

USDA National Center for Agricultural Utilization Research, Peoria, IL 2024 Summer Intern Lab Research Descriptions

Appell: 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.

Bantchev: The Bantchev's Lab is located within the Bio-Oils Research Unit at the AgLab 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 projects to characterize composition of plant oils and the products of their chemical modification. Depending on student interests and circumstances, the student will gain or strengthen skills in analytical chemistry (Gas Chromatography – Mass Spectroscopy, GC-MS), spectroscopy (Raman and infrared), evaluation of the lubricating performance, data analysis (R, Python) and presentation. If you like math and programming, a challenge awaits you!

Bowman: The Bowman 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 a combination of: separations/chromatography; analysis using various instruments for characterization; protein expression; and 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

Broders: The USDA-ARS Culture Collection, at the AgLab in Peoria, IL is looking for student interns interested in microbiology. The goal of our research is to characterize the genetic diversity of fungi and bacteria in the culture collection. The microbes in the ARS Culture Collection are used by our user communities for various applications including biological control of pests, food and beverage fermentation, biofuel conversion, diagnostics development, synthetic biology, molecular genetics, and antibiotic discovery and development. The success of all these projects depends on proper DNA-based identification of strain in our collection. The intern will learn how to culture fungi and bacteria, extract DNA, design primers, run a polymerase chain reaction (PCR), sequence genes of interest, edit sequence data and use phylogenetic methods to make species level identifications.

Cermak: The Bio-Oils Research Unit (BOR) is located at the Ag Lab in Peoria, IL. We focus on the development of industrial products from the oil and meal of common crops (soybean, sunflower) and non-traditional crops (pennycress, cuphea, coriander, hemp, etc.). As part of this goal, research in the lab varies from planting, harvesting, processing, refining, modifying, and testing the resulting industrial products via organic chemistry. The Cermak Lab will take the student through the phases of crop and product development, while the student takes an active role in ongoing projects in the lab. Interns will have firsthand experience with organic synthesis,

USDA National Center for Agricultural Utilization Research, Peoria, IL 2024 Summer Intern Lab Research Descriptions

gas chromatography (GC), GC–mass spectrometry (MS), nuclear magnetic resonance (NMR), and will gain valuable skills working as part of a team with other scientists in the BOR Unit.

Chisholm: The Chisholm Lab is part of the Plant Polymer Unit within the National Center for Agricultural Utilization Research 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 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 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 food packaging and/or paints.

Evangelista: The Evangelista Lab is in the Bio-Oils Research Unit (BOR) 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 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 the AgLab in Peoria, IL, the Evans's lab researches making nanoparticles from agricultural molecules like polysaccharides (complex sugars) or lipids (modified or unmodified) to act as encapsulation systems. We also characterize the physical properties of these nanoparticles (e.g. size, zeta potential, physical stability, thermal stability, etc). We also research these nanoparticles' ability to encapsulate and protect, deliver, or promote bioactives (molecules with desired bioactivity). We also explore the nanoparticles' ability to make films. Students will specifically learn skills in making encapsulation systems (e.g. high-pressure homogenization and extrusion), 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.

Jackson: The Jackson Lab is located within the Renewable Product Technology Unit at the AgLab in Peoria, IL. Our research is focused on finding ways to convert crop waste to useful

USDA National Center for Agricultural Utilization Research, Peoria, IL 2024 Summer Intern Lab Research Descriptions

products. As part of this effort, the student intern will be involved in current projects that use catalysts to convert field waste to alcohols. Specifically, the student will gain skills in assembling reactors, performing reactions, data collection, and analyzing results.

Johnson: The Eric Johnson laboratory is part of the Crop Bioprotection Unit at the National Center for Agricultural Utilization Research in Peoria, Illinois. We study organisms, primarily bacteria, that can promote growth and reduce disease in U.S. crops. One major focus is engineering *Bacillus* bacteria to produce potent antifungal compounds that damage pests of plants. A second goal is discovering organisms that produce antimicrobial compounds. Students in my laboratory will learn molecular biology techniques as well as basic microbiology to achieve their research goals. Specific techniques students may use in this research include PCR amplification, DNA gene cloning, DNA sequencing, fungi and bacteria culturing, and performing growth assays to identify antimicrobial compounds.

Kenar: The Kenar Lab is located within the Functional Food Research Unit at the AgLab in Peoria, IL and performs interdisciplinary research using organic chemistry, processing, and material sciences to modify the properties and functionality of polysaccharides (i.e., starch), lipids, and proteins. Students will have the opportunity to work with scientists and utilize organic and analytical chemistry techniques in conjunction with thermal and/or mechanical processing methods (bench top and pilot plant scale) to prepare materials of interest for food and non-food applications. Materials are characterized using a combination of analytical, enzymatic, and physical test methods. The student will learn basic laboratory skills, such as pipetting, setting up reactions, running chemical reactions, methods and analyses, and learn instrumentation such as HPLC, GC, and SEM. The student will also gain skills in data management and organization using Microsoft Excel.

Lu: The Lu lab, located in the Renewable Product Technology research unit, focuses on the development and testing of novel antimicrobial peptides and enzymes to treat bacterial contaminants commonly found in bioethanol fermentation facilities. Currently, the Lu Lab focuses on developing different protein expression systems in yeast and bacteria using molecular techniques to improve production of antimicrobial proteins and computational modeling techniques to improve efficacy of antimicrobial proteins. The student is expected to gain basic microbiology and molecular biology skillsets including bacterial and yeast transformations, DNA extractions and PCR, protein expression and purification, yeast fermentation, and cytotoxicity assays.

McCormick: The McCormick 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.

USDA National Center for Agricultural Utilization Research, Peoria, IL 2024 Summer Intern Lab Research Descriptions

Moser, B.: Bryan Moser is an organic chemist in the Bio-Oils Research Unit at the AgLab in Peoria, IL. The focus of my research is the development of new products from agricultural materials as sustainable substitutes for existing petrochemically-based commercial products. The overall goal is therefore to reduce the environmental impact of petroleum-derived materials while simultaneously enhancing utilization of agricultural resources. As part of this goal, the student intern will assist in ongoing projects to develop renewable polymers as potential biobased replacements for commercial epoxy resins. Epoxy resins have many important commercial applications, such as adhesives, coatings, paints, and others. Specifically, the student will gain laboratory experience in the synthesis and analysis of polymers from vegetable oils. The student will also gain experience in the measurement and interpretation of the thermal, mechanical, and physical properties of polymers using state-of-the-art instrumental techniques.

Moser, J.: Dr. Moser's lab is located within the Functional Foods Research Unit at the AgLab in Peoria, IL. We study new ways to lower the saturated content in fats and oils so that we can improve nutritional value of foods. We also study natural antioxidants to extend the shelf-life and quality of foods. As an intern, you will learn solvent extraction of foods, vegetable oils, and agricultural products to prepare for analysis of lipids and antioxidants by high performance liquid chromatography, gas chromatography, or spectrophotometry. Students may also learn about physical analysis techniques of food products, fats and oils using texture analysis, rheology and other instrumental techniques. You will learn how to safely work in a chemistry lab environment and gain skills in data management, organization, and presentation using Microsoft Excel and PowerPoint software.

Ramirez: The Ramirez lab is located in the Crop Bioprotection Unit. Research in our laboratory focuses on the isolation, characterization, and development of microbial biopesticides to control mosquitoes, ticks, and other agricultural pests. Our lab projects are highly interdisciplinary, spanning across the fields of entomology, microbiology, molecular biology, and immunology to understand the interactions between insect pests and microbes, as well as to improve biopesticide efficacy. The project for summer FY24 will focus on the detection and quantification of a microbial agent (a microsporidia currently evaluated to control Japanese beetles), from field-collected Japanese beetle samples. In this project, the intern will be involved in beetle dissections, DNA extraction, conducting PCR and real-time PCR detection and quantification of microbes, data collection and analysis.

Vaughan: Dr. Vaughan's lab is part of the Mycotoxin Prevention and Applied Microbiology Research Unit 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.

Whitaker: The Whitaker Lab is located within the Mycotoxin Prevention & Applied Microbiology Unit at the AgLab in Peoria, IL. We research how beneficial bacterial and fungal partners can be recruited to help reduce disease from the pathogen *Fusarium graminearum* in

USDA National Center for Agricultural Utilization Research, Peoria, IL 2024 Summer Intern Lab Research Descriptions

wheat and barley. As part of this goal, the student intern will assist in ongoing projects to identify how select bacterial and fungal partners impact wheat and barley growth. Specifically, the student will gain skills in plant growth and maintenance, basic microbiology skills such as growing microbiota, pipetting and inoculating plants with microbiota, and sterile technique. The student will also gain skills in data management and organization using Microsoft Excel and the R programming software.

Winfield: The Winfield Lab is located within the Bio-Oils Research Unit at the AgLab in Peoria, IL. We research the properties of plant oils and investigate how to make bio-based fuels, plastics, lubricants, or 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.