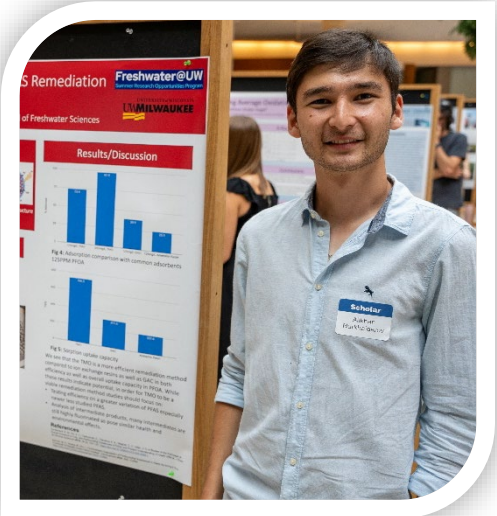
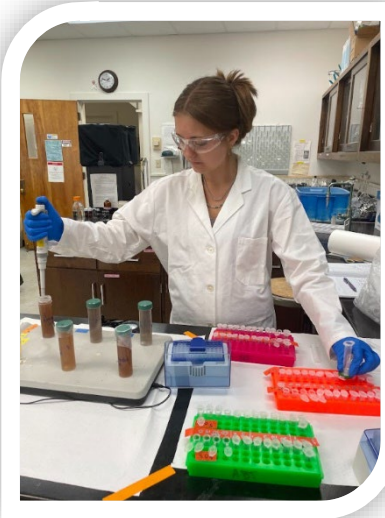
Freshwater@UW

Summer Research Opportunities Program

Research Project Catalog

Summer 2024





PROJECT TITLE **PAGE**

Project Code: GB-01

Mitigating PFAS Contamination of Groundwater: Biochar Sequestration of PFAS in Biosolid Leachate at the Field Scale

Mentor:	Kpoti Gunn
Mentor's institution:	University of Wisconsin - Green Bay
Project location:	Green Bay, WI
Keywords:	PFAS, sampling, lab analysis

Project description

Sewage sludges (biosolids) applied onto agricultural lands may be the most diffuse source of legacy per- and polyfluoroalkyl substances (PFAS) contamination of groundwater resources in Wisconsin. Previous laboratory research indicated that activated biochar may be an effective and economically viable material to immobilize PFAS in soils, therefore mitigating groundwater resources contamination. This project aims to evaluate onsite the PFAS immobilization performance of activated biochar incorporated in soils receiving biosolids, and to develop methods for PFAS analysis of soil and groundwater leachate. The project will be completed with the help of undergraduate students. Most particularly, student scholars funded under the Freshwater@UW Summer Research Opportunities Program will complete groundwater sampling and solid phase extraction in a laboratory setting necessary for PFAS analysis. Scholars will also participate in data analysis and results presentation at the 2025 Research in the Rotunda (March 2026). Overall, the project will provide scholars with water laboratory experience critical to the development of a water science professional workforce.

Project tasks

Groundwater sampling and solid phase extraction in a laboratory; data management and analysis; result presentation

Required Knowledge, Skills & Abilities

- Ability to follow directions and respect safety rules

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Analytical chemistry background; basic statistics.

Project Code: GB-02

Optimization of Sedimentation Basin Phosphorus Removal through Vegetation

Mentor:	Michael Holly
Mentor's institution:	University of Wisconsin - Green Bay
Project location:	Green Bay, WI
Keywords:	Analytical chemistry, wetland ecology, laboratory analysis, fieldwork

Project description

Vegetation within sedimentation basins, for urban and agricultural runoff treatment, could be managed to optimize sedimentation basin removal of P. Incorporating native plants and diverse mixtures in treatment basins could increase nutrient removal. Floating wetlands, consisting of artificial mats with emergent macrophytes, may increase treatment potential of basins. Plant selection will be prioritized to native species and potential crops that are harvested to generate revenue. The scholar will aid in identifying potential vegetation mixtures through analysis of mesocosm water quality and field experimentation. Experiments will be completed through a 56-day trial period with daily and weekly analysis of water quality. Samples of plant material before establishment in the stock tank treatments and at the end of the experiment will be dried, ground, and processed for total nitrogen, phosphorus, and carbon at UW Green Bay.

Project tasks

Weekly analysis of water quality

Support of ongoing agricultural runoff treatment research

Analysis and reporting of results

Required Knowledge, Skills & Abilities

- None

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Analytical chemistry, wetland ecology

Project Code: GB-03

Design and evaluate novel reactive media for removal of dissolved P and N through bench scale flow through testing and deployment at the field scale

Mentor:	Michael Holly
Mentor's institution:	UW - Green Bay
Project location:	Green Bay, WI
Keywords:	Analytical chemistry, laboratory analysis

Project description

Seasonal hypoxia of lakes of the Great Lakes as a result of excessive algal production, has a detrimental effect on the local aquatic species, environment, and recreation. Seasonal hypoxia is persistent in part due to non-point agricultural sources of phosphorus (P) (35% of total P load to Lake Michigan). Reactive media incorporated at the edge of agricultural fields could be used as a cost-effective and low maintenance treatment to remove dissolved phosphorus in agricultural runoff through sorption and precipitation. Reactive media derived from waste products would create beneficial product from waste, extend the time prior to disposal, and support a circular economy. The scholar will design and produce reactive media from waste residuals and evaluate runoff treatment potential through flow through columns. Influent and effluent samples will be collected at set time intervals hours until effluent P is >80% of influent P. Ortho-phosphorus and ammonia will be measured using a discrete analyzer (Seal AQ300) at UWGB.

Project tasks

Weekly analysis of water quality

Support of ongoing agricultural runoff treatment research

Analysis and reporting of results

Required Knowledge, Skills & Abilities

- None

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Analytical chemistry

Project Code: LAX-01

Preservation and Promotion of Oral Histories: Kickapoo River and Coon Creek Watersheds

Mentor:	Tiffany Trimmer
Mentor's institution:	UW - La Crosse
Project location:	La Crosse, WI
Keywords:	Oral history, digital storytelling, flood responses

Project description

Help us preserve freshwater-related oral histories and increase their chances of being used by researchers! UW-La Crosse's Oral History Program (OHP, est. 1968) has four interview collections describing daily life in the Kickapoo River and Coon Creek Watersheds ca. 1960s – late 2010s. But right now, the oral histories in these collections are not being listened to by researchers and community members because not many people know they exist. OHP seeks a summer research assistant to help us create subject matter guides (indexes) and interactive website and social media content describing the kinds of historical evidence contained in these four collections: the La Farge Dam Project, the Kickapoo Valley Project, the Gays Mills Project, and the "Stories From The Flood" project.

Project tasks

Listen to oral history interview recordings, read interview transcripts, and create topical subject matter guides (indexes) for them. Collaborate with OHP staff on content development related to evidence in oral history collections (interactive website guides and, potentially, social media). Conduct additional research to contextualize evidence in oral history collections (examples: visiting campus archives, searching in online databases, reading scholarly sources). Communicate professionally with archivists, librarians, scholars, and community groups.

Required Knowledge, Skills & Abilities

- Previous coursework in History or other Humanities-related subject(s) that focused on analyzing evidence and building a narrative.
- Ability to communicate ideas effectively in writing for diverse audiences.
- Strong listening comprehension skills.
- Strong research skills, and ability to find relevant information in different formats including archives, online databases, and scholarly publications.

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- None

Project Code: LAX-02

Mapping Inland Seas: Contextualizing Historical Maps of the Great Lakes

Mentor:	Penelope K. Hardy
Mentor's institution:	UW - La Crosse
Project location:	La Crosse, WI
Keywords:	Historical research, maritime history, maritime archaeology

Project description

Inland seas such as the Great Lakes are key to understanding the broader human relationship with water and waterways, as places to live, work, travel, gather resources, and enjoy ourselves, among many other uses. Maps can communicate information about all of these relationships, and historical maps document human efforts to understand and record our environment and activities. This project seeks to gather and contextualize historical maps of the Great Lakes and other inland seas that demonstrate the various ways in which humans have understood these bodies of water. This project forms one component of a larger project to collect historical maps exploring the global oceans and seas in three dimensions, for eventual publication. Each map will include a full color reproduction with about 400 words of history and contextualization. The scholar selected for this project will explore print and digital collections to identify maps of the Great Lakes and other inland seas that are both visually and historically interesting, and then assemble bibliographies of primary and secondary sources that can be used to contextualize them. They may help make map selections, plan written material to accompany the maps, and research image publication permissions.

Project tasks

Assist in identifying map holdings and collections. Search databases. Use archival finding aids. Organize and contribute to shared online files. Conduct additional research to contextualize maps as sources (examples: visiting campus archives, searching in online databases, reading scholarly sources). Communicate professionally via email, phone, and in person with archivists, librarians, and other scholars.

Required Knowledge, Skills & Abilities

- Previous coursework in History or other Humanities-related subject(s) that focused on analyzing evidence and building a narrative.
- Experience working with online archival and database collections.
- Strong research and organizational skills, and ability to find relevant information in different formats including online databases and scholarly publications
- Ability to communicate ideas effectively in writing

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- None

Project Code: LAX-03

Comparative toxicity of PFAS in various fish speces

Mentor:	Tisha King-Heiden
Mentor's institution:	UW - La Crosse
Project location:	La Crosse, WI
Keywords:	Toxicology, fish, physiology, laboratory analysis

Project description

PFAS are the "forever chemicals" you may be hearing about that are contaminating people's drinking water and causing fish consumption advisories across WI. We are lacking a good understanding of the risks these chemicals pose to our wild fish. This project will address this data gap by comparing the toxicity of different PFAS chemicals in various species of fish embryos/larvae.

Project tasks

Run standard toxicity assays, work with live animals (fish), data analysis, general fish care (some weekend work required), light cleaning of glassware and fish tanks

Required Knowledge, Skills & Abilities

- Coursework in general chemistry and biology
- Ability to follow protocols carefully and work independently following training

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Experience working with microscopes
- Coursework in upper-level chemistry, developmental biology, ecology, ichthyology, and/or physiology would be helpful.

Project Code: LAX-04

The impact of the surfactant, Dispersit, on the bacteria found in Myrick Marsh

Mentor:	Bonnie Jo Bratina
Mentor's institution:	UW - La Crosse
Project location:	La Crosse, WI
Keywords:	Bacteria, surfactant, biodegradation, hybridization, laboratory analysis

Project description

My lab is looking at the impact of oil and a surfactant (a chemical used in freshwater oil spills to help with remediation of the spill) on the bacterial community in the local Myrick Marsh. Previous research has indicated that the surfactant has a greater impact than the oil, so we have been isolating organisms from the marsh and testing whether they can grow using the surfactant as a carbon and energy source and at what concentration, if any, they are inhibited by the surfactant even if they can't use it. We have not been able to isolate some members of the community that the previous research identified as being affected by the presence of the surfactant, so I intend to use a targeted approach to get these bacteria. I will use specific DNA probes to identify where and when the organisms are present and if their numbers increasing to help determine what nutrients and conditions are necessary to isolate these organisms. Additionally, I want to sequence the 16S rRNA gene from some of the isolates to aid in identifying them.

Project tasks

Making media, sampling water, inoculating media/streaking plates, doing hybridizations with DNA probes, doing PCR reactions, some computer work to analyze results such as sequence DNA

Required Knowledge, Skills & Abilities

- Basic lab skills like using scales, pipettes, and micropippetors

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Some basic microbiology skills, like streaking a plate and using a microscope.

Project Code: MAN-01

Diving into History: A Research Scholar Opportunity at the Wisconsin Shipwreck Coast National Marine Sanctuary

Mentor:	Russ Green
Mentor's institution:	NOAA / Wisconsin Shipwreck Coast National Marine Sanctuary
Project location:	Wisconsin Maritime Museum, Manitowoc, WI
Keywords:	Maritime history, maritime archaeology, shipwrecks

Project description

Designated in 2021, Wisconsin Shipwreck Coast National Marine Sanctuary (WSCNMS) provides stewardship for our nation's maritime heritage in Lake Michigan. Co-managed by NOAA and the state of Wisconsin, the sanctuary expands on the state's 30-year management of these historic sites, bringing new opportunities for research, resource protection, and education. The 36 historic shipwreck sites within the sanctuary represent vessels that played a central role in building the nation between the 1830s and 1930s. Twenty-seven are listed on the National Register of Historic Places and research suggests that another 60 shipwrecks may yet to be discovered.

The scholar's work will be hands-on in both the artifact and historical research areas, and lends itself well to a final project report/write up. Related experiences/opportunities, such as on-water fieldwork, are anticipated as these projects develop.

Project tasks

The core activities for the research scholar include: 1) assisting with the assessment, photomodeling, and cataloging of a large collection of artifacts related to marine sanctuary and Lake Michigan shipwrecks; 2) conducting archival research at Wisconsin Maritime Museum, regional historical societies, and online collections to support historical analysis of sanctuary shipwrecks, other maritime cultural resources, and maritime cultural landscape.

Required Knowledge, Skills & Abilities

- Ability to work semi-independently, while given regular guidance and direction.

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- History or archaeology degree seekers encouraged to apply. Strong organizational and communication skills are helpful.

Project Code: MKE-01

Virtual Water Trade

Mentor:	Avik Chakrabarti
Mentor's institution:	UW – Milwaukee
Project location:	Milwaukee, WI
Keywords:	Economics, virtual water trade, data analysis

Project description

Virtual water trade is typically defined as international trade in water-intensive commodities. With the expansion of international trade in agricultural crops, virtual water trade has gained significant mileage. How can we distinguish the contribution of technology from that of relative endowments to virtual water trade? This challenging question has stimulated much debate among scientists, academics, and government policymakers ever since Merrett (1997) noted that the water content of imported grain is much less than the totality of water that was used to grow the grain. Early contributors, to this debate, had pinned the driving force behind virtual water trade to technology (Ricardian Theory) while an alternative explanation is founded on factor proportions (Heckscher-Ohlin-Samuelson Theory). In this project, the student mentee is expected to gain hands-on experience in data modeling and analysis in the process of measuring the factor content of virtual water trade to distinguish the contribution of technology from that of relative endowments.

Project tasks

Data management, modeling, and analysis: deliverables include the completion of a short communications assignment and a poster presentation.

Required Knowledge, Skills & Abilities

- Familiarity with reproducible data management, modeling, and analysis including use of an integrated statistical computing environment, data wrangling, R programming language, data graphics and visualization, and report generation using R Markdown.

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Experience using R to manipulate data; perform exploratory data analysis; write conditional expressions, loops, and functions; manipulating data matrices and arrays; extracting data from text; and making high level visualizations of data.

Project Code: MKE-02

The invasive crustacean, Hemimysis anomala: a gateway for microplastics to enter the Lake Michigan foodweb?

Mentor:	John A Berges
Mentor's institution:	UW – Milwaukee
Project location:	Milwaukee, WI
Keywords:	Aquatic invasive species, microplastics, chemistry, laboratory analysis, fieldwork

Project description

The mysid *Hemimysis anomala* (the "bloody red shrimp") is an invasive crustacean that established in Lake Michigan by 2007. Hemimysis inhabits shallow waters and has colonized many breakwalls in Wisconsin harbors. It is described as an opportunistic omnivore and we have been studying its diet and potential effects on the foodweb, but we have also found that it will consume microplastics particles non-selectively. Since Hemimysis is eaten by harbor-resident fishes (e. g. juvenile large- and small-mouth bass) and transients (e. g. alewife, rainbow smelt, and juvenile perch, trout, and salmon), this means that the crustaceans could facilitate the transfer of plastics into the foodweb. The significance of this is unclear, so we will: a) survey Hemimysis captured from Lake Michigan to determine what sort of plastic 'load' they carry, and b) conduct laboratory feeding experiments with plastic particles to characterize their feeding, allowing up to make predictions and estimate which stages and which particles sizes are most likely to be problematic.

Project tasks

Collection of animals from Lake Michigan using nets and traps. Culturing animals in aquaria. Feeding experiments with microplastics. Chemical analyses and staining for plastics. Microscope observations and quantitation.

Required Knowledge, Skills & Abilities

- Basic introductory chemistry course needed
- Willingness to work along rocky shorelines and from small boats.

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Experience with biochemical assays and some microscopy would be perfect.
- Experience working from boats or shoreline desirable.

Project Code: MKE-03

Environmental fate of emerging contaminants

Mentor:	Laodong Guo
Mentor's institution:	UW – Milwaukee
Project location:	Milwaukee, WI
Keywords:	Emerging contaminants, analytical chemistry, laboratory analysis

Project description

We seek to understand the fate and transport of emerging contaminants such as microplastics, nanoplastics and Per- and Polyfluorinated Substances (PFAS), and their interactions with natural organic matter and sediment in aquatic environments. Students will learn and conduct literature reviews, experimental designs, relevant laboratory techniques, and instrumentation, such as Total Organic Carbon analyzer, ultraviolet-visible spectroscopy, fluorescence spectroscopy, dynamic light scattering, and others for the characterization of dissolved organic matter (DOM), plastic polymers, sediment, and changes in surface and colloidal properties of macromolecules and nanoparticles.

Project tasks

Design and carry out a research project related to emerging contaminants, natural organic matter, and their carriers.

Required Knowledge, Skills & Abilities

- Junior or senior with science background

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Some chemistry and laboratory experience

Project Code: MKE-04

Study of Dietary Nutrient Optimization and Microplastic Contaminants in Fish Feed

Mentor:	Dong-Fang Deng
Mentor's institution:	UW – Milwaukee
Project location:	Milwaukee, WI
Keywords:	Fish diets, microplastics, stress tolerance, laboratory analysis

Project description

The first objective of this project centers on optimizing the combination of nutrients in formulated fish feed to bolster fish farming production and improve fisheries management. We are actively developing feeds that incorporate varying levels of macronutrients (including protein, lipid, and carbohydrate) as well as feed additives designed for species like yellow perch and walleye. The quality of these feeds will be assessed based on their impact on fish growth, nutritional quality, and stress tolerance.

The second objective of this project is to investigate the effects of microplastic-contaminated feed on fish at various life stages. We are utilizing models such as yellow perch, walleye, and lake sturgeon to examine their responses to different sizes and forms of microplastics. We will assess the impacts of microplastic contamination on fish by evaluating their growth, survival rates, nutritional status, and overall health.

Project tasks

Water quality monitoring, feed preparation for feeding, caring for fish during feeding trial (weigh and feed fish, clean fish tanks), record data, attend lab meetings, prepare lab reports

Required Knowledge, Skills & Abilities

- Basic math
- Basic software (word, excel, and power point)
- Willing to work in a fish wet lab setting
- Good team work

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Previous experience in fish lab or chemistry lab is preferred but not required.

Project Code: MKE-05

Design a portable sensor device to detect bacteria in water

Mentor:	Junjie Niu
Mentor's institution:	UW – Milwaukee
Project location:	Milwaukee, WI
Keywords:	Engineering, biosensor design, bacteria detection

Project description

The traditional and commercial bio-sensing methods such as lateral flow immunoassay, fluorescent microarray and electrochemical methods, polymerase chain reaction (PCR)-based methods, DNA microarrays, DNA sequencing technology, enzyme-linked immune sorbent assay (ELISA) require expensive reagents, highly sensitive instruments, and complex quantification methods to achieve sensitive detection. We propose to develop a portable biosensor with high sensitivity, rapid detection and low maintenance cost by using anti-microbial protein (AMP) anchored on graphene to detect various bacteria in water system.

Project tasks

Participate the sensor design and performance tests

Required Knowledge, Skills & Abilities

- Any engineering background is welcome

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- None

Project Code: MKE-06

Fabrication of functionalized nanomaterials for electrochemical-based bacterial detection in water

Mentor:	Junjie Niu
Mentor's institution:	UW – Milwaukee
Project location:	Milwaukee, WI
Keywords:	Engineering, microbial science, biosensors, bacteria detection

Project description

The contamination of bacterial pathogens in the drinking water causes various diseases in human beings. The conventional bacterial detection methods such as polymerase chain reaction (PCR)-based methods, DNA microarrays, DNA sequencing technology, enzyme-linked immune sorbent assay (ELISA) are either energy/time intensive or restricted due to high operational cost. To overcome this problem, researchers are trying to design a novel bacterial detection method, which detects the bacterial contaminants in the drinking water faster (less than 20 mins) with high accuracy and detection limit. The recent advances in nanoscience and technology and electrochemical methods provide an opportunity to solve this technical problem. The nanomaterials have a high surface area, surface active functional groups, easy functionalization, and readily interact with the bacterial species and provide noticeable signals in the electrochemical device. The electrochemical signal is directly proportional to the number of bacteria (in CFU/mL) in water. Therefore, this project aims to develop a novel, low cost and portable electrochemical-based biosensor with functionalized nanomaterials.

Project tasks

Sample preparation and performance tests

Required Knowledge, Skills & Abilities

- Any engineering background is welcome

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Preparation of media
- Culturing bacteria
- Basics of nanomaterials
- Electrochemical testing methods

Project Code: MKE-07

Organic pollutants removed from water

Mentor:	Junjie Niu
Mentor's institution:	UW – Milwaukee
Project location:	Milwaukee, WI
Keywords:	Engineering, water treatment technology, PFAS

Project description

The polyfluoroalkyl substances (PFAS) is a man manmade chemical and it is a collection of several subclasses of chemicals. The general molecular structure of PFAS consists of single and multiple aliphatic chains, with some of the hydrogens replaced by fluorine molecule and which contains at least one perfluoroalkyl moiety (Lehmler HJ, 2005). This carbon-fluorine bond is extremely strong, the fluorinated hydrocarbons are stable even at a higher temperature such as 150 °C, non-degradable, non-flammable and degradable. Perfluorinated compounds (PFCs) have been used extensively in a variety of products and industries. Unfortunately, these applications contributed to environmental contamination of soil and water, and in the Unites States, most of the people are detected with PFAS in their serum level. The toxicity studies were conducted using animals and they have found that long chain PFAS can cause hepatotoxicity, disruption of cells and degradation of lipids and it leads to endocrine disruption, neurological disorder, tumor in multiple organs and finally it leads to death (EPA, 2009).

The aim of this project is to assist to develop a hybrid material that can adsorb the PFAS molecules and degrade in continuous column set up. The hybrid composite material will be modified with several additives and developed into an adsorbent material that can remove PFAS molecule from water.

Project tasks

Participate in sample synthesis, characterization and performance tests

Required Knowledge, Skills & Abilities

- Any engineering background is welcome

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Any experience in a laboratory setting

Project Code: MSN-01

Resource recovery from wastewater using bioelectrochemical processes

Mentor:	Mohan Qin
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Chemistry, ion transport, nitrogen recovery, wastewater treatment

Project description

Recovery of nitrogen resources from wastewater is viewed as a new strategy to simultaneously fulfill the roles of nitrogen removal and fertilizer production. Membrane electrochemical system (MES), which uses electrochemical redox reactions to transport ions through ion exchange membranes, has been considered as an effective technology for separating ammonium ions from the wastewater. Ammonium ions move through the cation exchange membrane with the assistance or competition of other ions, and then are collected at the cathode side. However, only limited discussion has been reported regarding the impact of co-existing ions on the ammonium ion transport. We will use both experimental data and mathematical models to systematically investigate the ion transport behaviors in membrane electrochemical system.

Project tasks

Collect experimental data from reactors, analyze experimental data, and prepare technical reports

Required Knowledge, Skills & Abilities

- Basic chemistry

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- None

Project Code: MSN-02

Mapping aquifer susceptibility to PFAS contamination with hydraulic and geophysical methods

Mentor:	Michael Cardiff
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Drinking & groundwater, PFAS, spatial analysis, fieldwork

Project description

The Town of Campbell, Wisconsin lies on French Island, a small island located on the Mississippi River. Campbell is almost entirely reliant on shallow wells for residential drinking water. Recently, however, it has become clear that the shallow aquifer beneath the island has been contaminated by PFAS (per- and polyflouralkyl substances) associated with fire-fighting operations at the La Crosse Municipal Airport. To obtain a reliable, long-term source of drinking water for its residents, Campbell is in the beginning stages of developing a deeper water supply, pulling from a deeper sandstone aquifer. To support this effort, our project team is mapping the extent of protective "confining layers" to predict the long-term safety of this deeper pumping. We will use mapping capabilities, existing data sources, and geophysical surveys to build an understanding of the subsurface layers and aquifers beneath French Island and help ensure clean drinking water.

Project tasks

Organization and compilation of existing data sources; participation in 1-2 week field campaign in Campbell, WI, including help with geophysical surveying and equipment management; keeping diligent field notes; learning about hydrology and hydrogeology

Required Knowledge, Skills & Abilities

- Ability to carry up to 50 lbs
- Ability to travel for field work in Western WI (up to 2 weeks).
- Basic familiarity with computing and electronics
- Basic knowledge of GIS and working with spatial data

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Programming background (e.g., Python)
- Prior experience with geologic, hydrologic, or geophysical field equipment.

Project Code: MSN-03

Monitoring Aquatic Species Using Environmental DNA (eDNA) in the Wisconsin River

Mentor:	Amy Workman
Mentor's institution:	UW – Madison
Project location:	Upham Woods Outdoor Learning Center, Wisconsin Dells, WI
Keywords:	Aquatic invasive species, environmental DNA, biotechnology, laboratory analysis, fieldwork

Project description

Upham Woods is a residential, youth-focused, outdoor learning center located on the Wisconsin River, just north of Wisconsin Dells. We received a Wisconsin Sea Grant to create a novel program to monitor aquatic invasive species using environmental DNA (eDNA). The US Fish and Wildlife Service Great Lakes Region 3 uses eDNA to monitor Bighead Carp (*Hypophthalmichthys nobilis*) and Silver Carp (*H. molitrix*) in the Mississippi, Illinois, and Des Plaines rivers, as they have been steadily dispersing upstream and posing a threat to the Great Lakes ecosystem. The technique is appropriate for the Wisconsin River as the Department of Natural Resources discovered five adult bighead carp below the Prairie Du Sac Dam in 2017.

This project will involve working with a mentor to develop and field test sample collection and laboratory analysis of river samples to isolate and amplify DNA from target species. The goal of the project is to produce an innovative, field-tested set of eDNA sampling collection methods and laboratory protocols intended for use by high school aged youth to detect the presence or absence of both native (positive control) and invasive (experimental variable) species.

Project continues on the next page

Project tasks

Meet with project staff to review preliminary field sample collection and laboratory techniques and protocols.

Initially work with one or more mentors to collect water samples from the Wisconsin River at a variety of locations on the Upham Woods campus.

Use a peristaltic pump, tubing, filters and sample tubes to collect aquatic samples.

Work with one or more mentors to proficiently use basic biotechnology equipment including micropipettes, tubes, DNA extraction buffers/reagents, microcentrifuges, thermocycler, oligos, and computer software to extract, purify, amplify and analyze DNA results.

Run multiple assays to field test, troubleshoot, and evaluate the quality of the eDNA sampling collection methods and laboratory protocols.

Modify field collection and laboratory protocols to maximize successful eDNA collection and analysis.

Work with one or more mentors to write a plain language laboratory background and procedure for use by high school aged youth.

Provide input to an evaluation team on the project's activities and on changes in knowledge and skills in conducting field/laboratory investigations using eDNA.

Required Knowledge, Skills & Abilities

- Ability to work in a team setting with enthusiasm and creativity, as well as work independently.
- Ability to hike on uneven terrain in a wide variety of temperatures and environmental conditions.
- Knowledge of basic biotechnology principles and techniques, including use of P2-P1000 micropipettes, centrifuges, and gel electrophoresis equipment.
- Ability to follow, troubleshoot, and modify sample collection and laboratory protocols based on pilot tests.
- Ability to organize, analyze, and present scientific data in commonly used programs such as Word, Excel, and Google products (slides, sheets, etc).

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Experience performing standard column extractions to isolate and purify DNA from liquid samples.
- Experience using a thermocycler to amplify segments of DNA using polymerase chain reaction (PCR) on samples.

Project Code: MSN-04

Elucidating PFAS Bioaccumulation in aquatic ecosystems

Mentor:	Gavin Dehnert
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Chemistry, fish, PFAS, fieldwork

Project description

The presence of per and poly-fluoroalkyl substances (PFAS) in aquatic ecosystems of the Great Lakes Region is of concern. Because PFAS can be found in plants and animals, it is critical to decipher how much PFAS mixtures are in flora and fauna that are of concern for human consumption (e.g., wild rice, sugar bush sap, and fish). Therefore, we are assessing aquatic environments for PFAS contamination in the Ceded Territories and determining the accumulation of PFAS in different plants and animals.

Project tasks

Field sampling, LC-MS analysis

Required Knowledge, Skills & Abilities

- Hard work ethic
- Willingness to learn
- Driver's license

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Chemistry Background
- Field work experience
- LC-MS experience

Project Code: MSN-05

Real-time monitoring of pesticides in agricultural runoff using hot spot normalized surface-enhanced Raman spectroscopy

Mentor:	Haoran Wei
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Analytical chemistry, contaminants, water quality, laboratory analysis, data analysis

Project description

The primary goal of the proposed research effort is to develop an inexpensive and rapid method for real-time quantification of pesticides in agricultural runoff. According to the United States Geological Survey, a half million tons of pesticides have been applied to crops annually in the United States, which can transport to the natural water systems via agricultural runoff and threaten the safety of aquatic eco-systems and human health. Quantifying pesticide loads in agricultural runoff at a high spatial and temporal resolution can guide the stakeholders to make data-driven action plans for pest management and water protection. However, ramping up the detection capacity for pesticide analysis in water is largely limited by the current analytical methods, which are expensive, time-consuming, and restricted to specialized laboratories. We aim to overcome these disadvantages by leveraging a recently developed sensing technology – hot spot normalized surface-enhanced Raman spectroscopy. As contaminated water flows in our novel sensing platform, the targeted pesticides will partition onto a plasmonic passive sampler. The gold nanoparticles housed in the plasmonic passive sampler will then enhance the Raman scatterings of the pesticides upon laser interrogation and be used for their identification. The simultaneously enhanced elastic scatterings from the amplified spontaneous emission of laser will be used as an internal standard for pesticide quantification. The performance of the proposed sensing platform will be validated using field samples from the Central Sands region in Wisconsin and the standard analytical method based on liquid chromatography–tandem mass spectrometry.

Project tasks

Raman spectrum collection and analysis for neonicotinoid pesticides

Required Knowledge, Skills & Abilities

- General chemistry
- Laboratory skills
- Basic data processing and plotting

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Analytical chemistry
- Environmental Science and Engineering

Project Code: MSN-06

Fate of per- and polyfluoroalkyl substances (PFAS) in aquatic systems

Mentor:	Christy Remucal
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Analytical chemistry, PFAS, laboratory analysis, fieldwork

Project description

Per- and polyfluoroalkyl substances (PFAS) are a large group of organic chemicals that have been used in numerous industrial and consumer applications (e.g., water-repellent cookware, paper products, and fire-fighting foams). These persistent chemicals have been linked to multiple health concerns, including developmental toxicity, cancer, and bioaccumulation. The REU student will assist our PFAS research team on several projects related to measuring PFAS in aquatic systems, including surface water, groundwater, and precipitation. This research seeks to better understand the fate and transport of PFAS in the environment, as well as to develop forensics methods to identify PFAS sources. This research will involve using solid phase extraction for sample preparation and analysis of PFAS by liquid chromatography-tandem mass spectrometry, as well as measurement of other background water chemistry parameters. The REU student will also gain exposure to other ongoing aquatic contaminant research in our lab, familiarize themselves with scientific literature, and potentially assist with sample collection in the field.

Project tasks

Learn to extract and analyze PFAS in environmental samples, learn to use a variety of analytical instruments to characterize background water chemistry

Required Knowledge, Skills & Abilities

- Interest in environmental chemistry
- General chemistry or a similar course
- Willingness to work in lab and participate in field sampling

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Analytical chemistry course
- Previous lab experience

Project Code: MSN-07

Understanding Pollution and Environmental Processes in the Greater Milwaukee Estuary

Mentor:	Inna Popova
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Chemistry, emerging contaminants, PFAS, water treatment

Project description

The Greater Milwaukee Estuary faces pollution from emerging contaminants, such as PFAS and pharmaceuticals, posing risks to both the environment and public health. These contaminants can be removed from freshwater through physicochemical and biogeochemical processes including association with dissolved organic matter and deposition into sediment. Various contaminant species possess distinct chemical and surface properties that lead to different levels of interaction with natural organic matter and particle surfaces. This results in distinct environmental behaviors and fates in the water column, with some rapidly depositing in sediment and others remaining in the water column for an extended period, persistently polluting drinking water sources. This project is focused on the understanding of removal and deposition processes of these emerging contaminants, including the role of multiphase processes and the pollution history of PFAS and pharmaceuticals in the Greater Milwaukee Estuary.

Project tasks

Collecting and preparing samples of freshwater and sediments; analyzing samples for chemicals of emerging concern using HPLC/Q-TOF MS; analyzing data to elucidate trends and driving processes.

Required Knowledge, Skills & Abilities

- Basic laboratory skills
- Experience with literature search and report writing
- Creative thinking
- Scientific curiosity

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Experience with wet chemistry analysis
- Knowledge of extraction and chromatography techniques
- Data analysis

Understanding angler behavior and values among urban anglers of the Lake Michigan shoreline

Mentor:	Olaf Jensen
Mentor's institution:	UW – Madison
Project location:	Milwaukee, WI
Keywords:	Fish and fisheries, angler behavior, social science, fish management, fieldwork

Project description

Great Lakes anglers represent diverse ethnicities, genders, incomes, languages, and demographics. Much of our current understanding of Great Lakes anglers has focused on boat anglers, often targeting salmonids, who are likely not representative of the attitudes and values of shore anglers. Shore anglers likely target different species and comprising multiple underrepresented local communities. Therefore, standard agency survey methods that underestimate the true prevalence of shore angling can lead to an inequitable investment of agency resources. This project seeks to address this gap by measuring urban shore angling effort, catch, and harvest along the Milwaukee shoreline of Lake Michigan and comparing attitudes and values about fisheries management among boat and shore anglers. Ultimately, we will use this information to assess inequities in fishery management investment among concerns of boat and shore anglers. Anglers will be interviewed using in-person creel surveys along the Lake Michigan shoreline in the greater Milwaukee area. During interviews, anglers will be asked about their fishing trip, as well as the importance of fishing to their lifestyle, and other socio-demographic information. Using these data to describe behaviors and desires of shore anglers could help ensure equitable, sustainable fisheries management for all types of Great Lakes anglers.

Project tasks

The mentee will join the creel survey team and do day trips to Milwaukee to interview anglers along the Lake Michigan and river shorelines. Mentee will be responsible for conducting interviews, identifying and measuring fish, and recording and entering data.

Required Knowledge, Skills & Abilities

- Comfortable approaching and speaking with strangers (anglers) to conduct interviews.
- Comfortable working (with a partner) on the waterfront in an urban environment
- Willing to work on weekends and at night
- Willing and able to complete human subjects research training (an online course required for anyone conducting research with people)

Project continues on the next page

Project Code: MSN-08

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Enjoy talking with anglers and the public - are you a people person?
- Driver's license
- Spoken Spanish or Hmong
- Local knowledge of Milwaukee shore fishing sites
- Identification of Wisconsin fishes, particularly Great Lakes fishes
- Experience collecting and entering data (e.g., in Microsoft Excel)

Project Code: MSN-09

Tracing Nutrient, Microplastic and Nutrient Inputs into a WI Lake after Storm Events

Mentor:	Erica Majumder
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Chemistry, harmful algal blooms, microbial communities, microplastics, laboratory analysis, fieldwork

Project description

The student will participate in an ongoing project we have studying the interactions of microplastics and Harmful Algal Bloom (HAB) causing microbial communities in Wisconsin Lakes. Since microplastics and HAB microbes occupy the same place in the water column, we want to understand if there is an interaction between these two contaminants and what the consequences of the interactions are on microbial growth, toxin production and fate of the microplastics. In summer 2024, we will be studying Shangrila-Benet Lake in Southern Wisconsin. The lake has half agricultural and have residential/recreational use. There are no natural inputs and only 1 outflow making it a good system to study these questions. We are particularly interested in storm events as the increased runoff brings an influx of both nutrients and microplastics.

Project tasks

Collecting water samples from Shangrila-Benet Lakes, Measuring nutrient concentrations, Characterizing microplastics found in samples, Performing experiments with cyanobacteria, Microbial Community Sequencing.

Required Knowledge, Skills & Abilities

- Knowledge of basic chemistry lab skills acquired through general, organic or environmental chemistry
- Knowledge of basic biology
- Willingness to participate in field sampling

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Culturing bacteria

Project Code: MSN-10

Sustainable Aquaponics

Mentor:	Andrea Hicks
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Aquaculture, sustainability, fish, food systems

Project description

Assist on a project around closed loop food production systems. Aquaponics is the production of fish and plants in a symbiotic relationship, combining hydroponics (producing plants in a soilless environment) and aquaculture (farmed fish). The selected student will assist a graduate student working in this area, on the environmental impacts of this system of food production. Past students have completed activities such as working to design surveys, gathering literature data, and starting to design a coloring book focused in this area. The exact summer project will be determined based on the interests of the selected student and the needs at the time of the research project.

Project tasks

Office based research (we are not a wet lab experimental research group)

Required Knowledge, Skills & Abilities

- Enthusiasm for sustainability and/or food production systems
- Ability to handle data and use office tools such as excel

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Interest in research

Project Code: MSN-11

Exploring the impact of temporal variations in hyporheic zone fluxes on phosphorus transport and release in the Wisconsin River

Mentor:	Christopher Zahasky
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Groundwater, chemistry, phosphorus fate & transport, rivers

Project description

Elevated phosphorus (P) in surface waters can lead to eutrophication and impact aquatic health, human health, and local economies. Hyporheic zones represent an important reservoir for P storage. The transport, transformation, and sorption of P in the hyporheic zone can be impacted by river stage fluctuations, groundwater surface-water interactions, and landscape heterogeneities. The fate and transport is expected to be even more complex on managed rivers where sudden and episodic pulses of water from dam releases may cause reversals in hyporheic flow and impact the stability of P sorbed in the hyporheic zone. The aim of this project is to evaluate P fate and transport as a result of transient river stage changes associated with a dam-controlled reach of the Wisconsin River. This will include field sampling and laboratory measurements.

Project tasks

Water sampling, soil collection, column experiments, water chemistry analysis

Required Knowledge, Skills & Abilities

- Basic chemistry background
- Experience with Excel or Google Sheets

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Ability to paddle a canoe

Project Code: MSN-12

Impacts of invasive zebra mussels on the lower food web of lakes

Mentor:	Jake Vander Zanden
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Aquatic invasive species, zooplankton, harmful algal blooms, fieldwork

Project description

Invasive species have numerous well-documented impacts on aquatic ecosystem water quality and native biota. However, the broader effects of invasive species on food webs are exceedingly difficult to predict. In Lake Mendota, zebra mussels invaded in 2015 with preliminary data indicating they have influenced the timing and composition of cyanobacterial blooms. This project will test the hypothesis that zebra mussels preferentially graze on particle-associated bacteria and avoid cyanobacteria. This project will also address these questions over seasonal time scales by running mesocosm experiments at different time points across the summer.

Project tasks

Assist in collection of data from Lake Mendota, designing and running mesocosm experiments; microscopy; analysis of existing data

Required Knowledge, Skills & Abilities

- Intro biology and chemistry courses
- Comfortable on boats or enthusiastic about learning
- Interest in field sampling and experimental work

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Experience with boats
- Previous field research experience

Project Code: MSN-13

Cyanobacteria diversity and dynamics in a eutrophic lake

Mentor:	Trina McMahon
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Analytical chemistry, cyanobacteria communities, water quality, microbes, laboratory analysis, fieldwork

Project description

The McMahon lab has been studying harmful blue-green algae (cyanobacteria) blooms in Lake Mendota for 15 years. A summer student would continue this work through a combination of field work and lab work. The student will be a member of our summer Lake Mendota Microbial Observatory field crew that collects samples twice weekly, weather permitting. The student will learn basic methods to measure water quality. Under the mentorship of a PhD students in Genetics, the summer student will collect water samples specifically for isolating cyanobacteria. The student will learn how to prepare selective culture media, to maintain cultures on both solid media (agar) and in liquid. They will also learn how to identify cyanobacteria using a microscope. This work will contribute to our broader understanding of how cyanobacterial communities change across the summer season, with implications for production of potent toxins and degrading water quality.

Project tasks

Assist with routine field work. Collect samples for culturing cyanobacteria. Make cultures and transfer isolates. Microscopy to identify isolates.

Required Knowledge, Skills & Abilities

- Comfortable with water or boats
- Willing to tolerate the sometimes-uncomfortable parts of field work.

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Pipetting
- Microbial culturing
- Simple analytical chemistry (e.g. colorimetric assays)

Project Code: MSN-14

Adventures in stream restoration

Mentor:	Titus Seilheimer
Mentor's institution:	UW – Madison
Project location:	Manitowoc, WI
Keywords:	Stream ecology, fish ecology, restoration, fieldwork

Project description

Dip your toes in the field of aquatic habitat restoration in Northeastern Wisconsin with this opportunity to contribute to several restoration and monitoring projects. We are collecting pre-restoration data in several streams that will be used to track improvements through time. There will also be opportunities to survey fish species in Green Bay's coastal wetlands. Work locations include bay of Green Bay, Two Rivers, Manitowoc, and Port Washington.

Project tasks

Assist PI with planning and conducting monitoring in streams and coastal wetlands. Map stream habitat and physical conditions, measure stream flow, collect water for phosphate measurements, collect and identify invertebrates. Assist with wetland fish monitoring.

Required Knowledge, Skills & Abilities

- Ability to work in all conditions and weather
- Ability to lift 40 pounds and walk on uneven ground
- Interest in aquatic ecology and restoration
- Basic science experience
- Willingness to learn fish identification

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Coursework in stream ecology and aquatic science
- Statistical analysis
- GIS experience
- Comfortable in boats and water

Project Code: MSN-15

Broadening participation in water research by developing and communicating an accessible citizen science module.

Mentor:	Jessica Hua
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Global change biology, ponds, amphibian declines, pollutants, citizen science, science communication, fieldwork

Project description

Aquatic ecosystems face diverse challenges including shifting climate patterns, pollutants, and infectious diseases emerging at unprecedented rates. The ability to detect and monitor these threats and their effects on wildlife across space and time are imperative to protecting aquatic ecosystems. However, the ability to sample broad enough spatial scales across multiple time points remains a significant challenge for scientists. To address this gap, citizen science initiatives where community members contribute to data collection across multiple sites and times, are often described as a win-win. This project aims to design accessible citizen science methods for detecting and evaluating threats to ponds and the wildlife within. Towards this goal, the project has three phases (1) Gain field experience and identify threat of interest by participating in collaborative lab survey ponds around Madison, WI. (2) Design and test protocols and community science data collection kits. (3) Generate community interest in community science via non-traditional science communication avenues (past efforts integrated art, social media, card games).

Project tasks

This project has three main tasks (1) Gain field experience and identify threat of interest by participating in collaborative lab survey ponds around Madison, WI. (2) Design and test protocols and community science data collection kits. (3) Generate community interest in community science via non-traditional science communication avenues (past efforts integrated art, social media, card games).

Required Knowledge, Skills & Abilities

- Team-oriented
- Strong communicator

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Amphibian ecology

Project Code: MSN-16

Urban Pond Water Quality

Mentor:	Grace Wilkinson
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Urban pond ecology, greenhouse gasses, field work, science communication

Project description

The Midwest climate is rapidly changing with storms increasing in intensity and frequency. There are tens of thousands of storm water ponds in the upper Midwest, constructed for flood control and nutrient management, protecting humans and urban infrastructure from large precipitation events. Despite having 300 urban ponds in Madison alone, we know surprisingly little about these 'hotspots' of nutrient cycling, greenhouse gas production, and algal blooms. As a part of the North Temperate Lakes Long-Term Ecological Research program, we've developed an "Urban Pond Observatory" in Madison, Wisconsin with the goal of understanding how these numerous, but often overlooked, aquatic ecosystems function ecologically and respond to extreme events. The student in this position will contribute to ongoing data collection in a suite of urban ponds as a part of our larger research team while also developing their own research question on greenhouse gas production, harmful algal bloom dynamics, or phosphorus cycling. Additionally, we host a number of outreach events at the ponds to share our work with community members; the research team, including the student in this position, contributes to these events.

Project tasks

Weekly team monitoring of urban ponds including water, sediment, and greenhouse gas sample collection; sample processing and analysis in the lab for nutrients, carbon, gases, and algal pigments; developing (with mentor guidance) and executing an independent research project related to greenhouse gas production, nutrient cycling, or harmful algal blooms in the ponds.

Required Knowledge, Skills & Abilities

- Interest in field work in an urban setting
- Willingness to contribute to team science
- Interest in science communication and outreach

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Comfort operating canoes and/or kayaks
- Previous experience (including through coursework) in a chemistry lab

Project Code: MSN-17

Whole-Lake Experiment to Test Resilience to Algal Blooms

Mentor:	Grace Wilkinson
Mentor's institution:	UW – Madison
Project location:	Land O'Lakes, WI – ND Environmental Research Center
Keywords:	Harmful algal blooms, ecosystem experiment, fieldwork

Project description

Ecosystems are at widespread risk of losing resilience due to environmental changes from climate and other human actions. In lakes, the loss of resilience to nutrient loading can result in harmful algal blooms. As a part of a multi-institutional team of investigators, we will be performing whole lake experiments in northern Wisconsin, designed to directly alter resilience of phytoplankton to external nutrient loading. The primary goal of the experiment is to test if resilience can be enhanced and to assess the performance of various resilience metrics, thereby advancing our understanding of ecosystem resilience, methods for tracking environmental change, and providing management insight. The student in this position will be part of a team of researchers performing the whole-lake manipulations, collecting daily data, and contributing to our 40-year record of limnological monitoring. In addition to contributing to whole-lake experiment, the student in this position will develop an independent research project focused on zooplankton grazing, phosphorus cycling, or deep-water algal blooms.

Project tasks

Contribute to whole-lake manipulation through daily nutrient additions and monitoring (in conjunction with team of researchers), contribute to weekly water quality monitoring and sample analysis, develop (with guidance of mentor) an independent research project focused on zooplankton grazing, phosphorus cycling, or deep-water algal blooms.

Required Knowledge, Skills & Abilities

- Interest in limnology and harmful algal blooms
- Ability to work in a team setting

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Comfort with being on the water in small water craft (e.g., 10 ft boats, canoes)
- Previous experience in a chemistry lab (experience through coursework is fine!)

Project Code: MSN-18

Neonicotinoid groundwater leaching potential from potato cultivation

Mentor:	Matt Ginder-Vogel
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Neonicotinoid pesticides, potatoes, pollinators, fieldwork, laboratory analysis

Project description

The Central Sands region of Wisconsin is an intensively farmed highly productive growing region for high value vegetable crops, notably potatoes. However, the Central Sands has coarse grained soils and shallow depth to groundwater, making it particularly vulnerable to leaching of agricultural chemicals into groundwater and surface water. Neonicotinoids are commonly used on crops in this region and nationally potato crops are among the most treated (USEPA 2020). Well sampling by the Wisconsin Department of Agriculture, Trade and Consumer Protection have found numerous sites with detectable levels of neonicotinoid pesticides in this region. While it is known that regional use is leading to neonicotinoid infiltration into groundwater, the contributions of individual field-scale operations using seed treatments and soil application have not been quantified. Additionally, common farm management practices (companion cropping and variable irrigation rates) that may mitigate pesticide leaching have likewise not been quantified on the field-scale. Quantifying the potential leaching of field scale seed treatment and soil applied neonicotioid pesticides coupled with the impacts on pesticide leading by farm management practices are the primary goals of this project.

Project tasks

The mentee will assist with field sampling, sample preparation and analysis.

Required Knowledge, Skills & Abilities

- Some chemistry lab experience
- Desire to work in a potato field

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Organic chemistry
- Soils experience

Ecohydrology of Solar Farms

Mentor:	Steve Loheide
Mentor's institution:	UW – Madison
Project location:	Madison, WI
Keywords:	Ecohydrology, soil moisture, groundwater, vegetation, fieldwork, data analysis

Project description

Large-scale solar power generation has grown rapidly in WI during the last four years due to plummeting costs of photovoltaic solar panels and installation, which is helping to expand the portfolio of renewable energy generation in the state. Vegetation growing under the solar panels is sheltered from precipitation and grows in novel shading conditions; as a result the growth of vegetation and hydrologic processes at a site are likely to be altered by solar farm development. However, since solar farming is new in WI, the hydrologic and vegetative effects are not well understood. We will measure changes in soil moisture, groundwater, plant water use, and plant growth at newly developed solar farms. This information will help design solar arrays in the future to minimize unintended consequences and maximize co-benefits including forage production to support animal grazing at solar farms.

Project tasks

Installing and downloading soil moisture and groundwater sensors; data management and cleaning; data analysis.

Required Knowledge, Skills & Abilities

- Interest in hydrology and ecosystem science
- Desire to conduct field research

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Hydrology coursework
- Data processing skills including familiarity with Matlab or R

Project Code: MSN-20

Exploring Groundwater Changes Using Tree Rings

Mentor:	Steve Loheide
Mentor's institution:	UW – Madison
Project location:	Madison, WI or Platteville, WI
Keywords:	Ecohydrology, soil moisture, groundwater, vegetation, tree rings, fieldwork, laboratory analysis

Project description

Are you interested in the interactions between trees and groundwater? Coring trees and measuring groundwater in locations throughout WI? Solving the puzzle of how water levels impact tree growth? If so, come join the Hydroecology Lab at the UW-Madison for a summer of groundwater ecohydrology! This project will involve tree coring in Dane and/or Door Counties to determine how groundwater within the root zone affects tree growth. In addition, we will be installing shallow wells to monitor groundwater levels. Collaboration with Dr. Larson of UW-Platteville's TREES Laboratory will help you develop skills in processing and recording tree ring data. The goal of this project is to analyze tree ring data from areas of differing groundwater influence. You'll be involved in a mix of fieldwork, lab work, and office-based work. Your grad student mentor Eric (ekastelic@wisc.edu) will tailor this experience to your current skill sets and interests!

Project tasks

Collection of tree cores and analysis of tree rings; collection of groundwater data; data management and analysis.

Required Knowledge, Skills & Abilities

- Interest in ecohydrology
- Interest in dendrochronology

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Basic hydrology coursework
- Data processing skills

Measurement of Microplastics in Waters, Sediments, and Biota from Wisconsin Lakes

Mentor:	Sarah Janssen
Mentor's institution:	US Geological Survey
Project location:	Madison, WI
Keywords:	Microplastics, analytical chemistry, water quality, laboratory analysis, fieldwork

Project description

This project will involve a mixture of laboratory method development and field work. The student will work with U.S. Geological Survey (USGS) and University of Wisconsin (UW) research staff to develop digestion methods for microplastics in a variety of natural matrices (e.g., sediments, soils, fish tissue, and waters). They will then apply the methods they developed to analyze environmental samples for microplastics from different Wisconsin lakes including Lakes Mendota and Monona and Devil's Lake. The student will get hands on analytical experience with different sample digestion approaches and instrumentation including a confocal Raman microscope as well as field experience for water quality sampling. At the end of the project the student will participate in developing a standard operating procedure for microplastics collection, which will be used by other USGS and UW partners.

Project tasks

Field sampling, laboratory analyses including confocal Raman microscopy and dissolved organic carbon analysis, writing and visualizing data

Required Knowledge, Skills & Abilities

- General chemistry background

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- None

Project Code: OSH-01

Investigation of microplastics in recreational waters of Wisconsin (Oshkosh)

Mentor:	Greg Kleinheinz
Mentor's institution:	UW – Oshkosh
Project location:	Oshkosh, WI
Keywords:	Microplastics, laboratory analysis, fieldwork

Project description

This project is lab-based and will include evaluating samples collected from both water and beach sand for the presence of microplastics. This will include quantification and type determination of the microplastics found using FTIR. Housing provided with a group of other student researchers. Scholars will be able to obtain a combination of laboratory and field sampling and analysis techniques.

Project tasks

Field sampling and lab evaluation of various samples.

Required Knowledge, Skills & Abilities

- Willingness to learn
- Basic biology, chemistry, and/or engineering skills
- We will teach you everything you need if you have desire to learn

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Good communication skills
- Professionalism

Project Code: OSH-02

Marine Debris Recovery and Beach Monitoring of Door County

Mentor:	Greg Kleinheinz
Mentor's institution:	UW – Oshkosh
Project location:	Sturgeon Bay, WI
Keywords:	Marine debris removal, beach monitoring, laboratory analysis, fieldwork

Project description

This project will investigate marine debris removal devices and technology such as SeaBins, Pixidrones, and marine debris boat collection and evaluation of marine debris. The project will also include beach monitoring and evaluation of beach water samples for *E. coli* and coliforms at our state-certified lab. Housing provided with a group of other student researchers. Scholars will be able to obtain a combination of laboratory and field sampling and analysis techniques.

Project tasks

Field sampling and lab evaluation of various samples.

Required Knowledge, Skills & Abilities

- Willingness to learn
- Basic biology, chemistry, and/or engineering skills
- We will teach you everything you need if you have desire to learn

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Good communication skills
- Professionalism

Project Code: SP-01

Analyzing Response Metrics to Improve Marketing and Outreach of Shoreland Health Actions

Mentor:	Eric Olson
Mentor's institution:	UW – Stevens Point and UW – Madison Division of Extension
Project location:	Stevens Point, WI
Keywords:	Environmental outreach, community-based social marketing, shoreland restoration, social psychology

Project description

The Extension Lakes summer researcher will participate in a team project that also involves the Wisconsin DNR and local governments that are working to raise awareness of environmentally-sound landscape practices on the shores of Wisconsin lakes and rivers. Previous research suggests that riparian landowners are often unaware of the harmful consequences of typical suburban-style landscaping. Research also indicates that landowners prefer not to be told of their shortcomings by state and local regulatory authorities. Wisconsin has developed an online self-assessment tool to allow landowners to learn on their own about the impacts of landscaping choices and explore small steps that they can take to help protect water quality. Extension Lakes is looking to learn what the most cost effective strategies are for making landowners aware of the online tool. The summer researcher will design and deploy online advertising, mail, and social media outreach strategies to prompt waterfront landowners to complete the online self-assessment survey (Score My Shore). The success of different campaign approaches will be measured through ad metrics and Google analytics for the targeted site. Comparing the cost and conversion of different approaches will inform future outreach efforts for the Score My Shore tool.

Project tasks

Meet with the DNR-UW Healthy Lakes and Rivers team to plan, conceptualize, and coordinate overall marketing strategies and tactics.

Develop detailed budgets for direct mail and online marketing campaigns.

Collaborate with Extension Lakes staff to create and deploy online and social marketing components.

Analyze landowner responses to ads and changes in website analytics throughout the summer; calibrate marketing strategies based on interim results.

Develop final reports measuring campaign success and comparing costs for alternative approaches.

Propose future directions for marketing and outreach based on 2024 experience and findings

Required Knowledge, Skills & Abilities

- Familiarity with online advertising strategies
- Ability to read and understand Google analytics for websites
- Analytical ability to compare marketing costs across different approaches

Preferred Knowledge, Skills & Abilities

Note to applicants: These skills are helpful, but are not requirements. Most can be taught or trained, so if you have a strong interest in this project but lack these skills, you should still apply!

- Skilled in designing print and online advertisement
- Ability to create short-format online videos to promote environmentally-friendly behaviors
- Knowledge of social marketing for environmental protection and restoration

Appendix A – Project titles by code

Note: In your application, you will list the your top five projects using the project CODE.

CODE	Project Title
GB-01	Mitigating PFAS Contamination of Groundwater: Biochar Sequestration of PFAS in Biosolid Leachate at the Field Scale
GB-02	Optimization of Sedimentation Basin Phosphorus Removal through Vegetation
GB-03	Design and evaluate novel reactive media for removal of dissolved P and N through bench scale flow through testing and deployment at the field scale
LAX-01	Preservation and Promotion of Oral Histories: Kickapoo River and Coon Creek Watersheds
LAX-02	Mapping Inland Seas: Contextualizing Historical Maps of the Great Lakes
LAX-03	Comparative toxicity of PFAS in various fish speces
LAX-04	The impact of the surfactant, Dispersit, on the bacteria found in Myrick Marsh
MAN-01	Diving into History: A Research Scholar Opportunity at the Wisconsin Shipwreck Coast National Marine Sanctuary
MKE-01	Virtual Water Trade
MKE-02	The invasive crustacean, *Hemimysis anomala*: a gateway for microplastics to enter the Lake Michigan foodweb?
MKE-03	Environmental fate of emerging contaminants
MKE-04	Study of Dietary Nutrient Optimization and Microplastic Contaminants in Fish Feed
MKE-05	Design a portable sensor device to detect bacteria in water
MKE-06	Fabrication of functionalized nanomaterials for electrochemical-based bacterial detection in water
MKE-07	Organic pollutants removed from water
MSN-01	Resource recovery from wastewater using bioelectrochemical processes
MSN-02	Mapping aquifer susceptibility to PFAS contamination with hydraulic and geophysical methods
MSN-03	Monitoring Aquatic Species Using Environmental DNA (eDNA) in the Wisconsin River
MSN-04	Elucidating PFAS Bioaccumulation in aquatic ecosystems
MSN-05	Real-time monitoring of pesticides in agricultural runoff using hot spot normalized surface-enhanced Raman spectroscopy
MSN-06	Fate of per- and polyfluoroalkyl substances (PFAS) in aquatic systems
MSN-07	Understanding Pollution and Environmental Processes in the Greater Milwaukee Estuary
MSN-08	Understanding angler behavior and values among urban anglers of the Lake Michigan shoreline
MSN-09	Tracing Nutrient, Microplastic and Nutrient Inputs into a WI Lake after Storm Events
MSN-10	Sustainable Aquaponics
MSN-11	Exploring the impact of temporal variations in hyporheic zone fluxes on phosphorus transport and release in the Wisconsin River
MSN-12	Impacts of invasive zebra mussels on the lower food web of lakes
MSN-13	Cyanobacteria diversity and dynamics in a eutrophic lake

CODE	Project Title
MSN-14	Adventures in stream restoration
MSN-15	Broadening participation in water research by developing and communicating an accessible citizen science module.
MSN-16	Urban Pond Water Quality
MSN-17	Whole-Lake Experiment to Test Resilience to Algal Blooms
MSN-18	Neonicotinoid groundwater leaching potential from potato cultivation
MSN-19	Ecohydrology of Solar Farms
MSN-20	Exploring Groundwater Changes Using Tree Rings
MSN-21	Measurement of Microplastics in Waters, Sediments, and Biota from Wisconsin Lakes
OSH-01	Investigation of microplastics in recreational waters of Wisconsin (Oshkosh)
OSH-02	Marine Debris Recovery and Beach Monitoring of Door County
SP-01	Analyzing Response Metrics to Improve Marketing and Outreach of Shoreland Health Actions

Appendix B – Project location by code

CODE	Location
GB-01	Green Bay, WI
GB-02	Green Bay, WI
GB-03	Green Bay, WI
LAX-01	La Crosse, WI
LAX-02	La Crosse, WI
LAX-03	La Crosse, WI
LAX-04	La Crosse, WI
MAN-01	Wisconsin Maritime Museum, Manitowoc, WI
MKE-01	Milwaukee, WI
MKE-02	Milwaukee, WI
MKE-03	Milwaukee, WI
MKE-04	Milwaukee, WI
MKE-05	Milwaukee, WI
MKE-06	Milwaukee, WI
MKE-07	Milwaukee, WI
MSN-01	Madison, WI
MSN-02	Madison, WI
MSN-03	Wisconsin Dells, WI (Upham Woods Outdoor Learning Center)
MSN-04	Madison, WI
MSN-05	Madison, WI
MSN-06	Madison, WI
MSN-07	Madison, WI
MSN-08	Milwaukee, WI
MSN-09	Madison, WI
MSN-10	Madison, WI
MSN-11	Madison, WI
MSN-12	Madison, WI
MSN-13	Madison, WI
MSN-14	Manitowoc, WI
MSN-15	Madison, WI
MSN-16	Madison, WI
MSN-17	Land O'Lakes, WI University of Notre Dame's Environmental Research Center
MSN-18	Madison, WI
MSN-19	Madison, WI
MSN-20	Madison, WI or Platteville, WI
MSN-21	Madison, WI
OSH-01	Oshkosh, WI
OSH-02	Sturgeon Bay, WI
SP-01	Stevens Point, WI

Appendix C Project keywords by code

CODE	Keywords
MSN-05	Analytical chemistry, contaminants, water quality, laboratory analysis, data analysis
MSN-13	Analytical chemistry, cyanobacteria communities, water quality, microbes, laboratory analysis, fieldwork
GB-03	Analytical chemistry, laboratory analysis
GB-01	Analytical chemistry, PFAS, laboratory analysis
MSN-06	Analytical chemistry, PFAS, laboratory analysis, fieldwork
GB-02	Analytical chemistry, wetland ecology, laboratory analysis, fieldwork
MSN-10	Aquaculture, sustainability, fish, food systems
MSN-03	Aquatic invasive species, environmental DNA, biotechnology, laboratory analysis, fieldwork
MKE-02	Aquatic invasive species, microplastics, chemistry, laboratory analysis, fieldwork
MSN-12	Aquatic invasive species, zooplankton, harmful algal blooms, fieldwork
LAX-04	Bacteria, surfactant, biodegradation, hybridization, laboratory analysis
MSN-07	Chemistry, emerging contaminants, PFAS, water treatment
MSN-04	Chemistry, fish, PFAS, fieldwork
MSN-09	Chemistry, harmful algal blooms, microbial communities, microplastics, laboratory analysis, fieldwork
MSN-01	Chemistry, ion transport, nitrogen recovery, wastewater treatment
MSN-02	Drinking & groundwater, PFAS, spatial analysis, fieldwork
MSN-19	Ecohydrology, soil moisture, groundwater, vegetation, fieldwork, data analysis
MSN-20	Ecohydrology, soil moisture, groundwater, vegetation, tree rings, fieldwork, laboratory analysis
MKE-01	Economics, virtual water trade, data analysis
MKE-03	Emerging contaminants, analytical chemistry, laboratory analysis
MKE-05	Engineering, biosensor design, bacteria detection
MKE-06	Engineering, microbial science, biosensors, bacteria detection
MKE-07	Engineering, water treatment technology, PFAS
SP-01	Environmental outreach, community-based social marketing, shoreland restoration, social psychology
MSN-08	Fish and fisheries, angler behavior, social science, fish management, fieldwork
MKE-04	Fish diets, microplastics, stress tolerance, laboratory analysis
MSN-15	Global change biology, ponds, amphibian declines, pollutants, citizen science, science communication, fieldwork
MSN-11	Groundwater, chemistry, phosphorus fate & transport, rivers
MSN-17	Harmful algal blooms, whole-lake experiment, fieldwork
LAX-02	Historical research, maritime history, maritime archaeology
OSH-02	Marine debris removal, beach monitoring, laboratory analysis, fieldwork
MAN-01	Maritime history, maritime archaeology, shipwrecks

CODE	Keywords
MSN-21	Microplastics, analytical chemistry, water quality, laboratory analysis, fieldwork
OSH-01	Microplastics, laboratory analysis, fieldwork
MSN-18	Neonicotinoid pesticides, potatoes, pollinators, fieldwork, laboratory analysis
LAX-01	Oral history, digital storytelling, flood responses
MSN-14	Stream ecology, fish ecology, restoration, fieldwork
LAX-03	Toxicology, fish, physiology, laboratory analysis
MSN-16	Urban pond ecology, greenhouse gasses, field work, science communication

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