University of Michigan Environmental Engineering
Undergraduate Research Positions
Academic Year 2014-2015

We are hiring multiple undergraduate researchers (one student per project - see Project Descriptions) in the Environmental Biotechnology Labs at the University of Michigan.

Job Description
Research requires the students to explore advanced topics of environmental engineering, using critical and independent thinking. Students will independently perform routine analyses and maintenance of long term experiments, as well as help design and conduct short term experiments. Students will expand their knowledge of topics including experimental design, microbiology, mass transportation, and fluid dynamics, among others. We also invite students to participate in group meetings and journal club (where we critically review published research) to further their learning and enhance their research experience. The position is paid on an hourly basis. More specific information is provided in the project descriptions.

Expectations
The student researcher will be expected to work approximately 10 hours per week, scheduled around the student's class schedule.

Prerequisites
Preference will be given to incoming juniors and seniors with a focus in environmental or chemical engineering.

Start date
September 2014

Length of position
Academic Year 2014 (with possibility for continuation, including the summer)

How to Apply
Email love.biotech.research@gmail.com with:

- resume
- transcript (see http://www.ro.umich.edu/transcript/, pdf transcript version acceptable)
- a brief paragraph on why you are interested in the position and your past lab experience (e.g., chemistry lab course; summer internship, etc.)
- availability to work next summer
- order of preference for projects

WE WILL BEGIN TO REVIEW APPLICTIONS BEGINNING MONDAY, AUGUST 25th, 2014.
APPLICATIONS RECEIVED LATER WILL BE REVIEWED ON A ROLLING BASIS.

Project 1: Nutrient Recovery through Urine Separation
Faculty Advisors: Krista Wigginton and Nancy Love
Mentors: Post-doc Becky Lahr and Graduate Student Heather Goetsch

Existing water infrastructure is deteriorating and thus demands replacement. This provides an ideal opportunity for the installation of more sustainable water systems. Human urine contains the bulk of the nitrogen and phosphorus that passes through municipal wastewater treatment plants, while comprising only 1% of the total volume. Source-separation of urine and the production of urine-derived fertilizer could account for a quarter of fertilizer demands and simultaneously reduce excess nutrient release into water bodies. The environmental and human health implications of human urine use as fertilizer are under assessment in the first two pilot demonstrations of urine fertilizer production and use in North America (Rich Earth Institute in Brattleboro, VT and the Hampton Roads Sanitation District in Norfolk, VA). In collaboration with these two facilities bacteria, viruses, antibiotic resistance genes, and nutrients will be characterized at UM in collected urine, pasteurized urine, struvite fertilizer produced from urine, soil, lysimeter water, and vegetables. (See UM and NPR news articles for more info.)

Project 2: Rethinking Mainstream Domestic Wastewater Treatment - Operation of the Anaerobic Membrane Bioreactor at Pilot Scale
Faculty Advisors: Lutgarde Raskin, Nancy Love, and Steve Skerlos
Mentor: Graduate student Pedro Puente

Resource recovery is the trending technology on wastewater treatment. The Anaerobic Membrane Bioreactor (AnMBR) is an anaerobic technology that biologically converts organic pollutants to methane from domestic wastewater. The recovered methane can be used for energy generation. This project scales-up a laboratory sized system to a pilot plant located in Northfield Township. This pilot plant operates with real wastewater under ambient temperatures found in Michigan. Chosen applicants will be working primarily in the lab, but can make visits to the pilot plant based on their interest.

Project 3: Rethinking Mainstream Domestic Wastewater Treatment - Novel Biological Processes for Nitrogen Removal from Anaerobic Effluents
Faculty Advisors: Nancy Love, Lutgarde Raskin, and Steve Skerlos
Mentors: Graduate students Jeseth Vela Delgado, Andrea McFarland and Post-doc Kelly Martin

Using anaerobic technologies (see Project 1) to treat domestic wastewater can significantly decrease energy use and increase biogas production when compared to conventional treatment schemes. However, there has been little research on the treatment of nitrogen from anaerobic effluents, which have a notably different composition than conventional wastewater. Ammonia is a form of nitrogen that is regulated due to its ability to cause eutrophication and fish kills. This project studies removal of nitrogen and greenhouse gases from anaerobic effluents via microbial processes, that is, microorganisms are used to naturally treat the wastewater. Two bench-scale biofilm reactors are operated to study nitrogen removal from anaerobic effluents. Due to the unique composition of anaerobic effluents, we expect development of microbial communities novel to a wastewater treatment plant.

Project 4: Understanding the Impact of Low Oxygen Wastewater Treatment on Microbial Community Characteristics and Pharmaceutical Fate
Faculty Advisor: Nancy Love
Mentor: Graduate student Lauren Stadler

One strategy for implementing more sustainable wastewater treatment involves a reduction in energy consumption by moving towards treatment that minimizes aeration. As we move toward low dissolved oxygen (DO) treatment processes, there is a need for a better understanding of how these environments affect wastewater microbial communities to ensure stable performance and achieve improvements in energy efficiency. Low DO treatment may also impact the degree to which pharmaceuticals are transformed during wastewater treatment. Thousands of substances used in medicines are excreted by humans in intact and metabolized forms, reaching WWTPs before entering our waterways. WWTPs represent the entry point for the environmental proliferation of pharmaceuticals. Yet they are also the last line of defense against this chemical pollution. We lack a fundamental understanding of how pharmaceutical fate in these low DO processes differs from conventional, fully-aerobic treatment processes. See video made by a past undergraduate researcher.

Project 5: WASAC: A Novel Wastewater-to-Energy Process
Faculty Advisors: Lutgarde Raskin and Nancy Love
Mentor: Graduate student Anton Dapcic

The University of Michigan has partnered with Carollo Engineers, a nationwide environmental engineering consulting firm, to develop and optimize a novel wastewater treatment strategy that captures energy and nutrients in domestic and industrial wastewater. Current research efforts involve elucidating the fundamental processes and metabolisms involved with carbon removal in a conventional activated sludge reactor and its subsequent conversion to methane (energy). The student will be expected to assist with laboratory experimentation, wastewater constituent analyses, result reporting, and brainstorming to direct research. Expected outcomes for the student: Experience with both common and specialized laboratory techniques, a basic understanding of the key mechanisms involved with this novel treatment strategy, and engineering skills that will help to prepare the student for a future in environmental or chemical engineering.

Project 6: Emerging Viruses in Wastewater Treatment
Faculty Advisor: Krista Wigginton
Mentors: Graduate students Yinyin Yi and Miles Ellenberg

Recent respiratory virus outbreaks (e.g., SARS and SARS-like coronaviruses, etc.) have highlighted the need for pandemic preparedness. The potential exists for wastewater to contain high numbers of respiratory viruses, however environmental engineers have overwhelmingly focused their water and wastewater treatment efforts on monitoring and removing gastrointestinal pathogens, with little consideration of respiratory pathogens. This project examines the presence and fate of enveloped human viruses in Ann Arbor Wastewater. The student will assist with virus detection methods and help guide the overall project. A student who has taken or is currently taking a general chemistry laboratory and general biology is preferred.

Project 7: Antibiotic Resistance Gene Fate in Disinfection
Faculty Advisors: Krista Wigginton and Terri Olson
Mentor: Graduate student Brianna Juhrend

This research examines the chemical fate of antibiotic resistance genes during disinfection processes. Antibiotic resistance in pathogenic bacteria is a widely recognized phenomenon that has been exacerbated by antibiotic misuse and the release of antibiotic resistance genes (ARGs) into the environment. Prior to release, wastewater effluents are disinfected in order to remove harmful biological pollutants, but recent research suggests that this is ineffective at removing ARGs. The chemical reactions that take place between disinfectants and nucleotides are well characterized, but reactions that occur in nucleic acids during wastewater disinfection have, until recently, been difficult to analyze due to analytical limitations. The student will conduct UV disinfection experiments and learn how to perform ARG transformation assays. A student who has taken or is currently taking a general chemistry laboratory and general biology is preferred.