Women in Science Enabling Research
Faculty Research Proposal

Faculty Name and Department: Prof. Progna Banerjee, Chemistry and Biochemistry, PBEnergyLab

Project Title: Defect engineering in syntheses-driven materials discovery of inorganic solid electrolytes for alkali-ion batteries

1) Please provide a short description of your research project and goals for AY 2026-2027

At the P. Banerjee Energy Lab (PBEnergyLab), based in Chicago, we integrate synthetic inorganic chemistry, advanced electron microscopy, machine learning, and electrochemistry to accelerate discovery of next-generation solid electrolytes and nanoscale superionic conductors. Our work bridges atomic-level defect engineering with scalable solution processing, enabling transformative advances in solid-state batteries and energy conversion. Selected students will be interviewed and based on the outcome can be assigned to inorganic syntheses, materials characterization, battery prep or more surface chem based methods.

2) In what capacity will the student participate in your project?

Current and past undergraduate mentees in my lab are/have been deeply involved in sample prep, synthesis, characterization of new materials in my lab and externally including DOE National labs and external university facilities, preliminary data analyses and assistance with manuscript and poster preparation-and accordingly obtain co-authorship if/as justified.

3) What tasks might the student be expected to complete?

Students are expected to put in approximately 10 hrs/week to directly learn from me the various experimental and computational techniques we employ in my lab. They are expected to keep detailed lab notebook records from their task and write reports and assist with manuscript and poster preparation if that stage is reached.

4) What skills might be required of the student?

We expect students to have a strictly professional mindset, be punctual, have clear communication skills, put in 10 hrs per week in our lab, strictly adhere to lab policies including safety and data recording and have the capacity for quick learning. A minimum GPA of 3.5 on a 4.0 scale is required.

5) What do you hope the student will learn/gain from participating in your project?

Students in my lab receive exposure to scientific and technical projects of national interest and at the level of top performing research groups. Past/present students have been co-authors in multiple high-impact reputable journals at the top index % and impact factor of materials chemistry, materials science, inorganic chemistry, physical chemistry and energy. They have presented their posters at international and national conferences and selected for awards.

6) Provide a short INFORMAL biographical paragraph to introduce yourself to students. Feel free to share what drew you to your field and ways in which you have supported women in science.

Dr. Progna Banerjee is a tenure-track Professor of Chemistry & Biochemistry at Loyola University Chicago, where she leads the PBEnergy Lab. Her research focuses on discovering and scaling next-generation battery materials by integrating synthetic inorganic chemistry, advanced electron microscopy, machine learning, and electrochemistry.

She has an extensive academic background, having completed five university degrees across two continents. Her previous experience includes: Postdoctoral Appointments: Research at Argonne National Laboratory, the University of Texas at Austin, and Lawrence Berkeley National Laboratory.

Education: A Ph.D. and M.S. from the University of Illinois at Urbana-Champaign, following advanced degrees (M.Tech, M.Sc) from the Indian Institute of Technology, Kharagpur.

Recognition: Named a 2022 American Chemical Society-CAS Future Leader and recipient of the Scott Anderson Outstanding Graduate Assistant Award. Recently a 2026 Materials Au Rising Star from the ACS. She has mentored 20+ undergraduate student, several graduate students and three postdoctoral researchers in only 1.5 years since at Loyola and may if them were women.

Past/present students from various backgrounds and different years of study who have been mentored by Prof. Banerjee at Loyola have been co-authors in multiple high-impact reputable journals at the top index % and impact factor of materials chemistry, materials science, inorganic chemistry, physical chemistry and energy. They have presented their posters at international and national conferences and selected for awards. Almost all the undergraduates had no previous research experience. Read more about our work at https://pbanerjeelab.com/

Women in Science Enabling Research
Faculty Research Proposal

Faculty Name and Department: Eric Chan-Tin, Department of Computer Science

Project Title: Evolving Experiential Learning for Cybersecurity

1) **Please provide a short description of your research project and goals for AY 2026-2027**
Cybersecurity is an experiential hands-on field. Cybersecurity competitions such as Capture The Flag provide such an experience. In this project, students will be involved in a few cybersecurity competitions, rate their usefulness and accessibility, and then create some challenges. The student will learn to think outside the box, think like an adversary, and come up with creation of innovative cybersecurity challenges.

2) **In what capacity will the student participate in your project?**
The student will participate in all aspects, from completing cybersecurity challenges, to designing and creating new ones. Student will also present at URES 2027 and/or some other symposium/conference such as Women in Cybersecurity (WiCyS) 2027.

3) **What tasks might the student be expected to complete?**
Complete some cybersecurity challenges and create new ones. Also present at a conference – this could be a poster or oral.

4) **What skills might be required of the student?**
Problem solving, critical thinking, and basic knowledge of computers. Ideally, COMP 170 and COMP 141 or equivalent, but not required – ability to learn independently and think outside the box and problem solve are the most important.

5) **What do you hope the student will learn/gain from participating in your project?**
Experience presenting at a national conference, network opportunities at the conference. Improve ability to problem solve, complete cybersecurity challenges, and create new ones that could potentially be used by other students.

6) **Provide a short INFORMAL biographical paragraph to introduce yourself to students. Feel free to share what drew you to your field and ways in which you have supported women in science.**
Eric Chan-Tin is a professor in the Department of Computer Science. He came to Loyola in 2018 to lead the cybersecurity program. He loves hacking at and tinkering with things, discovering new hobbies, and coaching students in cybersecurity competitions and challenges. He got interested in cybersecurity since he was bored with the day-to-day programming and cybersecurity is an always-evolving field. He is the inaugural faculty advisor for the Loyola Women in Cybersecurity student chapter, is active in the Women in Cybersecurity Chicago chapter. He has mentored over 75 students in research and over 50% identify as female.

Women in Science Enabling Research
Faculty Research Proposal

Faculty Name and Department: Yanan Chen, Biology Department

Project Title: Establish and characterize a periphery nerve demyelination model

1) Please provide a short description of your research project and goals for AY 2026-2027

This overall goal of this project is to establish and characterize a periphery nerve demyelination model, which can be used for mechanistic studies and therapeutic intervention testing, including electrical and magnetic stimulation. Briefly, sciatic nerve ligation surgery will be conducted on the adult mice. A battery behavior tests will be performed bi-weekly to evaluate the motor function for 6 months and histology and electron microscopy analysis will be conducted after harvesting the sciatic nerve.

2) In what capacity will the student participate in your project?

The student will participate in the project in a hands-on, mentored research capacity. Under direct supervision, the student will receive trainings in basic laboratory techniques and animal research methods, including animal care and weekly behavior assessment. The student will also be introduced to tissue harvest, processing and histology analysis.

3) What tasks might the student be expected to complete?

The student will be expected to assist with animal handling and monitoring, perform weekly behavioral testing, and help with tissue harvesting and basic histological processing, including sectioning, immunohistochemical staining and imaging. The student will also assist with preparing samples for electron microscopy, TEM imaging and performing basic data analysis. The student is also expected to participate in lab meetings and research discussions.

4) What skills might be required of the student?

The student should demonstrate attention to details, willingness to learn, good organization skills, and reliability. The student should be comfortable working in a team and be able to communicate effectively. In addition, the student is willing to handle mice, although no prior experience with animals is required.

5) What do you hope the student will learn/gain from participating in your project?

The student will gain experience in biomedical research, including animal models of disease, behavior testing and histology analysis. The student will develop critical thinking skills by learning how to interpret experimental data. The student will also learn the teamwork in a research setting. I believe that this experience will increase student's confidence and prepare them for future research or healthcare-related careers.

6) Provide a short INFORMAL biographical paragraph to introduce yourself to students. Feel free to share what drew you to your field and ways in which you have supported women in science.

I studied medicine at China medical university and later pursued a PhD in biomedical science in the U.S. My PhD and postdoctoral training were in neuroscience field. Through my clinical training, I witnessed patients suffering from neurological disorders, losing their abilities, and the heavy burden carried by their caregivers. These experiences motivated my interest in translational science, where discoveries from the laboratory can be transformed into meaningful therapies that improve patients' lives.

As a female scientist, I understand how challenge it can be to stay in science, especially when facing self-doubt or the pressure to balance academic demands with personal and family responsibilities. Throughout my career, I have been passionate about mentoring students, especially women, by creating supportive learning environments, encouraging confidence in research setting, and helping students navigate academic and professional pathways in science and healthcare.

Women in Science Enabling Research
Faculty Research Proposal

Faculty: Janene Cielto, Department of Psychology

Project Title: Phenotypic Variation and AUtomatic Stereotype Activation

1. Understanding how social categories guide perception and interpretation is central to work on automatic stereotyping. Building on classic findings that stereotype activation can be automatic but also malleable (e.g., Devine, 1989) Spencer, Fein, Wolfe, Fong, and Dunn (1998) demonstrated that stereotype activation is sensitive to motivational factors. Specifically, researchers demonstrated that threats to self-image can increase the accessibility of stereotype-consistent knowledge, even under conditions that typically inhibit such activation (e.g., cognitive load). The present study builds on this framework by considering a different kind of cue that does not involve an explicit threat to the self but rather taps into phenotypic features that carry cultural and social weight. Specifically, we ask whether hair texture, as a salient and socially significant identity marker for Black women, can influence how individuals complete ambiguous linguistic stimuli. We ask: How does phenotypic variation within a racial category interact with existing stereotypes and cultural norms? Participants will be briefly exposed to a photograph of a Black woman with either straight or natural hair. Following this prime, they will complete a series of word fragments as part of a lexical decision task (LDT) that can be resolved in multiple ways (e.g., F_T → FAT or FIT). After completing the task, they will be asked to provide brief justifications for their responses. These post-task reflections are intended not only to probe explicit reasoning, but also to provide insight into how participants themselves interpret the task and their own behavior, which we suggest is often missing in work on implicit bias. Hypotheses include (but are not limited to): (a) Participants will be more likely to produce negative or stereotype-consistent completions following natural hair primes (b) Participants will be less likely to generate clearly positive completions. These findings would suggest that visual markers embedded in group identity can cue stereotype activation in the absence of identity threat or cognitive load, indicating that such activation may be mediated by deeply embedded cultural associations about beauty, professionalism, and respectability. This study extends stereotype activation research by shifting the focus from intergroup comparisons to intragroup variation. We suggest that hair texture, while not a category itself, may act as a powerful cue that may influence how Black women are perceived and treated.

2. The student will participate in my project at the level of research assistant.

3. The student will learn how to prepare and retrieve study materials using Prolific, aid with data entry, and assist with data analysis. The student will also collaborate with lab members on an extensive literature review, including locating relevant research, writing and organizing annotated bibilographies, and contributing to weekly discussions of research papers during lab meetings.

4. The student should be reliable, organized, and have an eye for detail. The student should be comfortable working both independently and collaboratively, participating in lab meetings, and asking questions as they learn new research methods. The student will also be required to become CITI certified as part of this role (free, four-hour ethics course on conducting responsible research).

5. My hope is that the student will gain hands-on experience with the research process in psychology, while developing skills in locating, reading, and critically analyzing research literature. Through engaging with the research process, the student will also learn how to work with research data and build confidence in discussing our research findings, and hopefully learn how research questions are developed and refined in my lab setting.

6. My name is Dr. Janene Cielto. I received my undergraduate training in psychology from Howard University in Washington D.C., and my doctoral training at Northwestern University in cognitive psychology. I have been on faculty at Loyola since 2022 where I teach and conduct research on person perception in social interaction. In my lab, we examine whether and how physical features influence others' decisions, with particular attention to how these processes shape opportunities and conversation spaces for Black women. My interest in psychology began in high school after taking an AP Psychology course with a super engaging teacher. I support women in science by fostering a collaborative, inclusive lab that brings together a diverse group of students, most of whom are women. This curated environment encourages open dialogue, mentorship and engagement with issues central to the lived experiences of all women.

Women in Science Enabling Research
Faculty Research Proposal

Faculty Name and Department: John Kelly, Department of Biology
Project Title: Development of a standard method to assess microbial decomposition of leaf-litter in streams

1) Please provide a short description of your research project and goals for AY 2026-2027
Rivers and streams are some of the most important ecosystems on earth. They provide us with important resources, including freshwater and food, which is why humans throughout the world often live close to rivers and streams. Rivers and streams also have significant impacts on the health of downstream ecosystems, including lakes and oceans, because the quality of water in the river will influence the quality of water downstream. Microorganisms (e.g., bacteria, algae, fungi) are important inhabitants of rivers and streams because they are responsible for breaking down organic material (e.g., plant leaves) and providing food to higher trophic level organisms (e.g., invertebrates and fish). Despite the importance of streams, they are among the most-impaired ecosystems on the planet, due to the negative effects of human activities such as agriculture and urbanization, which can introduce many different types of pollutants into streams. Many of these pollutants can have negative impacts on the microorganisms in the streams, which can put the health of streams at risk. The Kelly Lab at Loyola University Chicago is working with several partners to develop a standard method to analyze the microbial communities in streams so that we can compare the health of streams in different parts of the world. The method is based on the use of different types of plant-based textile strips as a model for the leaves that would normally fall into a stream. The textile strips can be placed in a river or stream and held in place (using nylon cord and a stake) for a period of time (usually 2 to 3 weeks) and then we can collect the strips and analyze the microbes that have attached themselves to the cotton, just as they would for a leaf. Our team is testing the feasibility of several plant-based textiles, including cotton, sisal, coir, and jute, to determine which would be the most appropriate proxy for an actual leaf. The plan for this project will be to incubate strips of each of these textiles alongside leaves from several different tree species in the North Branch of the Chicago River for 2-3 weeks and then to analyze and compare the microbes that grow on the textiles and the leaves.

2) In what capacity will the student participate in your project?
The student will participate in all aspects of this project, including filed work and lab work.

3) What tasks might the student be expected to complete?
Tasks that the student will complete will include preparation of textile strips and leaves, placement of the strips and leaves in the river, collecting the samples from the river, and analyzing the microbes. Analysis of the microbial communities colonizing the cotton and leaves will be done using DNA-based approaches, and will include DNA extraction, gene amplification via PCR, and DNA sequence analysis.

4) What skills might be required of the student?
No previous experience or skills are necessary for a student to join this project. The student will be trained on all the necessary techniques and will work in collaboration with Dr. Kelly and other students in the Kelly lab.

5) What do you hope the student will learn/gain from participating in your project?
I hope the student will gain an appreciation for the scientific method as well as experience in both field-based and lab-based research. I also hope the student will gain an appreciation for the important role that microorganisms play in the ecosystem.

6) Provide a short INFORMAL biographical paragraph to introduce yourself to students.
I obtained my B.S. degree in Biology from Dartmouth College in Hanover, NH, and my M.S. and Ph.D. degrees in Environmental Microbiology from Rutgers University. I worked at Northwestern as a post-doctoral fellow for three years, and I joined Loyola as a faculty member in the Department of Biology in 2001. Here at Loyola, I teach General Biology (BIOL 101) and General Microbiology (BIOL 302), and I have an active research lab that includes both graduate students and undergraduate students. My research generally focuses on the impacts of human activities on the structure and function of bacterial communities in the environment, with a focus on aquatic habitats. You can find more information about my work on my lab website (https://kellymicroecolab1.wixsite.com/kelly). I live in the city of Chicago in the Andersonville neighborhood, which is just a few miles south and west of Loyola. I live with my wife Eva, my 17-year-old son Liam, and our dogs Charlie and Hank. Charlie is a 9 year-old labrador retriever and Hank is a 2 year-old St. Bernard. Liam is a junior in high school and is just starting the college search process.

Women in Science Enabling Research
Faculty Research Proposal

Faculty Name and Department: Jennifer Mierisch, Biology

Project Title: Exploring the genetic mechanisms regulating spermatogenesis

1) Please provide a short description of your research project and goals for AY 2026-2027
Continued species propagation hinges on the ability of males and females to produce quality sperm and eggs via the process of gametogenesis. The development of sperm occurs via a stepwise process that begins with a germline stem cell that divides mitotically, undergoes meiosis, and completes maturation. This process requires supporting somatic cells that signal to the developing sperm to ensure its proper development. Defects in signaling between the somatic support cells and the developing sperm can arrest this process and lead to infertility. Therefore, characterizing the signals sent and received by each cell type and identifying the downstream outputs of these signals is needed to understand the infertility can arise. My lab is particularly interested in characterizing how the somatic cells of the gonad influence germline development. This project will focus on the spectraplakin, Short stop (Shot), as we have found it is highly expressed in the early somatic cells of the Drosophila testis, but its role in this tissue has not yet been characterized. Previous studies of the role of Shot during oogenesis have demonstrated that it regulates the cytoskeleton, suggesting that Shot may regulate the cytoskeleton in the supporting somatic cells in the testis. To explore Shot function, we will genetically manipulate Shot expression levels to characterize its role during spermatogenesis. We will dissect testes to analyze the process of spermatogenesis by immunofluorescence assay followed by confocal imaging. These studies will allow us to identify the specific stages of sperm development requiring the function of Shot.

2) In what capacity will the student participate in your project?
Students will learn how to perform each step of the project, from genetics to acquire flies of the desired genotype to tissue dissection and processing, sample visualization on the confocal microscope, and data analysis. Students will work alongside Dr. Mierisch and other students in the lab to learn each step and will progressively work toward performing the procedure independently, based on their comfort level. Students need only have an interest in research to get started, as all other skills will taught through the course of the project.

3) What tasks might the student be expected to complete?
Students will learn how to genotype flies, to dissect gonads out of adult flies under the microscope, to process tissues for labeling, and to image samples on the microscope.

4) What skills might be required of the student?
The student only needs an interest in research and cell biology to participate. An enjoyment of tissue dissection would be helpful.

4) What do you hope the student will learn/gain from participating in your project?
I hope the student will learn more about the scientific process and how it differs from their experience in an introductory lab course. I hope they will gain technical skills, as well as the ability to read and synthesize scientific papers and to discuss their work with others.

5) Provide a short INFORMAL biographical paragraph to introduce yourself to students. Feel free to share what drew you to your field and ways in which you have supported women in

science.

I earned my B.A. in Biology from Northwestern University in 2001, where I studied the process of receptor-mediated endocytosis in yeast. I went on to earn my Ph.D. in Biology from the Massachusetts Institute of Technology in 2007, studying the signals that regulate photoreceptor development in the *Drosophila* eye. As an NIH postdoctoral fellow at Johns Hopkins, I shifted my focus to embryonic gonad development in *Drosophila*. I joined Loyola as a faculty member in 2012. Currently, my lab is exploring the cell signaling mechanisms that occur between different cell types to promote gametogenesis in the fruit fly, as defects in this process can result in infertility and disease. We use a variety of approaches from genetics to immunohistochemistry and microscopy to examine how genes function to regulate gametogenesis using the fruit fly as a model. Outside of the lab, I teach BIOL251: Cell Biology, BIOL307: Stem Cells, and a BIOL397, a course-based undergraduate research course focused on Evolutionary Genomics. In my free time, I enjoy spending time with my husband and two sons and our menagerie of pets, traveling, reading, and crafting.

Women in Science Enabling Research
Faculty Research Proposal

Faculty Name and Department: Daniel Moreira, Department of Computer Science

Project Title: Identifying AI-generated Scientific Manuscripts via Reference Hallucination Detection

1) Please provide a short description of your research project and goals for AY 2026-2027

Artificial Intelligence (AI) services are increasingly being used to assist scientific writing, including drafting papers, summaries, proposals, and literature reviews. While these tools can produce text that reads fluently and convincingly, they sometimes generate references that contain incorrect information or point to nonexistent works. These errors, known as *reference hallucinations*, pose a serious challenge to scientific integrity because references are essential for verifying scientific claims and building upon prior research.

The goal of this project is to develop an automated tool that validates scientific references by identifying unverifiable or incorrect citations in a given scientific manuscript provided in Portable Document Format (PDF). Rather than analyzing writing style or language, this project focuses on the reference section of scientific documents and asks a simple but powerful question: "Do the cited works actually exist?"

To answer this question, the project will build a multi-step computational pipeline that extracts reference information from PDF documents and consults trusted and open scientific indexing services, such as OpenAlex, Semantic Scholar, CrossRef, and PubMed Central, to determine whether cited works are present in these databases. The tool will also examine potential inconsistencies in metadata such as authorship, publication venue, year, and other bibliographic details, and flag problematic or suspicious citations. Such a tool will be helpful to authors, peer reviewers, scientific editors, and other stakeholders of the scientific publication system.

By developing this software, the student will be introduced to core ideas in data processing, automation, and research validation, all within the context of scientific integrity and the ethical challenges of using AI in science.

2) In what capacity will the student participate in your project?

The student will participate in this project as a closely mentored undergraduate research assistant, working directly with the faculty mentor throughout the academic year. The student will be actively involved in all stages of the project, from understanding the research problem to implementing and testing individual components of the reference validation pipeline.

The project is designed to be accessible to students with little or no prior research experience. The student will begin with guided, well-defined tasks and gradually assume greater responsibility as their technical skills develop. Weekly meetings will be used to provide instruction, discuss progress, troubleshoot challenges, and reflect on ethical issues related to the use of AI in scientific research.

By the end of the project, the student will have contributed meaningfully to the development and evaluation of a real-world research tool, while gaining hands-on experience with the scientific research process in an academic environment.

3) What tasks might the student be expected to complete?

The student will complete a set of structured research and development tasks that contribute directly to the construction of the reference validation tool. Tasks will be introduced gradually and adjusted based on the student's interests and progress. These tasks will include:

- Learning how scientific references are structured and how they appear in different types of manuscripts.
- Extracting reference sections and bibliographic information from PDF documents using existing software libraries and scripts.
- Organizing extracted reference data into structured formats suitable for analysis.
- Querying open scientific indexing services to determine whether cited works exist and match the extracted bibliographic information.
- Identifying and categorizing different types of citation issues, such as missing works, incorrect authorship, or other inconsistent publication details.
- Assisting in the implementation and testing of simple rules or automated checks to flag potentially problematic references.

- Documenting methods, results, and observations in a clear and reproducible manner.

All tasks will be completed with close mentorship, clear documentation, and regular feedback, ensuring that the student develops both technical skills and confidence as an independent researcher.

4) What skills might be required of the student?

No prior research or technical experience is required for this project. The project is designed to support students who are new to research and interested in learning through hands-on experience. Helpful skills and qualities include:

- Curiosity about how AI and scientific research tools work.
- Willingness to learn new technical concepts and tools.
- Attention to detail, particularly when working with references and documentation.
- Basic computer literacy and comfort working with text files or PDF documents.
- Basic programming experience and the ability to use third-party software libraries (helpful but not required).
- Ability to ask questions, seek feedback, and work independently with guidance.

Any necessary technical skills, including basic programming concepts, scripting, and data-handling techniques, will be developed throughout the project.

5) What do you hope the student will learn/gain from participating in your project?

Through participation in this project, the student will gain their first experience conducting scientific research in an academic setting. They will learn how research questions are translated into concrete tasks, how data are collected and validated, and how computational tools can support scientific integrity.

The student will develop practical skills in data processing, automation, and working with real-world scientific documents, while also learning how to evaluate the reliability of AI-generated information. They will gain experience breaking down complex problems into manageable steps and implementing solutions in a guided, supportive environment.

Beyond technical skills, the student will build confidence in their ability to contribute meaningfully to a research project, communicate their work clearly, and reflect on ethical challenges related to the use of AI in science. The experience is intended to help the student better understand what it means to engage in scientific research and to consider future opportunities in STEM fields with greater confidence and clarity. The work may also open the door to future academic research, such as applying similar validation techniques to detect nonexistent legal cases in AI-generated legal documents or to identify misquotation and misrepresentation of prior work in scholarly writing.

6) Provide a short INFORMAL biographical paragraph to introduce yourself to students. Feel free to share what drew you to your field and ways in which you have supported women in science.

I am a tenure-track assistant professor in the Department of Computer Science. My research focuses on AI applied to media forensics and biometrics, with particular emphasis on media provenance analysis and scientific integrity. I am especially interested in developing computational tools that help address misinformation and research misconduct, and in understanding how AI technologies can be used responsibly in scientific settings.

Mentoring undergraduate students, especially those early in their academic journeys, is a central part of my work as a faculty member. I currently supervise eight students, of whom six are women. I strive to create inclusive and supportive research environments where students feel comfortable asking questions, learning from mistakes, and building confidence in their abilities. In recognition of my commitment to student learning and mentorship, I was recognized as a *Rising Star* for the 2025 St. Ignatius Loyola Award for Excellence in Teaching. I am particularly committed to supporting women in science and helping students develop a strong sense of belonging in STEM fields.

Through projects like this one, my goal is to help students gain meaningful, hands-on research experience, develop technical and critical-thinking skills, and see themselves as active contributors to the scientific community. More information about my work and mentoring activities is available at danielmoreira.github.io.

WISER (Women In Science Enabling Research)
Invitation to Participate in the 2026-2027 WISER Mentoring Program

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Faculty Name and Department: Martina Schmeling, Department of Chemistry and Biochemistry

Project Title: Assessment of Environmental Pollution in Chicago using Wild Carrot Plants

1) Please provide a short description of your research project and goals for AY 2025-2026

Our research specializes in identifying environmental pollution and involves the measurement of heavy metals in plants and soil. Heavy metals are common pollutants and toxic to all organisms when they exceed a certain threshold concentration. Some of the most notorious heavy metals are lead Pb, cadmium Cd, and chromium Cr. They are introduced into the environment mostly through industrial production and can impact drinking water and vegetation. Interestingly, certain plants can extract heavy metals from soil and incorporate them into their roots and shoots and thus serve as bioindicators for them. Previous studies from our lab showed that a common weed called wild carrot (*Daucus Carota*) can take up Pb, Cr, and Cd from industrial sites in Chicago.

Our research project for next year will investigate how much of these metals the wild carrot plant can extract and where they are stored within the plant. For this we will be growing our own wild carrot plants in the lab and exposing these to defined concentrations of Pb, Cr, and Cd under controlled conditions. When the plants reach a certain size, they will be harvested along with their roots. Plant shoots, roots and the soil in which they grew will then be analyzed to identify the uptake (bioaccumulation) of each element and its mobility (translocation) within the plant. Those parameters will tell us whether the wild carrot plant can be useful as bioindicator to identify heavy metal pollution in Chicago.

2) In what capacity will the student participate in your project?

When you decide to join our research group, you will participate in many aspects of the research project: you will take part in setting up, growing and harvesting the plants under controlled conditions in our lab. You will also be involved in sample preparation and analysis of the plants, roots and soil. Sample preparation involves washing, drying, grinding, weighing, and digestion of samples with acid to isolate the metals. The resulting solutions will then be transferred to specific vials for analyses by atomic absorption spectrometry. Since the analysis is mostly automated, you will learn how to operate the instrumentation and how to prepare standards for quantification.

3) What tasks might the student be expected to complete?

Your main task will be in growing and harvesting plants and subsequent analysis of the plants, roots and soil samples. This entails setting up growing boxes with plant seeds, watering and feeding plants regularly besides applying metal solutions containing Pb, Cd, and Cr to the plants. Once the plants reach a certain size, you will help harvesting them and separate roots from shoots. After that each sample needs to be carefully washed, dried and parts of it crushed before being digested with acid. The solution obtained through digestion will be distributed into vials and then transferred to the atomic absorption spectrometer for analysis. In addition, you will help to make standard solutions for each element to ensure quantification and learn how to program

the machine for analysis.
Moreover, you will also participate in processing the results and calculating bioaccumulation and translocation factors for those metals.

4) What skills might be required of the student?

If you have already acquired some laboratory skills such as pipetting or preparing solutions this will be helpful but is not a must to join our lab. The main skills needed are to be able to listen and follow instructions and to be conscientious and diligent when it comes to executing the instructions.

5) What do you hope the student will learn/gain from participating in your project?

Overall, my hope is that you will gain a better understanding of how research, specifically the combination of field and laboratory research, is an important tool to identify environmental pollution and crucial to address concerns surrounding our society.
Additionally, you will hone your laboratory skills with respect to preparing samples meticulously, manipulating chemicals and operating scientific instrumentation. Finally, you will learn how data processing and evaluation is important for providing an unbiased view of the results.

6) Provide a short INFORMAL biographical paragraph to introduce yourself to students. Feel free to share what drew you to your field and way in which you have supported women in science.

My research interests are focused on the analysis of pollutants in a variety of samples, mostly found in the environmental and biomedical field. Some of my former projects involved the study of air pollution in Chicago and the analyses of beverages and human cataract samples for heavy metals. Besides the current research project of studying heavy metal uptake and mobility by wild carrot plants using traditional analytical methods and new technologies such as X-ray microtomography, we also develop green and sustainable sample preparation methods for 'forever' chemicals like PFAS and PFOAS and for NASA samples returned from space. Each type of sample has its own unique challenge, and our lab seeks to overcome those by optimizing sample preparation procedures.

In my more than 25 years at Loyola, I have taught a variety of courses ranging from freshmen chemistry to graduate level advanced analytical chemistry and honors courses about environmental pollution and climate change. Our lab has a longstanding collaboration with scientists involved in planetary sciences and with researchers at the Advanced Photon Source.

Women in Science Enabling Research
Faculty Research Proposal

Faculty Name and Department: Caroline Turner, Biology

Project Title: Evolution of antibiotic resistance under carbon and nitrogen limitation

1) Please provide a short description of your research project and goals for AY 2026-2027
Although we often think of evolution as happening over long timescales, bacteria grow so quickly that we can actually observe their evolution in lab experiments. In our lab we have been studying how scarcity of different elements, such as carbon and nitrogen, can affect the evolution of *E. coli*. We have found that the bacteria are less likely to evolve resistance to antibiotics when nitrogen availability is low. We are now working to understand how specific mutations affect the evolution of antibiotic resistance when nitrogen is scarce.

2) In what capacity will the student participate in your project?
The student in this project will conduct competition experiments in which different mutants are mixed together in flasks to compete with each other for limited resources. They will work with me to identify a specific research question to address as their independent project.

3) What tasks might the student be expected to complete?
The student will conduct a research experiment working with bacteria that evolved under different conditions. This will involve growing bacteria under sterile conditions and measuring growth rates and other characteristics of the bacteria. We will begin with training in working with bacteria. The student will then plan out an experiment with my guidance. They will conduct the lab work, analyze the results, and determine next steps.

4) **What skills might be required of the student?**
I will train the student in all the necessary laboratory techniques. Some background in biology, such as having taken BIOL 101 or 102 or an equivalent course would be helpful. Curiosity, attention to detail, and critical thinking are always valuable!

5) What do you hope the student will learn/gain from participating in your project?
I hope that the student will gain an appreciation of the power of evolution, a deeper understanding of the scientific process, and confidence in communicating about science.

6) Provide a short INFORMAL biographical paragraph to introduce yourself to students. Feel free to share what drew you to your field and ways in which you have supported women in science.

My interest in microbiology was sparked by working at a sewage treatment system while I was an undergraduate student at Oberlin College in Ohio. I went on to do undergraduate research on the bacteria-driven reactions that removed nitrogen from the wastewater. I became fascinated by evolution when I took an evolution class during my senior year. A few years later, I was fortunate to do my Ph.D. research working with an experiment in which *E. coli* had been evolving in the lab for more than 20 years- more than 50,000 generations!

Faculty Name and Department: Wei-Ming Yu, Department of Biology

Project Title: Molecular Basis of Frequency Map Formation in the Auditory System

1) Please provide a short description of your research project and goals for AY 2026-2027

Our ability to hear and distinguish different sounds depends on precise wiring in the auditory system. A key feature of this wiring is the sound frequency map, an organized layout of neurons that allows the brain to process high- and low-pitched sounds accurately. When this map does not form properly, it can contribute to hearing problems and learning difficulties. Despite its importance, the biological signals that guide the formation of this map are still poorly understood. Preliminary work in my lab shows that signaling molecules called Ephs and ephrins are present in the developing auditory system and may help guide growing auditory nerve fibers. In this project, the student will investigate whether these molecules play a role in building the sound frequency map. Using mouse models, the student will assess hearing function and examine how auditory nerve fibers grow and connect under different experimental conditions. This work will provide insight into how the auditory system becomes precisely organized during development and may help explain the origins of certain hearing disorders.

2) In what capacity will the student participate in your project?

The student will be an active member of the research team and will participate in both experimental work and data analysis. They will learn how to work with mouse models and conduct hearing-related behavioral and physiological assays. The student will also receive training in basic statistical analysis to interpret experimental results and will contribute to the preparation of a poster to present the research findings at a scientific meeting.

3) What tasks might the student be expected to complete?

The student will perform auditory brainstem response recordings and frequency discrimination assays, which are well-established and straightforward tests used to measure hearing function in mice. In addition, the student will help isolate cochlear and brain tissue to establish explant cultures that allow us to study how auditory nerve fibers grow and find their correct paths under different conditions.

4) What skills might be required of the student?

No prior research experience is required. The student will receive thorough training in all techniques from senior lab members and Dr. Yu. The most important requirement is that the student is comfortable working with mice and eager to learn new laboratory skills.

5) What do you hope the student will learn/gain from participating in your project?

Through this project, I hope the student will gain hands-on experience conducting scientific research using animal models and develop confidence in laboratory techniques. The student will also learn how to read, understand, and critically evaluate scientific literature, as well as how to analyze and interpret data. More broadly, I aim for the student to develop curiosity, critical thinking, and problem-solving skills, qualities that are essential for success in scientific research and STEM careers.

6) Biographical information:

I received my Doctor of Veterinary Medicine (DVM) and M.S. in Biochemistry and Molecular Biology in Taiwan, followed by a Ph.D. in Neurobiology and Genetics in Dr. Sidney Strickland's lab at The Rockefeller University. I then completed seven years of postdoctoral training in Dr. Lisa Goodrich's lab at Harvard Medical School. I joined the faculty at Loyola University in 2016, where I teach Neurobiology and Neural Diseases. My research is supported by a National Institutes of Health (NIH) R15 grant and several internal awards. My lab includes 10 undergraduate researchers (eight women and two men) and one female postdoctoral researcher, and we maintain a collaborative, supportive, and inclusive research environment aligned with the mission of the WISER program.