 2.3M barrels of crude daily. The state is also home to 33 natural gas production facilities and is ranked 9th in the nation for installed wind capacity (4,250MW). In addition, the state has substantial energy production through other fossil fuel and renewable resources including natural gas, coal, synfuels, biodiesel, solar, hydro power and ethanol.

In North Dakota, energy production is six times greater than consumption, the sectors sustain over 75,000 jobs, and its annual economic impact exceeds \$3 billion.

One of the most prominent emerging sectors is renewable energy and North Dakota is harnessing its renewable energy potential, particularly wind energy. The state's vast open spaces and consistent wind patterns make it an ideal location for wind farm development. North Dakota ranks among the top states in the nation for wind energy production, with wind turbines dotting the landscape across rural areas. Wind energy projects contribute to energy diversity while reducing greenhouse gas emissions. As demand for clean energy sources continues to rise, North Dakota stands to benefit from investments in wind power generation, creating jobs and driving economic growth while reducing greenhouse gas emissions.

North Dakota is rich in natural resources with abundant sources of energy available including coal, oil, wind and solar energy. These complementary and abundant energy sources provide reliable and redundant energy for North Dakota businesses and residents and allow us to export to power the surrounding states.

Energy facts about North Dakota

- ✓ 3rd largest in national oil production
- ✓ 5th lowest cost of electricity in the United States
- ✓ 41% of energy generation from renewable sources
- ✓ 2nd largest known lignite deposit in the world
- ✓ Almost 2.3 million barrels of Williston Basin crude oil export capacity per day

Biofuel production holds a unique position as it is part of the Energy industry but is also considered part of the value-added agricultural network.

RESEARCH AND EDUCATIONAL OPPORTUNITIES

This plan recognizes and responds to the need for further research addressing solutions to energy challenges ranging from improved production/use of fossil fuels, renewable energy generation, hydrogen and emerging energy sources, energy storage, and carbon capture and sequestration to rare earth elements, advanced carbon materials, grid resiliency, and optimal energy use. UND has extensive expertise through the Energy & Environmental Research Center, and national leader in energy research. The College of Engineering and Mines at UND is also home to the Institute for Energy Studies which “focuses on the integration of energy education,

research and outreach” (<https://engineering.und.edu/research/ies/index.html>). The EERC is home to the State Energy Research Center (SERC), the DOE Heartland Hydrogen Hub, and is part of the DOE NETL-led Carbon Storage Assurance Facility Enterprise (CarbonSAFE) initiative. Commercialization of technologies from these projects will create new jobs, spur entrepreneurial activity, and address effects of climate change. The Institute for Energy Studies is working on ground breaking research in rare earth element extraction from iron ore resources as well as battery technologies. In addition, UND hosts the Renewable Hydrogen H2 Power laboratory which is a test facility to conduct research on renewable hydrogen production and its energy conversion. The test facility is equipped with Proton Exchange Membrane (PEM) fuel cells, state of the art PEM electrolyzer, and power electronics.

Additional Areas of Research Supporting Energy

- ✓ Renewable energy – wind, solar, biomass, biofuels, lignite coal, geothermal, and alternative fuels such as hydrogen-based fuels and syngas
- ✓ Solar energy and solar cells
- ✓ Power electronics system

EMERGING AND NEW RESEARCH AREAS FOR ENERGY:

- ✓ Biofuels and biomaterials
- ✓ Enhanced oil recovery
- ✓ Reduced carbon or carbon-free energy
- ✓ Emission reduction technology
- ✓ Increased energy production methodologies
- ✓ Solar power economics
- ✓ Advanced battery and fuel cell technologies and materials
- ✓ Carbon capture/sequestration
- ✓ Clean energy research
- ✓ Value-added energy processing for energy by-products
- ✓ Autonomous applications in energy
- ✓ Enhance the grid to meet future safe and reliable electrical needs
- ✓ Recovery and refinement of rare earth elements and critical minerals
- ✓ Carbon capture and utilization technology

ADVANCED MANUFACTURING

North Dakota has a long history of strength in manufacturing. With manufacturing accounting for 7.3 percent of North Dakota's Gross State Product, North Dakota has continued to see expansion within this industry sector despite other areas of the United States experiencing retractions in this industry sector.

Impact Dakota (North Dakota's MEP partner) reported that the North Dakota manufacturers they served in 2022 had \$667.2 Million in total sales retained/gained, 354 jobs retained/gain, \$2.1M total cost savings and \$10M in new investments. This contributed to the \$5.02 Billion in industry outputs North Dakota manufacturers delivered in 2022 per BEA and the 64.8% GDP growth seen between 2012 and 2022.

The North Dakota Department of Commerce reports that "future expansion of our manufacturing sector will come not from labor growth, but rather from innovation and productivity gains, as well as a strong focus on developing foreign markets."

ND Department of Commerce launched Automate ND which is designed to provide financial support to North Dakota primary sector certified businesses who are facing a workforce shortage. The funds may be used for the purchase or lease of machinery, equipment, and software (upfront configuration/setup costs) to automate existing processes to increase output per employee and provide opportunities for upskilling.

Included in the category of advanced manufacturing are technology-based businesses including biosciences and the AgTech industries.

Bioscience subsector

North Dakota is experiencing growth in the healthcare and biotechnology sectors. The state is home to leading research institutions and healthcare facilities that are driving advancements in medical research, pharmaceuticals, and healthcare delivery. Biotechnology companies are leveraging North Dakota's expertise in agriculture and natural resources to develop bioproducts, biofuels, and pharmaceuticals derived from renewable sources. This convergence of healthcare and biotechnology holds potential for creating high-paying jobs and attracting investment in research and development.

Bioscience subsectors being targeted by the region include:

- ✓ Medical and Testing Laboratories
- ✓ Medical Device and Equipment
- ✓ Medical Product Distribution
- ✓ Pharmaceuticals and Therapeutics
- ✓ Research and Development
- ✓ Vaccine Therapeutic Development
- ✓ Plant Biotechnology

AgTech subsector

North Dakota's agricultural innovation ecosystem is characterized by collaboration between farmers, researchers, technology developers, industry partners, and government agencies. The North Dakota Agriculture Experiment Station, Extension Services, and grower organization support research, extension, and technology adoption efforts, fostering a culture of innovation and entrepreneurship in the state's agricultural sector

AgTech subsectors being targeted by the region include:

- ✓ Precision agriculture equipment

- ✓ Agricultural drones equipped with cameras, sensors, and software for crop monitoring, mapping, and analysis
- ✓ Farm management software platforms
- ✓ Equipment manufacturing

RESEARCH AND EDUCATIONAL OPPORTUNITIES

Sensor and Automation Capabilities. NDSU has capabilities that span early theoretical (R&D) research, prototyping new platforms, translational research and commercial implementation in both of these major areas. Biomedical sensor research focuses on the development and design of electronic devices and sensors based on nanomaterials, including nanomaterial fabrication, device design and modeling, and variable sensing techniques. In agricultural sensors, research focuses on the development and design of electromagnetic sensors (microwave, images, RADAR, LIDAR, etc.) for the agricultural industry, and on the development and design of environmentally friendly materials for sensor applications in the field. Expertise includes the application and education of automation for engineers.

In addition, NDSU has Class 100 and 10,000 cleanrooms and equipment for research and workforce development in electronics fabrication. 77,000 ft² of cleanroom, laboratory and engineering spaces that house design, synthesis, fabrication and characterization capabilities.

The UND College of Engineering and Mines is home to an undergraduate and graduate program in biomedical engineering which sponsors the BioInnovation Zone (BIZ). The BIZ is dedicated to fostering innovation and industry interaction in the field and serves as a hub for cutting-edge research and development. The BIZ supports a wide range of industry projects, and uses an innovation-based learning approach to identify solutions that make a significant impact in the field of biomedical engineering. The BIZ also works closely with the Biomedical Engineering Research Complex (BERC), a state-of-the-art facility dedicated to bioengineering collaboration. The BERC provides researchers with access to cutting-edge equipment and technology, including 3D printing, imaging, and simulation tools. This allows researchers to conduct cutting-edge research and develop new technologies that can be used to improve healthcare and medicine. In addition, UND is opening a nanofactory and has a Class 1000 clean room with major instrumentation.

Additional Areas of Research Supporting Advanced Manufacturing

- ✓ Robotics and automation
- ✓ Biotechnology and biomanufacturing
- ✓ Agricultural and construction equipment
- ✓ Additive manufacturing

EMERGING AND NEW RESEARCH AREAS FOR ADVANCED MANUFACTURING:

- ✓ Supply chain
- ✓ Industrial and manufacturing engineering
- ✓ Microelectronics and nanomaterials

INFORMATION TECHNOLOGY

North Dakota's information technology (IT) industry is experiencing steady growth, driven by a combination of factors including strategic investments, a skilled workforce, and a supportive business environment. While traditionally known for its strengths in agriculture and energy, the state is increasingly diversifying its economy, with the IT sector playing a significant role in this transformation.

One of the key drivers of North Dakota's IT industry is its focus on innovation and technology-driven solutions. The state has been proactive in fostering a culture of entrepreneurship and innovation, with initiatives such as the Innovate ND program providing support and resources to tech startups and small businesses. This has led to the emergence of a vibrant tech ecosystem, particularly in cities like Fargo, which has been dubbed the "Silicon Prairie" due to its growing reputation as a tech hub.

Companies like Microsoft and Amazon have long called North Dakota home. They, together with other high-demand IT users like Unisys and Cargill Global Business Services and other entrepreneurs understand the state's economic landscape and have experienced our unbeatable work ethic. North Dakota is the best state for economic growth and one of the best entrepreneurship environments in the nation, reinforcing the fact that this is the place where you can innovate, grow and compete.

Moreover, North Dakota's educational institutions play a crucial role in nurturing talent for the IT industry. Universities such as NDSU and the University of North Dakota (UND) offer specialized programs in computer science, cybersecurity, and information systems, providing students with the skills and knowledge needed to excel in the tech sector. Additionally, the state has invested in workforce development programs to address the growing demand for IT professionals, ensuring a steady pipeline of talent for local businesses. North Dakota's IT industry contributes significantly to the state's overall growth and economic strength, too. It is connected to virtually every industry across the state. Nearly 3300 businesses employ close to 22,000 North Dakotans in various fields including IT, human relations, finance and marketing.

North Dakota is the first state to adopt the Cyber Sciences Initiative where students will be provided with the technological skills needed to meet future workforce needs.

ADVANCED COMPUTING AND DATA ANALYSIS

Advanced computing and data analytics combine:

- ✓ Data science is the collection, preparation, and analysis of data for visualization, decision making, and prediction;
- ✓ Artificial intelligence (AI) is a field that combines computer science and data science to interpret historical data, recognize patterns, and make predictions the way humans do; and
- ✓ Machine learning is a subset of AI that draws on statistics and algorithms to provide models for learning and processing data autonomously without human intervention

The ability to collect, store, and process large volumes of data is becoming a necessity across many sectors of the economy.

High power computers help scientists overcome the barriers encountered when accumulating massive amounts of data without viable means for processing. Supercomputers increase data versatility by evaluating

innumerable combinations of elements to discover things that humans do not have the time or brainpower to even consider. The resulting combinations identify, more rapidly and accurately, validate opportunities that would otherwise remain unknown. As a result, scientists and society will have reliable scenarios to consider when making present-day, real-time decisions.

RESEARCH AND EDUCATIONAL OPPORTUNITIES

Supercomputers at NDSU and UND represent the momentum in digital science and demonstrate that research utilizing high power computers, data science, and artificial intelligence research in alignment with and favorably advance the science and technology priorities of North Dakota.

NDSU houses the DoD- and NSA-funded [*Institute for Cyber Security Education and Research*](#), a National Center of Academic Excellence in Cyber Defense Research. This institute, led by a faculty member with expertise in AI and cybersecurity as it relates to autonomous systems, serves as a nexus for cyber security excellence and utilizes a student-centered approach to training future cyber security practitioners, researchers, and educators.

UND is an NSA/DHS-designated National Center of Academic Excellence in Cyber Research and houses the [*Center for Cyber Security Research*](#) in the College of Engineering & Mines. The Center for Cyber Security is a research entity bringing together faculty, researchers, and students working in cybersecurity across departments within the College of Engineering & Mines with a mission to develop cutting edge security solutions to solve next generation cyber security problems. In addition, UND is also a founding member of the Midwest Big Data Hub alongside five other regional institutions. As a founding Co-PI institution, UND provides direction, guidance and coordinates research and outreach activities across the data hub. The partners invest in data driven approaches to address grand challenges for society and science.

Additional Areas of Research Supporting Information Technology

- ✓ Supply chain
- ✓ Industrial and manufacturing engineering
- ✓ Microelectronics and nanomaterials
- ✓ Computational research and education capabilities (NDSU's Center for Computationally Assisted Science and Technology and UND's Computational Research Center)
- ✓ Big Data Pipeline Unit for agriculture automation, data management and analytics
- ✓ Cybersecurity
- ✓ Internet of Things (IoT)-related research, in terms of engineering and computational processes, storage, information transfer and also specific use cases for industry

EMERGING AND NEW RESEARCH AREAS FOR INFORMATION TECHNOLOGY:

- ✓ Cybersecurity
- ✓ Impact of technology on society/sociology
- ✓ Machine learning
- ✓ Digital twinning
- ✓ Augmented reality
- ✓ Artificial intelligence
- ✓ Aggregation and analysis of large data sets for practical use

AUTONOMOUS SYSTEMS

North Dakota is emerging as a leader in autonomous systems, particularly in the fields of UAS and autonomous vehicles. The state's expansive airspace, supportive regulatory environment, and collaborative ecosystem have positioned it as a hub for research, development, testing, and deployment of autonomous technologies.

In the realm of UAS, North Dakota boasts the Grand Sky, the nation's first commercial UAS business and aviation park. Located adjacent to the Grand Forks Air Force Base, Grand Sky provides a unique testing and development environment for UAS technologies. Companies and research institutions at Grand Sky are exploring applications of drones across various sectors, including agriculture, energy, infrastructure inspection, and public safety.

Moreover, North Dakota has established itself as a pioneer in the integration of UAS into the national airspace. UND's [Research Institute for Autonomous Systems](#) and the state's [Northern Plains UAS Test Site](#), one of only seven Federal Aviation Administration (FAA)-designated UAS test sites in the United States, are national leaders in conducting research and testing to advance UAS integration, safety, and operational capabilities. Collaborations between industry, academia, and government entities at the test site have led to innovations in UAS technology and expanded commercial applications.

North Dakota is also making strides in autonomous ground vehicles (AGVs) and other autonomous systems. Research institutions and companies in the state are developing and testing autonomous vehicles for agricultural, transportation, and logistics purposes. These advancements have the potential to increase efficiency, reduce costs, and improve safety in various industries, contributing to economic growth and innovation in North Dakota.

North Dakota has become a magnet for business and academic partnerships in the research, implementation, and advancement of autonomous system development and utilization. The autonomous systems industry has increased the state's leverage in national and international markets and shows no signs of slowing down.

Nearly 50 UAS businesses are based in North Dakota and employ more than 1,000 people. This business activity and associated research make North Dakota one of the largest business incubators and entrepreneurial clusters in the nation.

While best known for our expertise in autonomous aerial systems, North Dakota also has a distinct vision for the use of ground-based autonomous systems for long distance trucking, autonomous impact protection vehicles and the use of driverless trucks to solve labor shortages during harvest.

Further research of aerial, ground-based, and aquatic autonomous systems will help develop new technologies that can be integrated into transportation, precision agriculture, energy, health care, mining, and national security with greater efficiency and favorable impact. Partnerships between universities, industry, the private sector, and state, local, and tribal governments, will direct further research, development, and commercialization of autonomous systems technology.

RESEARCH AND EDUCATIONAL OPPORTUNITIES

Through its Research Institute for Autonomous Systems (RIAS), representing a long history of leading-edge research in autonomous systems (AS), UND is continuing to expand its R&D capacity in UAS/Autonomy and mobility across Surface-Maritime-Air-Space domains. UND cultivates partnerships across the nation with academic institutions, state and federal agencies, industry and tribal communities, to develop and field AS across defense and commercial applications. UND is positioned to address current technological challenges central to all AS applications including survivability, mission command systems, “data problems” (networks, computing power, edge computing, security chain), AI (including analysis, trust and decision-making), and energy. UND John D. Odegard School of Aerospace Studies sets a national standard for all things aviation training and is a core to UND’s AS capabilities, including housing the first B.S. degree in UAS Operations.

ND is positioned to take advantage of a unique set of capabilities that are driving accelerated fielding of AS, including established test beds to facilitate the development of technology and diffusion of new technology to industry. One of the most prominent components of the North Dakota (ND) AS ecosystem is the Northern Plains UAS Test Site (NPUASTS), which is leading the world in enabling broad commercial Beyond Visual Line of Sight (BVLOS) operations through establishment of the Vantis statewide network. This one-of-a-kind capability is designed to support broad commercial as well as defense interests, enabling use cases ranging from delivery of medical supplies and emergency services to infrastructure monitoring and to UTM and Advanced Air Mobility solutions in the field.

Additional Areas of Research Supporting Autonomous Systems

- ✓ NAS Integration
- ✓ Command & Control systems
- ✓ Data management/AI/Cybersecurity
- ✓ Communications
- ✓ Advanced Materials
- ✓ Energy Systems
- ✓ Uncrewed Autonomous Vehicles (especially trucking/surface)
- ✓ Drones in agricultural and other use cases (construction, infrastructure)

EMERGING AND NEW RESEARCH AREAS FOR AUTONOMOUS SYSTEMS:

- ✓ Autonomous Systems Control (cybersecurity)
- ✓ Precision livestock
- ✓ Beyond visual line of sight
- ✓ Use of robotics/autonomous systems in agriculture
- ✓ Data analytics

FOOD, ENERGY, AND WATER NEXUS

The same bountiful natural resources that make North Dakota a key player in agriculture and energy production require significant resources of water. The interdependency between water security, food security and energy is clear as actions in one area has effects in one or both of the other areas. Balance between the three sectors is necessary for human well-being, poverty reduction, and sustainable development across segments of North Dakota's economy.

The food-energy-water (FEW) nexus represents the interconnectedness of these three critical resources and the complex relationships between them. In North Dakota, the FEW nexus is particularly significant due to the state's reliance on agriculture, energy production, and water resources. Understanding and managing the interactions between food, energy, and water systems are essential for ensuring sustainable development, resource conservation, and resilience to environmental challenges.

1. **Agriculture and Water:** North Dakota has about 302,000 acres of actively irrigated land which amounts to just over 1.1% of the total cultivated land in the state. The predominant irrigated crops are corn, soybeans, small grains, potatoes, edible beans and sugar beets. Irrigated land is often sandy loams or loamy sands scattered across the state and typically located over shallow aquifers. Both water quality (and quantity) of these shallow aquifers can be affected by improper irrigation, highlighting the need for sustainable farming practices and water quality management.
2. **Energy and Water:** Energy production, particularly from oil and gas extraction, requires significant water resources for drilling, hydraulic fracturing, and other processes. In North Dakota's oil-rich Bakken Formation, water is essential for extracting oil and natural gas through hydraulic fracturing, setting up the potential for competition for water resources between energy production and other sectors, including agriculture.
3. **Food and Energy:** The production, processing, and distribution of food require energy inputs, including fuel for machinery, transportation, and refrigeration. In North Dakota, where agriculture is a key economic driver, energy-intensive farming practices contribute to the state's overall energy consumption.
4. **Interconnections and Trade-offs:** The interactions between food, energy, and water systems in North Dakota involve complex trade-offs and synergies. For example, increasing agricultural production to meet growing food demand may put pressure on water resources and energy inputs, leading to trade-offs between food security, water conservation, and energy efficiency.

By recognizing the interconnectedness of food, energy, and water systems and implementing integrated approaches to resource management and policymaking, North Dakota can address challenges related to water scarcity, energy security, and food sustainability while fostering economic growth and environmental stewardship. Collaboration among stakeholders, investment in research and innovation, and public engagement are key to advancing the understanding and management of the FEW nexus in North Dakota and beyond.

RESEARCH AND EDUCATIONAL OPPORTUNITIES

Upper Great Plains Transportation Institute (UGPTI) leads the eight-university Mountain-Plains Consortium (MPC), a competitively selected University Transportation Center sponsored by USDOT. UGPTI provides innovative transportation research, education and outreach, with key technologies of national importance are

employed in the Center for Surface Mobility Applications and Real-time Simulation environments (SMARTSe), as well as in transportation infrastructure and safety research using low-cost sensor technologies and advanced predictive modeling via machine-learning techniques.

Intertribal Research and Resource Center (IRRC) at United Tribes Technical College provides research, outreach, training, and education in sustainable food, energy, and water resources with expertise in renewable energy, health impacts of environmental toxins, biomaterials from agricultural products, sustainable agriculture, genetics, geology and wildlife ecology. The IRRC Mission is to provide services and build capacity for enhancing food, energy, and water sustainability for tribal communities in the Northern Plains.

Educational programs in transportation abound in North Dakota from NDSU's graduate program in Transportation and Supply Chain to Diesel Technician programs (Dickinson State University, North Dakota State College of Science and Bismarck State College) and Automotive Technician programs (Lake Region State College and United Tribes Technical College).

Additional Areas of Research Supporting Food, Energy, and Water Nexus

- ✓ Forecasting and risk (climate; economic; enhanced predictive analytics in multiple domains; etc.)
- ✓ Soil and water health (value added agriculture through the lens of natural resources/environmental science, minimizing input like fertilizer, etc.)
- ✓ Sensing and sensor development
- ✓ Pollinator research

EMERGING AND NEW RESEARCH AREAS FOR FOOD, ENERGY, AND WATER NEXUS:

- ✓ Climate aware-approaches to model and manage at the food-water-energy nexus for production, supply chain/transportation and disaster mitigation
- ✓ PFAS impact
- ✓ Groundwater and surface water quality, chemistry, and fluid dynamics
- ✓ Lifecycle and environmental impact of new materials and coatings
- ✓ Environmental research related to salt, water, and soil
- ✓ Precision agriculture research including sensors to decrease inputs
- ✓ Link between, soil, plants, animals, food and human health Enhanced oil recovery
- ✓ Life cycle/environmental impact
- ✓ Water management practices

COMMERCIALIZATION, ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT

North Dakota's economy is characterized by a resilient entrepreneurial spirit, evidenced by the proliferation of small businesses and startups across various industries. The state's business-friendly environment, low tax burden, and access to capital foster an atmosphere conducive to entrepreneurship and innovation.

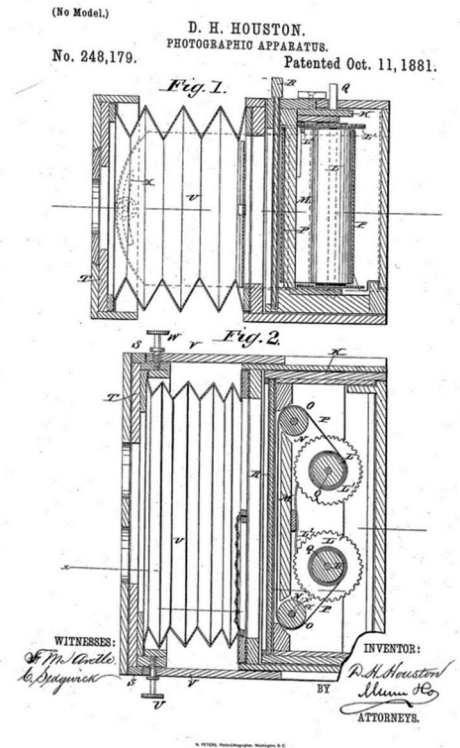
North Dakota has a long history of innovation and entrepreneurship from David Henderson Houston who invented the photography equipment in the late 1800's that was commercialized by the Eastman Kodak Company to Agricultural Technology equipment innovations and advanced technologies in UAS and battery technologies. This innovative spirit has given rise to an economy stabilized by established national and international companies with a flourishing ecosystem for entrepreneurs.

To further growth prospects in IT and emerging technologies, the North Dakota Department of Commerce is leading an IP commercialization initiative with the Bank of North Dakota and University System to enable job creation, spinoffs into private industry and clustering of new companies that leverage research in emerging sectors. This will be accomplished through refining current IP commercialization efforts within the University System as well as bringing entrepreneurs, venture capital firms, researchers and industry together to grow this sector.

The state economy relies on small businesses and self-employment, and four North Dakota institutions of higher learning offer entrepreneurship degrees and certificates to ensure that graduates understand fundamentals of economics, legal environment, management, financial management, and starting a business. However, the knowledge acquired from the coursework has little utility until graduates can see how that information functions. North Dakota research universities and other entities host business incubators so students and scientists have the opportunity to engage, evaluate, and enhance the functionality of their discoveries.

North Dakota supports its businesses and entrepreneurs through:

- ✓ Opportunities to increase and expand business partners and sponsorships to support business incubators
- ✓ Incubation space and business coaches
- ✓ Commercialization expertise
- ✓ Entrepreneur ecosystem referrals
- ✓ Student-run enterprises
- ✓ Project-based internships and mentorship matching
- ✓ Creativity student fellowships
- ✓ Internship opportunities
- ✓ Business education
- ✓ Regional contexts to understand how different industries and sectors work together for sustainable growth



Even with a strong history of innovation and entrepreneurship, challenges have been identified by stakeholder and many of the current programs are located along the Eastern and Central corridor of North Dakota. Mapping of the existing entrepreneurial ecosystem and its resources is a high priority for North Dakota to identify gaps and needs across the state to better facilitate the likelihood that a budding entrepreneur has access to needed resources regardless of location.

EDUCATION AND WORKFORCE DEVELOPMENT

North Dakota is making the requisite investments in infrastructure, K-12 education and in its university system to provide a solid foundation for industry to continue to grow; with projected increases of 20-30 percent in IT and technical positions, North Dakota will be positioned to have the necessary workforce in place to meet demand. Ensure availability of technical workforce and trained scientists and engineers

EDUCATION

North Dakota's K-12 education system faces challenges similar to other states with a rural population, including:

- ✓ **Rural School Districts:** The state's rural geography presents challenges for school districts in terms of access to resources, teacher recruitment, and funding.
- ✓ **Teacher Shortages:** Like many states, North Dakota grapples with shortages of qualified teachers, particularly in certain subject areas such as mathematics, science, and special education. Recruiting and retaining teachers, especially in rural and remote areas, is challenging. Most recently, the North Dakota Education Standards and Practices Board declared all content areas as critical shortage teaching positions at their February 8, 2024, meeting for the 2024-2025 school year.
- ✓ **Funding Equity:** Ensuring equitable funding distribution and adequate resources for all students is essential for promoting educational equity and excellence. The 2023 Legislative session included Bill 2328 that created a school funding task force to, among other things, 1) review school payment formulas to determine whether education costs can be equalized across the state, 2) develop and study sliding-scale models within school districts based on size, student populations and economics, and 3) assess the negative impacts of the current funding formula.
- ✓ **Technology and Connectivity:** The digital divide exacerbates disparities in educational opportunities and access to resources, hindering students' ability to engage in online learning, access digital resources, and develop essential digital literacy skills. Bridging the digital divide through investments in infrastructure, technology integration, and digital equity initiatives is essential for ensuring all students have access to high-quality education in the digital age.

Public and private sector leaders in North Dakota recognize the urgent need for more science and research graduates to accommodate employers. Investing in K-20 STEM education to create the technical workforce that can fuel the growth of both new and existing business through research, development and commercialization.

In 2023, the ND EPSCoR Office partnered with the UND's Bureau for Evaluation and Research Services Initiative for Rural Education, Equity, and Economic Development to undertake a [P-12 STEM Needs Assessment](#). Over 1,000 P-12 school administrators and teachers completed the assessment. Participants represented schools in urban, suburban, small town, and rural areas and 63% self-identified as working at a school serving either working class or high poverty areas. Highlights from the attached report identified:

- ✓ Financial assistance for classroom equipment and supplies along with online curriculum/lesson plan resources were the two most commonly indicated resources to increase STEM teaching effectiveness;
- ✓ Preferred STEM activities included visits from scientists, tours of industry or higher education and curriculum-related field trips – activities which involve students coming into direct contact with STEM practitioners or facilities.

WORKFORCE DEVELOPMENT

The state collaborates closely with employers, educational institutions, and training providers to identify skill gaps and develop relevant curriculum and training programs. This ensures that workers are equipped with the skills and qualifications needed to succeed in high-demand industries, such as energy, agriculture, healthcare, and technology.

Moreover, North Dakota has invested in apprenticeship programs and career and technical education (CTE) initiatives and increasing registered apprenticeship opportunities that provide hands-on training and pathways to employment in various trades and professions. These programs offer opportunities for individuals to gain valuable experience and credentials faster, while earning a living wage, helping to address both workforce shortages and unemployment.

North Dakota's commitment to workforce development and education is helping to cultivate a skilled talent pool for the industry. Universities and technical colleges in the state offer specialized programs in UAS, robotics, artificial intelligence, precision agriculture and related fields. This includes strong and growing participation in STEM degree and advance degree programs from international students that are eligible upon graduation to fill jobs in critical STEM fields in North Dakota.

EDA Good Jobs Challenge bolstering our region's economy by training and developing a skilled workforce in the industries of precision agriculture, advanced manufacturing and cybersecurity/IT. This overall initiative is called the Ignite Initiative Regional Workforce Training System (IIRWTS), and within those industries, the focus is specifically on enrollment of new Americans, justice-involved, people of color, military veterans and spouses, and high school students.

North Dakota's unemployment remains below 2% which poses challenges for employers especially when looking to fill highly technical or skilled positions. Focusing on K-20 and workforce development, recruitment and retention programs to fill these positions will bolster North Dakota's economy into the future.

APPENDIX I: KEY STAKEHOLDERS

FOOD AND AGRICULTURE

- Appareo/AGCO
- Bobcat
- BioMed Protection
- Bushel
- Case IH
- Cavendish Farms
- CHS Inc.
- Dakota Specialty Enterprises, Inc.
- Grand Farm
- John Deere
- Minot Milling
- ProGold LLC
- RDO Equipment
- Two Track Malting
- Thread

ENERGY

- Trilogy
- Basin Electric
- MDU Resources Group
- Hess
- Marathon Oil
- Whiting Oil and Gas Production
- EOG Resources
- Continental Resources
- Tharaldson Ethanol
- Guardian Energy Hankinson
- Red Trail Energy
- Red River Biorefinery
- Blue Flint
- Steffes Corporation

INFORMATION TECHNOLOGY

- Appareo/AGCO
- Botlink
- Bushel
- DCN
- Microsoft

AUTONOMOUS SYSTEMS

- Northern Plains UAS Test Site
- Grand Sky
- General Atomics
- Northrup Grumman
- Innovets Aerospace
- Appareo
- Sky Skopes
- Botlink
- ND UAS Council

ADVANCED MANUFACTURING

- Appareo/AGCO
- Botlink
- Bushel
- DCN
- Microsoft
- *Life Sciences/Biotechnology*
 - Aldevron
 - CorVent
 - Agathos Biologics
 - IpA
 - GenoVac
 - SafetySpect
 - BioMed Protection
- *AgTech*
 - Appareo/AGCO
 - Bobcat
 - BioMed Protection
 - Bushel
 - Case IH
 - CHS Inc.
 - Grand Farm
 - John Deere
 - RDO Equipment
 - Thread

COMMERCIALIZATION, ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT

- Emerging Prairie
- Gener8tor
- Great Plains I-Corps Hub
- ND Department of Commerce
- ND Small Business Development Center
- UND Center for Innovation
- NDSU Research & Tech Park
- Jamestown Regional Entrepreneur Center
- ND Women’s Business Center
- Economic Development Association of North Dakota
- Regional Planning Councils

EDUCATION AND WORKFORCE DEVELOPMENT

- Fargo, Moorhead, West Fargo Chamber Foundation
- Golden Path Solutions
- ND Department of Public Instruction
- Continuing and Technical Education
- Workforce Development Council

APPENDIX II: NORTH DAKOTA POPULATION AND DEMOGRAPHICS

Figure 1. North Dakota Population Demographics

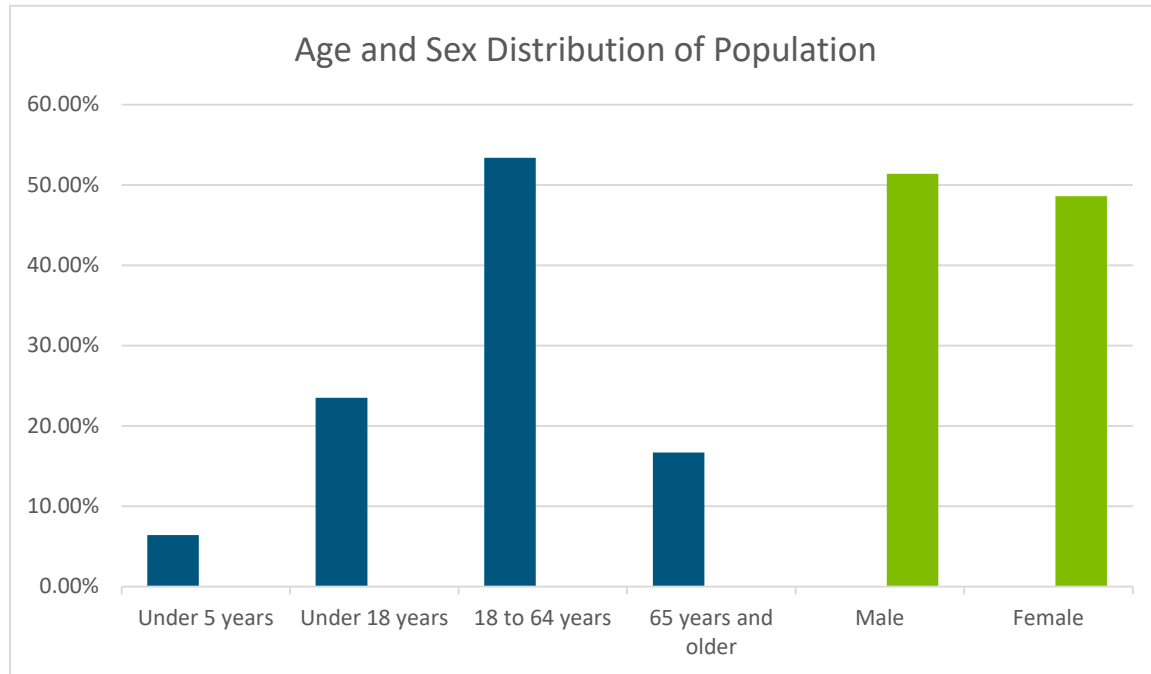


Table 1. North Dakota Population by Race and Ethnic Group

Race and Ethnic Origin	Percent
White alone	86.60%
White alone, not Hispanic or Latino	83.00%
American Indian or Alaska Native, alone	5.3%
Black or African American, alone	3.6%
Asian alone	1.70%
Native Hawaiian and Other Pacific Islander alone	0.10%
Two or more races	2.60%
Hispanic or Latino	4.60%

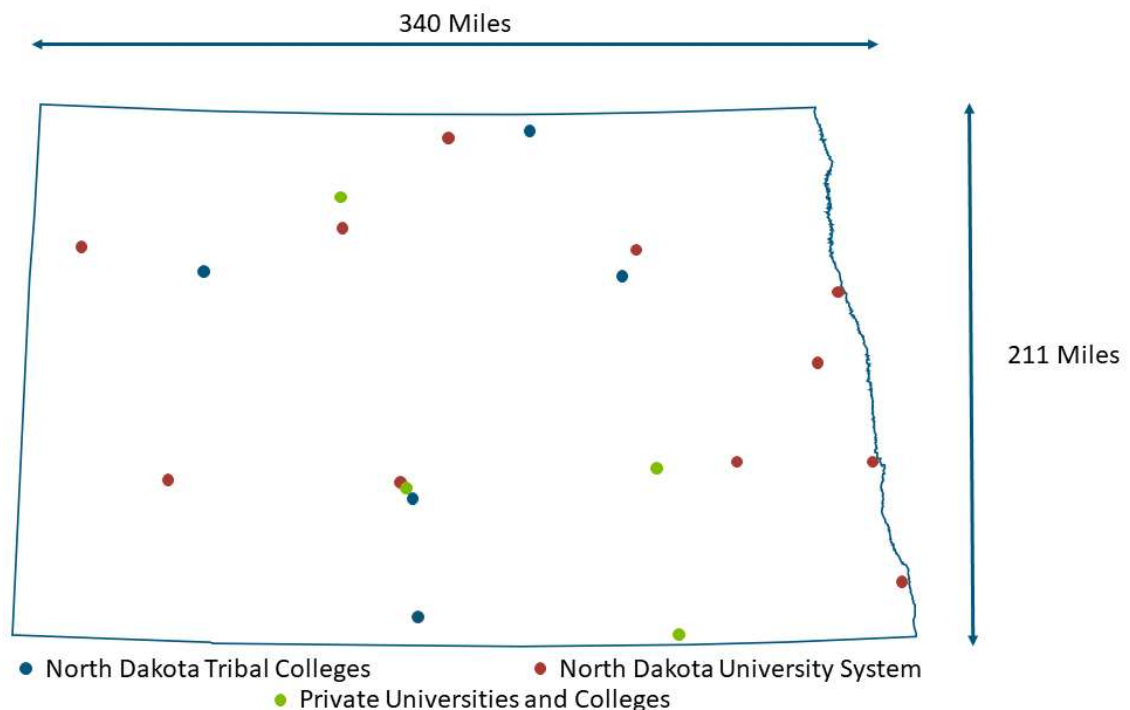
Table 2. North Dakota Population Educational Attainment

Degree	Percent
High school graduate or higher, percent of persons 25 years and older	93.5%
Bachelor's degree or higher, percent of persons 25 years and older	31.4%

APPENDIX III: HIGHER EDUCATION

A. INSTITUTIONS OF HIGHER EDUCATION

Name	Abbreviation
North Dakota University System	NDUS
Bismarck State College	BSC
Dakota College at Bottineau	DCB
Dickinson State University	DSU
Lake Region State College	LRSC
Mayville State University	MaSU
Minot State University	MiSU
North Dakota State College of Science	NDSCS
North Dakota State University	NDSU
University of North Dakota	UND
Valley City State University	VCSU
Williston State College	WSC
North Dakota Tribal College System	ND TCS
Cankdeska Cikana Community College	CCCC
Nueta Hidatsa Sahnish College	NHSC
Sitting Bull College	SBC
Turtle Mountain Community College	TMC
United Tribes Technical College	UTTC
Private Colleges	
Columbia College	
Trinity Bible College	
University of Jamestown	
University of Mary	



B. RESEARCH EXPENDITURES

Table 3. R&D Expenditures at ND Higher Education Institutions by Source FY 2022 (in thousands)

	All R&D	Federal	State	Institution	Business	Nonprofit	Other
NDSU	\$174,904	\$45,343	\$50,066	\$71,056	\$1,507	\$864	\$6,068
UND	\$147,717	\$62,737	\$26,441	\$44,072	\$13,559	\$727	\$181
MaSU	\$116	\$102	\$0	\$0	\$0	\$0	\$0
MiSU	\$187	\$143	\$14	\$30	\$0	\$0	\$0
UTTC	\$1,270	\$869	\$143	\$225	\$21	\$12	\$0
Total	\$324,194	\$109,194	\$76,664	\$115,383	\$15,087	\$1,603	\$6,249

SOURCES OF DATA

National Center for Science and Engineering Statistics | NSF 24-308

<https://nces.nsf.gov/surveys/higher-education-research-development/2022>

Table 4. R&D Expenditures at ND Higher Education Institutions by Source FY 2014 - 2021 (in thousands)

	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
NDSU	\$154,437	\$153,542	\$156,297	\$153,119	\$145,669	\$152,381	\$155,645	\$164,050
UND	\$67,595	\$64,384	\$70,275	\$102,823	\$109,865	\$110,836	\$111,663	\$143,506
MaSU	\$0	\$0	\$0	\$0	\$0	\$0	\$509	\$634
MiSU	\$0	\$0	\$0	\$0	\$0	\$0	\$253	\$512
UTTC	\$0	\$0	\$0	\$0	\$0	\$379	\$976	\$441
Total	\$222,032	\$217,926	\$226,572	\$255,942	\$255,534	\$263,596	\$269,046	\$309,143

SOURCES OF DATA

Higher Education R&D Expenditures Ranked by FY 2020 R&D Expenditures: FYs2010-2020

<https://nces.nsf.gov/pubs/nsf22311/assets/data-tables/tables/nsf22311-tab020.pdf>

<https://nces.nsf.gov/surveys/higher-education-research-development/2021>

R&D Expenditures include institutional expenditures supporting research including new faculty start-up packages, institutional research competitions and other expenditures supporting research from institutional funds.

C. CERTIFICATE AND DEGREE INFORMATION

Table 5. Certificates and Degrees – All.

	Certificate	Assoc. Degree	Bachelor Degree	Master Degree	Ph.D. Degree
NDUS					
BSC	262	696	57	0	0
DCB	69	150	0	0	0
DSU	31	45	206	42	0
LRSC	99	173	0	0	0
MaSU	1	15	209	8	0
MiSU	27	2	488	91	0
NDSCS	68	501	0	0	0
NDSU	97	0	2,273	467	196
UND	345	0	1,833	822	378
VCSU	122	2	263	44	0
WSC	101	252	0	0	0
ND TCS					
CCCC	12	31	0	0	0
NHSC	5	22	2	0	0
SBC	33	25	10	2	0
TMCC	95	82	14	0	0
UTTC	16	47	22	0	0
Private Colleges					
Columbia College	0	0	372	16	0
Trinity Bible College	0	4	40	18	0
University of Jamestown	0	0	161	87	33
University of Mary	8	0	595	338	139

SOURCES OF DATA

National Center for Education Statistics

<https://nces.ed.gov/ipeds/datacenter/InstitutionList.aspx?sid=11634191-c5fd-4897-b199-e54cdf4f2465&rtid=5>

Table 6. Certificates and Degrees – STEM

	Certificate	Assoc. Degree	Bachelor Degree	Master Degree	Ph.D. Degree
NDUS					
BSC	146	343	10	0	0
DCB	49	57	0	0	0
DSU	8	34	50	0	0
LRSC	38	44	0	0	0
MaSU	0	0	58	3	0
MiSU	0	0	136	23	0
NDSCS	16	293	0	0	0
NDSU	14	0	1211	180	165
UND	140	0	612	261	237
VCSU	0	0	26	0	0
WSC	48	48	0	0	0
ND TCS					
CCCC	0	3	0	0	0
NHSC	0	2	0	0	0
SBC	7	12	0	0	0
TMCC	39	15	0	0	0
UTTC	0	6	1	0	0
Private Colleges					
Columbia College	0	0	0	0	0
Trinity Bible College	0	0	0	0	0
University of Jamestown	0	0	42	0	33
University of Mary	2	0	197	99	130

SOURCES OF DATA

National Center for Education Statistics

CIP Codes 01, 03, 11, 14, 15, 26, 27, 40, 41, and 51

<https://nces.ed.gov/ipeds/datacenter/InstitutionList.aspx?sid=11634191-c5fd-4897-b199-e54cdf4f2465&rtid=5>

Table 7. STEM Certificates and Degrees by Race/Ethnicity

	American Indian or Alaska Native	Asian	Black or African American	Hispanic or Latino	Native Hawaiian or Other Pacific Islander	White	Two or more races	Race/ethnicity unknown	Total
NDUS									
BSC	3	3	6	22	0	452	8	4	498
Certificates	1	0	2	3	0	138	2	0	146
Associate's Degree	2	3	4	19	0	304	6	4	342
Bachelor's Degree	0	0	0	0	0	10	0	0	10
DCB	1	1	11	7	0	78	4	0	102
Certificates	1	0	4	4	0	37	2	0	48
Associate's Degree	0	1	7	3	0	41	2	0	54
DSU	1	0	2	1	0	78	0	2	84
Certificates	1	0	0	0	0	6	0	0	7
Associate's Degree	0	0	2	1	0	28	0	1	32
Bachelor's Degree	0	0	0	0	0	44	0	1	45
LRSC	2	0	1	5	0	72	1	0	81
Certificates	2	0	0	2	0	33	1	0	38
Associate's Degree	0	0	1	3	0	39	0	0	43
MaSU	0	0	4	1	0	50	3	0	58
Certificates	0	0	0	0	0	0	0	0	0
Bachelor's Degree	0	0	4	1	0	47	3	0	55
Master's Degree	0	0	0	0	0	3	0	0	3
MiSU	1	3	6	5	1	105	4	0	125
Certificates	0	0	0	0	0	0	0	0	0
Bachelor's Degree	1	2	6	4	1	99	4	0	117
Master's Degree	0	1	0	1	0	6	0	0	8
NDSCS	2	4	3	4	0	284	12	0	309
Certificates	0	1	0	0	0	15	0	0	16
Associate's Degree	2	3	3	4	0	269	12	0	293
NDSU	8	36	23	29	1	1275	41	16	1429
Certificates	0	0	0	0	0	4	0	0	4
Bachelor's Degree	5	22	20	22	1	1076	37	14	1197
Master's Degree	3	8	1	7	0	94	4	1	118
Doctor's degree	0	6	2	0	0	101	0	1	110
UND	21	38	52	37	1	954	50	13	1166
Certificates	0	11	8	12	1	95	8	0	135
Bachelor's Degree	9	11	15	21	0	499	26	5	586
Master's Degree	4	8	20	1	0	184	10	1	228
Doctor's degree	8	8	9	3	0	176	6	7	217
VCSU	0	0	2	1	0	19	3	0	25
Certificates	0	0	0	0	0	0	0	0	0
Bachelor's Degree	0	0	2	1	0	19	3	0	25
WSC	1	7	0	7	2	72	5	0	94
Certificates	0	4	0	4	1	35	3	0	47
Associate's Degree	1	3	0	3	1	37	2	0	47

	American Indian or Alaska Native	Asian	Black or African American	Hispanic or Latino	Native Hawaiian or Other Pacific Islander	White	Two or more races	Race/ethnicity unknown	Total
ND TCS									
CCCC	1	0	0	0	0	1	1	0	3
Associate's Degree	1	0	0	0	0	1	1	0	3
NHSC	2	0	0	0	0	0	0	0	2
Associate's Degree	2	0	0	0	0	0	0	0	2
Bachelor's Degree	0	0	0	0	0	0	0	0	0
SBC	18	0	0	0	0	1	0	0	19
Certificates	7	0	0	0	0	0	0	0	7
Associate's Degree	11	0	0	0	0	1	0	0	12
Bachelor's Degree	0	0	0	0	0	0	0	0	0
Master's Degree	0	0	0	0	0	0	0	0	0
TMCC	52	0	0	0	0	2	0	0	54
Certificates	39	0	0	0	0	0	0	0	39
Associate's Degree	13	0	0	0	0	2	0	0	15
UTTC	6	0	0	0	0	1	0	0	7
Associate's Degree	5	0	0	0	0	1	0	0	6
Bachelor's Degree	1	0	0	0	0	0	0	0	1
Private Colleges									
University of Jamestown	0	1	0	1	0	68	0	1	71
Bachelor's Degree	0	1	0	1	0	36	0	1	39
Doctor's degree	0	0	0	0	0	32	0	0	32
University of Mary	0	3	5	18	0	360	13	29	428
Certificates	0	0	0	0	0	2	0	0	2
Bachelor's Degree	0	1	2	11	0	159	5	19	197
Master's Degree	0	1	3	5	0	82	4	4	99
Doctor's degree	0	1	0	2	0	117	4	6	130
Grand Total	119	96	115	138	5	3872	145	65	4555

SOURCES OF DATA

National Center for Education Statistics

CIP Codes 01, 03, 11, 14, 15, 26, 27, 40, 41, and 51

<https://nces.ed.gov/ipeds/datacenter/InstitutionList.aspx?sid=11634191-c5fd-4897-b199-e54cdf4f2465&rtid=5>

Figure 2. Degrees by Race/Ethnicity

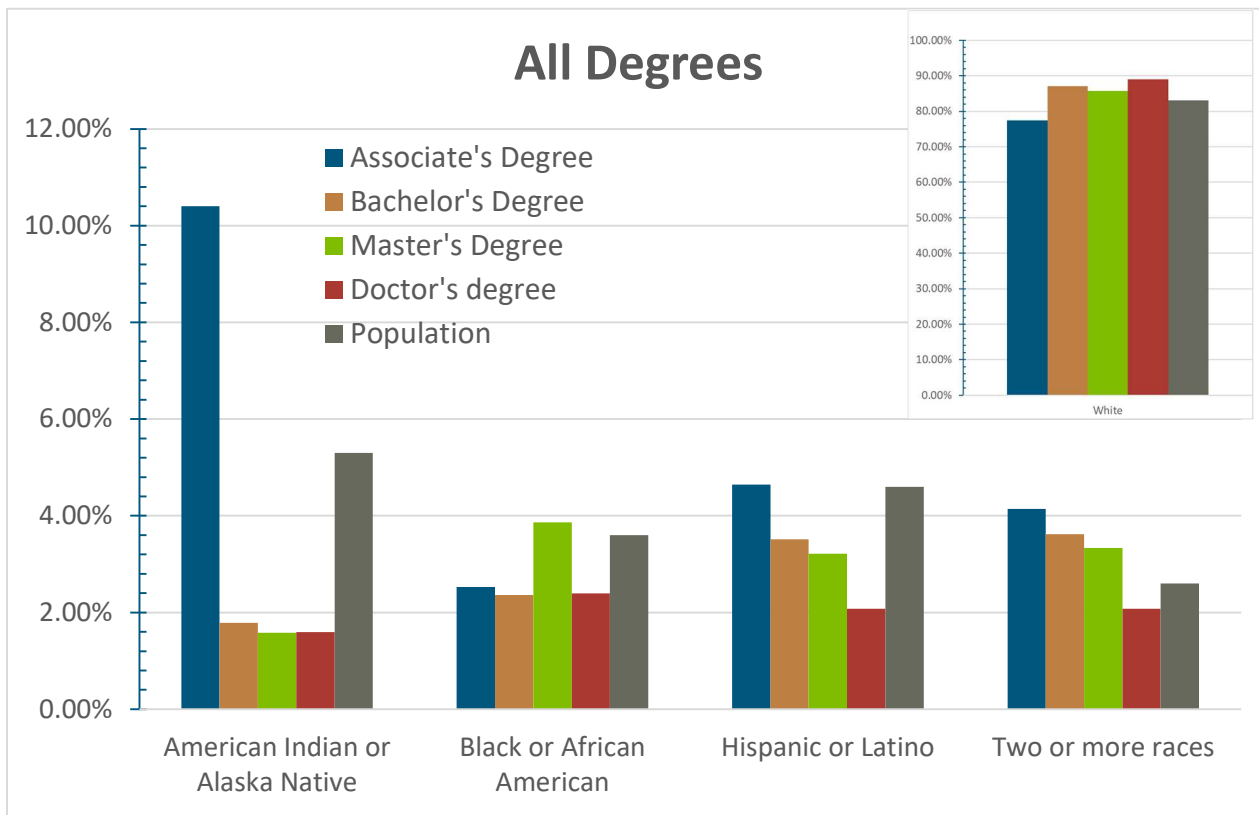
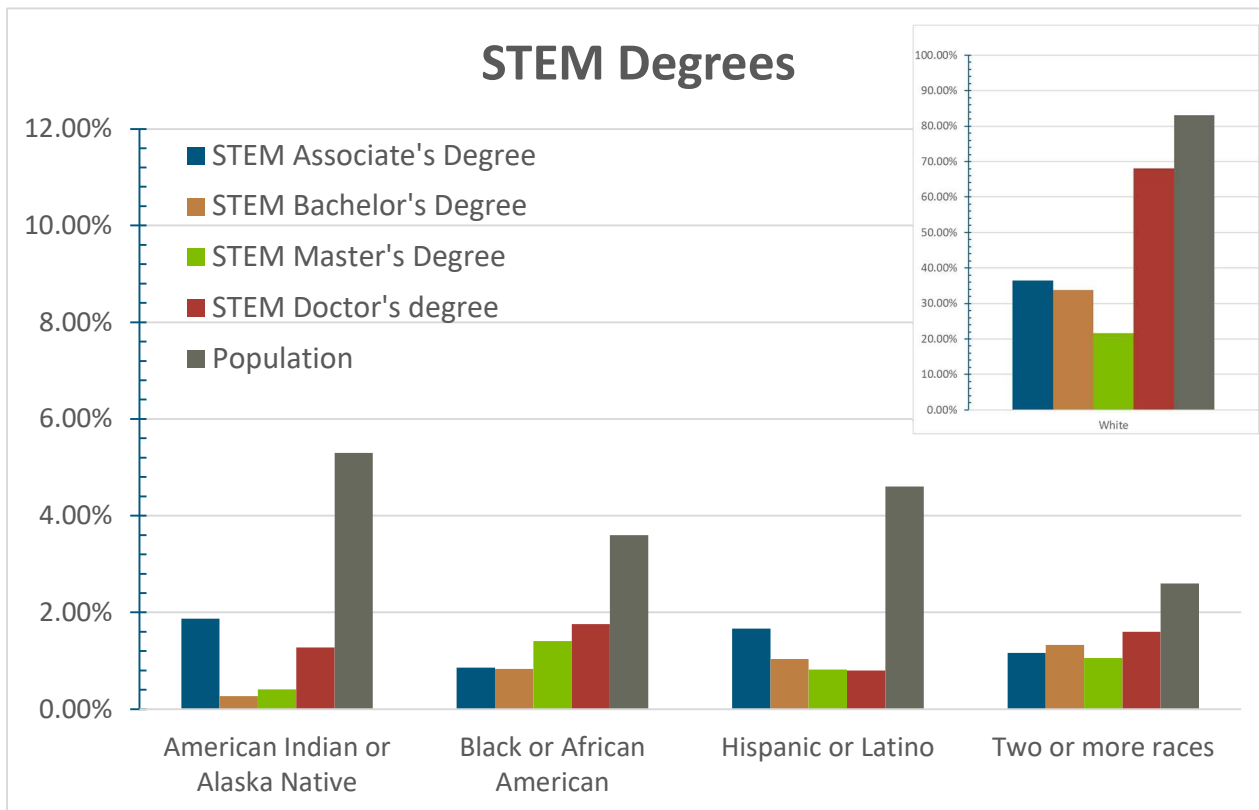


Figure 3. STEM Degrees by Race/Ethnicity



D. ENROLLMENT AND DEMOGRAPHICS

Table 8. Student Enrollment and Demographic information - Gender

	Enrollment		Gender	
	Undergraduate	Graduate	Female	Male
NDUS				
BSC	3,771	0	48%	52%
DCB	1,080	0	62%	38%
DSU	1,411	62	55%	45%
LRSC	1,679	0	59%	41%
MaSU	1,077	46	63%	37%
MiSU	2,530	247	64%	36%
NDSCS	2,942	0	43%	57%
NDSU	12,242	2,146	51%	49%
UND	9,928	3,948	44%	56%
VCSU	1,521	137	58%	42%
WSC	924	0	65%	35%
ND TCS				
CCCC	316	0	72%	28%
NHSC	172	0	70%	30%
SBC	231	26	53%	47%
TMC	599	0	61%	39%
UTTC	506	0	65%	35%
Private Colleges				
Columbia College	1,827	76	53%	47%
Trinity Bible College	170	119	52%	48%
University of Jamestown	978	264	44%	56%
University of Mary	2,506	1,146	58%	42%

SOURCES OF DATA

National Center for Education Statistics

<https://nces.ed.gov/collegenavigator/?s=ND>

Table 9. Student Demographic information – Race/Ethnicity

	American Indian or Alaska Native	Asian	Black or African American	Hispanic/Latino	Native Hawaiian or other Pacific...	White	Two or more	Race/Ethnicity Unknown
NDUS								
BSC	2%	1%	2%	5%	0%	73%	5%	12%
DCB	3%	0%	2%	5%	0%	77%	4%	3%
DSU	1%	1%	3%	7%	0%	75%	5%	6%
LRSC	2%	1%	2%	4%	0%	70%	5%	11%
MaSU	1%	1%	4%	4%	0%	81%	5%	1%
MiSU	2%	2%	4%	8%	0%	68%	6%	1%
NDSCS	1%	1%	4%	3%	0%	68%	3%	21%
NDSU	0%	1%	3%	3%	0%	86%	4%	1%
UND	1%	3%	2%	5%	0%	77%	5%	3%
VCSU	1%	0%	2%	5%	1%	82%	4%	3%
WSC	2%	1%	4%	10%	0%	66%	7%	3%
ND TCS								
CCCC	86%	0%	0%	3%	0%	9%	1%	1%
NHSC	70%	2%	6%	6%	0%	9%	8%	0%
SBC	90%	0%	0%	1%	0%	9%	0%	0%
TMC	97%	0%	0%	0%	0%	2%	0%	0%
UTTC	84%	0%	1%	4%	0%	3%	8%	0%
Private Colleges								
Columbia College	1%	3%	4%	3%	0%	77%	2%	3%
Trinity Bible College	2%	3%	6%	4%	0%	75%	8%	2%
University of Jamestown	1%	1%	4%	9%	0%	72%	3%	1%
University of Mary	1%	2%	2%	0%	0%	78%	3%	14%

SOURCES OF DATA

National Center for Education Statistics

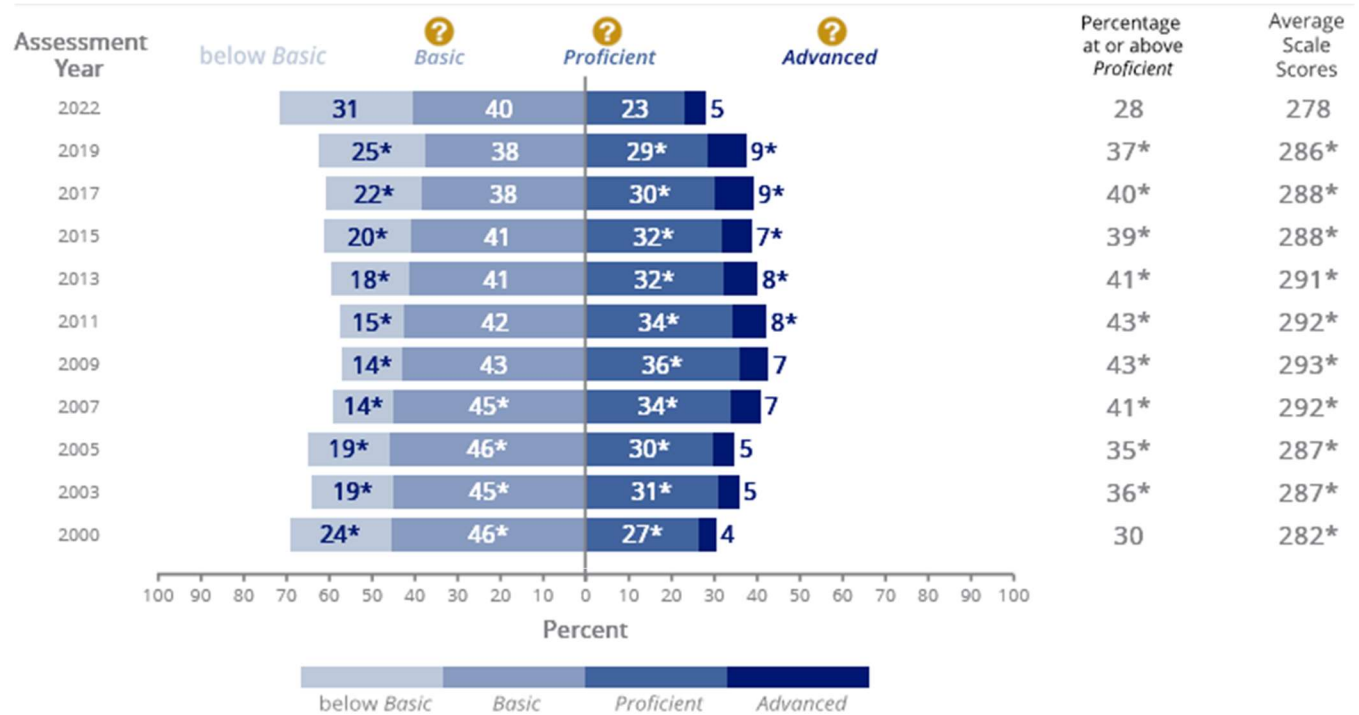
<https://nces.ed.gov/collegenavigator/?s=ND>

Table 10. Graduation Rates within 150% of Average

	8/31/2022	8/31/2021	8/31/2020	8/31/2019	8/31/2018	8/31/2017	8/31/2016	8/31/2015	8/31/2014	8/31/2013
NDUS										
BSC	51.1%	52.6%	47.7%	51.8%	49.1%	43.7%	44.5%	46.0%	41.8%	40.7%
DCB	-	-	-	-	-	-	-	-	-	-
DSU	44.4%	36.4%	36.3%	41.1%	34.4%	31.6%	33.9%	32.2%	35.3%	39.2%
LRSC	-	-	-	-	-	-	-	-	-	-
MaSU	34.6%	31.9%	30.8%	34.1%	28.1%	35.1%	30.8%	25.2%	41.6%	36.0%
MiSU	44.9%	46.5%	54.6%	45.1%	46.0%	37.0%	43.2%	43.3%	39.9%	37.3%
NDSCS	-	-	-	-	-	-	-	-	-	-
NDSU	63.2%	64.9%	62.3%	60.3%	57.6%	58.0%	55.5%	53.9%	56.1%	53.1%
UND	63.1%	61.8%	61.1%	61.0%	54.6%	53.6%	55.4%	54.2%	55.5%	55.3%
VCSU	47.5%	53.2%	44.9%	50.0%	40.6%	34.9%	35.0%	40.8%	48.1%	46.2%
WSC	-	-	-	-	-	-	-	-	-	-
ND TCS										
CCCC	-	-	-	-	-	-	-	-	-	-
NHSC	6.1%	10.9%	-	2.6%	-	9.5%	4.3%	5.6%	38.5%	31.0%
SBC	21.1%	10.6%	15.6%	13.3%	12.5%	20.9%	14.3%	9.8%	8.8%	11.5%
TMCC	37.8%	29.3%	43.0%	27.9%	39.5%	24.8%	24.3%	19.1%	20.8%	21.2%
UTTC	12.4%	17.5%	9.7%	15.1%	23.1%	7.3%	18.4%	60.6%	44.3%	17.6%
Private Colleges										
Trinity Bible College	40.7%	39.6%	45.9%	50.0%	39.3%	40.8%	35.6%	45.6%	38.7%	36.7%
University of Jamestown	48.9%	55.7%	55.0%	45.1%	42.5%	52.6%	49.5%	44.6%	48.7%	52.3%
University of Mary	63.7%	64.3%	58.7%	60.1%	54.9%	53.7%	53.6%	59.8%	46.1%	48.6%

APPENDIX IV: K-12 EDUCATION

Figure 4. 8th Grade NAEP Proficiency Levels for Math (2000 – 2022)



— Not available.

¹ Accommodations were not permitted for this assessment.

* Significantly different ($p < .05$) from 2022.

NOTE: Some apparent differences between estimates may not be statistically significant.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2022 Mathematics Assessment.

Figure 5. 8th Grade NAEP Proficiency Levels for Science, and Reading (2009 – 2015)

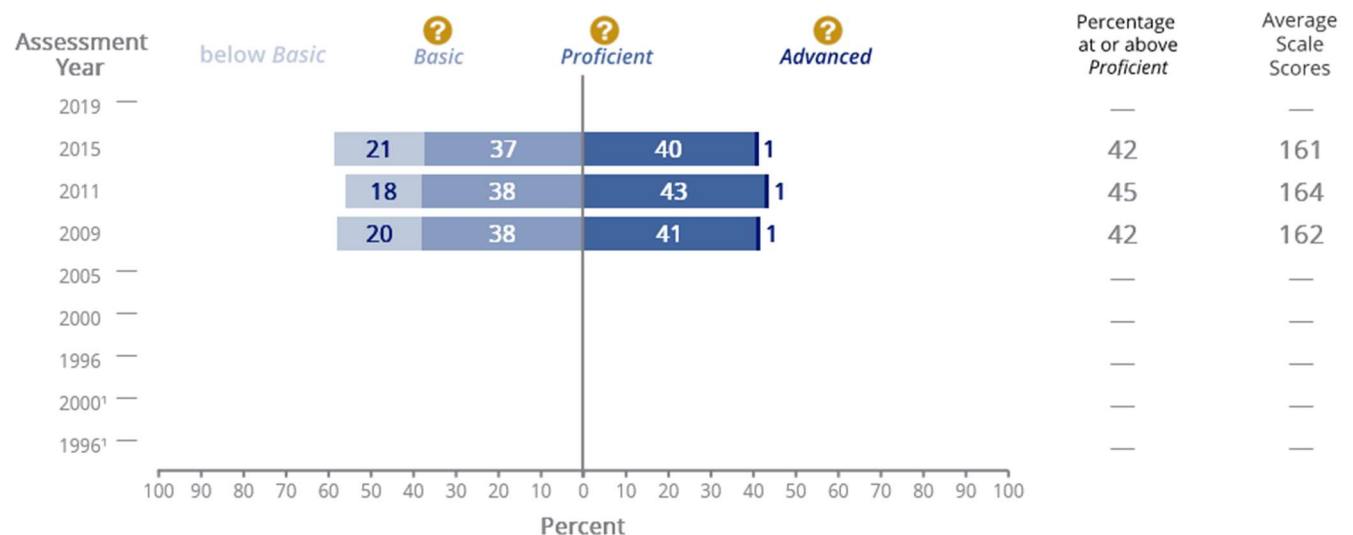
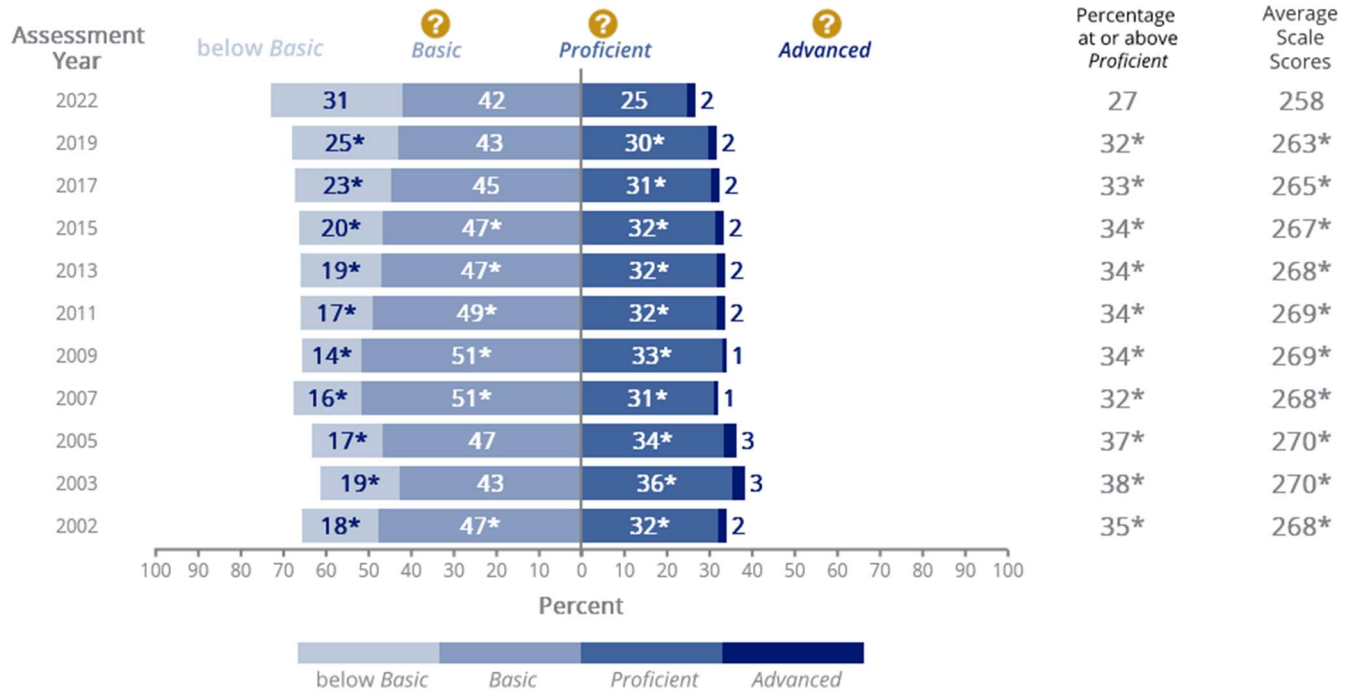


Figure 6. 8th Grade NAEP Proficiency Levels for Reading (2000 – 2022)



* Significantly different ($p < .05$) from 2022.

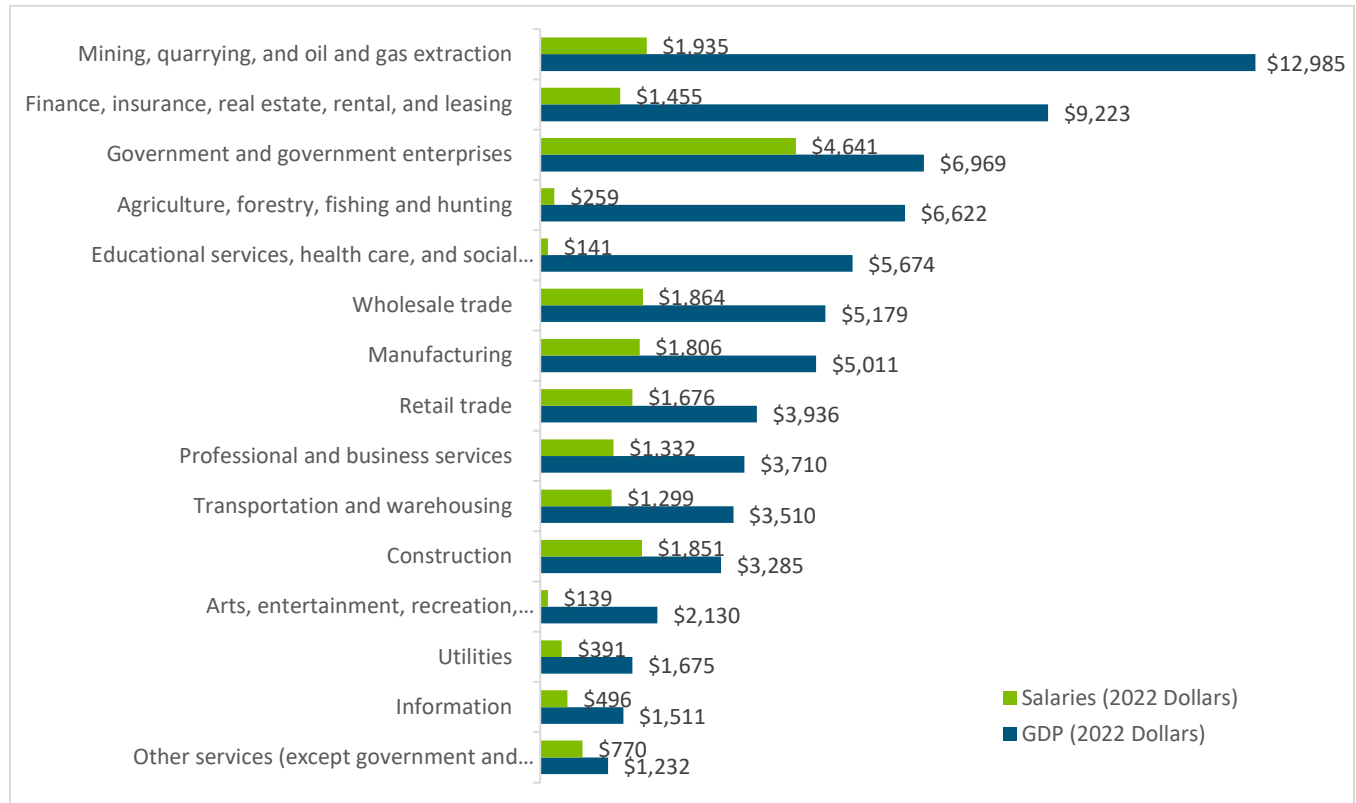
NOTE: Some apparent differences between estimates may not be statistically significant.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2022 Reading Assessment.

https://www.nationsreportcard.gov/profiles/stateprofile/overview/ND?cti=PgTab_OT&chort=2&sub=MAT&sj=ND&fs=Grade&st=MN&year=2022R3&sq=Gender%3A%20Male%20vs.%20Female&sqv=%3F&ts=Single%20Year&tss=2022R3&sfj=NP

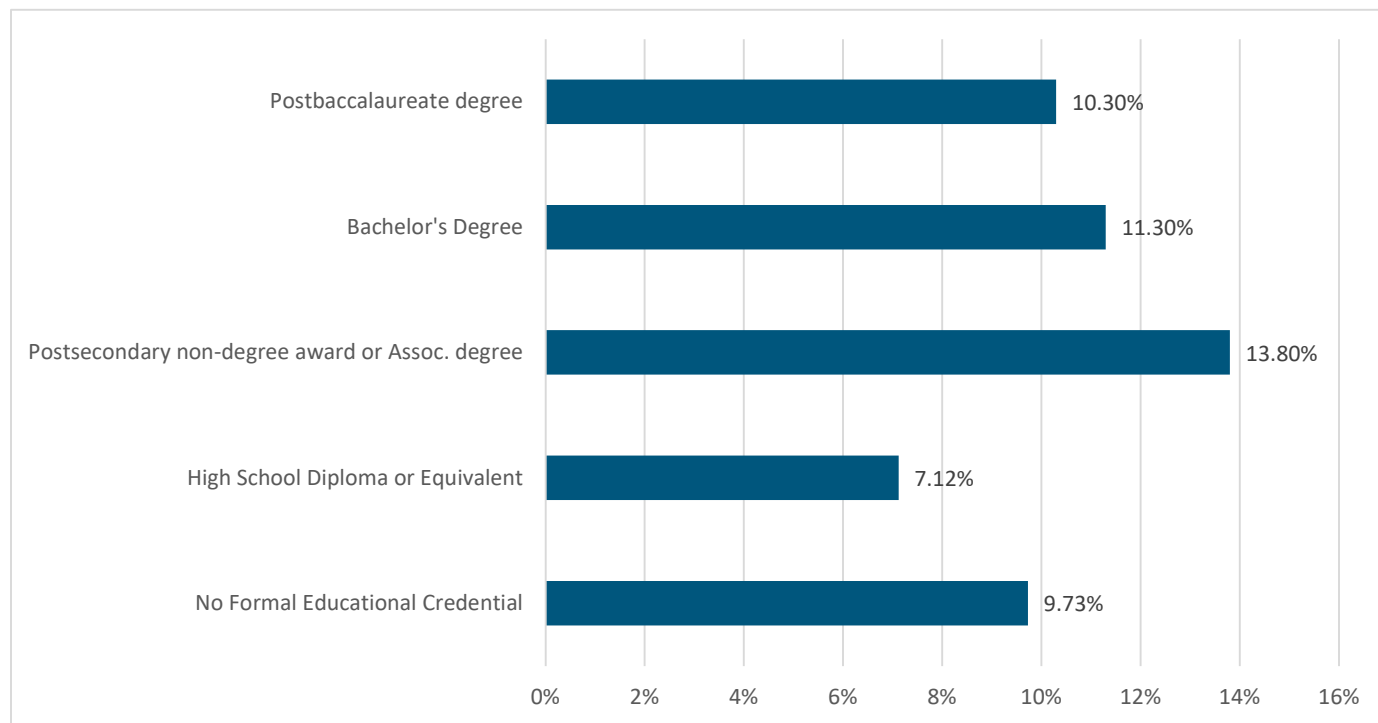
APPENDIX V: ECONOMIC INFORMATION

Figure 7. ND GDP and Salaries/Wages by Industry (Millions)



APPENDIX VI: LABOR MARKET INFORMATION

Figure 8. Projected Percentage Change of All Jobs by Education and Training (2021-2031)

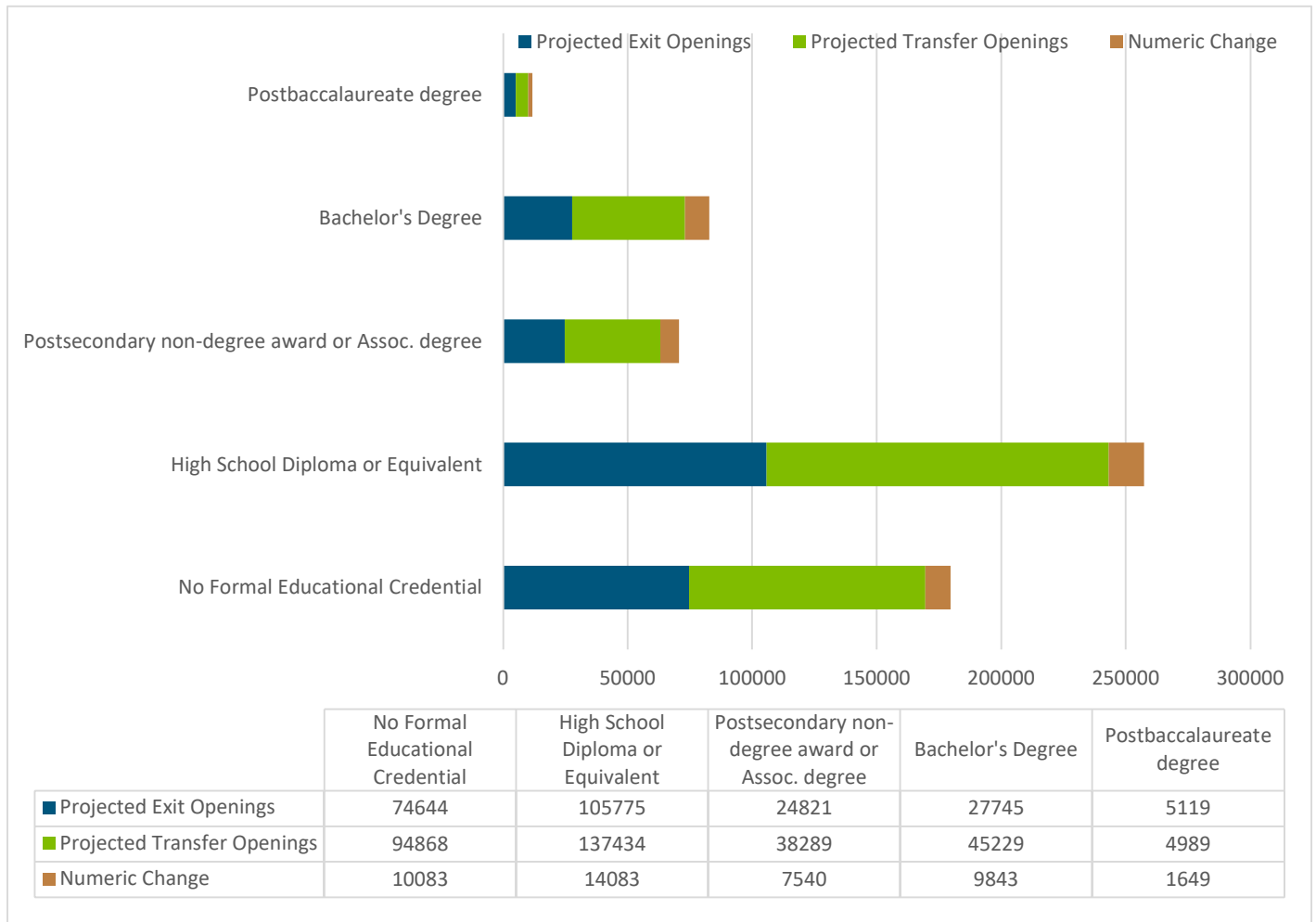


SOURCES OF DATA

ND Job Service Labor Market Information
Long-Term Employment Projections

https://www.ndlmi.com/admin/qsipub/htmlarea/uploads/lmi_LTedutrproj2031.pdf

Figure 9. Projected Openings of All Jobs by Education and Training (2021-2031)



SOURCES OF DATA

ND Job Service Labor Market Information

Long-Term Employment Projections

https://www.ndlmi.com/admin/gsipub/htmlarea/uploads/lmi_LTedutrnproj2031.pdf

Table 11. Occupation Long-Term Employment Projections - Computer and Mathematical Occupations

Occupation Code	Bright Outlook	Occupation Title [long]	Typical Entry-Level Education	2021 Employment	2031 Employment	Numeric Change	Percent Change	Labor Force Exit Openings	Occupational Transfer Openings	Total Openings	Avg 2021 Wages
150000		Computer and Mathematical Occupations	N/A	6,994	8,104	+1,110	+15.87	1,654	3,729	6,493	\$73,050
152051		Data Scientists	Bachelor's degree	34	46	+12	+35.29	10	19	41	\$94,230
152031	[Y]	Operations Research Analysts	Bachelor's degree	157	203	+46	+29.30	48	74	168	\$82,940
152041		Statisticians	Master's degree	60	77	+17	+28.33	17	32	66	\$73,860
151252	[Y]	Software Developers	Bachelor's degree	1,769	2,261	+492	+27.81	356	973	1,821	\$83,460
151212	[Y]	Information Security Analysts	Bachelor's degree	129	162	+33	+25.58	33	72	138	\$83,830
151254		Web Developers	Bachelor's degree	86	108	+22	+25.58	21	51	94	\$65,680
151253		Software Quality Assurance Analysts and Testers	Bachelor's degree	94	114	+20	+21.28	24	50	94	\$75,350
151255		Web and Digital Interface Designers	Bachelor's degree	92	107	+15	+16.30	30	53	98	\$68,550
151211		Computer Systems Analysts	Bachelor's degree	207	238	+31	+14.98	55	100	186	\$92,340
151232	[Y]	Computer User Support Specialists	Associate's degree	1,718	1,960	+242	+14.09	433	979	1,654	\$54,180
151241		Computer Network Architects	Bachelor's degree	121	135	+14	+11.57	21	58	93	\$106,620
151231	[Y]	Computer Network Support Specialists	Associate's degree	865	962	+97	+11.21	215	486	798	\$62,760
151299	[Y]	Computer Occupations, All Other	Bachelor's degree	617	667	+50	+8.10	153	306	509	\$73,870
151242		Database Administrators	Bachelor's degree	88	93	+5	+5.68	22	40	67	\$66,860
151243		Database Architects	Bachelor's degree	48	50	+2	+4.17	12	22	36	\$96,870
151244		Network and Computer Systems Administrators	Bachelor's degree	500	518	+18	+3.60	108	234	360	\$82,720
151251		Computer Programmers	Bachelor's degree	398	391	-7	-1.76	94	176	263	\$86,670

Table 12. Occupation Long-Term Employment Projections - Architecture and Engineering Occupations

Occupation Code	Bright Outlook	Occupation Title [long]	Typical Entry-Level Education	2021 Employment	2031 Employment	Numeric Change	Percent Change	Labor Force Exit Openings	Occupational Transfer Openings	Total Openings	Avg 2021 Wages
170000		Architecture and Engineering Occupations	N/A	5725	6525	800	13.97	1710	2890	5400	83020
171011		Architects, Except Landscape and Naval	Bachelor's degree	302	330	28	9.27	97	120	245	83160
171012		Landscape Architects	Bachelor's degree	33	34	1	3.03	13	13	27	67690
171021		Cartographers and Photogrammetrists	Bachelor's degree	23	21	-2	-8.7	7	9	14	N/A
171022		Surveyors	Bachelor's degree	264	302	38	14.39	91	120	249	71890
172021		Agricultural Engineers	Bachelor's degree	38	42	4	10.53	6	16	26	92970
172061		Computer Hardware Engineers	Bachelor's degree	144	148	4	2.78	31	61	96	N/A
172071		Electrical Engineers	Bachelor's degree	316	344	28	8.86	84	120	232	100650
172072		Electronics Engineers, Except Computer	Bachelor's degree	78	90	12	15.38	21	31	64	95550
172081		Environmental Engineers	Bachelor's degree	95	101	6	6.32	29	41	76	98320
172111		Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	Bachelor's degree	17	19	2	11.76	4	7	13	121270
172199		Engineers, All Other	Bachelor's degree	262	265	3	1.15	64	106	173	96100
173011		Architectural and Civil Drafters	Associate's degree	320	360	40	12.5	168	218	426	55090
173013		Mechanical Drafters	Associate's degree	86	91	5	5.81	29	52	86	60100
173019		Drafters, All Other	Associate's degree	49	47	-2	-4.08	16	28	42	59620
173022		Civil Engineering Technologists and Technicians	Associate's degree	429	473	44	10.26	160	282	486	62030
173023		Electrical and Electronic Engineering Technologists and Technicians	Associate's degree	129	141	12	9.3	67	77	156	74840
173025		Environmental Engineering Technologists and Technicians	Associate's degree	66	73	7	10.61	25	43	75	66310
173026		Industrial Engineering Technologists and Technicians	Associate's degree	50	59	9	18	19	34	62	64400
173027		Mechanical Engineering Technologists and Technicians	Associate's degree	82	89	7	8.54	30	53	90	78760
173029		Engineering Technologists and Technicians, Except Drafters, All Other	Associate's degree	131	137	6	4.58	47	84	137	70010
173031		Surveying and Mapping Technicians	High school diploma or equivalent	130	145	15	11.54	55	116	186	56910

Table 13. Occupation Long-Term Employment Projections - Life, Physical, and Social Science Occupations

Occupation Code	Bright Outlook	Occupation Title [long]	Typical Entry-Level Education	2021 Employment t	2031 Employment t	Numeric Change	Percent Change	Labor Force Exit	Openings	Occupational Transferal Openings	Total Openings	Avg 2021 Wages
190000		Life, Physical, and Social Science Occupations	N/A	4550	5045	495	10.88	1087	3569	5151	69660	
191042		Medical Scientists, Except Epidemiologists	Doctoral or professional degree	65	85	20	30.77	11	35	66	89550	
193033		Clinical and Counseling Psychologists	Doctoral or professional degree	195	215	20	10.26	61	70	151	112160	
194021		Biological Technicians	Bachelor's degree	271	289	18	6.64	80	283	381	46050	
191013		Soil and Plant Scientists	Bachelor's degree	274	289	15	5.47	76	202	293	64650	
192041		Environmental Scientists and Specialists, Including Health	Bachelor's degree	210	225	15	7.14	46	151	212	63110	
194042		Environmental Science and Protection Technicians, Including Health	Associate's degree	86	101	15	17.44	21	75	111	53690	
193051		Urban and Regional Planners	Bachelor's degree	169	183	14	8.28	36	114	164	79740	
194012		Agricultural Technicians	Associate's degree	224	238	14	6.25	46	277	337	38270	
194043		Geological Technicians, Except Hydrologic Technicians	Associate's degree	35	49	14	40	10	34	58	52200	
194031		Chemical Technicians	Associate's degree	82	95	13	15.85	19	89	121	56440	
194071		Forest and Conservation Technicians	Associate's degree	212	223	11	5.19	58	210	279	48200	
191031		Conservation Scientists	Bachelor's degree	358	368	10	2.79	81	241	332	65960	
193034		School Psychologists	Master's degree	75	82	7	9.33	17	42	66	68730	
191041		Epidemiologists	Master's degree	16	22	6	37.5	3	9	18	N/A	
193039		Psychologists, All Other	Master's degree	133	138	5	3.76	45	49	99	92820	
191022		Microbiologists	Bachelor's degree	45	49	4	8.89	9	31	44	72750	
192031		Chemists	Bachelor's degree	148	152	4	2.7	26	96	126	86440	
194061		Social Science Research Assistants	Bachelor's degree	25	29	4	16	7	26	37	47920	
191029		Biological Scientists, All Other	Bachelor's degree	206	209	3	1.46	40	136	179	75750	
192099		Physical Scientists, All Other	Bachelor's degree	113	116	3	2.65	17	69	89	85470	
191032		Foresters	Bachelor's degree	27	29	2	7.41	6	19	27	68610	
193091		Anthropologists and Archeologists	Master's degree	31	33	2	6.45	7	22	31	63960	
194044		Hydrologic Technicians	Associate's degree	26	27	1	3.85	6	21	28	82120	
194092		Forensic Science Technicians	Bachelor's degree	25	26	1	4	7	25	33	N/A	

Occupation Code	Bright Outlook	Occupation Title [long]	Typical Entry-Level Education	2021 Employment	2031 Employment	Numeric Change	Percent Change	Labor Force Exit Openings	Occupational Transfer Openings	Total Openings	Avg 2021 Wages
194099		Life, Physical, and Social Science Technicians, All Other	Associate's degree	90	91	1	1.11	24	87	112	55220
191011		Animal Scientists	Bachelor's degree	25	25	0	0	7	18	25	N/A
191012		Food Scientists and Technologists	Bachelor's degree	25	25	0	0	7	18	25	74070
191099		Life Scientists, All Other	Bachelor's degree	82	82	0	0	12	38	50	N/A
192021		Atmospheric and Space Scientists	Bachelor's degree	50	50	0	0	8	31	39	83130
192043		Hydrologists	Bachelor's degree	52	52	0	0	8	38	46	81460
193099		Social Scientists and Related Workers, All Other	Bachelor's degree	119	119	0	0	27	82	109	66870
191023		Zoologists and Wildlife Biologists	Bachelor's degree	102	98	-4	-3.92	19	65	80	73330

Table 14. Occupation Long-Term Employment Projections - Management Occupations

Occupation Code	Bright Outlook	Occupation Title [long]	Typical Entry-Level Education	2021 Employment	2031 Employment	Numeric Change	Percent Change	Labor Force Exit	Openings	Occupational Transferal Openings	Total Openings	Avg 2021 Wages
113021	[Y]	Computer and Information Systems Managers	Bachelor's degree	409	478	69	16.87	82	243	394	122960	
119041		Architectural and Engineering Managers	Bachelor's degree	229	249	20	8.73	48	120	188	143830	
119121		Natural Sciences Managers	Bachelor's degree	105	106	1	0.95	26	57	84	117250	

SOURCES OF DATA for Tables 11-14
ND Job Service Labor Market Information
Long-Term Employment Projections

https://www.ndlmi.com/admin/gsipub/htmlarea/uploads/lmi_LTedutrproj2031.pdf

APPENDIX VII: HIGHLIGHTS OF FEDERAL AND STATE INVESTMENTS IN THE JURISDICTION

NATIONAL SCIENCE FOUNDATION

Awards from NSF limited to those >\$500K or greater

Molecular mechanisms regulating Poly(ADP-ribosyl)ation pathway in living cells

Award Number:2231403; Principal Investigator: Alexei Tulin; Organization: University of North Dakota Main Campus; NSF Organization: MCB Start Date:04/01/2023; Award Amount: \$740,691.00; Relevance:72.0;

NSF Engines: North Dakota Advanced Agriculture Technology Engine

Award Number:2315315; Principal Investigator: Colleen Fitzgerald; Co-Principal Investigator: Phillip McClean, Jenna Mueller, Hollie Mackey, Brian Carroll; Organization: North Dakota State University Fargo; NSF Organization: ITE Start Date:03/01/2024; Award Amount: \$15,000,000.00; Relevance:72.0;

BIORETS: Genes & the Environment: Research Experiences for Teachers from Rural & Tribal Schools

Award Number:2341459; Principal Investigator: Van Doze; Co-Principal Investigator: Donald Sens; Organization: University of North Dakota Main Campus; NSF Organization: DBI Start Date:02/01/2024; Award Amount: \$599,997.00; Relevance:72.0;

RII Track-4: NSF: Continental-scale, high-order, high-spatial-resolution, ice flow modeling based on graphics processing units (GPUs)

Award Number:2327095; Principal Investigator: Anjali Sandip; Organization: University of North Dakota Main Campus; NSF Organization: OIA Start Date:01/15/2024; Award Amount: \$286,102.00; Relevance:72.0;

CAREER: Nanoscale Interactions of Stimuli-responsive Nanoparticles with Enzymes

Award Number:2239629; Principal Investigator: Mohiuddin Quadir; Organization: North Dakota State University Fargo; NSF Organization: CBET Start Date:05/01/2023; Award Amount: \$676,969.00; Relevance:72.0;

IUCRC Phase II: North Dakota State University: Center for Bioplastics and Biocomposites [CB2]

Award Number:2113804; Principal Investigator: Dean Webster; Co-Principal Investigator: Chad Ulven, Alan Kallmeyer, Dean Webster; Organization: North Dakota State University Fargo; NSF Organization: EEC Start Date:08/01/2021; Award Amount: \$793,875.00; Relevance:72.0;

MRI: Track 1 Acquisition of Multi-Material 3D Printer for Additively Manufactured Electronics to Enable Interdisciplinary Research and Education

Award Number:2320798; Principal Investigator: Shuvashis Dey; Co-Principal Investigator: Mijia Yang, Sanku Mallik, Mohiuddin Quadir, Benjamin Braaten; Organization: North Dakota State University Fargo; NSF Organization: CMMI Start Date:09/01/2023; Award Amount: \$770,100.00; Relevance:72.0;

CAREER: Non-additive control of gene expression by long-range interactions between multiple regulatory elements

Award Number:1942471; Principal Investigator: Manu Manu; Organization: University of North Dakota Main Campus; NSF Organization: MCB Start Date:04/01/2020; Award Amount: \$903,578.00; Relevance:72.0;

REU Site: Genes & the Environment: Research Experiences for Undergraduates from Rural & Tribal colleges
Award Number:2244080; Principal Investigator: Van Doze; Co-Principal Investigator: Rebecca Simmons;
Organization: University of North Dakota Main Campus; NSF Organization: DBI Start Date:05/01/2023; Award
Amount: \$560,868.00; Relevance:72.0;

Turtle Mountain STEM Infusion Project

Award Number:1855385; Principal Investigator: LaVonne Fox; Organization: Turtle Mountain Community
College; NSF Organization: EES Start Date:04/01/2020; Award Amount: \$535,959.00; Relevance:72.0;

CAREER: Investigation of Laser-driven Chemical Reactions by Molecular Dynamics

Award Number:1944921; Principal Investigator: Dmitri Kilin; Organization: North Dakota State University Fargo;
NSF Organization: CHE Start Date:08/01/2020; Award Amount: \$650,000.00; Relevance:72.0;

TSIP: United Tribes Technical College's Community STEM Engagement Initiative

Award Number:1953864; Principal Investigator: Jeremy Guinn; Co-Principal Investigator: Anna Bahnsen;
Organization: United Tribes Technical College; NSF Organization: EES Start Date:05/15/2020; Award Amount:
\$541,967.00; Relevance:72.0;

Collaborative Research: Should I Stay or Should I Go? Understanding the Retention of Latinx in Engineering Jobs
Award Number:2000636; Principal Investigator: Rachel Navarro; Organization: University of North Dakota Main
Campus; NSF Organization: EES Start Date:08/15/2020; Award Amount: \$808,418.00; Relevance:72.0;

REU Site: Research Experience for Undergraduates in Big Data Analytics and Machine Learning

Award Number:2050175; Principal Investigator: Simone Ludwig; Co-Principal Investigator: Nita Yodo, Shafiqur
Rahman; Organization: North Dakota State University Fargo; NSF Organization: EEC Start Date:09/01/2021;
Award Amount: \$514,253.00; Relevance:72.0;

CAREER: Coffee fungi below and aboveground: agroecological experiments for teaching and learning about
fungal diversity and ecosystem function

Award Number:2048131; Principal Investigator: Laura Aldrich-Wolfe; Organization: North Dakota State
University Fargo; NSF Organization: DEB Start Date:04/15/2021; Award Amount: \$996,899.00; Relevance:72.0;

TCUP Research Symposiums

Award Number:2027482; Principal Investigator: Anita Parisien Frederick; Organization: Tribal Nations Research
Group; NSF Organization: EES Start Date:05/15/2020; Award Amount: \$784,455.00; Relevance:72.0;

Collaborative Research: HNDS-I: The Digital Society Project: Infrastructure for Measuring Internet Politics

Award Number:2121851; Principal Investigator: Daniel Pemstein; Organization: North Dakota State University
Fargo; NSF Organization: BCS Start Date:09/01/2021; Award Amount: \$737,487.00; Relevance:72.0;

Collaborative Research: Elucidating the Nanoscale Interaction between Invertible Micellar Assemblies (IMAs)
and Biopolymer Cargos under Varied Environments

Award Number:2217474; Principal Investigator: Zhongyu Yang; Co-Principal Investigator: Andriy Voronov;

Organization: North Dakota State University Fargo; NSF Organization: CBET Start Date:08/01/2022; Award Amount: \$609,189.00; Relevance:72.0;

Collaborative Research: Insights for free: the roles of metamorphosis and dormancy in aging dynamics
Award Number:2311952; Principal Investigator: Julia Bowsher; Co-Principal Investigator: Britt Heidinger, Kendra Greenlee, Joe Rinehart; Organization: North Dakota State University Fargo; NSF Organization: IOS Start Date:08/01/2023; Award Amount: \$880,218.00; Relevance:72.0;

NSF Engines Development Award: Advancing autonomous systems technologies in the Northern Front (ND, SD, MT, ID)

Award Number:2306532; Principal Investigator: Mark Askelson; Organization: University of North Dakota Main Campus; NSF Organization: ITE Start Date:05/15/2023; Award Amount: \$992,699.00; Relevance:72.0;

Multi-enzyme immobilization in metal-organic materials for rapid and sustainable degradation of biomass
Award Number:2306137; Principal Investigator: Zhongyu Yang; Co-Principal Investigator: Organization: North Dakota State University Fargo; NSF Organization: DMR Start Date:04/15/2023; Award Amount: \$550,176.00; Relevance:72.0;

AIM Scholars Program– Accomplish-Innovate-Motivate

Award Number:2130259; Principal Investigator: Hamza Raheel; Co-Principal Investigator: Virginia Saiki, Alicia Uhde, Anne Seidler, Taryn Chase, Charlotte Williams, Marko Davinic; Organization: Bismarck State College; NSF Organization: DUE Start Date:01/15/2022; Award Amount: \$1,368,264.00; Relevance:72.0;

Investigating how combining intensive professional development and modest support affects rural, elementary teachers' science and engineering practice

Award Number:2201249; Principal Investigator: Ryan Summers; Co-Principal Investigator: Ashley Iveland, Cathy Ringstaff, Rebekah Hammack, Martha Inouye; Organization: University of North Dakota Main Campus; NSF Organization: DRL Start Date:08/01/2022; Award Amount: \$1,467,932.00; Relevance:72.0;

RII Track-1: ND-ACES: New Discoveries in the Advanced Interface of Computation, Engineering, and Science
Award Number:1946202; Principal Investigator: Colleen Fitzgerald; Co-Principal Investigator: John Mihelich; Organization: North Dakota State University Fargo; NSF Organization: OIA Start Date:07/01/2020; Award Amount: \$16,092,546.00; Relevance:72.0;

RII Track-2 FEC: Sustainable Engineering Infrastructures and Solutions for Tribal Energy Sovereignty
Award Number:2316355; Principal Investigator: Wayne Seames; Co-Principal Investigator: Hongyu Wu, Adam Gladen, Bethany Klemetsrud; Organization: University of North Dakota Main Campus; NSF Organization: OIA Start Date:08/15/2023; Award Amount: \$2,000,000.00; Relevance:72.0;

ICE-TI: STEM Expansion at TMCC

Award Number:1951506; Principal Investigator: LaVonne Fox; Organization: Turtle Mountain Community College; NSF Organization: EES Start Date:08/01/2020; Award Amount: \$2,246,034.00; Relevance:72.0;

Nueta Hidatsa Sahnish College (NHSC) Full-Circle Engineering Center of Excellence: Meeting the Engineering needs of the MHA Nation

Award Number:1937213; Principal Investigator: Lori Nelson; Co-Principal Investigator: Kerry Hartman, Ann

Vallie; Organization: Nueta Hidatsa Sahnish College; NSF Organization: EES Start Date:04/15/2020; Award Amount: \$3,199,998.00; Relevance:72.0;

TEA Center: Sitting Bull College's Native American Prairie Ecosystems Research Center (PERC)
Award Number:2055064; Principal Investigator: Mafany Ndiva Mongoh; Co-Principal Investigator: Gary Halvorson, Francis Onduso; Organization: Sitting Bull College; NSF Organization: EES Start Date:07/01/2021; Award Amount: \$3,500,000.00; Relevance:72.0;

ICE-TI: An Innovative Framework for the Development and Implementation of a Culturally Responsive Fisheries and Wildlife (CuRFiW) Bachelor of Science Degree Program
Award Number:2225648; Principal Investigator: Mandy Guinn; Co-Principal Investigator: Alicia Andes-Buysse; Organization: United Tribes Technical College; NSF Organization: EES Start Date:12/01/2022; Award Amount: \$1,500,000.00; Relevance:72.0;

RII Track-2 FEC: Artificial Intelligence on Sustainable Energy Infrastructure Network (AI SUSTEIN) and Beyond towards Industries of the Future
Award Number:2119691; Principal Investigator: Ying Huang; Co-Principal Investigator: Haitao Liao, Trung Le, Kerry Hartman, Israt Jahan, Di Wu, Eakalak Khan; Organization: North Dakota State University Fargo; NSF Organization: OIA Start Date:10/01/2021; Award Amount: \$4,499,058.00; Relevance:72.0;

NSF I-Corps Hub (Track 2): Great Plains Region
Award Number:2229452; Principal Investigator: Alan Kallmeyer; Co-Principal Investigator: David Grewell, Chad Ulven; Organization: North Dakota State University Fargo; NSF Organization: TI Start Date:01/01/2023; Award Amount: \$5,000,000.00; Relevance:72.0;

RaMP: Exploration of Variation across Levels of Organization in a CHANGEable World: Fostering CHANGE through Research in a Community of Practice
Award Number:2216605; Principal Investigator: Timothy Greives; Co-Principal Investigator: Jennifer Momsen, Britt Heidinger; Organization: North Dakota State University Fargo; NSF Organization: DBI Start Date:08/01/2022; Award Amount: \$2,896,763.00; Relevance:72.0;

The Science of Success: Addressing Workforce Needs in North Dakota
Award Number:2221627; Principal Investigator: William Shay; Co-Principal Investigator: Lisa Wixo, Jeff Jelinek; Organization: North Dakota State College of Science; NSF Organization: DUE Start Date:10/01/2022; Award Amount: \$1,447,429.00; Relevance:72.0;

Partnering with Rural and Low-income Students for Academic Success in the Biological Sciences
Award Number:2221637; Principal Investigator: Angela Hodgson; Co-Principal Investigator: Jennifer Momsen, Julia Bowsher, Kendra Greenlee; Organization: North Dakota State University Fargo; NSF Organization: DUE Start Date:07/01/2022; Award Amount: \$1,469,211.00; Relevance:72.0;

Collaborations in Discipline-Based Education Research to Train Postdoctoral Scholars
Award Number:2329292; Principal Investigator: Jennifer Momsen; Co-Principal Investigator: John Buncher, Mila Kryjevskaja, Kathryn Wissman, James Nyachwaya; Organization: North Dakota State University Fargo; NSF Organization: DGE Start Date:10/01/2023; Award Amount: \$1,249,912.00; Relevance:72.0;

NATIONAL INSTITUTES OF HEALTH

Center for Excellence in Host Pathogen Interactions

Award Number: 5T P20Act GM113123; Principal Investigator: David Bradley, Catherine Brissette; Organization: University of North Dakota; NIGM; Award Amount: \$2,038,822

- Flow Cytometry Core; Principal Investigator: David Bradley, Jonathan Geiger; Award Amount: \$223,119
- Administrative Core; Principal Investigator: David Bradley; Award Amount: \$805,198

ND INBRE Health & the Environment

Award Number: 5T P20 GM103442; Principal Investigator: Donald A. Sens; Organization: University of North Dakota; NIGMS; Award Amount: \$3,379,827

- Administrative Core; Principal Investigator: Donald A. Sens; Award Amount: \$346,731
- Research Cores; Principal Investigator: Donald A. Sens; Award Amount: \$346,731
- Mentoring Core; Principal Investigator: Seema Somji; Award Amount: \$760,036
- Informatics Core; Principal Investigator: Donald A. Sens; Award Amount: \$248,016
- Developmental Research Project Program; Principal Investigator: Donald A. Sens; Award Amount: \$1,169,651

Center of Biomedical Research Excellence, Epigenomics of Development and Disease

Award Number: 5T P20 GM104360; Principal Investigator: Roxanne A. Vahghan; Organization: University of North Dakota; NIGMS; Award Amount: \$1,973,118

- Genomics Core; Principal Investigator: Bony De Kumar; Award Amount: \$428,323
- Mechanical Signaling mediated 3D chromatin remodeling in stem cell fate; Principal Investigator: Susan Eliazer; Award Amount: \$170,550
- Epigenetics of Regeneration; Principal Investigator: John A. Watt; Award Amount: \$184,721
- Biomedical Research Excellence, Epigenomics of Development and Disease; Principal Investigator: Roxanne A. Vahghan; Award Amount: \$826,541

Center for Diagnostic and Therapeutic Strategies in Pancreatic Cancer

Award Number: 5T P20 GM109024; Principal Investigator: Sanku Mallik; Organization: North Dakota State University; NIGMS; Award Amount: \$1,894,145

- Computational and theoretical fluid mechanics modeling for transport in dense tumors; Principal Investigator: Saikat Basu; Award Amount: \$134,785
- Administrative Core: Center for Diagnostic and Therapeutic Strategies in Pancreatic Cancer; Principal Investigator: Sanku Mallik; Award Amount: \$562,229
- Mesenchymal Stem Cell-Based Targeted Combined Therapy for Pancreatic Ductal Adenocarcinoma; Principal Investigator: Buddhadev Layek; Award Amount: \$226,317
- Animal Core Facility; Principal Investigator: John C. Wilkinson; Award Amount: \$597,234
- Biostatistics and Bioinformatics Core Facility; Principal Investigator: Megan Orr; Award Amount: \$147,255
- Selective inhibition of COPZ1 in PDAC cells; Principal Investigator: Roberto Gomes; Award Amount: \$226,325

Center for Excellence in Host Pathogen Interactions

Award Number: 5T P20 GM113123; Principal Investigator: David S. Bradley; Catherine A. Brisette; Organization: University of North Dakota; NIGMS; Award Amount: \$2,038,822

- Flow Cytometry Core; Principal Investigator: David S. Bradley; Award Amount: \$223,119
- Computational Data Analysis Core; Principal Investigator: Junguk Hur; Award Amount: \$218,602
- Project 2; Principal Investigator: Shahram Solaymani-Mohammadi; Award Amount: \$326,130
- Imaging Core; Principal Investigator: Bryon D. Grove; Award Amount: \$235,638
- Imaging Core; Principal Investigator: Bryon D. Grove; Award Amount: \$235,638
- Histology Core; Principal Investigator: Colin Combs; Award Amount: \$230,135
- Administrative Core; Principal Investigator: David S. Bradley; Award Amount: \$805,198

Dakota Cancer Collaborative on Translational Activity

Award Number: 5T U54 GM128729; Principal Investigator: Gary G. Schwartz; Organization: University of North Dakota; NIGMS; Award Amount: \$4,000,000

SMALL BUSINESS ADMINISTRATION SBIR/STTR

Dechlorination of Mixed-Plastics Feedstock with Low Temperature Pyrolysis for Downstream Gasification and Hydrogen Production

Contract Number: DE-SC0023858; Recipient Organization: MicroBeam Technologies, Inc.; Funding Agency: Department of Energy; Award Year: 2023; Award Amount: \$249,952

Optimization of Coal Waste/Biomass Gasification for Hydrogen Production

Contract Number: DE-SC0022871; Recipient Organization: MicroBeam Technologies, Inc.; Funding Agency: Department of Energy; Award Year: 2022; Award Amount: \$249,974

Development of Sorting Algorithm for Critical Mineral-rich Coal Resource Feedstocks for Use in Full-Stream Analyzers

Contract Number: DE- SC0021837; Recipient Organization: MicroBeam Technologies, Inc.; Funding Agency: Department of Energy; Award Year: 2021; Award Amount: \$249,886

Integration of Coal-fired Power Plants Fireside Optimization Tools with the IDAES Platform

Contract Number: DE- SC0020803; Recipient Organization: MicroBeam Technologies, Inc.; Funding Agency: Department of Energy; Award Year: 2020; Award Amount: \$249,969

Novel Biodegradable Biobased Polymers for Agricultural Applications

Contract Number: 2020-00907; Recipient Organization: Renuvix LLC; Funding Agency: Department of Agriculture; Award Year: 2020; Award Amount: \$100,000

Nanocomposite Binder Systems for Dispersion Coatings that Enable Biodegradable, Paper-Based Packaging with Enhanced Barrier Properties

Contract Number: 2019-02380; Recipient Organization: Renuvix LLC; Funding Agency: Department of Agriculture; Award Year: 2019; Award Amount: \$600,000

USDA NATIONAL INSTITUTE OF FOOD AND AGRICULTURE

Award Number: 20215130034909; Organization: North Dakota State University; USDA Program: ORGANIC AGRICULTURE RESEARCH AND EXTENSION INITIATIVE; Award Amount: 1300372; FY 2021

Award Number: 20194152030051; Organization: North Dakota State University; USDA Program: COOPERATIVE EXTENSION SERVICE; Award Amount: 1302421; FY 2021

Award Number: NI21HFPXXXXG036; Organization: North Dakota State University; USDA Program: PAYMENTS TO AGRICULTURAL EXPERIMENT STATIONS UNDER THE HATCH ACT; Award Amount: 2258253; FY 2021

Award Number: Organization: NA; USDA Program: SMITH - LEVER FUNDING (VARIOUS PROGRAMS); Award Amount: 3561904; FY 2021

Award Number: 20216701334115; Organization: North Dakota State University; USDA Program: AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI); Award Amount: 500000; FY 2021

Award Number: 20216701534277; Organization: North Dakota State University; USDA Program: AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI); Award Amount: 500000; FY 2021

Award Number: 20216701534419; Organization: North Dakota State University; USDA Program: AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI); Award Amount: 500000; FY 2021

Award Number: 20216703734169; Organization: North Dakota State College of Science; USDA Program: AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI); Award Amount: 500000; FY 2021

Award Number: 20217003535565; Organization: North Dakota Department of Agriculture; USDA Program: FARM AND RANCH STRESS ASSISTANCE NETWORK COMPETITIVE GRANTS PROGRAM; Award Amount: 500000; FY 2021

Award Number: 20217041135210; Organization: North Dakota State University; USDA Program: NEW BEGINNINGS FOR TRIBAL STUDENTS; Award Amount: 518928; FY 2021

Award Number: Organization: USDA Program: NEW BEGINNINGS FOR TRIBAL STUDENTS; Award Amount: 534217; FY 2021

Award Number: 20206701631341; Organization: North Dakota State University; USDA Program: AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI); Award Amount: 540000; FY 2021

Award Number: 20184700228647; Organization: Nueta Hidatsa Sahnish College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 660000; FY 2021

Award Number: 20184700228652; Organization: United Tribes Technical College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 660000; FY 2021

Award Number: 20184700228668; Organization: Turtle Mountain Community College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 660000; FY 2021

Award Number: 20184700228670; Organization: Cankdeska Cikana Community College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 660000; FY 2021

Award Number: 20184700228671; Organization: Sitting Bull College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 660000; FY 2021

Award Number: 20217000635330; Organization: North Dakota State University; USDA Program: CROP PROTECTION AND PEST MANAGEMENT COMPETITIVE GRANTS PROGRAM; Award Amount: 684338; FY 2021

Award Number: NI21HMFXXXXG018; Organization: North Dakota State University; USDA Program: PAYMENTS TO AGRICULTURAL EXPERIMENT STATIONS UNDER THE HATCH ACT; Award Amount: 882129; FY 2021

Award Number: NI22HFPXXXXG044; Organization: North Dakota State University; USDA Program: PAYMENTS TO AGRICULTURAL EXPERIMENT STATIONS UNDER THE HATCH ACT; Award Amount: 2259341; FY 2022

Award Number: NI20HFPXXXXG011; Organization: North Dakota State University; USDA Program: PAYMENTS TO AGRICULTURAL EXPERIMENT STATIONS UNDER THE HATCH ACT; Award Amount: 2264986; FY 2022

Award Number: Organization: USDA Program: SMITH - LEVER FUNDING (VARIOUS PROGRAMS); Award Amount: 3568673; FY 2022

Award Number: Organization: USDA Program: SMITH - LEVER FUNDING (VARIOUS PROGRAMS); Award Amount: 3606780; FY 2022

Award Number: 20224700338381; Organization: Cankdeska Cikana Community College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 519000; FY 2022

Award Number: 20224700338384; Organization: Turtle Mountain Community College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 519000; FY 2022

Award Number: 20224700338387; Organization: Nueta Hidatsa Sahnish College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 519000; FY 2022

Award Number: 20224700338392; Organization: Sitting Bull College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 519000; FY 2022

Award Number: 20224700338379; Organization: United Tribes Technical College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 541359; FY 2022

Award Number: 20227000538225; Organization: North Dakota State University; USDA Program: ALFALFA AND FORAGE RESEARCH PROGRAM; Award Amount: 587671; FY 2022

Award Number: 20226701637092; Organization: North Dakota State University; USDA Program: AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI); Award Amount: 650000; FY 2022

Award Number: 20226702237016; Organization: North Dakota State University; USDA Program: AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI); Award Amount: 725925; FY 2022

Award Number: NI20HMFXXXXG005; Organization: North Dakota State University; USDA Program: PAYMENTS TO AGRICULTURAL EXPERIMENT STATIONS UNDER THE HATCH ACT; Award Amount: 879266; FY 2022

Award Number: NI22HMFXXXXG015; Organization: North Dakota State University; USDA Program: PAYMENTS TO AGRICULTURAL EXPERIMENT STATIONS UNDER THE HATCH ACT; Award Amount: 885763; FY 2022

Award Number: NI23HFPXXXXG024; Organization: North Dakota State University; USDA Program: PAYMENTS TO AGRICULTURAL EXPERIMENT STATIONS UNDER THE HATCH ACT; Award Amount: 2276789; FY 2023

Award Number: NI18SLBCXXXXG033; Organization: North Dakota State University; USDA Program: SMITH - LEVER FUNDING (VARIOUS PROGRAMS); Award Amount: 3431891; FY 2023

Award Number: Organization: USDA Program: SMITH - LEVER FUNDING (VARIOUS PROGRAMS); Award Amount: 3645467; FY 2023

Award Number: 20237044040221; Organization: Nueta Hidatsa Sahnish College; USDA Program: FROM LEARNING TO LEADING: CULTIVATING THE NEXT GENERATION OF DIVERSE FOOD AND AGRICULTURE PROFESSIONALS; Award Amount: 5000000; FY 2023

Award Number: 20237050440441; Organization: Sovereign Equity Fund; USDA Program: AMERICAN RESCUE PLAN TECHNICAL ASSISTANCE INVESTMENT PROGRAM; Award Amount: 5000000; FY 2023

Award Number: 20207041132768; Organization: North Dakota State University; USDA Program: NEW BEGINNING FOR TRIBAL STUDENTS; Award Amount: 534217; FY 2023

Award Number: Organization: United Tribes Technical College; USDA Program: Tribal Colleges Extension Programs; Award Amount: 541359; FY 2023

Award Number: Organization: USDA Program: MINOR CROP PEST MANAGEMENT (IR; Award Amount: 684338; FY 2023

Award Number: 20236801840320; Organization: North Dakota State University; USDA Program: AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI); Award Amount: 749997; FY 2023

Award Number: 20236702339114; Organization: North Dakota State University; USDA Program: AGRICULTURE AND FOOD RESEARCH INITIATIVE (AFRI); Award Amount: 800000; FY 2023

Award Number: NI23HMFXXXXG048; Organization: North Dakota State University; USDA Program: PAYMENTS TO AGRICULTURAL EXPERIMENT STATIONS UNDER THE HATCH ACT; Award Amount: 893113; FY 2023

Award Number: NI21SLBCXXXXG011; Organization: North Dakota State University; USDA Program: Smith - Lever Extension Funding; Award Amount: 3561904; FY 2024

Award Number: NI20SLBCXXXXG002; Organization: North Dakota State University; USDA Program: Smith - Lever Extension Funding; Award Amount: 3568673; FY 2024

Award Number: NI19SLBCXXXXG035; Organization: North Dakota State University; USDA Program: Smith - Lever Extension Funding; Award Amount: 3575055; FY 2024

Award Number: NI22SLBCXXXXG045; Organization: North Dakota State University; USDA Program: Smith - Lever Extension Funding; Award Amount: 3606779; FY 2024

Award Number: NI23SLBCXXXXG020; Organization: North Dakota State University; USDA Program: Smith - Lever Extension Funding; Award Amount: 3645467; FY 2024