

National Center for Agricultural Utilization Research, Peoria, IL 2025 Summer Intern Lab Research Descriptions

Appell

Dr. Michael Appell's current research is in chemical aspects of food safety. Food safety is important for supporting public health and reducing foodborne illness. Occasionally, agricultural commodities can be contaminated with fungi capable of producing toxins, known as mycotoxins. The research project develops better ways to detect and reduce levels of mycotoxins in commodities used in food and feed. The technology developed uses a combination of **analytical chemistry**, **cheminformatics**, and **materials science**.

Bowman

Dr. Michael Bowman's lab is part of the Bioenergy Research Unit at NCAUR in Peoria, IL. The overall mission of the Bioenergy Research Unit is to develop bioproducts and bioprocesses for the conversion of agricultural commodities into biofuels and chemicals, enzymes, and polymers. The focus of our lab is to improve the hydrolysis of biomass to component sugars. An improvement in the yield of biomass sugars will lead to more economical conversion to bioproducts. To accomplish this goal, we use many techniques, including separations / chromatography; analysis using various instruments for characterization; protein expression; biomass conversion/fermentation and product characterization. A student working in this lab will gain experience in the following skills: instrument use and maintenance; **chromatography**; basic **microbiology** and protein purification; and data management and interpretation using Microsoft Excel and instrument control software packages.

Bantchev

Dr. Grigor Bantchev's lab is located within the Bio-Oils Research Unit at NCAUR in Peoria, IL. We research how plant oils can be transformed into biobased materials (lubricants, plastics, biofuels). As part of this goal, the student intern will assist in ongoing project to characterize physicochemical properties of biobased waxes, hydrogenated oils and their blends with the aim to formulate an improved candle wax composition. Depending on student interests and circumstances, the student will gain or strengthen skills in differential scanning **calorimetry** (DSC), data analysis, **spectroscopy** (Raman and infrared), and scientific presentations.

Chisholm

Dr. Bret Chisholm's lab is part of the Plant Polymer Unit at NCAUR in Peoria, IL. The lab is focused on developing new high-value chemicals and materials from agricultural resources to potentially replace analogs derived from crude oil / petroleum. The team utilizes the unique chemical structures nature provides as a means to create new materials with improved performance over petrochemical-derived materials as well as new materials that can biodegrade to minimize negative effects on the environment. The types of end-use applications being addressed include antimicrobial surface treatments, food packaging, plastics, and paints. The student intern will assist in the synthesis and characterization of new molecules and materials derived from agriculture resources and investigate their utility for application in surface treatments for wood and paper, food packaging, and paints. The student will develop laboratory skills associated with conducting **organic chemistry** reactions, isolating and purifying reaction products, using analytical methods to determine chemical composition of reaction products, as well as formulating and testing new compositions for potential application in surface treatments for wood and paper, food packaging, and paints.

Evangelista

Dr. Roque Evangelista's lab is in the Bio-Oils Research Unit of NCAUR in Peoria, IL. The overall goal of our research is to enable the commercialization of new oilseed crops, like pennycress, camelina, and industrial hemp, for use off-season or in rotation with commodity crop production. These alternative crops will serve as new sources of raw materials and products for food, feed, and industrial applications. We conduct **physical and chemical analyses** of the seeds from experimental lines or varieties for the crop improvement and breeding portion of this project. We develop processing methods and evaluate value-added products (oils, proteins, gums, biofuels, lubricants, and others) obtained from the seeds. Students who wish to work with us will gain firsthand experience in preparing samples, using modern instruments (TD-NMR, N analyzer, thermogravimetric analyzer, GC, HPLC, and others), and performing **composition analyses** (oil, protein, ash, chlorophyll, and fatty acid profile) of industrial hemp seeds. The data collected will be used to calibrate an NIR spectrometer for use in rapid screening of experimental hemp lines currently under investigation.

Evans

Located within the Renewable Products Technology Unit at NCAUR in Peoria, IL, Dr. Kervin Evans' lab researches **developing encapsulation systems** from agri-based molecules like polysaccharides (complex sugars) or lipids (modified or natural). We also **characterize the physical properties** (e.g. size, zeta potential, physical stability, thermal stability, morphology, etc) of these encapsulation systems and other agri-based materials. Once developed, we also characterize these encapsulation systems for their efficacy to protect, deliver, or promote bioactives (molecules with desired bioactivity). Finally, we also explore film formation from polysaccharide nanoparticles. Students will specifically learn skills in making encapsulation systems (e.g. high-pressure homogenization, extrusion, microfluidic device, or thin), basic lab skills (e.g. pipetting, buffer preparation, etc), size-exclusion **chromatography**, and instrument analysis (fluorometer, nano differential scanning **calorimetry**, zetasizer, atomic force microscope, or low-voltage electron microscope). The students will also develop their skills in data management and organization using Microsoft Excel.

Hay

Dr. William Hay's lab is in the Mycotoxin Prevention and Applied Microbiology Unit at NCAUR in Peoria, IL. We investigate the effects of abiotic stresses on cereal crop disease resistance and plant performance and ways to use natural products to mitigate food safety threats. Our goal is to evaluate plant-derived antimicrobials to protect U.S. cereal crops pre- and post-harvest, in particular protecting malting barley from fungal contamination. As a member of our research team, the intern would help in assessing a number of natural compounds for their efficacy against the cereal pathogen *Fusarium graminearum*. Due to the multi-disciplinary nature of the research, the student is expected to gain skills in **plant physiology, plant pathology, microbiology, molecular biology**, confocal and scanning electron **microscopy**, and barley malt evaluation.

Hector

Dr. Ron Hector's lab is part of the Bioenergy Research Unit at NCAUR in Peoria, IL. This unit focuses on developing ways to convert agricultural products into useful biofuels, chemicals, and enzymes. Xylose, a type of sugar found in plants, is an important part of this process, and

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finding efficient ways to use it is essential for converting agricultural materials into bio-based products. Dr. Hector's research aims to enhance the use of xylose by brewer's yeast, *Saccharomyces cerevisiae*. The project for the summer of 2025 will involve studying and testing enzymes needed for this process. A student working in this lab will gain hands-on experience in basic **microbiology**, working with bacteria and brewer's yeast, **protein expression** and purification, as well as experimental techniques for determining **enzyme activity**.

Lu

Dr. Shao Lu's lab is part of the Renewable Products Technology Unit at NCAUR in Peoria, IL, and focuses on developing innovative strategies to control bacterial contamination in bioethanol and fermentation facilities without relying on antibiotics. By leveraging **molecular biology**, **bioinformatics** and **microbiology**, the lab identifies and characterizes alternative antimicrobial peptides and enzymes, including bacteriophage-derived endolysins. These enzymes are explored as eco-friendly solutions to mitigate contamination, enhancing industrial fermentation efficiency. Students in Dr. Lu's lab will gain comprehensive training in microbiological and molecular techniques, including: sterile technique, molecular cloning, gene manipulation, and protein expression and purification. The primary focus of the student's project will be the development of acid- and thermal-tolerant endolysins using a directed evolution mutagenesis approach. This involves iterative cycles of mutagenesis and screening to enhance enzyme stability and activity. The research offers a unique opportunity to combine theoretical knowledge with practical skills in applied microbiology, molecular biology, and protein engineering, contributing to sustainable practices in fermentation industries. **Students are expected to have taken general chemistry with lab and some knowledge in molecular biology is helpful but not required.**

McCormick

Dr. Susan McCormick's lab is located within the Mycotoxin Prevention & Applied Microbiology Unit at the AgLab in Peoria, IL. We research toxins produced by *Fusarium* and how it affects wheat and barley. We also study other plant and fungal natural products that may help to fight diseases caused by *Fusarium*. The student intern will assist in ongoing projects to identify and measure the amounts of mycotoxins and other fungal and plant natural products. The student will gain skills in column, thin-layer, and gas **chromatography** and mass **spectrometry**, as well as data management and organization using Microsoft Excel software. The student will also gain basic **microbiology** skills such sterile technique, how to prepare media, and how to grow fungi..

Muturi

Dr. Ephantus Muturi's lab is part of the Crop Bioprotection Research Unit at NCAUR in Peoria, IL. CBP strives to be a world leader in research to develop novel, performance-competitive biological control technologies that reduce the use of chemical herbicides, pesticides and fungicides for a variety of farm and rural public health applications. Research in Dr. Muturi's lab focuses on discovery of novel plant or bacterial derived chemical and protein compounds that have the potential to exhibit insecticidal properties. We work within multiple scientific disciplines, including **entomology**, **molecular biology**, and **chemistry**. The student intern will work alongside a new Entomology postdoctoral scientist excited about discovering solutions to control a variety of insect pests, and a laboratory technician with 25+ years of experience in insect rearing and insect bioassay techniques. The intern will learn how to work safely in a

biology lab environment, and gain skills in data management, organization, and presentation using Microsoft Excel and PowerPoint software.

Opoku

The Opoku Lab is part of the Mycotoxin Prevention and Applied Microbiology Research Unit at NCAUR in Peoria, IL. We study how environmental factors, agricultural practices, and the diversity of mycotoxigenic fungi influence disease severity and mycotoxin contamination. Our primary goal is to help develop epidemiological models that can predict the severity of mycotoxin contamination in corn. The student intern will have the opportunity to gain hands-on experience with **molecular biology** and **plant pathology** techniques, including DNA extraction, gel electrophoresis, data management, **microscopy**, and mycotoxin extraction and quantification.

Qi

Dr. Yunci Qi's lab in the Renewable Products Technology Unit at NCAUR in Peoria, IL, is interested in genetically engineering bacteria to produce useful compounds like tunicamycin, which improves the efficacy of beta-lactam antibiotics. The project the summer student would work on involves screening a range of *Actinomyces* bacteria as potential hosts to express the tunicamycin biosynthetic pathway, in order to identify a strain that supports higher tunicamycin production than the current producer, *Streptomyces chartreusis*. The student would use conjugation to insert a plasmid containing the tunicamycin-producing genes into a collection of *Actinomyces* strains obtained from the NRRL Culture Collection, an academic collaborator, or possibly even new strains isolated as part of their project. The student would then use PCR to verify the stability of the tunicamycin pathway genes, culture the successful transformants in flask cultures, and extract them for tunicamycin analysis by LC-MS. This project would expose the student to **microbiology** and **molecular biology** techniques, and **analytical chemistry** instrumentation. **It would be preferable if the student had a biology or chemistry related major.**

Vaughan

Dr. Martha Vaughan's lab is part of the Mycotoxin Prevention and Applied Microbiology Research Unit at NCAUR in Peoria, IL, which is driven by of the mission of enhancing global food safety and crop production by conducting research to eliminate mycotoxin contaminants produced by fungal plant pathogens. Dr. Vaughan's research team focusses on how climate change, production practices, and diversity of mycotoxigenic fungi affect disease severity and mycotoxin contamination of cereal crops. Student interns will have the opportunity to explore **ecological, molecular and biochemical approaches** to evaluate **plant pathogenicity** and the phenomena that naturally regulate mycotoxin production during plant-fungal interactions.

Winfield

Dr. DeMichael Winfield's lab is located within the Bio-Oils Research Unit at NCAUR in Peoria, IL. We research the properties of plant oils and investigate how to make bio-based fuels, plastics, lubricants, and other materials from them. The student intern will assist in research on converting plant oils into monomers. The student will gain skills in **organic synthesis, analytical chemistry**, and extraction and purification of organic compounds. The student will receive hands-on experience with a variety of lab instrumentation as well as gaining skills in data analysis and presentation by Microsoft Excel.

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