University of Nebraska-Lincoln
Center for Biotechnology

Newsletter

New Vice Chancellor Mike Boehm visits the UNL Biotech Center, March 9, 2017

Introduction

Welcome to the first UNL Center for Biotechnology newsletter. We will be sending this out 1 – 2 times per year to update you on our services, activities, and new equipment. The Biotech Center is made up of 5 core facilities: Bioinformatics, Flow Cytometry, Microscopy, Plant Transformation, and Proteomics and Metabolomics. Our mission is to provide faculty, students, postdocs, and staff with advanced instrumentation that would be too expensive to purchase and/or expertise in areas not currently available in individual labs. The cores provide the level of service required by customers.

We would like to thank Dr. Melanie Simpson for serving as the Associate Director of the UNL Center for Biotechnology. We wish her well in her move to North Carolina State and will miss her many contributions to the Center.

Center for Biotechnology
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In this issue
Summer 2017

Proteomics & Metabolomics Facility (PMF)

The Proteomics & Metabolomics Facility at the Center for Biotechnology was recently added to offer the UNL science community a range of technical analytical services using mass spectrometry. Since September 2015, **over $1.5M of investment** from NRI, ORED, and IANR has been made for the purchase of new analytical instruments and computational tools to provide state-of-the-art results in the fields of proteomics and metabolomics. Applications and platforms offered include identification and relative quantification of proteins and several advanced methods for profiling and quantitation of small molecules. For a more comprehensive list see http://biotech.unl.edu/proteomics-and-metabolomics. The available services are offered for a fee. The facility is constantly adding new applications to respond to the growing demand and diversity of requests from the scientists across campus, often with their collaboration.

The facility is under the operation and direction of Drs. Sophie Alvarez and Mike Naldrett, who have over 30 years of combined experience in the field. They not only have the technical skills required to run the instruments and services, but they also provide valuable expertise in defining the best approaches and techniques to address the biological questions not only at the data acquisition stage, but also at the different stages of grant proposal and research publication.

Currently the proteomics platform achieves **identification and quantification of proteins** from assorted matrices (leaves, roots, cells, organs, tissue, blood) and a variety of species (plant, algae, bacteria, yeast, human and other mammals), from the study of **protein-protein interactions** (protein complexes), to changes in overall protein abundance of an organism in response to various treatments (drug action, environmental change, external stimuli) or gene manipulation (knock-outs, overexpression) or in **protein post-translational modifications** (phosphorylation, ubiquitination, acetylation). The metabolomics platform offers both **targeted and untargeted analysis** which can be applied to plant biology, crop biotechnology, food research, toxicology, pharmacology, and biomedical research. Because of the wide diversity of metabolites from primary and secondary metabolism, it is recommended to consult first to determine the specific need and approach required on a per project basis.

With highly specialized technology capabilities and proficiency and expertise of personnel in the field of mass spectrometry, the facility is well positioned to serve as a regional, national, and international shared resource and to foster collaboration in the fast developing fields of proteomics and metabolomics.

Personnel Spotlight: Dirk Anderson

While working in an immunology research lab at Creighton University, I was able to assist a grad student with his flow cytometry experiment. I very quickly became fascinated with the technology and tried to learn as much as I could about what it would allow researchers to study. I was soon assisting the flow core manager, and eventually became the backup operator for the facility.

After nearly five years in that lab, my wife and I moved to Ann Arbor, MI so that she could start her post-doc, and I was lucky enough to find a job at a startup company that had just started selling a small flow cytometer to individual research labs. During the next seven years, the company went through a number of changes and eventually was acquired by one of the world's flow cytometry leaders. All the while, I was continuing to learn as much as I could about the hardware and software side of the field.

Seven years later, our site was closed and I was searching for another position. I was fortunate enough to find something in the field of flow cytometry. Last June I started the next phase of my career as the first full-time manager of UNL's Flow Cytometry Service Center. It has been very rewarding to continue learning more about what flow cytometry can do. I really enjoy utilizing the technology for agricultural research.

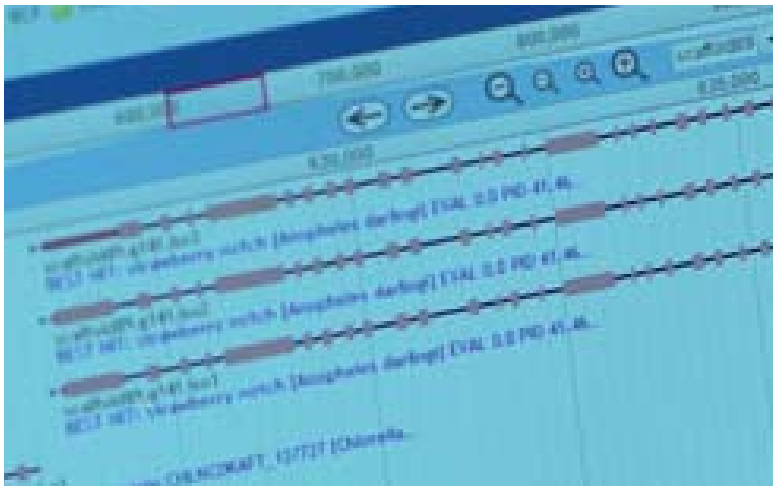
My wife and I both feel so blessed to be back in Nebraska. She grew up in Lincoln, and we're very happy to be able to live near her parents so that our daughter can have grandparents nearby.

Plant Transformation Core Research Facility

The Plant Transformation Core Research Facility (PTCRF) was established in 1996 with support of a National Science Foundation EPSCoR program grant. The PTCRF provides the capacity for the introduction of novel genetic variation into plants through the tools of biotechnology. The PTCRF has a major emphasis on crops pertinent to the state of Nebraska including soybean, sorghum, wheat, and maize. What distinguishes the PTCRF from other public sector plant transformation facilities is the infrastructure created to permit evaluation of novel traits developed through the PTCRF under field conditions. To this end, in 2005 UNL established dedicated transgenic trait field-testing facilities to strengthen the University's commitment to stewardship with respect to movement, release, and storage of regulated plants. This infrastructure is designed to ensure identity preservation, containment, and chain of custody tracking of the regulated seed. These resources include a Field Coordinator, along with two field technologists, who are responsible for training of personnel and oversight of all field-testing of the regulated material, isolated storage facility, and separate planting and harvesting equipment. The Facilities encompass two dedicated acreages, app. 30 acres in total, located at the University of Nebraska's Agriculture Research and Development Center and The High Plains Ag Laboratory, situated in the eastern and western part of the state, respectively. The University's Plant Biotechnology Field Facility is certified under the APHIS's Biotechnology Quality Management System (BQMS), a compliance assistance program that aids participants in properly addressing the guidelines governing the movement and release of regulated plants. This infrastructure permits the researcher to evaluate transgenic traits from the lab bench to the field under strict identity preservation.

Biotech Center Course of Students

As part of reaching out to graduate students each spring we offer a short course for one unit credit. The course name is Intro to Core Facilities and Research Methods at UNL – Life 491/891. Over 10 weeks, the core facility directors introduce students to the methods and equipment in each core. We also invite several core directors outside of the Biotech Cores to give a brief introduction of the capabilities of their cores. At the end of the course, students present a brief 15 minute presentation describing how they would use two different core facilities in their PhD research. Successful completion of the course entitles each student to a voucher to cover the cost of using any of the Biotechnology Cores. This past year the voucher was for $500, but will vary depending on yearly budgetary constraints. The purpose of the voucher is to give students the opportunity to work in one or two of the cores of their choice.



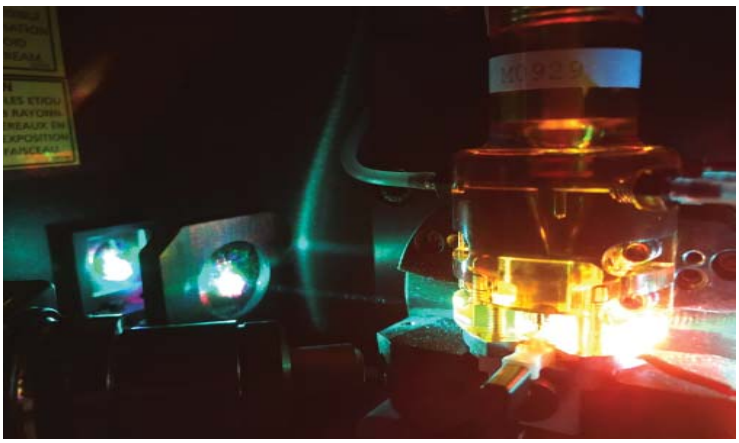
Bioinformatics Core offers metagenomics analysis and bioinformatics consultancy

The Bioinformatics Core Research Facility (BCRF) offers a wide variety of both routine and custom bioinformatics analyses; for example, differential gene expression, genome assembly, gene prediction/annotation, and life sciences related coding. This year, we introduced metagenomics analysis - both 16S and shotgun sequencing - as part of our services. We can take care of data downloading, classification and abundance counts, differential presence, integration with other data, and final presentation in publication-ready graphs and figures.

We also like to highlight our efforts in consultancy; this can take the form of pre-proposal discussions with faculty or on the other end of the spectrum one-on-one mentoring of (under)graduate students in your labs that require help to start on their bioinformatics journey.

"Experience is what you get when you didn't get what you wanted" (R. Pausch) – the Core has collectively almost 35 years of experience in bioinformatics and computational biology, with this year to date approximately 4.75 million CPU hours on the Holland Computing Center and Open Science Grid combined. We are ready to help you with your research projects as well.

Flow Cytometry Service Center



The Flow Cytometry Service Center is excited to announce that in April 2017, our BD FACS Aria Cell Sorter received a major upgrade! A 405nm Violet laser and 6 new fluorescence detectors were installed, making the system capable of analyzing up to 16 colors at the same time. Fluorochromes excited by a violet laser source are currently one of the fastest growing product groups in the field, so it is very exciting to have this enhanced capability available for use.

The Service Center also has several analyzers capable of detecting 4 – 10 fluorochromes. And Dirk Anderson, the Center's manager, is always willing to provide consultation on potential projects, assist with multi-color panel design, and train users on software and instrumentation.

For more information on the instruments available, policies, rates, and scheduling, please visit the lab's website; http://biotech.unl.edu/flow-cytometry-0.

Morrison Microscopy Core Research Facility (MCRF)

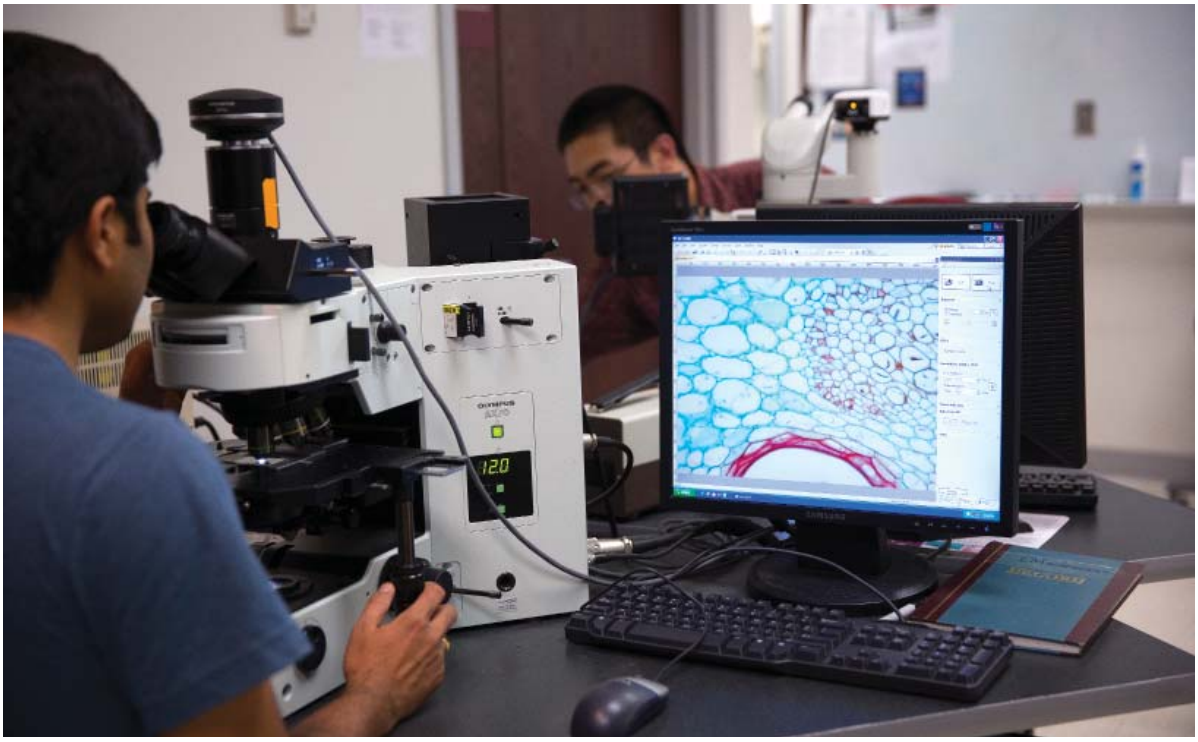
The Biotech MCRF, which is located in the Beadle Center (Suite E119.5) of the UNL city campus, is a state-of-the-art multi-user advanced microscopic imaging facility supported by the Nebraska Research Initiative (NRI), federal funds (mainly NIH COBREs), The UNL Center for Biotechnology, and usage fees from core services and users. The MCRF provides expert services and instrumentation for studies focusing on biology and its related disciplines, such as bioengineering, food/nutritional, and medical research. The MCRF provides training and service for light/fluorescence and confocal microscopy using live cells or fixed samples. The core also provides sample processing services for both scanning and transmission electron microscopy (SEM and TEM). In addition, we train users to operate fluorescence, confocal, and SEM and TEM so that users can operate the image systems independently when qualified. Please check out the following link for more information about the MCRF: http://biotech.unl.edu/microscopy

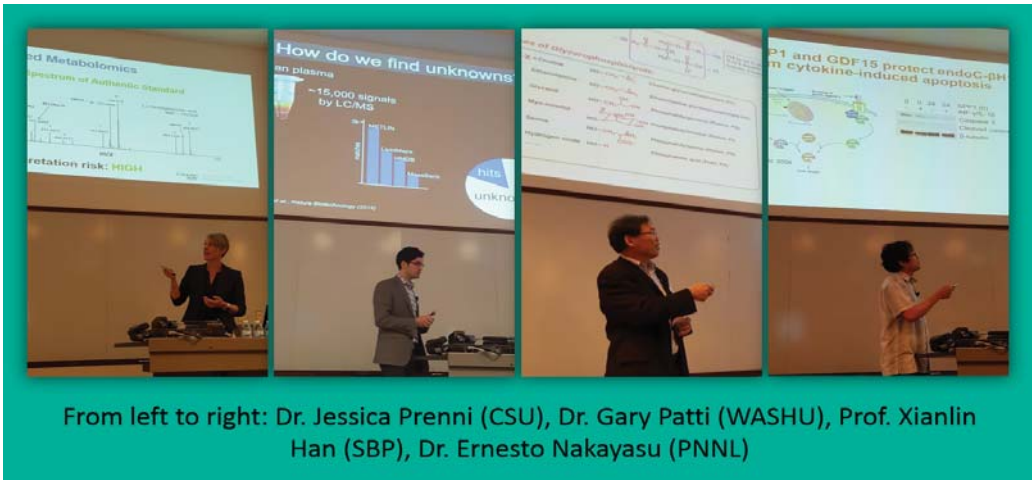
Announcements:

1) A new inverted live-cell imaging confocal system (Nikon A1R-Ti-E) was purchased and installed in late March. The system will be fine-tuned during training of the core specialists and is available to all users as of June 1. This state-of-the art imaging system includes: a) A hybrid resonant dual scanner unit for ultrafast photo-activation imaging, b) An up-to-date, 8-Core 128-GB RAM computer workstation with built-in fiber-optics for fast data communication, c) An integrated six-solid-state laser package (with 405nm, 440nm, 488nm, 514nm, 561nm, and 640nm laser lines) and GaAsp hybrid 4+1 channel detector system, d) An advanced inverted microscope with a fully motorized stage, and e) The NIS-Elements Confocal Enhanced Resolution Module (NIS-ER), which increases confocal image resolution beyond that of a conventional confocal image (currently 200nm) by 1.5 times on XY image and 1.7 times of Z resolution.

2) An online reservation system, FOM (Facility Online Management), is currently being set up and customized. FOM allows users to identify times available for imaging systems and make reservations for one or more specific instruments online. FOM went live for online scheduling/instrument reservation on June 1. A link for the access for users to register to log-on to this program was sent to all faculty members. Access FOM at http://fommcrf-biotech.unl.edu/fom/welcome

3) New staff:
Julia Russ, an EM technician (0.5 FTE; supported by the CIBC COBRE) joined the core in February this year and will be mainly responsible for biological sample processing for TEM and SEM. She is currently going through the training process, including sample fixation, embedding and ultra-sectioning/staining for TEM, and fixation and processing for critical point drying/mounting for SEM. We started accepting research samples for processing for TEM/SEM projects in April.





From left to right: Dr. Jessica Prenni (CSU), Dr. Gary Patti (WASHU), Prof. Xianlin Han (SBP), Dr. Ernesto Nakayasu (PNNL)

Archie Clutter, dean of Agricultural Research Division, welcomed the attendees.

Metabolomics Workshop May 9, 2017

The Proteomics & Metabolomics Facility organized its first metabolomics workshop on May 9th, which attracted over 110 attendees from all parts of the local campus and also from UNMC in Omaha. The 1-day workshop consisted of a mini-symposium in the morning and teaching presentations in the afternoon. The mini symposium was focused on highlighting mass spectrometry-based metabolomics platforms and pipelines and how best to use these tools to understand systems biology. Dr. Jessica Prenni (Colorado State University) and Dr. Gary Patti (Washington University - St Louis) ably introduced the audience to the complexities of the subject matter with talks covering topics from using mass spectrometry-based untargeted metabolomics in sorghum to understand low nitrogen conditions and its interaction with the soil microbiome, followed by stable isotope labeling of substrates of primary metabolism to discover new metabolic pathways. Lipidomics was then addressed by Professor Xianlin Han (Sanford Burhnam Prebys Medical Discovery Institute) from the perspective of a shotgun lipidomics technique and its use to study autoimmune diseases such as systemic lupus erythematosus. To end the morning session, an example of an "omics" study integrating proteomics, metabolomics, and lipidomics was given by Dr. Ernesto Nakayasu (Pacific Northwest National Laboratories). In the afternoon session, Dr. Suraj Dhungana from Waters Corp, co-sponsor of the event with the Center for Biotechnology, presented a 3-part workshop highlighting best practices and considerations in sample preparation, the differences between targeted and untargeted metabolomics, and the challenges of identifying unknown compounds from such a diverse range of metabolites. Overall the workshop gave a general overview of the metabolomics tools and how they can be used in various biological applications. It also provided attendees with tips and tricks on what to consider in this type of experiment.

At the top: attendees of workshop during breaks. At the bottom: Dr. Suraj Dhungana teaching attendees the practicalities of metabolomics.