**University of Nebraska-Lincoln**

**Facilities, Equipment, and Other Resources**

[This document provides easily accessible and up-to-date information on UNL’s major research centers, NU-wide major research centers, and UNL’s research core facilities. Principal Investigators are encouraged to copy and paste relevant information into the Facilities, Equipment, and Other Resources section of their proposals. UNL faculty, staff, and administrators are welcome to contact the [Office of Proposal Development](mailto:%20tgilreathmullen2@unl.edu) with requests for the inclusion of additional facilities or with updates to existing information.]

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# **UNL Major Research Centers**

## Academy for Child and Family Well Being

The Academy for Child and Family Well Being (ACFW), a partnership between UNL’s Department of Special Education and Communication Disorders and Boys Town, seeks to improve the lives of youth with emotional and behavioral challenges by researching, developing, and supporting evidence-based practices. ACFW works throughout the continuum of care for youth, including school-based programs, family-support interventions, out-of-home services for youth, and youth transitioning from residential care back to their communities. ACFW is engaged in implementing research into real-world practices to help youth and families in Nebraska and throughout the nation. Researchers at the ACFW conduct a wide variety of studies, including pilot studies, interviews, focus groups, literature reviews, and secondary analyses of national data sets, with students, parents, teachers, and other service professionals throughout Nebraska, western Iowa, and the nation.

## Center for Brain, Biology and Behavior

The Center for Brain, Biology and Behavior (CB3) is an interdisciplinary research center that brings together distinguished University of Nebraska faculty in the social, biological, and behavioral sciences and engineering who are studying the biological mechanisms underlying social dynamics and human behavior. CB3’s state-of-the-art facilities support research on biological, neural, and cognitive mechanisms of behavior and include high-density electroencephalography brain recording systems, a functional magnetic resonance imaging laboratory, high-density near infrared spectroscopy, behavioral genetics equipment, eye tracking devices, and a salivary bioscience laboratory. These facilities, coupled with the Center’s highly multidisciplinary environment, enable diverse studies to expand understanding of brain function and its effects on human behavior.

## Center for Digital Research in the Humanities

The Center for Digital Research in the Humanities, a joint initiative of the University of Nebraska-Lincoln Libraries and the College of Arts and Sciences, promotes collaborative, transdisciplinary digital humanities research and encourages grants in the humanities. As a Program of Excellence, the Center fosters and serves as a catalyst for digital humanities research by providing spaces for collaborative research teams to meet, technological support, infrastructure for long-term sustainability of research, and connections to international research networks. While Faculty Fellows of the Center have tenure homes in Anthropology, Art and Art History, Classics and Religious Studies, English, History, and the Libraries, the Center serves any discipline in which research intersects with the humanities. The Center is a founding member of centerNet, an international network of digital humanities centers, and is an institutional member of the Text Encoding Initiative Consortium, the National Humanities Alliance, and the Consortium of Humanities Centers and Institutes. The Center is also one of 15 partners of the Humanities Without Walls consortium, which seeks to create new avenues of collaborative research, teaching, and scholarship in the humanities.

## Center for Plant Science Innovation

The Center for Plant Science Innovation (PSI) links molecular plant sciences between UNL’s East and City Campuses. PSI was founded as an interdisciplinary research and development, training, and mentoring program in the basic and translational plant sciences at UNL. PSI members provide research leadership to the national and international plant science community by contributing to a basic understanding of the biology underlying plant systems; developing the tools and resources necessary for translation of discoveries into applied technologies that improve the productivity and value of crop plants; and providing a strong educational foundation for the scientific and professional development of students, staff, and postdoctoral associates. PSI provides a framework and resources for collaborative research and training opportunities beyond what is available in home departments to broaden and enhance the scientific scope and research quality of member labs.

## Center on Children, Families, and the Law

The Center on Children, Families, and the Law (CCFL) was established in 1987 to serve as a home for interdisciplinary research, teaching, and public service on issues related to child and family policy and services. Knowledge gained about child and family issues is used to help educate policy makers, scholars, service providers, and the general public. Work by CCFL serves as the primary basis for new local, state, and national legislation and has been cited in court rulings, including the U.S. Supreme Court. In Nebraska, CCFL faculty and staff work closely with state and local agencies and nonprofit organizations to promote child and family welfare through training and educational programs, legal and policy analyses, program evaluation, consultation with service providers, and research intended to address practical child and family welfare issues. Nationwide, CCFL is committed to the development and dissemination of knowledge that advances the well-being of all the nation's children and families. CCFL faculty also serve on a variety of boards and advisory committees for national organizations concerned with child and family policy.

## Johnny Carson Center for Emerging Media Arts

Established through a $57 million partnership between the Hixson-Lied College of Fine and Performing Arts at the University of Nebraska-Lincoln, the Johnny Carson Foundation, and numerous private industry partners, the Johnny Carson Center for Emerging Media Arts aims to produce transformative creative leaders by building the ultimate student-centered program where every graduate is able to realize their dream job or raise money to start their dream company, straight out of school. The Center prepares students for careers in filmmaking, game design, special effects, app development, theme park experiences, virtual reality, and animation. The Center offers informal learning and meeting spaces that are integrated with formal learning zones, creating a community of interdisciplinary learners, peer-to-peer teachers, and entrepreneurs. The Center also includes two Emerging Media Arts Labs for shooting, motion capture, and data capture; an Audio Lab; and walls that can be seen through, written on, and opened up.

## Minority Health Disparities Initiative

The Minority Health Disparities Initiative (MHDI) links scientific research with policy, practice, and training to improve the health and well-being of Nebraskans. The MHDI’s objectives are to identify and strengthen the research infrastructure and the network of investigators and practitioners addressing critical health issues in the state and the nation. In addition to recruiting and supporting researchers in minority health at UNL, the MHDI administers the National Science Foundation-funded Minority Health Disparities summer research program, which aims to conduct and transform cutting-edge social and behavioral research to understand and reduce health disparities and diversify minority health researchers.

## Nebraska Center for Biotechnology

The Nebraska Center for Biotechnology promotes research on all aspects of molecular life sciences by providing state-of-the-art technologies for research through core facilities; enriching the research environment at UNL through a weekly seminar series; providing training to faculty, students, and staff through workshops and short courses; and awarding student fellowships and scholarships. The Center currently offers core facilities for bioinformatics, genomics, flow cytometry, microscopy, plant transformation, and proteomics and metabolomics.

## Nebraska Center for Energy Sciences Research

The Nebraska Center for Energy Sciences Research (NCESR), a collaboration between the Nebraska Public Power District and the University of Nebraska-Lincoln (UNL), was established in 2006 to conduct energy research that produces technologies, processes, and systems that provide new or significantly enhanced renewable energy sources and improve the quality of life and economic opportunity for all Nebraskans.NCESR’s overall goal is to develop research and education programs in energy sciences by fostering interdisciplinary collaboration among UNL faculty and with other research institutions, public-sector agencies, and private sector companies with similar interests. NCESR supports both basic and applied research and has a broad mandate to explore a range of renewable energy opportunities, such as biofuels, wind, and solar energy, as well as opportunities for energy conservation.

## Nebraska Center for Integrated Biomolecular Communication

The Nebraska Center for Integrated Biomolecular Communication (CIBC) promotes and coordinates interdisciplinary research focused on filling fundamental gaps in understanding spatial and temporal aspects of biomolecular communication. By embracing approaches that span from the molecular and tissue levels to computational modeling, the CIBC fosters the development of integrated, interdisciplinary research teams with broad disciplinary representation to interrogate complex disease pathways from a wide range of perspectives.

## Nebraska Center for Materials and Nanoscience

The Nebraska Center for Materials and Nanoscience (NCMN) was founded by the Board of Regents in 1988 to serve as the focal point of interdisciplinary research in materials in the College of Arts and Sciences and College of Engineering. The overall goal of NCMN is to provide for the state of Nebraska and the University of Nebraska a nationally recognized center of excellence in materials research science and engineering, nanoscience, and nanotechnology.

The NCMN has six facilities that are available to all University of Nebraska-Lincoln (UNL) faculty, companies in Nebraska, and outside interests: the Cryogenics Instrumentation Facility, the Electron Nanoscopy Instrumentation Facility, the Nanofabrication Cleanroom Facility, the Central Facility for Nanomaterials and Thin Films, the Surface and Materials Characterization Facility, and the X-Ray Structural Characterization Facility.

## Nebraska Center for the Prevention of Obesity Diseases through Dietary Molecules

Research at the Nebraska Center for the Prevention of Obesity Diseases through Dietary Molecules (NPOD) centers around developing innovative approaches to combating obesity and related diseases such as cardiovascular disease, type 2 diabetes, and non-alcoholic fatty liver disease. A collaboration between UNL and the University of Nebraska Medical Center, NPOD serves as a hub for researchers focused on leveraging and manipulating nutrient-dependent cell signals to devise consumer-friendly strategies to combat obesity and related diseases. NPOD’s Biomedical and Obesity Research Core provides Center researchers and external users with services in biostatistics, bioinformatics, large-capacity and high-speed computation, animal imaging and phenotyping, molecular biology, and metabolomics.

## Nebraska Center for Research on Children, Youth, Families and Schools

The mission of the Nebraska Center for Research on Children, Youth, Families and Schools (CYFS) is to impact lives through research that advances learning and development. CYFS conducts, supports, and shares research in the following areas: academic intervention and learning, early education and development, psychosocial development and behavioral health, research and evaluation methods, and rural education.

CYFS provides comprehensive grant support for faculty as they conceptualize, develop, submit, and manage their grants. This support includes complimentary pre- and post-award services. Grant support is available in the following areas: research development and coordination (e.g., content reviews and line edits); statistics and research methodology (e.g., collaboration, design, and analyses); administrative services (e.g., pre- and post-award budgeting and event planning); and web, technology, and communications (e.g., database development, media presence, and dissemination).

## Nebraska Center for Virology

The Nebraska Center for Virology (NCV) is a world-renowned center supporting virology research and education. Combining the expertise and facilities of Nebraska’s leading biomedical research institutions – UNL, the University of Nebraska Medical Center, and Creighton University – the NCV’s research programs focus on important viral diseases of humans, including HIV-1, Kaposi’s sarcoma, and herpes, as well as viruses within plants and animals. The NCV’s impact stretches across the globe as is evidenced by established research, training, and outreach programs in China and Zambia. Training in virology is provided at all levels and includes mechanisms for formal and informal education.

## Nebraska Food for Health Center

The multidisciplinary Nebraska Food for Health Center brings together strengths in agriculture and medicine from throughout the University of Nebraska system. The Center helps to develop hybrid crops and foods to improve the quality of life of those affected by critical diseases including heart disease, diabetes, obesity, cancers, inflammatory bowel disease, and mental disorders. The Center focuses on: bringing together a research team to tie gastrointestinal and biomedical research to agriculture, plant and animal breeding, and genetics; establishing a research program to develop foods with proven health benefits, particularly those that affect the human gut microbiome; and preparing a talented workforce for careers in food health, including researchers, food and health industry leaders, and food innovation entrepreneurs.

## Nebraska Transportation Center

Established in 2006, the Nebraska Transportation Center (NTC) is the umbrella organization for transportation research at the University of Nebraska and represents a unique partnership between university researchers, industry leaders, and government entities. NTC integrates transportation research, education, and technology transfer programs across the four NU campuses, making it one of the largest university transportation centers in the region. NTC transportation research areas include bicycles and pedestrians, economics, environment, freight, highways, intelligent transport systems, logistics, multimodal transportation, pavements, railroad, roundabouts, structures, and work zones. Multidisciplinary research includes policy, rural transportation, safety and human performance, and workforce development.

More than 70 faculty researchers representing over a dozen disciplines across the NU system are affiliated with NTC, conducting millions of dollars' worth of research. In addition, NTC has provided funding for nearly 80 graduate student research assistants and almost 90 undergraduate students and interns to date. NTC also seeks to educate K-12 students in Nebraska about the many aspects of transportation engineering. Students are introduced to engineering through opportunities that include field trips to NTC research labs, presentations from University of Nebraska-Lincoln students, hands-on activities, and professional development opportunities for K-12 math and science teachers. Technology transfer activities help keep the transportation workforce updated on the developments made by NTC research faculty and students. This includes workshops, webinars, and short courses on the latest transportation advances and technology.

## Redox Biology Center

The internationally recognized Redox Biology Center (RBC) is a broad-based interdisciplinary and multi-institutional entity involving researchers from UNL and the University of Nebraska Medical Center. The RBC aims to support and expand Nebraska’s existing strengths in redox biology by mentoring junior faculty to success, recruiting new faculty with complementary research interests, and strategically enhancing biomedical research structure. Affiliated programs include undergraduate summer research opportunities, an international graduate-level course with the Karolinska Institute in Sweden, and collaborative pilot projects.

## Rural Drug Addiction Research Center

The mission of the Rural Drug Addiction Research (RDAR) Center is to apply complementary approaches across a variety of disciplines to better understand the causes and consequences of substance use and identify new avenues to address substance use problems. The Center brings together basic and health scientists from neuroscience, cognition, simulation, epidemiology, psychology, and sociology to address the etiology, assessment, prevention, and treatment of this critical public health challenge. RDAR’s vision is to understand substance use and misuse from synapse to society. Center projects are supported by RDAR’s Administrative Core and the Longitudinal Networks Core to expand impact and contributions from work on substance use and related health disparities.

# **NU Major Research Centers**

## Buffet Early Childhood Institute

The Buffett Early Childhood Institute seeks to transform early childhood learning and development, especially for children ages eight and under who live in poverty, live under conditions of high stress and familial challenges, or have developmental delays, by leveraging the resources of the four campuses of the University of Nebraska and applying the best of what is known about the science and benefits of early childhood intervention. The Buffett Institute focuses on applied research, professional preparation for early childhood educators and providers, public policy, and outreach to all corners of the state and beyond. The Institute partners with schools, communities, policymakers, and others to share and apply knowledge about early childhood development in order to improve the lives of vulnerable young children and their families.

## Daugherty Water for Food Global Institute

The Daugherty Water for Food Global Institute (DWFI) works to address the global challenge of achieving food security with less stress on water resources through water management in agricultural and food systems. The institute’s impact is achieved through the work of its talented staff of more than 100 faculty and global fellows, postdoctoral researchers, and students in a wide variety of fields pursuing projects focused on increasing water and agricultural productivity. Additionally, the institute includes the valuable assets of the Nebraska Water Center and the Water Sciences Laboratory and benefits from the expertise of the National Drought Mitigation Center at the University of Nebraska-Lincoln. As a system-wide institute, DWFI taps the specialized resources available at all four NU campuses. DWFI also collaborates with other universities, businesses, non-governmental organizations, and government agencies around the world to address issues on a global scale. Through research and policy development, education, and communication, the institute is enhancing knowledge, fostering future water and food security leaders, and developing effective techniques to sustainably manage water and increase food security.

## Rural Futures Institute

The Rural Futures Institute leverages the talents and research-based expertise from across the four NU campuses on behalf of rural communities in Nebraska, the United States, and around the world. Through a culture of innovation and entrepreneurship, the Institute encourages bold and futuristic approaches to address critical rural issues. It works collaboratively with educational, business, community, non-profit, government, and foundation partners to empower rural communities and their leaders by connecting partners and doers, stimulating research and applications of future-focused ideas and evidence-based practices, and sharing insight and solutions to elevate the value and voice of rural nationwide.

# **Research Core Facilities**

## Bioinformatics Core Research Facility

*Parent Facility/Center: Nebraska Center for Biotechnology*

The Bioinformatics Core Research Facility (BCRF) offers education, analysis, and computational services in the areas of bioinformatics and computational biology. The BCRF provides various standard bioinformatics services (e.g., transcriptome or genome assembly, gene prediction and annotation, differential gene expression analysis, ortholog/homolog detection, phylogenetic analysis, etc.) with a quick turnaround time and very reasonable fees. The BCRF also helps to prepare and write grant proposals that include life sciences-related computation or analyses; collaborates on larger projects and grants; provides custom-program solutions (e.g., Java, Perl, Python) ranging from simple (e.g., conversion or integration of data files) to complex (e.g., developing and programming solutions for large-scale analyses); gives lectures and workshops on bioinformatics topics; installs and maintains, in collaboration with the Holland Computing Center, up-to-date software and databases in the life sciences (specifically bioinformatics) domain; provides support for bioinformatics software and analyses on the Holland Computing Cluster; and hosts servers and research database-driven websites (e.g., species-specific genome browsers).

BCRF instruments include a high-performance Linux compute cluster dedicated to life sciences research (approximately 250 CPU cores, 1 TB of RAM, and 150 TB of central SAS RAID6 disk storage), which contains: compute worker nodes, most of which have at least 8GB of RAM and are capable of running MPI jobs; a dedicated four-CPU, six-core large-memory server (320 GB RAM) suitable for larger transcriptome and genome assembly jobs; and two web servers and database backend machines for hosting several database-driven research websites.

For more information, contact Jean-Jack Riethoven (jeanjack@unl.edu, 402-472-7949).

## Biological Process Development Facility

The Biological Process Development Facility (BPDF) at the University of Nebraska offers biopharmaceutical process development and biomanufacturing services that transition discoveries into early phase clinical trials. BPDF capabilities include: master and working cell banks; upstream and downstream process development; stability testing services; analytical method development and qualification; and microbial manufacture of biologics.

Fermentation processes focus on optimizing and controlling high cell-density fermentations of *Pichia pastoris*, *Saccharomyces cerevisiae*, and *Escherichia coli* for recombinant protein production. Activities are governed by a rigorous quality system as well as regulatory support.

The BPDF has produced a wide range of biologics – including vaccines, recombinant proteins, gene therapies, and other biotherapeutics – in partnership with government agencies, biotechnology companies, academic researchers, and non-profit organizations. The BPDF applies decades of expertise and experience to developing scalable and reproducible cGMP manufacturing processes.

For more information, contact Jill Hereth (jhereth2@unl.edu, 402-472-1983).

## Biomedical and Obesity Research Core

*Parent Facility/Center: Nebraska Center for the Prevention of Obesity Diseases through Dietary Molecules*

The Biomedical and Obesity Research Core (BORC) provides research services for both internal and external users. BORC has approximately 2,000 ft2 of laboratory space in Leverton Hall and designated space in the Life Sciences Annex for animal studies. BORC offers a variety of services in molecular and cell biology, metabolic study, animal behavior research, and small animal imaging. BORC also offers training sessions and supports research tool development programs that would benefit research for multiple labs.

Key equipment in Leverton Hall includes: Bio-Rad QX200™ Droplet Digital™ PCR System; XFe-24 Extracellular Flux Analyzer (Seahorse Bioscience); Vitros-250 Chemistry Analyzer; Agilent 5975C/7890A GC-MS; LI-COR Odyssey® CLx; Malvern NanoSight NS300; Bio-Rad CFX Connect Real-Time PCR; BioTek Cytation C10 Confocal Imaging Reader; nCS1 Nano Particle Analyzer; MinION MK1c Nanopore Sequencer; BioTek Synergy™ H1m Plate Reader; MAGPIX Multiplexing System; Hamilton Micro-Prep Liquid Handling System; ImageStream®X Mark II Imaging Flow Cytometer; Branson S-450D Digital Ultrasonic Sonifier; and FreeZone® 4.5-liter Freeze Dry Systems. Key equipment in the Life Sciences Annex (for *in vivo* study) includes: TSE Metabolic Cages; Harvard Apparatus Small Animal Treadmill; Barnes Maze; Radial Arm Maze; Morris Water Maze; Place Conditioning Preference System; Animal Grip Strength System; ROTOR-ROD™ System; SR-LAB™ Startle Response System; UltraFocus DXA; iBox Scientia™ Small Animal Imaging System; and Pearl® Impulse Small Animal Imaging System.

For more information, contact BORC@unl.edu or Jingjie Hao (jingjie.hao@unl.edu, 402-472-4243).

## Bureau of Sociological Research

Established in 1964, the Bureau of Sociological Research (BOSR) is a one-stop survey research shop that collects data to help answer important questions facing society. BOSR provides a wide range of research services for faculty, students, administrative units, government agencies, and nonprofit groups.

BOSR has conducted national, regional, and local surveys using a variety of survey research methods. These include mail surveys, web surveys, telephone interviewing, in-person interviews, qualitative interviews, focus groups, and mixed-mode designs. BOSR also offers a twice a year omnibus survey and probability-based panel that are useful tools for researchers. BOSR provides many services beyond surveys, including participant/subject recruitment, observation and field work, IRB documentation preparation assistance, translation services, data entry, transcription, data analysis and reporting, and evaluation.

BOSR supports all aspects of social science research applications. Staff can complete as little or as much of a project as the researcher prefers, though many BOSR clients prefer BOSR oversee the project from beginning to end. BOSR can also work with budgets of all sizes. Trainings and demonstrations of survey research methods and focus group facilitation are available by request.

For more information, contact Lindsey Witt-Swanson (lwitt2@unl.edu, 402-472-3672).

## Cell Development Facility

The Cell Development Facility creates cell lines of all types – including mammalian, yeast, and bacterial – for recombinant proteins and metabolites. The facility specializes in biomedical proteins. Areas of assistance include: general microbiology: susceptibility testing of BSL-1 and BSL-2 organisms; cell line development: genetic engineering (synthetic biology) of cell lines to achieve heterologous gene expression or endogenous alterations in gene expression and function; fermentation process development: small to mid-scale (10 L) reactor volumes monitoring and controlling cell density, pH, and oxygen; protein purification development (e.g., chromatography resins with single or multiple chemistries and protein identification partnering through other UNL core facilities (LC-MS/MS); antibody-based services (e.g., qualitative and quantitative western blot, enzyme-linked immunosorbent assay [ELISA], antigen immunopreciptation for protein complex analysis or chromatin immunoprecipitation sequencing [ChIP-Seq], and other methodologies); cell biology services (e.g., protein stability, protein potency, protein toxicity, and protein localization); and microscopy (e.g., epi-fluorescence, confocal fluorescence, and Nomarski light, as well as transmission electron [TEM] and scanning electron [SEM]) partnering through other UNL core facilities.

For more information, contact Cayetana Lazcano Etchebarne (clazcanoetchebarne2@unl.edu).

## Central Plains Research Data Center

The Central Plains Research Data Center (CPRDC) is part of a network of federal statistical research data centers operated in conjunction with the U.S. Census Bureau that provides researchers with access to restricted-use federal datasets, including Census and health data (through the National Center for Health Statistics and the Agency for Healthcare Research Quality) and data through other federal agencies (such as the Internal Revenue Service, the Bureau of Labor Statistics, and the Bureau of Economic Analysis). These are micro-level, less processed data that provide finer geographic coverage than comparable public-use data sets.

By providing access to these data in a secure facility, the CPRDC aims to bolster research that expands basic knowledge and provides benefits to the federal statistical system with a secure computing laboratory where qualified researchers with approved projects can conduct research using restricted-access versions of important datasets maintained by the U.S. Census Bureau and other federal agencies. Researchers may access establishment-level business data and/or unreleased household data. In many cases, linked economic and demographic data are available.

The CPRDC is supported by a consortium of university entities in the Central Plains region, including the University of Nebraska-Lincoln, the University of Nebraska Medical Center, the University of Iowa, Iowa State University, and the University of South Dakota. Researchers at these consortium partner institutions have access to the CPRDC at reduced rates.

For more information, contact John Anderson (janderson4@unl.edu, 402-472-1190).

## CryoEM Core Facility

*Parent Facility/Center: Nebraska Center for Biotechnology*

Located in the Morrison Center, the CryoEM Core Facility has a state-of-the-art Glacios 200kV electron microscope available for structure determination of protein, nucleic acids, and other molecules of biological interest, including small molecules in a crystalline state. CryoEM Core services include: single-particle CryoEM; cryo-electron tomography (CryoET) of thin specimens; micro-crystal electron diffraction (MicroED); sample preparation; comprehensive data collection and analysis of CryoEM samples; sample storage and shipping; and data processing. Instruments include:

*A 200kV Glacios CryoTEM:* The Thermo Scientific Glacios cryo-transmission electron microscope (Cryo-TEM) allows users to easily collect near atomic data from a broad range of biological targets. Compared to the previous generation, the Glacios cryo-TEM delivers higher throughput and makes cryo-EM more accessible and efficient, thanks to the Aberration Free Imaging System (AFIS) and Fringe-Free Imaging ( FFI) system. The Glacios features a Falcon 4i direct electron detector, a Selectris energy filter, and the Thermo Scientific EPU software. In addition, the instrument can load up to 12 grids, reducing sample contamination and speeding up the screening process. Furthermore, the Glacios has the MicroED package, which includes a CetaD camera, optimized apertures, a smaller beam stop, and EPU-D. The Glacios cryo-TEM is ideally suited for single-particle analysis, cryo-electron (CryoET) tomography, and MicroED.

*A TFS Vitrobot Mark IV:* The Vitrobot is a fully computer-controlled double-sided bloating robot for the vitrification of aqueous samples. Minimal training is required for operating the instrument in a laboratory environment. The process of plunging, blotting, and vitrification is fully automated upon placing a vial in the chamber and setting up the liquid coolant container. Operational parameters tend to be reproducible, enabling a high throughput of vitrified samples with a straightforward control of the vitrification process. The Vitrobot allows users to control the temperature, humidity, number of blotting, and several critical time settings. The instrument consistently produces excellent specimens for cryo-electron microscopy, including single-particle, CryoET, and MicroED.

*A Leica EM GP2:* The Leica EM GP2 is a fully computer-controlled single-sided bloating vitrification robot. Bloating on the EM GP2 can be performed using sensor bloating or manual blotting using the onboard eyepiece. This instrument allows the user to perform multiple bloating operations, including back and front bloat. The possibility of back bloating makes the EM GP2 a perfect tool for the vitrification of cells and microcrystals. In contrast with the Vitrobot, the EM GP2 is capable of controlling the temperature of liquid ethane and providing a continuum flow of liquid nitrogen in the sample vitrification area, considerably reducing ice contamination. The instrument is highly reproducible and excellent for the three main CryoEM workflows, including single-particle CryoEM, CryoET, and MicroED.

*A PELCO easiGlow™:* The PELCO easiGlow™ glow discharge cleaning system is a compact, quick, easy-to-use standalone system. It is designed for cleaning and hydrophilizing TEM carbon support films or grids, which tend to be hydrophobic. A glow discharge treatment with air makes a carbon film surface negatively charged (hydrophilic), which allows aqueous solutions to spread evenly. Glow discharge treatment of TEM grids removes adsorbed hydrocarbons, cleaning them while making them hydrophilic. The PELCO easiGlow™ supports hydrophilic and hydrophobic treatment with either negative or positive charge and includes two separately controlled gas inlets. The vacuum level in the instrument is precision-controlled electronically by a proportional valve, a novel approach that eliminates manual settings with a needle valve. A gentle venting procedure ensures that the TEM grids are not disturbed when the system is vented.

For more information, contact Eduardo E. Romero (402-472-3360, eduardo.romero@unl.edu)

## Edgeworks

*Parent Facility/Center: Johnny Carson Center for Emerging Media Arts*

Edgeworks is the full-service design, research, and production bureau housed in the Johnny Carson Center for Emerging Media Arts. Its mission is to harness the collective talent, knowledge, resources, and networks of the Johnny Carson Center for Emerging Media Arts to advance research, collaborations, and experiential learning through a culture of interdisciplinary practice, play, and experimentation. Edgeworks is pioneering "edge of field practice"—cultivating new possibilities past the boundaries of traditional disciplines. Edgeworks partners with university researchers, community organizations, and global companies to create effective solutions to wicked problems. Edgeworks seeks to establish regenerative relationships between the Center, the university, and the surrounding community by concentrating on innovation at the margins and leading from the Edge across three areas of service: (1) Sponsored Research: Edgeworks collaborates across the University of Nebraska System and beyond to develop distinctive and inventive outreach strategies for research endeavors, surpassing the expectations of grant providers. The approach involves conceptualizing, constructing, and aiding in the execution of solutions tailored specifically to a collaborator’s research project. (2) Fee-for-Service Projects: Edgeworks partners with collaborators to deliver tailored services that meet their specific needs. This approach focuses on creatively designing solutions and elements that are precisely crafted to captivate the collaborator’s target audience. (3) Co-Design and Production: Edgeworks supports co-design and production, including: media production (video, audio, and video games [2D, 3D, and VR]); ideation services (speculative design, multi-species design, multi-sensory storytelling, worldbuilding, and concept prototyping); event services (technology demos, artistic displays, group experiences, media enhancements, and robotic services); and collaborative research (human robot interaction, human centered design, artificial intelligence, contemplative technology and design, and digital twins).

For more information, contact Lindsey Clausen (402-472-2060, lclausen5@unl.edu)

## Electron Nanoscopy Instrumentation Facility

*Parent Facility/Center: Nebraska Center for Materials and Nanoscience*

The Electron Nanoscopy Instrumentation Facility provides hands-on access to electron microscopes, sample preparation equipment, data collection and data reduction instrumentation, as well as consulting, training, and research collaboration. The scope of the facility is materials characterization of the topography, morphology, elemental composition, crystalline microstructure, crystal defects, and atomic arrangements of materials, mainly on a scale from 10 micrometers down to the near-atomic level.

The *Thermo Fisher* *Scientific (TFS/FEI) Tecnai Osiris (scanning) transmission electron microscope (S/TEM)* is a fully digital 200 kV and 80 kV TEM and STEM system with extreme field emission gun (X-FEG) with high-brightness and high-stability Schottky FEG, a high-angle annular dark-field imaging (HAADF) detector and super-X windowless EDX detector, and biprism for a holography and tomographic holder. The *Thermo Fisher Scientific (TFS/FEI) Nova NanoSEM450* is a field emission SEM with an ultra-stable, high-current Schottky FEG. The system has advanced optics and detection, including immersion mode, beam deceleration, Everhart Thornley Detector for secondary electrons (ETD-SE), “through-the-lens” detector for secondary electrons (TLD-SE) and backscattered electrons (BSE) for best selection of the information and image optimization, Oxford Instrumental EDS system, and a Bruker QUANTAX Micro-XRF system. The *JEOL JEM 2010 TEM* system is 200kV and analytical mode, which has LaB6 filament, single-tilting and double-tilting sample holders, Gatan Erlangshen CCD camera, and TSL texture analysis system. The facility also offers *TEM and SEM specimen preparation equipment*, including slow-speed diamond disk and wire saws, ultrasonic/rotation disc cutter, dimpling grinder, metallurgical polishing wheel, precision ion polishing system (PIPS)/PIPS II, plasma nanoclean, and Au/C sputter coater.

For more information, contact Xing-Zhong “Jim” Li (xzli@unl.edu, 402-472-8762).

## Extreme Light Laboratory

The Extreme Light Laboratory (ELL) at the University of Nebraska-Lincoln (UNL) houses the Diocles laser, which has a petawatt-peak power level and has been in operation for over 14 years. The laser and experimental research facility occupy 8,000-sq.-ft. across three floors of the Behlen Lab building on UNL’s City Campus. The laboratories meet stringent requirements on temperature (< ±1○ C), humidity (< 5%), and vibration control, made possible by separate designated electrical, processed-chilled-water, and air-handling systems.

Diocles is distinguished by exceptional laser beam quality, stability, and parameter control, which enables research with high laser light intensity interacting with either plasmas or GeV-energy electron beams from a coupled laser-driven wakefield accelerator. The interactions can be proved with synchronized pulses of laser light, electrons, or tunable X-rays. The laser offers two separate target chambers with different focal geometries, which can be changed based on the desired parameters and can be adjusted to either a 3” (100 TW line) or 7” (0.7 PW) line. The laser is focused by OAPs (orthogonal beam lines) with f/# ranging from f/6”, f/12”, f/18”, and f/40” (for 3” beam) and f/10” and f/40” (for 7” beam). Diocles peak intensity ranges from to 1018- 1021 W/cm2 (measured).

*Beamline configuration and experimental areas:* ELL offers flexible experimental arrangements and diagnostics. A total of six large 72”x48”x24” vacuum chambers are available with three separate and independent beamlines: 1) 0.7-PW peak power at 0.1-Hz repetition rate, 2) 100-TW at 10-Hz, and 3) 6-TW at 10-Hz. All use Ti:sapphire chirped-pulse amplification and lase at 800-nm in 30-fs duration pulses. Three independent pulse compression systems allow for independent control of pulse durations of separate beams used in same experiment. Wavefront sensors and deformable mirrors control spatial phase. Spatial and temporal active feedback control provides consistent transform-limited pulses and diffraction-limited focusing at the interaction point. The lab also offers control rooms for remote control of the laser and experimental parameters, which are connected to a real-time DAQ system.

*Diagnostics:* ELL has an extensive supply of diagnostics for users, which include real-time measurement and optimization at full power of pulse characteristics on target (energy, contrast, and spatial mode). Available optics include: custom-built dielectric-coated paraboloids with focal lengths ranging from 6” to 100”; detectors (12-bit, 14-bit, and 16-bit charge-coupled device [CCD] cameras for imaging); 0.2-1.6-T magnets for electron spectroscopy; X-ray CCD and complementary metal oxide semiconductor [CMOS] cameras for X-ray imaging 10 keV-160-keV X-rays; phosphor screens and image plates for electron beam imaging; CsI for gamma imaging; a Compton spectrometer; and sodium iodide and HP-Ge detectors for high-energy gamma-ray spectroscopy.

Users are provided with a data acquisition system that consists of a server-class computer connected to a PXI chassis with DAQ cards that handle the device triggering and data acquisition. ELL also has 1-GHz oscilloscopes and radiation area monitors. Cluster computing support is available at UNL’s Holland Computing Center, which includes a Linux cluster with 5,024 compute cores, 175 TB of storage, and 3 TB of local scratch per node. Other equipment and resources include: an electron accelerator (laser-wakefield-driven, quasi-monogenetic 0.8 GeV electron beams); a state-licensed accelerator facility with periodic radiation safety monitoring and training; and an X-ray source (laser-accelerator-driven Compton narrow-band X-rays tunable from 10 keV-10 MeV).

For more information, contact Donald Umstadter (donald.umstadter@unl.edu, 402-472-8115).

## Flow Cytometry Service Center

*Parent Facility/Center: Nebraska Center for Biotechnology*

The Flow Cytometry Service Center provides comprehensive data collection, consultation, instrument training, and data analysis assistance as well as training and education in flow cytometry. The Center is capable of running a wide variety of flow cytometry-based assays, including but not limited to: 1-16 color immunophenotyping studies, cell cycle analysis, plant ploidy, apoptosis, bead-based assays, and cell sorting.

Instruments include: (1) A Beckman Coulter CytoFLEX LX – a four-laser system (405, 488, 561, and 638nm) capable of detecting FSC, SSC, and 16 colors. It is also equipped with a 96-well plate loader for automated sampling. It operates under CytExpert Software. (2) A NanoFCM NanoAnalyzer – a two laser system (488, 640nm) capable of detecting side scatter signal and up to two fluorescent parameters. The system is designed to measure the size and concentration of nanoparticle samples. (3) A Beckman Coulter CytoFLEX SRT – a four-laser system (405, 488, 561, 638nm) capable of detecting FSC, SSC, and 15-fluorescent parameters. It is the Core’s only instrument capable of sorting samples. It is designed to sort up to four separate populations of interest from a sample and deposit those cells into a variety of tubes and plates. It is housed in a BSL2+ cabinet and is operated by CytExpert SRT software. (4) An Agilent 2100 Bioanalyzer – a system designed for chip-based automated electrophoresis. The system provides highly precise analytical evaluation of DNA, RNA, and protein samples. It can determine sizing, sample integrity, and purity.

For more information, contact Dirk Anderson (dirk.anderson@unl.edu, 402-472-3129).

## The Food Processing Center

The Food Processing Center (FPC) is a multi-disciplinary resource for the food industry, providing a combination of consulting, educational, technical, and entrepreneur development services. Through the integration of applied research with state-of-the-art pilot plants, laboratory services, a team of product developers, and a team that supports food entrepreneurship, the FPC is equipped to work with products in every major food group including grains and oilseeds, fruits, vegetables, dairy products, meat, and poultry. The FPC provides a wide range of customizable services, all delivered in a confidential, price-competitive, and timely manner.

FPC services include: applied research and engineering, pilot plant processing, product and process development, labeling and regulatory compliance, laboratory services, validation studies (thermal and non-thermal), sensory analysis labs, educational internship in food processing, experiential hands-on learning in food preservation and transformation for graduate and undergraduate students; professional development opportunities, food entrepreneur development seminars, workshops (e.g., extrusion, microbiology, etc.), and distance training opportunities for industry. Facilities include: teaching laboratories, classrooms, an auditorium with distance learning capabilities, product development modules; clinical subject and lab space, innovation training space, expanded sensory prep and evaluation space, a pilot plant (capabilities for extrusion, milling, brewing and fermenting, high-pressure processing, drying, etc.), and a dairy plant (capabilities for ice cream, cheese, and other products).

For more information, contact Terry Howell (terry.howell@unl.edu, 402-472-2142).

## Holland Computing Center

The Holland Computing Center (HCC) has two primary locations directly interconnected by a 100 Gbps primary link with a 10 Gbps backup. The 1,800 sq. ft. HCC machine room at the Peter Kiewit Institute (PKI) in Omaha can provide up to 500 kVA in UPS and genset protected power, as well as 160 ton cooling. A 2,200 sq. ft. second machine room in the Schorr Center at the University of Nebraska-Lincoln (UNL) provides up to 100 ton cooling with up to 400 kVA of power. Dell S4248FB-ON edge switches and Z9264F-ON core switches provide high WAN bandwidth and Software Defined Networking capabilities for both locations. The Schorr and PKI machine rooms both have 100 Gbps paths to the University of Nebraska, Internet2, and ESnet as well as a 100 Gbps geographically diverse backup path. HCC uses multiple data transfer nodes as well as a FIONA (Flash IO Network Appliance) to facilitate end-to-end performance for data intensive workflows.

HCC's main resources at UNL include Red – a high throughput cluster for high energy physics – and hardware supporting the Partnership to Advance Throughput Computing (PATh), National Research Platform (NRP), and Open Science Grid (OSG) National Science Foundation projects. Red is the largest machine on the Lincoln campus with 15,984 job slots interconnected by a mixture of 1, 10, 25, 40, and 100 Gbps Ethernet. Red serves up over 11 PB of storage using the CEPH filesystem. Red primarily serves as a major site for storage and analysis in the international high energy physics project known as Compact Muon Solenoid and is integrated with the OSG. Other resources at UNL include hardware supporting the PATh, NRP, and OSG projects as well as the off-site replica of the Attic archival storage system.

HCC's resources at PKI in Omaha include the Swan and Anvil clusters along with the Attic and Common storage services. Swan is the newest HPC resource and currently contains 8,848 modern CPU cores with high speed Mellanox HDR100 interconnects and 5.3PB of scratch lustre storage. Swan additionally contains 24x NVIDIA T4 GPUs and will be expanded over time as HCC's primary HPC system. Anvil is an OpenStack cloud environment consisting of 1,520 cores and 400TB of CEPH storage all connected by 10 Gbps networking. The Anvil cloud exists to address needs of Nebraska researchers that cannot be served by traditional scheduler-based HPC environments such as GUI applications, Windows based software, test environments, and persistent services. Attic and Silo form a near line archive with 3PB of usable storage. Attic is located at PKI in Omaha, while Silo acts as an online backup located in Lincoln. Both Attic and Silo are connected with 10 Gbps network connections. In addition to the cluster specific Lustre storage, a shared storage space known as Common exists between all HCC resources with 1.9PB capacity.

For more information, contact Hongfeng Yu (hfyu@unl.edu, 402-472-5013) or hcc-support@unl.edu

## Life Sciences Annex and Manter Hall

The University of Nebraska-Lincoln Institutional Animal Care Program (IACP) manages the Life Sciences Annex located on East Campus and Manter Hall located on City Campus. Daily care of animals at both facilities is provided by staff in the IACP. Health care is provided by the IACP veterinarians and technician staff.

UNL’s animal care program is accredited by the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC), USDA registered, and PHS assured. IACP and its Service Centers at the University of Nebraska-Lincoln ensure the humane care, use, and health of animals used in the teaching, research, and extension missions of the university. IACP provides veterinary services and coordinates animal health care oversight on campus and at satellite facilities around the state and provides the support and training necessary to assure high quality care and use of the university’s animals. The program carries out this mission by providing exceptional animal care; ensuring compliance with federal, state, local, and institutional regulations; and being an advocate and resource for research involving animals.

IACP also manages an Animal Biological Safety Level 3 (ABSL-3) Laboratory that is designed and engineered to meet all requirements. The Biocontainment Lab meets the rigorous specifications of a BSL-3 facility as well as additional requirements for properly housing and handling animals. The ABSL-3 labs have advanced primary and secondary containment systems for handling any potential hazards to personnel or the environment. Additionally, the facility is constructed to be highly durable, easily cleaned, and compliant with all parameters for animal well-being.

Manter Hall is 4,700 sq. ft. in size and is designed to accommodate traditional laboratory animals at a BSL-1 level. The 53,000 sq. ft. Life Sciences Annex houses multiple species and operates as a BSL-2 facility. The facility accommodates rodent, laboratory animal, and agricultural animal research. Facilities and equipment include an animal holding facility; per diem-based animal husbandry; Biosafety Level (BSL)-1, BSL-2, and BSL-3 space; surgery and procedure rooms; imaging modalities such as microCT, Pearl Imager, IBox, Bruker Minispec, Radiography, Ultrasound, and MRI; a mouse incubator for hot/cold housing; rodent metabolic cages; and anesthesia machine support and training. Technical support is also available, including tissue collection for genotyping; breeding colony management; blood draws; fecal collection; large and small animal surgical support; advanced anesthetic case management and support; research staff training; animal ordering and delivery; medication and supply ordering; and a dedicated vehicle for transport.

For more information, contact Kelly Heath (kheath3@unl.edu, 402-472-6958).

## Longitudinal Networks Core

*Parent Facility/Center: Rural Drug Addiction Research Center*

The Rural Drug Addiction Research Center (RDAR) serves as the incubator for the Longitudinal Networks Core (LNC) at the University of Nebraska-Lincoln. The long-term goal of the LNC is to enhance the fields of rural substance use research and mobile health interventions by offering longitudinal human subjects cohort study capacity to Center research projects and researchers throughout the Central Plains. RDAR research focuses on the neuroscience of substance use, cognitive implications of chronic drug use, the relationship between rural drug use and violence exposure, and simulation of drug-related disease epidemiology. To support these research goals, the LNC will recruit and retain a cohort of individuals with substance use experiences (the Regional Health Cohort) from which RDAR projects will regularly collect data. This effort lays the groundwork for long-term Center infrastructure that allows RDAR researchers to address specific challenges raised by substance use in rural settings and develop appropriate interventions. Services and resources include:

*Data describing factors affecting regional patterns of substance use.*The LNC’s Regional Health Cohort (RHC) provides access to longitudinal data on attitudes, behaviors, and social networks from persons who use drugs through six-to-nine monthly interviews and responsive ecological momentary assessment. The LNC will continue to follow participants longitudinally and recruit new participants over the next five years to replenish the sample due to expected attrition. Using community-engaged outreach, peer-referral techniques, and rural partnerships, recruitment will continue to focus on those who are underrepresented in substance use research. In doing so, the LNC will strengthen this secondary data resource for RDAR-affiliated researchers and create new opportunities for innovative approaches to understanding regional patterns of substance use.

*Access to a longitudinal cohort of people who use drugs from which to recruit study participants.*The LNC also provides access to the RHC Participant Pool of individuals who have agreed to be contacted for other Center-affiliated research. The cost of creating and maintaining a cohort of this scope for five to 15 years is prohibitive for most investigators. This resource is integral to investigator success, substantially decreasing the start-up time for projects, reducing the cost of personnel training through shared staffing models, and increasing individual project participant retention through regular interaction with the broader RHC Study. This resource has elevated and enhanced other campus centers, which have seen increased grant submission and service use in collaboration with researchers accessing the RHC Participant Pool.

*Use of Core software to collect responsive fine-grained mobile health data from participants.*The LNC provides access to in-house software: (1) The Open Dynamic Interaction Network (ODIN) is a unique cellphone-based app, designed to map social network interactions, facilitate *r*EMA, and provide an avenue for just-in-time mobile health intervention messaging. At present, no other software exists that provides its level and range of functionalities. These include mobile continuous-time interaction data captured anonymously when participants interact; web-based, continuous, remote administration of survey questions and participant retention communication; and a specialized suite of dynamic interaction analysis tools to work with continuous time data and wearable sensors. (2) The Social Network Analysis via Perceptual Taxonomy (SNAPT) is a tablet-based platform that enables rapid mapping of both actual and perceived social networks, by having participants quickly sort photographs and answer questions about community members. (3) The Multi-Actor-Based Universal Simulation Environment (MABUSE) is a cloud-based, agent-based simulator that generates ecologically valid synthetic (computational) social systems based on real-world social network and risk data (e.g., collected via ODIN and SNAPT). MABUSE can be used to map the potential long-term impacts of bio-behavioral public health interventions on epidemiological outcomes in a broad range of risk settings, including HIV and HCV among drug-using populations.

*Support for network sampling and analytic approaches.*The LNC has expertise on network sampling and related analytic approaches. Project support typically falls into one or more ‘focus areas’ such as community health, sexual and gender minority participants, substance use, and homelessness. The LNC is available to offer a primer on sampling and population estimates for hard-to-reach and hidden populations that can be adapted for faculty, graduate student, or community audiences.

*Consultation in community-engaged research, field-based biospecimen testing, epidemiological data collection, respondent driven sampling, prevention/intervention design, and research with hard-to-access populations.*For over a decade, LNC faculty and staff have collaborated on field-based data collection projects with hard-to-access and community populations. This includes peer network-based sampling in rural Puerto Rico; longitudinal studies with users of methamphetamine, cocaine, and opioids in the Great Plains; cellphone-based data collection with youth experiencing homelessness in the Midwest; and community-based substance use prevention programming with rural Alaska Native and Indigenous populations in the United States and Canada. These projects were successful in recruiting and retaining participants through carefully planned engagement strategies focused on community-specific needs and partnership with local advisory groups. The LNC provides consultation on these various research approaches.

For more information, contact Nova Gocchi Carrasco (ngocchicarrasco2@unl.edu, 402-472-5976)

## Magnetic Resonance Imaging Facility

*Parent Facility/Center: Center for Brain, Biology and Behavior*

The Center for Brain, Biology and Behavior houses its own research-dedicated Siemens 3T Skyra Magnetic Resonance Imaging (MRI) scanner. The scanner includes multiple head and body coils for different applications and optional capabilities for concurrent 256-channel high-density electroencephalography (EEG), eye tracking, BioPac physiological monitoring, and real-time motion monitoring. It is also equipped with all standard sequences for functional and structural neuroimaging and for sequences enabling multiband imaging for faster and higher-resolution fMRI data acquisition. The Magnetic Resonance Imaging Facility maintains a Siemens Master Research Agreement, making the facility part of a network of research imaging centers that have access to cutting-edge, research-grade MRI protocols and sequences. A full-time MRI technologist is on site during normal working hours. Additional MRI technologists are available to conduct scans in the evenings and on weekends as needed. In addition, neuroradiologists from the University of Nebraska Medical Center review scans from all research subjects for incidental findings.

MRI facilities may be rented hourly and are available to all UNL faculty who have undergone appropriate safety training and have received Institutional Review Board approval. A highly realistic mock scanner is also available in an adjoining room for familiarizing research subjects with the MRI environment and cognitive testing protocols.

For more information, contact Joanne Murray (jmurray14@unl.edu, 402-472-5219).

## Methodology and Evaluation Research Core Facility

The Methodology and Evaluation Research Core (MERC) Facility is a fee-for-service center in the Office of Research and Innovation. MERC supports all stages of program evaluation and research, with expertise in evaluation, human data collection, qualitative methods, and survey methodology.

MERC works with faculty, staff, and units at the University of Nebraska-Lincoln, researchers at other institutions, as well as local, state, and national agencies and organizations. In addition to assisting with program evaluation and broader impacts components of grant applications and funded projects, MERC provides a variety of data supports such as quantitative and qualitative data collection, cleaning, management, and analysis. Reporting is provided in the format that best meets client and audience needs, such as full-length reports, brief summaries, fact sheets, and slide decks. MERC also administers REDCap, a web-based survey platform.

For more information, contact Alian Kasabian (aliank@unl.edu, 402-472-6145) or Jenn Rutt (jenn.rutt@unl.edu, 402-472-3423)

## Morrison Microscopy Core Research Facility

*Parent Facility/Center: Nebraska Center for Biotechnology*

The Morrison Microscopy Core Research Facility provides state-of-the-art imaging instrumentation and services to support multidisciplinary research in the state of Nebraska. The facility also provides services and training for Nebraska academic and industrial communities.

*Confocal microscopes* include: a Nikon A1R-Ti2 (inverted) confocal live-cell imaging system (temp/CO2 chamber) with a hybrid resonant dual scanner, automated stage, integrated six solid-state lasers (405/445/488/514/561/640 nm), and Spectral Scanning System; and a Nikon A1-NiE (upright) confocal imaging system with integrated six solid-stage lasers (405/ 445/488/514/561/640 nm).

*Electron microscopes* include: a Hitachi HT 7800 transmission electron microscope (TEM) with an upgraded high-resolution digital camera for ultrastructural analysis, assay of nano-particles/fibers, and examination of negative stained microbial samples up to 200,000x (high contrast mode) and up to 600,000x (high resolution mode); and a Hitachi S4700 field-emission scanning electron microscope (SEM) for topographic analysis from 25x to 500,000x magnification at nanoscale levels.

*Epifluorescence/light imaging systems* include: an EVOS® M7000 imaging system with an automated microscopic stage, dual cameras, selectable excitation/emission filters from seven fluorescent LED light cubes, and 2x to 100x objective lenses; a Nikon Ti2 inverted epifluorescence microscope with a monochrome and color camera, seven fluorescent cubes, and 4x to 60x objective lenses; an Olympus AX70 upright epifluorescence microscope with a digital camera and multiple filter slider sets; and a Nikon SMZ25 stereo fluorescence microscope with a DS-Ri2 camera with dissecting illumination and epifluorescence illumination, three LED light cubes (GFP [488], DS Red [560], and Long Pass [GFP and DS Red]), and two lenses (.5X with Optical Zoom from .32 to 7.88 and 1X with Optical Zoom from .63 to 15.75), which allow users to screen fluorescent samples or capture images for phenotypic selections.

*Other instrumentation and services* available through the facility include: a Leica cryostat for frozen sectioning; a Leica rotary microtome for paraffin sectioning; sputter coaters for SEM sample preparation (sample preparation service from fixation to sputter coating for SEM); a Tousimis SAMDRI-795 critical point dryer for SEM sample preparation; a Leica UC7 ultra-microtome for semi-thin and ultrathin sectioning for TEM (sample preparation services from fixation, dehydration, embedding, ultrathin sectioning, and staining [including negative staining] for TEM); and training and setup for H&E staining and immunochemical staining for light microscopy.

For more information, contact You (Joe) Zhou (yzhou2@unl.edu, 402-472-5935 [office], 402-472-5942 [laboratory]).

## Nano-Engineering Research Core Facility

*Parent Facility/Center: Voelte-Keegan Nanoscience Research Center*

Located within the College of Engineering, the goal of the Nano-Engineering Research Core Facility (NERCF) is to create a centralized, shared-user core facility that houses the state-of-the-art research instrumentation necessary to position University of Nebraska-Lincoln (UNL) researchers at the forefront of global research efforts focused on advanced manufacturing of materials, nanostructures, and nanodevices. The NERCF enhances research capacity and quality by providing in-house nanofabrication and nanocharacterization facilities open to use by faculty across the University of Nebraska system. Further, it is the intent of this facility to become a regional hub for nano-engineering. The equipment and operations are funded in part by the Nebraska Research Initiative and the UNL Office of Research and Innovation. The mission of the NERCF is to advance materials manufacturing efforts within the University and the state of Nebraska.

Equipment for characterization work includes: a Lake Shore cryogenic probe station, an FEI Quanta 200 environmental scanning electron microscope (SEM), a Hysitron TI 950 TriboIndenter, an Asylum Research MFP-3D-BIO™ atomic force microscope (AFM), an Anasys Instruments AFM+, a Keyence VK-X200K series laser scanning microscope, a VersaLab 3 Tesla cryogen-free vibrating sample magnetometer, a Bruker Nanoscale Infrared Spectrometer, a Zeiss laser confocal microscope (LSM 800), a CellScale Biomechanical testing system, and a Nikon Industrial X-ray and CT (XT H 225 ST). Equipment for manufacturing work includes: an FEI Helios NanoLab™ 660 DualBeam™ system, a Stratasys Objet 500 Connex3 3D printer, an Astrella ultrafast amplifier laser system, a Spark plasma sintering system, an Optomec LENS 3D metal hybrid vertical milling center inert system, a Lumex Avance-25 Metal 3D Printer, an EnvironTec bioplotter manufacturing series, and a LPKF ProtoLaser U4.

For more information, contact Director Joseph Turner (jaturner@unl.edu, 402-472-8856) or Manager Wen Qian (wqian2@unl.edu, 402-472-1668).

## Nanofabrication Cleanroom Facility

*Parent Facility/Center: Nebraska Center for Materials and Nanoscience*

The Nanofabrication Cleanroom Facility provides state-of-the-art instrumentation for designing, fabricating, characterizing, and testing complex nano/micro-scale structures and devices. These advanced toolsets are housed within the 4,000-sq.-ft. cleanroom at the Voelte-Keegan Nanoscience Research Center. The facility is open to all UNL researchers as well as external (including private sector) researchers for carrying out research projects in physics, chemistry, nano/microelectronics, microelectromechanical and nanoelectromechanical systems, nano-bio, and other related and interdisciplinary areas. Staff support is also available for training, process consultation, collaboration on new process development, and sample fabrication.

In addition to the certified class 10,000 (ISO-7) cleanroom, which spans over 4,000 sq. ft. and includes 2,500 sq. ft. for work space, the facility provides the following instrumentation: electron beam lithography (EBL), laser lithography system (Heidelberg DWL66), and optic lithography (SUSS MJB-4 Mask Aligner); reactive ion etching (Trion Minilock), deep RIE (Oxford Plasmalab 100), two ionic milling/Sputtering (Intlvac Nanoquest-I), and wet etching benches; a Stylus profilometer (Dektak XT), a reflective film thickness measurement system (Filmetrics F40), an optic microscope with camera (Nikon Eclipse L200N), and a four-probe resistivity measurement stand (Lucas 302); a focused ion beam (FEI Strata 201); e-beam evaporation (AJA ATC-ORION 8000); and a Spinner (Laurell WS-400-6NPP), hot plate (Super Nuova 120), oven (Thermo Scientific 3492M), Wire bonder (K&S iBond5000), and UltraSonic cleaner (Brason 2510) for wafer processing.

For more information, contact Jiong Hua (jhua2@unl.edu, 402-472-3773).

## Nanomaterials and Thin Films Facility

*Parent Facility/Center: Nebraska Center for Materials and Nanoscience*

The Nanomaterials and Thin Films Facility provides state-of-the-art instruments for fabricating material samples and devices. The primary focus of the facility is on nanostructuring by using thin film deposition and multi-layering. The facility has four thin film deposition systems that can deposit sub-nanometer-thick films in which two or more materials can be layered together in different orders to form a multilayer structure. The facility also provides systems to alloy materials together to study the bulk material properties.

Available equipment includes: four thin film systems for thin film deposition (two AJA International, Inc. sputtering systems [ATC-2000F and Orion]), PVD Products laser deposition system [PLD-MBE 2500], and HEX deposition from Mantis Deposition Inc.); gold and platinum target for use in facility deposition systems; two tube furnaces for heat treatment, including a Lindberg 55322 oven (Split-Hinge Single Zone Furnace, Tmax = 1100 °C, working tube diameter = 2.5 inches) and a MTI furnace (Tmax = 1700 °C, working tube diameter = 2 inches); systems for bulk sample preparation (Materials Research Furnaces, Inc. Arc Melt Furnace ABJ-338, Edmund Bühler GmbH Melt Spinner SC, and Fritsch Pulverisette 7 ball mill system); a Micromeritics ASAP 2460 Surface Area and Porosimetry Analyzer; and a J.A Woollam Alpha–SE Ellipsometer for measuring thin film thickness and film properties.

For more information, contact Steve Michalski (smichalski@unl.edu, 402-472-7096).

## Nebraska Center for Mass Spectrometry

*Parent Facility/Center: Molecular Analysis and Characterization Facility*

Housed within the Department of Chemistry, the Nebraska Center for Mass Spectrometry (NCMS) maintains cutting-edge analytical capabilities in support of researchers within the University of Nebraska as well as external users in academia, government, and industry. The facility hosts a unique suite of high-end mass spectrometry instrumentation, a wide array of data handling resources, and a highly adept staff that enable the facility to engage with the full range of molecular analyses accessible by mass spectrometry. These include ultra-high resolution / ultra-high mass accuracy molecular weight determination for analytes ranging from small molecules to intact proteins; “bottom-up” and “top-down” proteomics; untargeted discovery metabolomics; discrimination of isomers and conformers by ion mobility; and spatial resolution of analytes in tissues, films, and other materials by mass spectrometry imaging.

Major instruments within the NCMS include: *a Bruker Solarix XR 15 T Q-FTICR-MS:* A quadrupole / Fourier transform ion cyclotron resonance mass spectrometer equipped with a 15 T superconducting magnet, multiple ionization methods (conventional electrospray ionization [ESI]; pump-driven and static-mode nanoflow ESI; matrix-assisted laser desorption/ionization [MALDI]), and multiple tandem mass spectrometry methods (beam-type and trapping-type collision-induced dissociation [CID]; electron transfer dissociation [ETD] and negative electron transfer dissociation [nETD]; electron capture dissociation [ECD] and electron detachment dissociation [EDD]; infrared multiphoton dissociation [IRMPD]). The instrument is also fitted with an Advion TriVersa NanoMate for automated, zero-carryover sample introduction. This instrument is particularly well-suited for untargeted metabolomic analysis; intact protein characterization; and imaging of target compound distributions in tissues and other materials. *A Waters Synapt G2-S HDMS Q-IM-TOF-MS:* A quadrupole / ion mobility / time-of-flight mass spectrometer equipped with multiple sample inlets (conventional ESI; pump-driven and static-mode nanoflow ESI), multiple ion mobility separators (commercially available TWIMS; DTIMS courtesy Waters R&D), and multiple tandem mass spectrometry methods (beam-type CID; surface-induced dissociation [SID]; ETD; ECD *via* modules from e-MSIon). It is also equipped with a Waters Acquity UPLC and autosampler. This instrument is especially useful for rapid gas-phase separation of isomers / conformers by ion mobility and the analysis of peptides with labile post-translational modifications (*e.g.*, phosphorylation, glycosylation, etc.). *A Waters Xevo G2-XS Q-TOF-MS for Proteomics:*A quadrupole / time-of-flight mass spectrometer configured for proteomics workflows based on LC-MS and LC-MS/MS through coupling to a Waters Acquity UPLC system and autosampler via ESI, or MALDI-MS and MALDI MS/MS through coupling to a MassTech AP-MALDI HR atmospheric pressure MALDI source. *A Waters Xevo G2-XS Q-TOF-MS for Metabolomics:*A quadrupole / time-of-flight mass spectrometer configured for metabolomics workflows based on GC-MS and GC-MS/MS through coupling to an Agilent 7890 GC with autosampler via an atmospheric pressure interface / ionization source, or LC-MS and LC-MS/MS through coupling to a Waters Acquity UPLC system with autosampler via ESI. *AB Sciex Voyager DE Pro TOF-MS* *with ionization by MALDI:* This instrument is well-suited to the analysis of large non-volatile compounds (*e.g.*, intact proteins and synthetic polymers). *MicroMass GCT TOF-MS with ionization by electron impact (EI) and chemical ionization (CI):* This instrument is especially useful for analysis of small volatile compounds (*e.g.*, certain metabolites and environmental contaminants). *Thermo Finnigan LCQ IT-MS with ionization by ESI:* This ion trap instrument is primarily useful for rapid low-resolution molecular weight determination and structural analysis using MS*n*. *Thermo Scientific ISQ* *GC-Q-MS:* Quadrupole mass spectrometer coupled to a Thermo Trace GC for low-resolution GC-MS analyses with ionization by EI and CI.

Data handling and data processing resources within the NCMS include: *Proteomics Data Handling:*Byonic (ProteinMetrics),Mascot Server (Matrix Science), ProGenesis QI-P (Nonlinear Dynamics),ProteinLynx Global Server (Waters), andProteinScape (Bruker). *Metabolomics Data Handling:*MetaboScape (Bruker) and ProGenesis QI (Nonlinear Dynamics). *Mass Spectrometry Imaging Data Handling:*FlexImaging (Bruker) and Scils Pro (Bruker). *Other Applications:*BioPharmaLynx (Waters), DriftScope (Waters), TargetLynx (Waters), SimIon (Scientific Instrument Services), and SmartFormula XR (Bruker).

For more information, contact Eric Dodds (edodds2@unl.edu, 402-472-3592).

## Nebraska Innovation Studio

Nebraska Innovation Studio (NIS) – the University of Nebraska-Lincoln (UNL) makerspace – is a community-oriented makerspace that serves as a hub for innovators, artists, and entrepreneurs. As the creative and collaborative hub of Nebraska Innovation Campus, NIS makers and builders team up to conceptualize, prototype, and iterate projects that solve problems and influence change. NIS membership is open to all UNL staff, faculty, and students as well as the surrounding Nebraska community. NIS is a do-it-yourself membership-based workshop that offers access to tools in a variety of areas. Within the area of *Computer Numerical Control (CNC) and rapid prototyping*, major equipment includes: an Epilog 50 watt 30 x 20 Fusion laser cutter, an Epilog 60 watt 24 x 12 laser cutter, an Epilog 60 watt 40 x 28 laser cutter, Epilog 60 watt 30 x 20 laser; six Ultimaker 2+ & three extended 3D printers, two Formlab resin 3D printers, a Markforged carbon fiber onyx and fiberglass 3D printer, an Artec Eva 3D scanner, a NextEngine 3D scanner, a ShopBot Alpha CNC router, a Carvey Desktop CNC router, a Graphtec 24” vinyl cutter, and a Lincoln Electric virtual reality welding trainer.

Major equipment in the NIS *woodshop* includes: sanders (a Jet 10” disc sander; a Jet 6” belt sander; a Jet oscillating spindle sander; a Woodmaster 38” drum sander; and FesTool orbital, eccentric, delta, profile, and rotary sanders); saws (a Festool 10” compound miter saw, a Bosch 12” compound miter saw, a Festool track saw, two Laguna 18” band saws, a SawStop table saw, a panel saw, and a scroll saw); a table router; a Powermatic 36” wood lathe; six Turncrafter mini lathes, two Jet mini lathes, a Nova DVR 18” smart drill press; a Felder 19” planer; a Powermatic 16” jointer; two Festool Domino jointers; a Festool manual router, two Makita manual routers; a Powermatic Mortizer, a Hoffman Dovetail Joining System; a Kreg Foreman pocket drilling system; and two Downdraft sanding tables. *Metal Shop* equipment includes: an Ellis horizontal band saw, and Ellis belt sander, a Baileigh vertical band saw, a Baileigh pipe bender, a National 48” metal shear, a National 72” finger brake, a Scotchman cold saw, a Scotchman iron worker, two multimatic MIG/TIG/stick welders, an Allsource abrasive cabinet, two Bridgeport 1-2J knee mills, two Clausing 2500 gear head lathes, a Dayton 36” 16 gauge slip roller, a weld fixture table, a Clausing drill press, a dust-free grinding room and grinding tools, a downdraft griding table, a Fablight 50x25 fiber laser for metal sheet and tube, and a Lonestar waterjet and CNC plasma cutter.

*Textiles* equipment includes: a Juki MO-6700 Serger, a Juki DDL-5550N straight stitch sewing machine, an APQS 14’ Longarm Quilter, two Bernina regular sewing machines, a Silver Reed LK150 knitting machine, a Baby Lock six-needle embroidery machine, four weaving looms, and an Elnapress heat press. *Electronics* equipment includes: soldering irons, a dual channel function/arbitrary waveform generator, oscilloscopes, a reflow oven, and a hot air rework station. *Ceramics* equipment includes: a 22” x 22” Skutt electric kiln (fires at cone 6), a 10” wide x 12” Skutt electric kiln (fires at cone 6), five VL Whisper & Brent C electric throwing wheels, a 30” slab roller, and a Bailey Pug Mill. *Printmaking* equipment includes: screenprinting screens (for rent); a variety of water-based ink colors (for purchase); two dri-cabs; a 12-bulb vacuum exposure unit; a four-station color press; and an Epson 17” printer. *Computers and software* equipment includes twelve computer stations with access to design software such as Adobe Illustrator Suite, Solidworks Educational, Fusion 360, AutoCad, Rhino, VCarve, and Inventor.

For more information, contact Jerry Reif (jreif@unl.edu, 402-472-5114).

## Nebraska Water Sciences Laboratory

*Parent Facility/Center: Nebraska Water Center*

The Nebraska Water Center (NWC) is one of more than 50 Water Resources Research Institutes nationwide and focuses on helping the University of Nebraska solve state water quality and quantity issues. The NWC coordinates faculty research; trains future water researchers; and promotes water research results through publications, research colloquiums and conferences, lectures, and tours. The Water Sciences Laboratory provides advanced methods, technical expertise, and sophisticated analytical instrumentation for environmental and water resources research. Specialized methods and instrumentation are available for measuring traces of organic and inorganic contaminants and a variety of stable isotopes.

Major instrumentation includes: Waters Xevo TQS ultrahigh pressure liquid chromatography-triple quadrupole mass spectrometer (UPLC-MS/MS) with Uni-Spray ionization source and 2D sample introduction system; Waters Quattro Micro liquid chromatography-triple quadrupole mass spectrometer (LC-MS/MS) system with electrospray (ESI), atmospheric pressure chemical ionization (APCI), and atmospheric pressure photoionization (APPI) interfaces; Agilent 5972 gas chromatography-mass spectrometry (GC/MS) with an electron ionization (EI) source; Agilent 5973 GC/MS with EI and chemical ionization sources, a Combi-PAL automated extraction system, and OI Analytical Eclipse Purge and Trap Concentrator for volatiles; a Thermo ICAP-RQ inductively coupled plasma mass spectrometer (ICP-MS) with IC5+ ion chromatography speciation inlet; Agilent 720 inductively coupled plasmas optical emission spectrophotometer (ICP-OES); a Thermo Helix SFT noble gas mass spectrometer with an ultra-low temperature gas extraction purification system and Hiden quadrupole residual gas analyzer; an Isoprime dual inlet isotope ratio mass spectrometer (IRMS) with a Multiprep and Tracegas cryogenic preconcentrator; Isoprime continuous flow IRMS with liquid and solids elemental analyzers; GV2003 continuous flow IRMS with CO2 Multiprep and Carlo Erba NA1500 elemental analyzer for solids; Dionex ICS 5000 ion chromatography system; Perkin-Elmer AAnalyst 400 and Lambda ultraviolet spectrophotometers; a CEM MARS XPress microwave digester/extraction system; Seal AQ2 and Lachat 8500 autoanalyzers; an OI Analytical Model 1010 organic carbon analyzer; and a Trace Analytical reduced gas analyzer (hydrogen GC).

For more information, contact Dan Snow (dsnow1@unl.edu or watersciences@unl.edu, 402-472-7539).

## NIMBUS Outdoor Netted Facility

The NIMBUS Outdoor Netted Facility (or Quidditch Pitch) is a 50 ft x 100 ft x 45 ft netted facility devoted to the outdoor testing and experimentation of robotics, with a focus on aerial robotic vehicles. NIMBUS provides time in half-day and full-day increments to groups associated with any campus in the University of Nebraska system. NIMBUS prioritizes research experiments but remote flight training is also supported.

Resources and services available include: a 50 ft x 100 ft x 45 ft outdoor netted facility, where multicopters can easily be flown and remain safely confined to the caged area; a locked gate restricting access; a heated/cooled building with observation rooms; power available onsite; and Wi-Fi, including eduroam.

For more information, contact Justin Bradley (justin.bradley@unl.edu, 402-472-5072).

## Physical Properties Instrumentation Facility

*Parent Facility/Center: Nebraska Center for Materials and Nanoscience*

The Physical Properties Instrumentation Facility provides the means for obtaining liquid nitrogen (LN2) for low-temperature research, cold traps, and other forms of research. Available resources through the facility include: (1) A 230-L supply of LN2 is maintained at this facility. Researchers can transfer LN2 to their own dewars (typically 1-30 L) as needed. (2) A DynaCool Physical Property Measurement System from Quantum Design. The DynaCool comes equipped with a 9 T conduction-cooled superconducting magnet system. The DynaCool offers an array of measurement options: A VSM for magnetometry measurements, an electrical transport option (ETO), and a Horizontal Rotator Option that allows for the ETO measurements on samples rotating a full 360° in the presence of a 9 T applied magnetic field.  The temperature range of the DynaCool is 1.8 K to 400 K for most measurements such as the VSM option. The DynaCool also comes with a Helium 3 option that allows for sub-Kelvin measurements for the ETO option down to 0.4 K but with a maximum temperature of 350 K. (3) The MPMS-XL superconducting quantum interference device (SQUID) magnetometer from Quantum Design offers advanced performance in all areas of magnetometry.  The SQUID magnetometer monitors very small changes in magnetic flux and the magnetic properties of samples. The system offers a user-friendly automated software, dynamic range in temperature, and sensitivity of 1×10-8 emu. Data can be collected as magnetic moment vs. temperature measurement (ZFC-FC, susceptibility) or moment vs. magnetic field (hysteresis loops). (4) The 4.5 T magnetic annealing system combines high temperature annealing with a high magnetic field to potentially modify the magnetic properties of thin film and alloys. The system makes use of exchange interactions at high temperature to form new magnetic phases and/or control crystal growth.

For more information, contact Steve Michalski (smichalski@unl.edu, 402-472-7096).

## Plant Phenotyping Facilities

The University of Nebraska-Lincoln (UNL) Institute of Agriculture and Natural Resources offers cutting-edge instrumentation and supporting infrastructure for plant phenotyping in the plant sciences. These technologies offer the opportunity to integrate proximal remote sensing and imaging measurements of intricate morphological and functional characteristics of plants. This integration is of paramount importance in the quest to link phenomics to genomic expression, optimize yields, achieve crop efficiencies (e.g., water, nutrient, and photosynthetic), understand resistance to biotic and abiotic stresses, and develop biomass for bioenergy and other valuable traits in plants.

Located at the Nebraska Innovation Campus Greenhouse, the *Lemnatec 3D High-throughput Scanalyzer* is an automated, high-throughput plant phenotyping platform system that includes greenhouse bays and an automated conveyor belt with a 672-plant capacity. The system is fully automated and environmentally controlled with automated watering and weighing stations and four chambers equipped with cameras capable of collecting images in the visible, infrared, fluorescent, and hyperspectral range of each plant up to maturity or 2.5 m height.

The *Spidercam Field Phenotyping Facility* is a one-acre field phenotyping site at the Agricultural Research and Development Center. The facility features an automated cable suspended carrier system that holds multiple cameras and sensors for positioning over plots, an advanced automated weather station, and a state-of-the-art subsurface drip irrigation system for water and nutrient delivery and manipulations at the plot level (15 x 20 square feet).

Within the Beadle Center on UNL’s city campus, the *Lemnatec HTS Scanalyzer* specializes in small plants and other organisms and is equipped with four types of sensing and imaging cameras (visible, infra-red, near infra-red, and fluorescent). Various parameters can be derived from the images that can be used to create digital phenotypes and link them to plant morphological and biophysical traits (e.g., leaf area, chlorophyll content, stem diameter, etc.).

For more information, contact Yufeng Ge (yge2@unl.edu).

## Plant Transformation Core Research Facility

*Parent Facility/Center: Nebraska Center for Biotechnology*

The Plant Transformation Core Research Facility provides services for vector constructions, plant transformations, and characterizations of the derived transformants. The facility has the capacity to conduct transformations for major commodity crops, including maize, soybeans, sorghum, and wheat, and can provide full service transformations for tobacco (*Nicotiana tabacum* and *Nicotiana benthamiana*) and tomato (*Solanum lycopersicum*) upon request. All transformations are conducted using *Agrobacterium*-mediated protocols. Transformations with commodities are carried out on a project agreement basis, and custom quotes are provided for each project.

Available equipment includes: Nine laminar flow hoods for tissue culture; a -20° C freezer; a -80° C freezer; a 4° C deli cooler; a 4° C walk-in cooler; seven shakers/incubators for culture of microbes; a freeze dryer; a PDS 1000 gene gun for delivery of reagents into cells; a hybridization oven; a baking oven; a gas chromatograph for lipid analysis; a H2/CO2 generator; a wheat harvester; a plant harvester; Perten NIR for monitoring seed reserves; a LiCor 6400 for physiological measurements in plants; droplet PCR for monitoring gene expression; four PCR rigs; centrifuges (floor/bench top); a bead-based tissue grinder; a BioRad Imager; an ELISA plate reader; a nano drop rig; a seed counter; and a sorghum stalk juice extractor.

For more information, contact Tom Clemente (tclemente1@unl.edu, 402-472-1428).

## Proteomics and Metabolomics Core Facility (Redox)

*Parent Facility/Center: Redox Biology Center*

The Proteomics and Metabolomics Core Facility supports faculty, scientists, clinicians, and students within the RBC, UNL, UNMC, and other universities and industries. The Facility is equipped with chromatography and mass spectrometry-based state-of-the-art technologies for proteomics and metabolomics (clinical and non-clinical) and offers personalized experimental design consultation and comprehensive, individualized bioinformatics support. General services include: small-molecule exact mass determination or quantitation using positive or negative ion modes, including MS/MS structural analysis; protein identification using liquid chromatography-tandem mass spectrometry (LC/MS/MS) analysis and MASCOT and SEQUEST database search; protein complex isolation and identification of interacting partners and its quantitation; post-translational modification analysis and quantitation; Coomassie blue and silver stained protein gel analysis; confirmation of site mutations in protein; post-translational modifications (phosphorylation, sumoylation, ubiquitination, oxidation, etc.); determination of oxidation state of cysteine (disulfide bonds, sulfenic, sulfinic, sulfonic states, etc.); mass determination of intact proteins and other macromolecules; and targeted metabolite quantification and profiling by means of LC-MRM-MS analysis. This includes isotope incorporation analysis.

Instruments and technology include: a SCIEX QTRAP 4000 mass spectrometer integrated with an Agilent 1200 series LC system and a Dionex U3000 nano LC system; a ThermoFisher LTQ Velos Pro ion trap mass spectrometer system with electron transfer dissociation; and Protein bioinformatics software (e.g., Bioworks, Metaboanalyst, SEQUEST, Scaffold, Mascot).

For more information, contact Javier Seravalli (jseravalli1@unl.edu, 402-570-3532).

## Proteomics and Metabolomics Facility (Biotechnology)

*Parent Facility/Center: Nebraska Center for Biotechnology*

The Proteomics and Metabolomics Facility offers a range of technical services using mass spectrometry for identification and relative quantification of proteins and several advanced methods for profiling and quantitation of small molecules. With highly specialized technology capabilities and proficient personnel with joint expertise spanning >30 years in the fields of mass spectrometry, protein chemistry, and metabolite analysis, the facility serves as a regional, national, and international resource and fosters collaboration in the quickly developing fields of proteomics and metabolomics.

Proteomics services include: basic protein identification from gel bands, protein identification from solution or bead samples, complex quantitative proteomic analyses using labeling (TMT up to 16-plex) or label-free approaches, identification and quantification of post‐translational modifications, phosphopeptide enrichment followed by identification, localization, and quantification of phosphorylation sites, and targeted quantification of peptides using data independent acquisition. Proteomics instrumentation includes: one ThermoFisher Scientific Orbitrap Eclipse Tribrid High Resolution – Mass Accuracy mass spectrometer coupled to Dionex U3000 RSLCnano LC system; a Mascot 2.7.1 search engine (Matrix Science Ltd.) for protein identification against sequence databases using tandem mass spectrometry (MS/MS) spectra (A); one Proteome Discoverer 2.5 (Thermo) study workflow tool for set up of complex processing pipelines with large datasets for metabolic, isotope labeling, and label-free quantitative proteomics and phosphoproteomics; Scaffold 4.8.9 (Proteome Software Inc.) for protein identification, reporting, and label-free quantitative proteomics; PEAKS 7.5 (Bioinformatics Solutions Inc.) for de novo sequencing and post-translational modification (PTM) characterization; Skyline 4.1 (University of Washington) for targeted proteomic workflows; and Progenesis QI-P 4.1 (Non-Linear Dynamics) for basic proteomic label-free quantification.

In the area of metabolomics, services include: free amino acid analysis; hydrolyzed amino acid analysis; free sugars assay; stress and growth plant hormone assay; flavonoids, carotenoids, THC/THCA; TCA/glycolysis assay; polyamines, pyrimidines pathway intermediates pathway; non-mevalonate pathway intermediates assay; targeted quantification of small molecules using either high-performance liquid chromatography (HPLC) separation, gas chromatography-mass spectrometry (GC-MS), or multiple-reaction monitoring (MRM)-based assay; and untargeted metabolomics using liquid chromatography-MS/MS (LC-MS/MS) and/or GC-MS. Instrumentation includes: a ThermoFisher Scientific Q ExactiveTM High Field (QE-HF) mass spectrometer coupled to a Thermo Vanquish H ultra-high performance liquid chromatography (UHPLC) system; a Sciex QTRAP 6500+ mass spectrometer with SelexION+ ion mobility coupled to a Shimadzu Nexera II UHPLC; a Progenesis QI (Nonlinear Dynamics) for qualitative and quantitative comparison of small molecules and identification using various databases; a Compound Discoverer 3.1 including mzCloud and Mass Frontier 8.0 for identification of small molecules and quantitative study; an Agilent 1290 Infinity II UPLC equipped with three detectors that can be used online – a diode array detector, a fluorescence detector, and an evaporative light scattering detector – and a fraction collector; and an Agilent GC-MS 5977A equipped with an autosampler for liquid injection, a headspace sampler, and solid phase microextraction for enrichment of volatile compounds.

For more information, contact Sophie Alvarez (salvarez@unl.edu, 402-472-4575).

## Quantitative Life Sciences Initiative

The Quantitative Life Sciences Initiative (QLSI) is a University of Nebraska-Lincoln (UNL)-wide faculty-driven program to enable and develop resources for Big Data and data science, with a special emphasis on the life sciences. Supported with funding from multiple federal funding agencies and a UNL Chancellor’s Program of Excellence award, the objective of the QLSI is to establish a cross-campus nexus focused on data science in the life sciences that will conduct research, training, and consulting with cross-sector partners and provide information to the local community about relevant activities in Big Data and data science. The QLSI serves as the primary UNL representative to the Midwest Big Data Hub, the National Agricultural Producers Data Cooperative, and national and international networks in plant phenotyping, including the International Plant Phenotyping Network and the North American Plant Phenotyping Network. The initiative also provides leadership for the Ph.D. program in Complex Biosystems.

For more information, contact Jennifer Clarke (jclarke3@unl.edu, 402-472-2512).

## Research Instrumentation Facility

*Parent Facility/Center: Molecular Analysis and Characterization Facility*

Located within the University of Nebraska-Lincoln Department of Chemistry, the Research Instrumentation Facility (RIF) ispart of the Molecular Analysis and Characterization Facility (MAC) and is equipped with instrumentation that can run a range of analytical techniques, including NMR spectroscopy. Its primary mission is to support research within the Department of Chemistry and the wider University of Nebraska system, but it is additionally available to support the analytical chemistry needs of other academic institutions, research laboratories, businesses, and individuals and can run samples and compile data or reports as necessary.

*NMR spectroscopy equipment includes:* 1) A Bruker Avance III-HD 700 MHz NMR Spectrometer with SampleJet sample changer and QCI-P cryoprobe. This NMR spectrometer is the highest magnetic field in the state of Nebraska. 1H, 13C, 15N, 31P and 2H NMR spectra can be observed. The 700 MHz is configured for small molecules, natural products, and labeled biomolecules such as proteins, enzymes, RNA, DNA, and carbohydrates. The 700 MHz NMR spectrometer has a SampleJet sample changer that will allow high throughput screening of 510 samples. 2) A Bruker NEO 600 MHz NMR Spectrometer with solid state and solution state probes, including a TCI-F cryoprobe. 1H, 13C, 15N, 19F and 2H NMR spectra on the cryoprobe can be observed. The solids probe allows a wide tuning range for observing heteroatoms. The 600 MHz is configured for small molecules, natural products, polymers, perovskites, and labeled biomolecules such as proteins, enzymes, RNA, DNA, and carbohydrates. The 600 MHz NMR spectrometer has a SampleCase sample changer that allows high throughput screening of 24 samples. The SampleCase sample is used for solution state NMR only but allows access to researchers with physical disabilities. 3) A Bruker Avance III-HD 400 MHz NMR Spectrometer with BB(F)O probe. The 400 MHz NMR spectrometer is walk-up access and is capable of running a wide range of NMR active nuclei. 4) A Bruker Avance III-HD 300 MHz NMR Spectrometer with SampleExpress sample changer and BB(F)O probe. The 300 MHz NMR spectrometer has a SampleExpress sample changer, which holds 60 samples. The 300 MHz NMR spectrometer is capable of running a wide range of NMR active nuclei.

*Optical spectroscopy equipment includes:* a Shimadzu UV-2401 ultraviolet-visible (UV-VIS) spectrometer with a range of 190-700 nm and several sampling formats, which can be temperature controlled; a Shimadzu UV-2501 ultraviolet-visible (UV-VIS) spectrometer capable of specular measurement that has a range of 190-700 nm and has two sampling formats; a Jasco 815 circular dichroism spectrometer, which has a range of 190-700 nm, can be temperature controlled, and is used to look at the folding structure of biomolecules; a Shimadzu RF-5301PC fluorimeter, which has a range of 190-700 nm, two sampling formats, and is mainly used to measure fluorescence for materials science projects; a Rudolph Autopol III polarimeter that measures the rotation of light in the presence of chiral molecules at 589 nm; a Nicolet AVATAR 380 FT-IR with multiple attachments to observe the infrared spectrum from 4000-600 cm -1 and an Attenuated Reflectance attachment with a diamond crystal (ATR-IR, gas phase FT-IR, and older IR methods are available on this spectrophotometer); a Thermo iS-50 for NIR, FT-IR, Raman, and TGA-IR with multiple attachments to observe mid-range infrared spectrum from 4000-400 cm -1 and an Attenuated Reflectance attachment with a diamond crystal (ATR-IR, gas phase FT-IR, and older IR methods are available on this spectrophotometer; Near Infrared (NIR) is also available); a Leica optical microscope; and an Invitrogen iBright FL1500 Imaging System used for imaging gels and Western Blots.

*Thermal analysis equipment includes:* a TA Instruments Discovery 550 TGA with evolved gas furnace (part of the Thermo iS-50); and a Micromeritics ASAP 2020 BET to measure surface area and porosimetry. *Chromatography and other instruments include:* a Carl Zeiss SEM-EDX scanning electron microscope with an X-ray detection system; an Agilent 1100 HPLC with continuous wave detector and sample changer; an Agilent 1260 HPLC with Diode Array and Refractive Index Detectors and sample changer used for size exclusion chromatography, as well as samples with multiple components; an Agilent 7820 GC-FID with a flame ionization detector and sample changer; and a Gilson 215 Liquid Handlerfor automated sample preparation station. *Software includes:* Chenomyx for screening and assigning metabolites; AssureNMR for aiding in metabolite assignment; and Protein Dynamics for measuring protein folding properties and assignment.

For more information, contact Martha Morton (mmorton4@unl.edu, 402-472-6255).

## Spectroscopy and Biophysics Core

*Parent Facility/Center: Redox Biology Center*

The Spectroscopy and Biophysics Core Facility provides instrumentation, training, and support for any type of experimental work involving biophysical and spectroscopic measurements. While most of the facility’s instruments are configured for use in protein and other macromolecule characterization work, the facility’s services can be extended to partially purified proteins, whole cells with and without media assays, tissues, and small molecules. Current instrumentation includes: an Agilent 7500 cx inductively coupled plasma mass spectrometer (ICP-MS) with a 96-well autosampler handling as little as 100 uL of diluted sample per injection, and a total of 20 elements (not including C, H, N, O, F, and Si) can be quantitated in a single injection; an Agilent LC1200 high-performance liquid chromatograph with diode array detector, also used in conjunction with a QqQ Hybrid mass spectrometer; a Hi-Tech (Tgk Scientific) stopped-flow rapid kinetics instrument with absorbance, fluorescence, and chemical quench that is also capable of diode-array detection for absorbance and double-mixing for the generation of reaction intermediates; a Microcal (Malvern) differential scanning calorimeter (DSC) for thermal denaturation studies (range from 10-130 oC) with each compartment having a volume of 0.7 mL (the protein concentration must be below 1 mg/ML); a Microcal (Malvern) isothermal titration calorimeter (ITC) for the study of macromolecule-ligand or macromolecule-macromolecule binding processes (the cell compartment requires 1.50 mL of target solution at >10 uM concentration and 0.5 mL of ligand or binding partner solution at >200 uM to ensure saturation); a Varian-Agilent Cary Eclipse spectrofluorimeter with multiple adaptors for cell holders, thermostating, and 96-well plates (wavelength range from 190 to 1100 nm) for high throughput assays at room temperature; a Beckman XL analytical ultracentrifuge (sedimentation velocity and sedimentation equilibrium can be determined on this instrument without prior knowledge of the system properties, monitored by either absorbance or light interference modes); and a Jasco J-815 circular dichroism equipped with fluorescence and fluorescence polarization accessories as well as stopped-flow for the kinetic study of unfolding processes.

Core services include: determination of protein stability and thermodynamic parameters for protein conformational changes by DSC; ligand-protein and protein-protein binding studies by means of isothermal mirocalorimetryor fluorescence anisotropy; stopped-flow spectrophotometry and chemical quench (dead time of 25 ms); fluorescence, phosphorescence, and chemiluminescence experiments in spectral and kinetic modes; elemental analysis by ICP-MS; ligand binding and protein-protein kinetics using SPR technology; and analytical ultracentrifugation to determine protein size and protein aggregation, intact mass analysis of proteins by LC-MS, bottom-up proteomics analysis of purified and semi-purified proteins, targeted metabolite analysis using QqQ mass spectrometry, and metabolite profiling using QqQ mass spectrometry with statistical analysis.

For more information, contact Javier Seravalli (jseravalli1@unl.edu, 402-472-3124).

## Surface and Materials Characterization Facility

*Parent Facility/Center: Nebraska Center for Materials and Nanoscience*

The Surface and Materials Characterization Facility (SMCF) provides state-of-the-art instruments for nanometer-scale surface measurement, thermal analysis, and mechanical characterization of a variety of materials. The SMCF provides services in four areas (bays): scanning probe microscopy, thermal and optical analysis, X-ray photoelectron spectroscopy, and mechanical characterization and sample preparation. The *scanning probe microscopy (SPM) bay* currently contains four scanning probe microscopies: 1) An Attocube SPM with attoDRY2100 cryostat and 9T superconducting magnet, 2) A Bruker Dimension Icon® Atomic Force Microscopy, 3) A Digital Instruments Dimension 3100 Scanning Probe Microscopy, and 4) A DI EnviroScope Atomic Force Microscopy (ESCOPE). The SPM offers a large variety of applications, including Atomic Force Microscopy (AFM), Magnetic Force Microscopy (MFM), Electrostatic Force Microscopy (EFM), Surface Potential (PeakForce KPFM), Conductive AFM, PeakForce Tunneling (PFTUNA), Piezoresponse Microscopy (PFM), and Quantitative Nanomechanical Property Mapping (PF-QNM). The SPM system is capable of many imaging modes in air, fluid, vacuum, or a purged gas, as well as a heating/cooling environment. The unique capabilities of the new multifunctional Attocube SPM with a wide temperature range (4-300 K) and magnetic field range (0-9 T) are useful for nanoscale science and engineering research.

The *thermal and optical analysis* *bay* contains two thermal analysis systems: a differential scanning calorimeter (DSC 204 F1 Phoenix) and a thermogravimetry analysis system (TGA 209 F1 Libra), which allow users to study and measure various thermal properties of materials such as glass-transition, melting, and crystallization temperatures. The Olympus BX51 polarizing optical microscope includes differential interference contrast capabilities for sample viewing and image analysis. In addition, the thermal behavior of a sample can be observed under the microscope using a Mettler Toledo FP900 thermal system equipped with a FP 82 hot stage with a temperature range from room temperature up to 375 °C.

*The Thermo Scientific K-alpha+ X-ray photoelectron spectroscopy (XPS)*system is useful for analyzing the surface chemistry of materials. This instrument also has an option for ultraviolet photoelectron spectroscopy (UPS), which can be used to investigate the valence-band electronic structure of a material. The system software allows complete instrument control, data acquisition, and data processing for samples in solid forms such as thin films, powders, pellets, fibers, etc. The *mechanical characterization and sample preparation* *bay* houses: a Tukon 2500 Knoop/Vickers Hardness tester, a Buehler ISOMet 1000 precision saw, a Buehler MiniMet 1000 grinder-polisher, and a Sartorius Cubis MSU2.7S-000-DM microbalance with readability of 0.0001 mg.

For more information, contact Lanping Yue (lyue2@unl.edu, 402-472-2742).

## Systems Biology Core Facility

*Parent Facility/Center: Nebraska Center for Integrated Biomolecular Communication*

The Systems Biology Core (SBC) Facility incorporates existing systems biology instrumentation, methodologies, and expertise at the University of Nebraska-Lincoln – including the Morrison Microscopy Core Research Facility and the Molecular Analysis and Characterization Facility, which is the recent merge of the Nebraska Center for Mass Spectrometry and the Research Instrumentation Facility – under a single organizational structure. SBC facility personnel have expertise in nuclear magnetic resonance (NMR) spectroscopy and mass spectrometry (MS)-based metabolomics, MS proteomics (e.g.*,* qualitative protein identification, protein quantitation, posttranslational modifications), microscopy (confocal, digital fluorescence, transmission electron microscopy [TEM], scanning electron microscopy [SEM], etc.), and biostatistics and bioinformatics.

Within the SBC facility, the *Morrison Microscopy Core Research Facility* includes: *Confocal microscopes:* a Nikon A1R-Ti2 (inverted) confocal live-cell imaging system (temp/CO2 chamber) with a hybrid resonant dual scanner, automated stage, integrated six solid-state lasers (405/ 445/488/514/561/640 nm), and spectral scanning system; and a Nikon A1-NiE (upright) confocal imaging system with automated stage and integrated six solid-state lasers (405/ 445/488/514/561/640 nm). *Electron microscopes:* a Hitachi H7500 transmission electron microscope (TEM) with an upgraded high-resolution digital camera for ultrastructural analysis, assay of nano-particles/fibers, and examination of negative stained microbial samples up to 200,000x; and a Hitachi S4700 field-emission scanning electron microscope (SEM) for topographic analysis from 25x to 500,000x magnification at nanoscale levels. *Epifluorescence/light imaging systems:* an EVOS® FL Auto cell-imaging system with an automated microscopic stage, dual cameras, selectable excitation/emission filters from five fluorescent LED light cubes, and 2x to 100x objective lenses; a Nikon Ti2 inverted epifluorescence microscope with a monochrome and color camera, six fluorescent cube positions, and 4x to 60x objective lenses; an Olympus AX70 upright epifluorescence microscope with a digital camera and different filter sets; and a Nikon SMZ25 stereo fluorescence microscope with a DS-Ri2 camera with dissecting illumination and epifluorescence illumination, three LED light cubes (GFP [488], DS Red [560], and Long Pass [GFP and DS Red]), and two lenses (.5X with Optical Zoom from .32 to 7.88 and 1X with Optical Zoom from .63 to 15.75), which allow users to screen fluorescent samples or capture images for phenotypic selections. *Other instrumentation and services:* a Leica cryostat for frozen sectioning; a Leica rotary microtome for paraffin sectioning; sputter coaters for SEM sample preparation (sample preparation service from fixation to sputter coating for SEM); a Tousimis SAMDRI-795 critical point dryer for SEM sample preparation; a Leica UC7 ultra-microtome for semi-thin and ultrathin sectioning for TEM (sample preparation services from fixation, dehydration, embedding, and ultrathin sectioning, and staining [including negative staining] for TEM); and training and setup for H&E staining and immunochemical staining for light microscopy and immunoelectron microscopy.

Equipment within the *Nebraska Center for Mass Spectrometry (NCMS)* includes: *a Bruker Solarix XR 15 T Q-FTICR-MS:* A quadrupole / Fourier transform ion cyclotron resonance mass spectrometer equipped with a 15 T superconducting magnet, multiple ionization methods (conventional electrospray ionization [ESI]; pump-driven and static-mode nanoflow ESI; matrix-assisted laser desorption/ionization [MALDI]), and multiple tandem mass spectrometry methods (beam-type and trapping-type collision-induced dissociation [CID]; electron transfer dissociation [ETD] and negative electron transfer dissociation [nETD]; electron capture dissociation [ECD] and electron detachment dissociation [EDD]; infrared multiphoton dissociation [IRMPD]). The instrument is also fitted with an Advion TriVersa NanoMate for automated, zero-carryover sample introduction. This instrument is particularly well-suited for untargeted metabolomic analysis; intact protein characterization; and imaging of target compound distributions in tissues and other materials. *A Waters Synapt G2-S HDMS Q-IM-TOF-MS:* A quadrupole / ion mobility / time-of-flight mass spectrometer equipped with multiple sample inlets (conventional ESI; pump-driven and static-mode nanoflow ESI), multiple ion mobility separators (commercially available TWIMS; DTIMS courtesy Waters R&D), and multiple tandem mass spectrometry methods (beam-type CID; surface-induced dissociation [SID]; ETD; ECD *via* modules from e-MSIon). It is also equipped with a Waters Acquity UPLC and autosampler. This instrument is especially useful for rapid gas-phase separation of isomers / conformers by ion mobility and the analysis of peptides with labile post-translational modifications (*e.g.*, phosphorylation, glycosylation, etc.). *A Waters Xevo G2-XS Q-TOF-MS for Proteomics:*A quadrupole / time-of-flight mass spectrometer configured for proteomics workflows based on LC-MS and LC-MS/MS through coupling to a Waters Acquity UPLC system and autosampler via ESI, or MALDI-MS and MALDI MS/MS through coupling to a MassTech AP-MALDI HR atmospheric pressure MALDI source. *A Waters Xevo G2-XS Q-TOF-MS for Metabolomics:*A quadrupole / time-of-flight mass spectrometer configured for metabolomics workflows based on GC-MS and GC-MS/MS through coupling to an Agilent 7890 GC with autosampler via an atmospheric pressure interface / ionization source, or LC-MS and LC-MS/MS through coupling to a Waters Acquity UPLC system with autosampler via ESI. *AB Sciex Voyager DE Pro TOF-MS* *with ionization by MALDI:* This instrument is well-suited to the analysis of large non-volatile compounds (*e.g.*, intact proteins and synthetic polymers). *MicroMass GCT TOF-MS with ionization by electron impact (EI) and chemical ionization (CI):* This instrument is especially useful for analysis of small volatile compounds (*e.g.*, certain metabolites and environmental contaminants). *Thermo Finnigan LCQ IT-MS with ionization by ESI:* This ion trap instrument is primarily useful for rapid low-resolution molecular weight determination and structural analysis using MS*n*. *Thermo Scientific ISQ* *GC-Q-MS:* Quadrupole mass spectrometer coupled to a Thermo Trace GC for low-resolution GC-MS analyses with ionization by EI and CI.

Data handling and data processing resources within the NCMS include: *Proteomics Data Handling:*Byonic (ProteinMetrics),Mascot Server (Matrix Science), ProGenesis QI-P (Nonlinear Dynamics),ProteinLynx Global Server (Waters), andProteinScape (Bruker). *Metabolomics Data Handling:*MetaboScape (Bruker) and ProGenesis QI (Nonlinear Dynamics). *Mass Spectrometry Imaging Data Handling:*FlexImaging (Bruker) and Scils Pro (Bruker). *Other Applications:*BioPharmaLynx (Waters), DriftScope (Waters), TargetLynx (Waters), SimIon (Scientific Instrument Services), and SmartFormula XR (Bruker).

Equipment within the *Research Instrumentation Facility* includes: *NMR spectroscopy:* 1) A Bruker Avance III-HD 700 MHz NMR Spectrometer with SampleJet sample changer and QCI-P cryoprobe. This NMR spectrometer is the highest magnetic field in the state of Nebraska. 1H, 13C, 15N, 31P and 2H NMR spectra can be observed. The 700 MHz is configured for small molecules, natural products, and labeled biomolecules such as proteins, enzymes, RNA, DNA, and carbohydrates. The 700 MHz NMR spectrometer has a SampleJet sample changer that will allow high throughput screening of 510 samples. 2) A Bruker NEO 600 MHz NMR Spectrometer with solid state and solution state probes, including a TCI-F cryoprobe. 1H, 13C, 15N, 19F and 2H NMR spectra on the cryoprobe can be observed. The solids probe allows a wide tuning range for observing heteroatoms. The 600 MHz is configured for small molecules, natural products, polymers, perovskites, and labeled biomolecules such as proteins, enzymes, RNA, DNA, and carbohydrates. The 600 MHz NMR spectrometer has a SampleCase sample changer that allows high throughput screening of 24 samples. The SampleCase sample is used for solution state NMR only but allows access to researchers with physical disabilities. 3) A Bruker Avance III-HD 400 MHz NMR Spectrometer with BB(F)O probe. The 400 MHz NMR spectrometer is walk-up access and is capable of running a wide range of NMR active nuclei. 4) A Bruker Avance III-HD 300 MHz NMR Spectrometer with SampleExpress sample changer and BB(F)O probe. The 300 MHz NMR spectrometer has a SampleExpress sample changer, which holds 60 samples. The 300 MHz NMR spectrometer is capable of running a wide range of NMR active nuclei.

*Optical spectroscopy:* a Shimadzu UV-2401 ultraviolet-visible (UV-VIS) spectrometer with a range of 190-700 nm and several sampling formats, which can be temperature controlled; a Shimadzu UV-2501 ultraviolet-visible (UV-VIS) spectrometer capable of specular measurement that has a range of 190-700 nm and has two sampling formats; a Jasco 815 circular dichroism spectrometer, which has a range of 190-700 nm, can be temperature controlled, and is used to look at the folding structure of biomolecules; a Shimadzu RF-5301PC fluorimeter, which has a range of 190-700 nm, two sampling formats, and is mainly used to measure fluorescence for materials science projects; a Rudolph Autopol III polarimeter that measures the rotation of light in the presence of chiral molecules at 589 nm; a Nicolet AVATAR 380 FT-IR with multiple attachments to observe the infrared spectrum from 4000-600 cm -1 and an Attenuated Reflectance attachment with a diamond crystal (ATR-IR, gas phase FT-IR, and older IR methods are available on this spectrophotometer); a Thermo iS-50 for NIR, FT-IR, Raman, and TGA-IR with multiple attachments to observe mid-range infrared spectrum from 4000-400 cm -1 and an Attenuated Reflectance attachment with a diamond crystal (ATR-IR, gas phase FT-IR, and older IR methods are available on this spectrophotometer; Near Infrared (NIR) is also available); a Leica optical microscope; and an Invitrogen iBright FL1500 Imaging System used for imaging gels and Western Blots.

*Thermal analysis:* a TA Instruments Discovery 550 TGA with evolved gas furnace (part of the Thermo iS-50); and a Micromeritics ASAP 2020 BET to measure surface area and porosimetry. *Chromatography and other instruments:* a Carl Zeiss SEM-EDX scanning electron microscope with an X-ray detection system; an Agilent 1100 HPLC with continuous wave detector and sample changer; an Agilent 1260 HPLC with Diode Array and Refractive Index Detectors and sample changer used for size exclusion chromatography, as well as samples with multiple components; an Agilent 7820 GC-FID with a flame ionization detector and sample changer; and a Gilson 215 Liquid Handlerfor automated sample preparation station. *Software:* Chenomyx for screening and assigning metabolites; AssureNMR for aiding in metabolite assignment; and Protein Dynamics for measuring protein folding properties and assignment.

For more information, contact Robert Powers (rpowers3@unl.edu, 402-472-3039).

## University of Nebraska-Lincoln Libraries Data Management Services

The University of Nebraska-Lincoln Libraries offers data management services for university faculty, staff, and students. This includes workshops and one-on-one consultations on data management and writing data management plans for grant proposals, as well as a data repository for preserving and sharing research data.

For more information, contact Leslie Delserone (datamanagement@unl.edu, 402-472-6297).

## University of Nebraska State Museum

As Nebraska’s largest natural history museum, the University of Nebraska State Museum promotes discovery of natural science and natural history through research, scientific collections, learner-centered education, and public exhibitions. Its vast collections of organisms, fossils, and artifacts serve to foster scientific understanding and help us interpret the Earth’s past, present, and future. It also is part of the museum’s mission to enhance stewardship of the natural and cultural heritage of Nebraska, promote scientific literacy, and stimulate curiosity about and discovery of the natural world and heritage of diverse cultures.

The State Museum has three locations: *Morrill Hall* is located on the University of Nebraska-Lincoln City Campus and boasts the world’s premier collection of fossil elephants, including the world’s largest mounted mammoth, on display in Elephant Hall Gallery. Visitors can interact with hands-on exhibits and explore natural wonders in the Marx Science Discovery Center or experience an immersive full-dome show in Mueller Planetarium. *The Trailside Museum of Natural History* is located in northwest Nebraska at Fort Robinson State Park. The Trailside Museum displays fossil remains from The Tertiary deposits near Fort Robinson and exhibits focus on natural history specimens of the area. *Ashfall Fossil Beds State Park,*located in the northern part of Nebraska’s Antelope County, is a joint project of the Nebraska Game and Parks Commission and the State Museum that offers visitors a chance to step back in time and see what Nebraska wildlife was like long before modern man ventured onto the Great Plains.

The State Museum also offers outreach opportunities that are part-day or full-day events (e.g., Sunday with a Scientist, Science Café, Investigate Saturday), PK-12 and pre-service educator professional development workshops, science communication professional development for faculty and graduate students, and virtual learning that is delivered across the nation. The State Museum also has substantial research facilities. The Systematics Research Collections of the State Museum house approximately 14 million specimens and artifacts representing nearly 150 years of data gathering in the Great Plains and elsewhere. These collections form the basis of research in the Divisions of Anthropology, Botany, Entomology, Parasitology, Vertebrate and Invertebrate Paleontology, and Zoology that have resulted in thousands of scientific publications and presentations. The collections of Entomology, Parasitology, and Vertebrate Paleontology are of international significance because of the breadth and size of their holdings, and the other collections are of regional significance. The collections and their associated data also form the foundation for the public exhibits and outreach in Morrill Hall, the Trailside Museum, and Ashfall Fossil Beds State Park.

For more information, contact Susan Weller (susan.weller@unl.edu, 402-472-0577).

## X-Ray Structural Characterization Facility

*Parent Facility/Center: Nebraska Center for Materials and Nanoscience*

The X-Ray Structural Characterization Facility is dedicated to materials identification and characterization through non-destructive x-ray scattering techniques. Specific applications of this technique include powder diffraction, x-ray reflectometry, small angle scattering, pole figure analysis, reciprocal space mapping, grazing incidence in-plane diffraction, x-ray crystallography, etc. Non-ambient powder and single crystal diffraction is also available at a selected temperature range. Instrumentationincludes: a Rigaku SmartLab diffractometer, a Bruker-AXS D8 Discover diffractometer, a PANalytical Empyrean diffractometer, a Rigaku D-Max/B diffractometer, a Rigaku Multiflex diffractometer, a Bruker Photon 100 single crystal diffractometer, and a Rigaku Supermini200 WDXFR Spectrometer.

In addition to providing access to instrumentation, the facility also makes available various XRD data reduction and analysis software from Rigaku Corp., Bruker Corp., and Malvern Panalytical Ltd., as well as molecular graphical visualization and analysis tools to users of the facility.

For more information, contact Shah Valloppilly (svalloppilly2@unl.edu, 402-472-3693).