2023 ABI Summer Internship Mentor List

Mohammad Abrar Alam, Ph.D., Associate Professor of Chemistry
Department of Chemistry & Physics
Office Phone: 870-972-3319

Synthesis of novel small molecule heterocycles as potent anticancer and antimicrobial agents

In my group, we synthesize small molecules such as pyrazole, thiazole, imidazole, and androstane derivatives by using readily available starting material and mild reaction conditions. We have generated a library of small molecules to test their potential to treat different diseases. Several lead compounds are potent antibacterial and antimelanoma agents.

Students doing their research in my group will get the opportunity to learn to synthesize new molecules by using commercially available substrates and reagents under mild reaction conditions. Based on their interest, students will also get the opportunity to test the compounds against different bacterial strains and several cancer cell lines. Interested students will get the opportunity to work on different in models such mice, C. elegans, and Galleria mellonella for antineoplastic and antibacterial studies.

Finding new antibiotics and anticancer agents is extremely important to save lives and alleviate the suffering of millions of people. My group's research is in consistent with the ABI mission to improve the health of Arkansans through medical research initiatives.

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Jianfeng Xu, PhD, Research Professor, Arkansas Biosciences Institute
Email: jxu@astate.edu; Tel: 870-680-4812, Office: ABI 306

1) The Xu lab conducts research with the goal of producing recombinant proteins that have potential applications in pharmaceuticals or industry, such as vaccines, interleukins, growth factors, and enzymes, using plant cell and tissue culture techniques. One of the ongoing projects in the lab involves engineering "designer" anti-TNFα biologics for the oral treatment of inflammatory bowel disease (IBD), which is sponsored by NIH. As an intern in the lab, the student may have the opportunity to participate in this project or propose a suitable project related to genetic engineering and recombinant protein expression, based on your interests and the guidance of the PI.

2) Intern student will have the opportunity to learn a variety of laboratory techniques in the Xu lab, including standard molecular cloning, bacterial culture and induced protein expression, plant cell culture and genetic transformation, recombinant protein detection using techniques such as Western blotting and ELISA, and mammalian cell culture. To ensure that you feel comfortable and confident performing these techniques, I will always demonstrate new techniques in person before allowing you to perform experiments independently.

3) My research exploits plant cell/tissue culture as a safe and cost-effective bioproduction "factory" to produce protein therapeutics, such as antibodies, vaccines, interleukins and enzymes. It supports the ABI Mission Statement to "improve the health of Arkansans through new and expanded agricultural and medical research initiatives". Successful completion of ongoing or upcoming projects will facilitate availability of high-quality low-cost protein therapeutics to the state and to the country. Particularly, ABI at A-State selects "Plant-based production of medicinal molecules" as one of major research growth areas and my research projects dovetails nicely with this effort.

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Fabricio Medina-Bolivar, Professor of Plant Metabolic Engineering
Department of Biological Sciences
Director, Environmental Sciences Graduate Program
Director, Molecular Biosciences Graduate Program
Email: fmedinabolivar@astate.edu, Phone: (870) 680-4319, Office: ABI 308
Lab website: https://www.fabriciomedinabolivarlab.com

1. Research Project:
   Discovery and bioproduction of medicinal compounds from plants. The Medina-Bolivar research team is involved in the discovery and bioproduction of bioactive plant compounds with medicinal applications. Our studies utilize "immortalized" root cultures (known as "hairy roots") as factories for a large diversity of plant natural products. Using a combination of molecular, cellular, and biochemical approaches, our research team has developed strategies to increase the levels of selected natural products in hairy roots by more than 1,000 times when compared to the parental plant. Students participating in the ABI Internship Program will work specifically with hairy root cultures to produce biologically active natural products, including phenolics and terpenoids. These compounds have potential applications as preventive and therapeutic agents for cancer and cardiovascular diseases. The interns will be involved in different aspects of the research, including production, analysis, and purification of these compounds in hairy root cultures, and assessing their activity in chemical and cellular assays.

2. Students will learn:
   Interns will learn the technical skills of plant tissue culture/analytical/molecular and cellular laboratory. These include aseptic techniques, plant tissue culture, analysis of natural products by high-performance liquid chromatography (HPLC), and mammalian cell culture. In addition, the interns will learn how to maintain a research laboratory notebook, how to do research as part of a team, and how to present the results of their research in laboratory and scientific meetings. The interns will also learn how to communicate their research to the general public.

3. ABI Mission compatibility:
   The research focus of this internship is on the production and bioactivity of novel plant compounds that have potential applications as preventive and therapeutic agents for cancer and cardiovascular diseases. These are major health concerns in Arkansas. To this end, this research adheres to the ABI mission to improve the health of Arkansans through new and expanded agricultural and medical research initiatives.

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Kyle D Gustafson, PhD Assistant Professor of Parasitology, Arkansas State University, Department of Biological Sciences
Email: kgustafson@astate.edu

1) The Gustafson Lab is seeking a highly motivated undergraduate student with interests in parasite biodiversity and disease. Briefly, our lab seeks to discover the diversity of mammal, amphibian, reptile, bird, and fish trematode parasites that are being transmitted throughout Arkansas. The student may be involved in outdoor sampling, but the focus will be on morphological identifications, DNA preservation, and DNA sequencing of hosts and parasites.
2) Interns will gain many valuable experiences when joining our lab, which currently has 4 graduate students and several undergraduate students. Interns would be involved in field sampling, parasite monitoring, microscopy, and DNA handling. Basic techniques that will be learned include pipetting, notebook keeping, DNA extractions, gel electrophoresis, and polymerase chain reactions. The most important characteristic we are looking for is an eagerness to learn. We will train the intern on new techniques before expecting them to work independently.

3) ABI Mission Statement: "to improve the health of Arkansans through new and expanded agricultural and medical research initiatives." This project is in line with the ABI mission statement because parasites are of economic, veterinary, and medical importance. As hosts continue to shift habitats through changes in climate or introductions, it is becoming important to understand parasite diversity in regards to how hosts can affect agriculture and how parasites may affect vertebrates, such as humans.

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Dr. Lori Neuman-Lee, Assistant Professor of Physiology
Email: lneumanlee@astate.edu

1) The innate immune system clears the majority of potential pathogens and is required for complete immune system activation, but it is still poorly studied. One way to learn more about the innate immune system is to examine its functioning in reptiles, which rely almost exclusively on this arm of immunity. The Neuman-Lee lab focuses three primary objectives: 1) isolating and identifying reptilian immune cells, 2) examining functional immune responses in reptiles, and 3) testing the influence of different endocrine and environmental factors on the immune response. Students working in the Neuman-Lee lab would expect to gain experience using the flow cytometer and cell sorter, making and processing blood smears, and conducting immunological assays on blood samples.
2) The intern would join an active lab group that emphasizes the benefits of collaboration and teamwork. Any intern would have opportunities to learn skills and techniques outside their direct project, such as handling reptiles, processing blood, sonography, and hormone analyses. The intern would learn about the scientific process, the value of presentation skills, and basic statistical analyses.
3) This work addresses ABI's mission by using innovative methods to study the innate immune system, which can be very difficult in mammalian models. By increasing our understanding of this arm of the immune system, we may be able to better develop therapies and novel approaches to improve health outcomes.

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Dr. Richard Segall, Professor of Information Systems and Business Analytics
Department of Information Systems and Business Analytics (ISBA)
Email: rsegall@astate.edu, Phone: 870-972-3989, Office: BU 216
Webpage: https://www.astate.edu/college/business/faculty-staff/Information-Systems-Business-Analytics/people-details.dot?pid=896fcc4a-5756-47ee-9595-408aacd49be8

Research Project: Data Mining and Visualization and Interpretation of Big Data for Predictive Analyses and Clinical Diagnoses for Human Diseases and Plant Pathogens

1. Short paragraph describing the research/work the student will be doing:

The student will create data visualizations and perform data mining using software available in Neil Griffin College of Business (NGCB) computer labs with software of Tableau, Power BI, SAS JMP Pro, SAS Enterprise Miner and SAS Viya. Several of these softwares are also available virtually for student use outside of the NGCB computer lab.

(i.) Potential Datasets for Human Diseases that can be used include but not limited to the following:

1. Epidemiology of seven cancer sites: breast, colorectal, kidney, esophagus, ovarian, pancreas, uterine from 1985-2017 with 36,000+ data values available at URL: https://www.data.gov.uk/dataset/bb1561fa-2697-476d-ae93-0a9e047b635c/cancer-registration-epidemiology-of-seven-cancer-sites-breast-colorectal-kidney-oesophagus-ovarian-pancreas-uterine-1985-2017

2. Cervical cancer risk factors with estimate of 800+ data available at URL: https://data.world/uci/cervical-cancer-risk-factors
3. Data on the daily number of new reported COVID-19 cases and deaths by EU/EEA country with 75,000+ data values available at URL: https://www.ecdc.europa.eu/en/publications-data/data-daily-new-cases-covid-19-eueea-country
4. MalaCards Human Disease Database: https://www.malacards.org/

(ii.) Potential Datasets for Plant Pathogens that can be used include but are not limited to the following:

1. Plant Health Progress database: https://www.plantmanagementnetwork.org/php/
2. Agricultural Research Service (ARS) Germplasm Resources Information Network (GRIN): https://www.ars-grin.gov/npgs/index.html
3. Integrated Pest Management (IPM) database: https://www.ipmcenters.org/ipmsymposium07/proceedings/abstract.php?ID=103
4. National Center for Biotechnology Information (NCBI) GenBank: https://www.ncbi.nlm.nih.gov/genbank/
5. Data.World Repository https://data.world/datasets/health

2. Some Description of what the intern would learn and experience if they chose to work with you this summer:

- Generates new knowledge using data mining and data visualization techniques for Big Data in Biosciences, in this case with clinical diagnoses and plant pathogens.
- Also be able to contribute towards anticipated output of publishable papers/articles of which the student would be co-authored.

3. Details of how your research/project/creative work adheres to the ABI Mission Statement:

- This project aligns with ABI's mission statement in that it "improves the health of Arkansans through new and expanded agricultural and medical research initiatives" by analyzing and visualizing data about different clinical diagnoses and plant pathogens that might help in improving and understanding both the medical care and agriculture for Arkansans."
- This project using predictive modeling might help in deeper understandings of different clinical diagnoses and plant pathogens for Arkansans.

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Asela Wijeratne– Assistant Professor, Bioinformatics
Contact Info: awijeratne@astate.edu; 870-972-3311, Office ABI 303

1) Research Project:

As more people live on Earth in the future, we will need more food to feed them. But plant diseases can make it hard to grow enough food, and the chemicals we use to kill the diseases can hurt the environment. So, our research team is looking for new ways to solve this problem. We want to find new methods that are strong enough to fight plant diseases but also safe for the environment. To achieve this goal, we will study tiny living things in the soil called microbes that can stop plant diseases. We will use a special technique called metagenomics to see what the microbes are doing over time. The idea is to find a better way to fight plant diseases to help farmers grow more food and keep people healthy.

2) Description of what the intern would learn and experience:

Interns will learn various laboratory techniques, such as DNA/RNA extractions and Polymerase Chain Reaction (PCR) based genotyping, which are highly in demand in academia and industry. These techniques will prepare interns for future careers, including human health-related research. For example, metagenomics is used to study human gut microbes' activities and their impact on human health. In addition to technical skills, interns will also learn how to maintain a laboratory notebook, communicate with other researchers, work collaboratively, and present their research work in various meetings.

3) ABI Mission compatibility:

Our research aims to address the ABI Mandated Research Areas 2: Bioengineering research that expands genetic knowledge & creates new applications in agriculture/medicine. Our long-term goal is understanding how pathogens interact with microbes near soybean roots for infection and colonization. This research will help us discover novel bio-based materials for the biocontrol of soil-borne pathogens and contribute to the long-range improvement in and sustainability of US agriculture and food systems**.**

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Jennifer Yanhua Xie, PhD, Associate Professor of Basic Sciences, NYITCOM-Arkansas, Department of Basic Sciences
Email: jennifer.xie@nyit.edu

1. Current research projects at Xie lab:

The long-term goal of Xie lab is to *seek new, non-opioid analgesics to treat chronic pain*. Currently we are collaborating with other faculty within the ABI or at the University of Utah to discover novel molecules to reduce the development of chronic pain and functional deficits after nerve injury or following migraine triggers *in vivo* using a variety of rat and mouse pain models. We will use a battery of *behavioral, cellular, molecular,* and *immunohistochemical* methods to assess the normalization of the damaged nervous system and restore the normal sensory and motor functions.

2. What the students will do/learn in Xie lab:

The scholars joining our lab will learn various techniques involving *live animals* including, but not limited to, *behavioral testing, rodent surgeries, transcardial perfusion of the animals, tissue collection and dissection, electromyogram recording, cell culture, and Western Blot*, etc. All lab members are expected to attend weekly lab meetings to discuss the experimental design, review the results, troubleshoot any issues, as well as critique relevant journal articles. Students take active roles intellectually and are offered opportunities to *attend national and international meetings* and present their results (*authorship for abstracts guaranteed*). If sufficient contribution, *authorship for manuscripts will be awarded* as well.

3. ABI Mission Statement:

In light of the national crisis of opioid pandemic, seeking new, non-opioid analgesics as well as non-pharmacological therapies for chronic pain has never been more important. Our research is perfectly in line with the ABI mission, especially for Arkansans suffering from low back pain and other chronic pain originated from other illnesses. It will help facilitate the discovery of new drug targets that are non-addictive and complementary with minimal side effects to help alleviate patients' sufferings and improve the quality of healthcare.

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Viswanathan Rajagopalan, Ph.D., FCVS (APS), Associate Professor
NYIT College of Osteopathic Medicine & Faculty at Arkansas State University
Ph: 870-680-8822, vrajagop@nyit.edu, www.nyit.edu/bio/vrajagop

The **persistent and leading cause of death** not only **in Arkansas** (both males and females), but also in the **United States** and **worldwide** is **Cardiovascular disease**. The laboratory investigates mechanisms of cardiovascular disorders and strategies to improve heart health using **animal (in vivo), cellular (in vitro), patient-based** and **computational** approaches.

The students in Dr. V. Raj's laboratory gain hands-on experience in **cutting-edge biological/medical technologies** including **CRISPR/dCas9, stem cells, differentiation, 3D tissue engineering, etc.** Traditional areas covered include molecular and cell biology, genetics, biotechnology, clinical sciences, biochemistry, physiology, pharmacology, histology, diagnostics, therapeutics, surgery, invasive and non-invasive methods, engineering, etc. in addition to the above, the interns also learn teamwork, maintaining laboratory notebook, scientific presentation skills, and opportunities to actively participate in lab

meetings. Substantial student contributions may also yield opportunities to co-author presentations beyond the school level. Previous A-State undergraduate students in the lab have won multiple **awards/fellowships including at national and state levels**. The research exposure and experience gained by the intern will be highly valuable to pursue **graduate studies, medical education, paramedical/allied health programs in academic or industry settings.**

Various conditions studied include, but are not limited to, heart attack, heart muscle disease, heart failure, associated disorders such as hormonal disorders, obesity, diabetes, high blood pressure, etc. Particularly, a major area of Dr. Raj's laboratory is related to the role of novel **noncoding ribonucleic acid** molecules in cardiovascular disorders associated with hormonal abnormalities. Collaborative projects include **plant-derived products** for cardiovascular applications.

In alignment with the ABI's mission, the projects in the laboratory involve **improving the health of Arkansas** through new and expanded **biological, medical, and plant-based** research initiatives. The diagnostic and therapeutic agents studied and developed are expected to benefit our state and beyond.

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Dr. Maureen Dolan, "Exploring biotechnology approaches for harnessing plastic biodegradation capabilities of the Greater Waxworm"

Please check out this weblink for more information about research that serves as the background for this project at: https://www.astatespocs.org/ or contact me at:

Email: mdolan@astate.edu; **Phone:** 870-680-4359

The most common plastic waste in our landfills, polyethylene, is particularly dangerous for the environment because of its frequent use and extremely slow degradation rate. While recycling this material is one approach, the reality is accepted forms of polyethylene (PE) that can actually be recycled is highly restricted and limited. Recently ***Galleria mellonella* larvae, commonly called waxworm**, was shown to voraciously ingest, quickly metabolize, and efficiently convert polyethylene (PE) plastic to a clear by-product excrement--ethylene glycol (EG). Interestingly, EG has other common uses including a component of pen ink and antifreeze. Recently (July 2022) an A-State student team conducted a waxworm experiment on the International Space Station for @30 days demonstrated for the first time that these larvae not only survived in microgravity, but consumed plastic at levels similar to Earth control waxworms. One of the remaining objectives from this microgravity experiment is to quantify the amount of EG produced to confirm waxworms biodegraded the plastic they consumed in space.

Student researchers involved in this project will have opportunity for hands-on experience with techniques introduced in lab courses or learned in classes including buffer preparation, micro- and multichannel pipetting, spectrophotometry in designing and executing a biochemical-based assay for detecting this by-product of plastic degradation. Additional projects in the lab will provide opportunities for interns to be involved in learning additional techniques including PCR, gel electrophoresis and metagenomics analyses. Interns working on this project will also work with the lab team in maintaining our research-grade waxworm colony. Student scholars will be paired with senior researchers in the lab to train in the techniques they will use to carry out their research project. In addition, this project has potential to extend beyond the ABI SURF in providing opportunities for independent study projects and Honors thesis.

The goals of this project aims to contribute knowledge and innovations to improve the lives and health of Arkansans in offering more sustainable approaches to managing our plastic waste problem here on Earth. In addition, this research may lead to future opportunities for building new knowledge-based technologies and jobs, here in our State, for addressing the global plastic crisis.

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Kris Biondolillo, PhD
Professor of Psychology – Experimental: Nonhuman Learning and Behavior
Department of Psychology and Counseling, College of Education and Behavioral Science
kdbiondo@astate.edu, Ph: 870-972-3064

1. Comparative psychology is where biology and experimental psychology join forces. This fascinating branch of science rests on the assumptions that (1) nature is lawful and determined; (2) behavior is nature and thus lawful and determined – even human behavior; (3) there are universal principles that govern behavior that extend across species (thus, the comparative). The comparative psychology experimental knowledge base is full of empirical work with primates and standard laboratory species like mice, rats, and pigeons. There is an unfortunate lack of data on insects – especially roaches. If one considers just the roach literature available, there is a paucity of data from the species Blaberus discoidalis. I find this fascinating, as this species is a potentially excellent model for comparative work. They are a gregarious creature that is well-suited for laboratory conditions and is easily socialized to human contact and handling. My lab has three aims: (1) extending established principles of learning and behavior beyond "standard" laboratory species using Blaberus discoidalis; (2) increasing our understanding of the sensory systems that allow Blaberus discoidalis to respond and adapt to its environment; (3) developing awareness of the development factors that interact with the previous two aims.

2. Interns would be involved in learning various methodological strategies to investigate behavior including discrete trial vs. free operant techniques; the logic behind, and application of, small-n experimental design strategies; the importance of experimental control and validity; the analysis of data from small-n designs; and the importance of comparative inferences and non-human modeling to better understand all behavior, including human behavior.

3. ABI Mission Statement: "to improve the health of Arkansas through new and expanded agricultural and medical research initiatives." This project is in line with the ABI mission statement in that understanding human behavior at a basic level is key to understanding the human condition in general. Non-human models of human behavior allow us to investigate human health conditions related to psychology that cannot be experimentally investigated in humans. Our understanding of the causal factors related to issues like stress, anxiety, fear, and addiction (to name a few) depends on our ability to exert experimental control over environmental conditions. This is easily accomplished with a non-human model and the field of comparative psychology provides a basis for establishing the external validity of our findings.

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R. Shea Harris, Co-Principal Investigator, Worms Organic Recycling Management System (W.O.R. M.S), Outreach Coordinator, Arkansas Biosciences Institute,
Email: rsharris@astate.edu

1) The W.O.R.M.S. (Worms Organic Recycling Management System) with Citizen Science project focuses on plastic biodegradation capabilities of the greater waxworm (*Galleria mellonella*) as an ideal research and teaching model for doing K-16 authentic Project-Based Learning (PBL). This 2 year grant is an extension and expansion of our NASA-funded SPOCS (Student Payload Opportunity with Citizen Science) research project testing waxworm plastic biodegradation in a microgravity environment, on the International Space Station (ISS), for 30 days, in June 2022. In early 2023, the research surveyed 150 intermediate students at WORMS partner school, Nettleton STEAM (Jonesboro, AR). The focus of this survey was to capture the preexisting baseline of students' STEM identifies, attitudes towards project-based learning, and interest in STEM careers. After engagement, a post survey will be conducted to compare how effective the WORMS activities and curricula have affected, if any, the previous described baseline.

2) The intern will work within the WORMS's assessment and scientific engagement teams. Their primary objective will be to identify trends, interpret assessments, and provide support for data analyses on pre-post intermediate grade-level assessment occurring during the 2023 year. The intern will work within the educational engagement team to create and implement novel waxworm authentic PBL activities and curricula for expanded Junior High level WORMS projects. The intern will directly engage both intermediate and Jr. High level students in Northeast Arkansas classrooms will research based scientific educational activities.

3) ABI Mission Statement: "to improve the health of Arkansans through new and expanded agricultural and medical research initiatives." This project is in line with the ABI mission statement, with particular regard to improving the health of Arkansans by providing a sustainable solution to global plastic pollution problem. The project could lead to new technologies for biodegradation of plastics and decrease effect of microplastic associated illnesses.

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Jonathan M Berman, PhD Assistant Professor of Basic Sciences, NYITCOM-Arkansas
Department of Basic Sciences
Email: Jberma03@nyit.edu

1) The main project in the Berman lab right now studies the regulation of sodium channels in the kidney (ENaC). These channels are important for renal control of blood pressure. Berman lab focuses on the regulation of these channels by various proteases, and to analogous processes, such as proteolytic cleavage of the SARS-CoV-2 coronavirus prior to cell entry at a site which mimics the ENaC cleavage site. Students would have the opportunity to work on projects directly relevant to human health.

2) Interns would be involved in learning various laboratory techniques ranging from pipetting, bacterial culture, cell culture, recombinant DNA techniques, amidolytic assays, as well as general scientific skills such as writing, paper reading for a journal club, note-taking and data analysis and presentation to a scientific team. I expect to show students new techniques in person before expecting them to perform them in the lab.

3) ABI Mission Statement: "to improve the health of Arkansans through new and expanded agricultural and medical research initiatives." This project is in line with the ABI mission statement, with particular regard to 1) improving the health of Arkansans, and 2) being a medical research initiative. This project will help develop a deeper understanding of a disease which has been determined to be a global pandemic by the WHO, and which has infected many Arkansans and killed many others. It has affected the daily life of most to at least some degree.

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