

ReNUWIt NSF ERC Research Experience for Undergraduates Program at Stanford University 2012

The Engineering Research Center (ERC) for Re-inventing the Nation's Urban Water Infrastructure (ReNUWIt) at Stanford University has several undergraduate research positions available for the summer of 2012. The program is 10 weeks long; the start and end dates are negotiable. Each student will receive a stipend of \$5600 to cover room and board during the summer, as well as \$500 towards research supplies. ***Interested students should submit their application and statement of interest, following the guidelines given below, before February 15, 2012 at 5:00 pm Pacific Time.*** Decisions regarding awards will be announced by March 1, 2012 via e-mail.

About the Center: ReNUWIt is a collaboration between Stanford, Colorado School of Mines, New Mexico State University, and Univ California Berkeley. The Center is undertaking research to develop technologies for safe, sustainable urban water infrastructure. Research is being undertaken in natural and engineered systems, and is informed by a deeper understanding of institutional frameworks. Example projects include engineering wetlands for improved water treatment and membrane bioreactors for distributed water treatment. The research team consists of individuals trained in environmental engineering, ecology, city planning, economics and law. Working in close partnership with utilities, water service providers, equipment manufacturers and international research partners, we convert great ideas into practical and sustainable solutions to problems facing urban water systems.

Interested students are directed to ReNUWIt's website (<http://urbanwatererc.org/>) for more details on the Center's research.

Research Opportunities: REU participants can work with Richard Luthy, Alexandria Boehm, or Peter Kitanidis on Center research projects described below. Additional projects may become available to work with ERC faculty members Jim Leckie, Craig Criddle, Martin Reinhard, and Yi Cui.

Project 1. Water recycling may benefit ecosystems, but this practice is not common. This project will examine ways in which water reuse projects have been successfully implemented for ecosystem restoration. The work would entail examination of case studies and assist with some analysis of success metrics. Faculty Mentor: Dick Luthy (luthy@stanford.edu)

Project 2. Bivalves [clams, mussels] filter large quantities of water and act as living filters. This project studies ways in which bivalves may improve water quality by removing trace contaminants from water. The work will involve laboratory studies with bivalves in controlled feeding experiments to evaluate mechanisms of trace contaminant removal. Faculty Mentor: Dick Luthy (luthy@stanford.edu)

Project 3. Riparian flora, such as rushes, reeds, and sedges, grow on the periphery of wetlands and provide a potential sink for trace contaminants. In the natural environment, some trace contaminants are found in the organic material of sediments and surface waters, making the riparian zone an ideal environment for contaminant uptake due to the high organic content of riparian sediment and increased residence time of the pore waters. This project will examine how for reclaimed wastewater treatment, perfluorochemical uptake by plants in a managed riparian zone offers the advantage of accumulating, harvesting, and disposing of perfluorochemicals in a controlled manner versus widespread environmental dispersal. Faculty Mentor: Dick Luthy (luthy@stanford.edu)

Project 4. One of the methods available for **subsurface characterization** is hydraulic tomography. In this method, pressure perturbations are initiated at input ports and their effects are recorded at many sensor ports. The large data sets collected are then processed through sophisticated inversion algorithms to develop an image of the conductivity and storage properties of the subsurface. In the next summer, we will test in the field several innovative methods. REU undergraduate students will assist in the field work. Faculty Mentor: Peter Kitanidis (kitanidis@stanford.edu)

Project 5. To minimize adverse impacts of **stormwater** on aquatic systems (e.g., hydromodification, chemical and biological contamination) practitioners including engineers, city planners and architects have embraced various approaches for capturing and infiltrating stormwater runoff using low impact development (LID). The use of rain gardens and permeable pavements is increasing rapidly around US urban centers. However, little effort has focused on improving stormwater quality during infiltration and storage, and the subsequent harvesting of the

water for potable and non-potable applications. Stormwater is a complex matrix with myriad chemical and biological constituents. Thus, it is imperative to conduct research to understand if and how contaminants are mitigated during aquifer recharge and storage. An REU student will work on laboratory column experiments to study the fate and transport of colloids in soils subjected to transient wetting and drying. Faculty mentor: Alexandria Boehm (aboehm@stanford.edu)

Project 6. Prof. Criddle's lab has opportunities to work on batteries that extract energy from the salinity gradient between seawater and treated wastewater effluent, microbial fuel cells that use graphene-coated sponge electrodes to extract energy from wastewater organics, and microbial biotechnology to recover energy from waste nitrogen by converting it to nitrous oxide, a powerful oxidant and propellant. Faculty mentor: Craig Criddle (criddle@stanford.edu).

Obligations: In accepting the research position, students are agreeing to fulfill the following obligations:

1. Develop a research plan, including objectives, scope, milestones, and deliverables with their faculty research adviser. With regard to research deliverables, the student and their adviser should agree on what types of report, papers, or other documentation the student is expected to complete as part of the research. *[Note – this aspect of reporting is between the faculty adviser and the student].*
2. **This award requires research be performed full time (40 hr per week) for 10 full weeks.**
3. **Prior to completion of their project**, all students are required to submit the following to Alexandria Boehm in electronic format:
 - **One or two PowerPoint slides**, which summarize in a concise manner the project title, research team members, objectives, scope and major outcomes of the research. Where appropriate, the slide(s) should include a graphic that helps describe a significant aspect of the project. Note that we want ONLY one or two slides (more is not better). We are requesting these slides for the purpose of disseminating information on the research program via the web or in Center reports.
 - **A two-page written abstract of the research project** (MS Word format), which describes the research objectives, scope, procedures, and major outcomes. The abstract should be no more than two pages (500 to 1000 words) and, preferably, will include one or two graphics to help describe the research.
4. **Upon completion of the project** (but no later than October 1, 2012), all students must **complete an evaluation form**, which will be made available on-line.
5. We expect student researchers to **participate in special events** organized during the summer. These events will include lunches, seminars, and field trips and are required.
6. Students will participate in **an oral ERC-REU symposium** where they will be required to present a 10 min talk about their research project. REU students across the ERC universities will be in attendance. Attendance and participation in this conference is required.

Funding: Student summer salary will be provided in the form of a \$5600 stipend, which will be paid over the course of the research appointment, subject to the student making continuous progress on the research. Up to \$500 is available for supplies for project expenses.

Requirements and Restrictions: *Eligibility* is limited to undergraduates, who are working under the supervision of an ERC faculty member. An undergraduate is a student whose BS degree has not been conferred before or during the REU 10 week program.

Administrative Procedure: Applications should include the following: [1] student applicant information (name, major, expected graduation date, address, e-mail address), [2] brief (500 word max.) statement of your research interests and a ranking of the projects you are interested in working on, [3] copy of your transcript (an unofficial transcript is fine), [5] resume or summary of relevant experience.

Applications should be submitted either by e-mail to aboehm@stanford.edu before **5 PM on Feb 15**. Applications received after this date may still be considered, pending availability of funding.

Questions about the program should be directed to Professor Alexandria Boehm <aboehm@stanford.edu>.

Note that the start date is negotiable to match with the academic calendar at the student's home institution. Also, on campus housing may or may not be available, depending on start date, but Center staff can assist with location housing nearby campus.