

Title: Urban Soil Assessment and Education Collaboration

Lead Faculty: Julie Maxson, Department of Natural Sciences, College of Science

Community Partner: Urban Roots

Overview

The work proposed in this request will continue a collaborative relationship between the Environmental Science program at Metropolitan State University and our neighbors at Urban Roots. We seek funding for continuation of previous work, and for development of a new “Soil Kitchen” event that will help both the university and Urban Roots to meet our shared goals of promoting healthy communities on St. Paul’s east side.

History of our collaboration

The proposed project continues a partnership begun with Urban Roots in 2014, which was funded by ICES grants in 2014 and 2017. During our work in 2014, four Metropolitan State University students worked to sample soils at Urban Roots growing sites at the corner of Third and Maria Avenues, and the gardens adjacent to the Urban Roots office. At the time, the university lacked the facilities and equipment to test soils for lead and arsenic, so samples were sent to laboratories at the University of Minnesota (Lead) and University of Massachusetts (Arsenic). At that time, we found no significant levels of either lead or arsenic at these sites.

Funding for our new Science Education Center included funds for analytical equipment, and the university now owns an instrument that allows for quick and accurate assessment of Lead contamination. We can now easily perform dozens of accurate Lead analyses at virtually no cost, and identify the presence of Arsenic (though with low precision). During summer of 2017 and the 2017-2018 academic year, four more Metropolitan State University students and two students from Japan who were part of the 2017 Nagasaki Exchange Program have contributed to the scientific goals of this project, to identify Lead contamination at Urban Roots’ garden sites.

Unfortunately, due to a misunderstanding about Metropolitan State’s deadlines for encumbering funds, we weren’t able to get funding to Urban Roots in the previous grant period. In order to help redress this error, College of Science Dean Kyle Swanson has agreed to make contributions to this project, covering costs for accurate testing for Arsenic (something our instrument doesn’t do very well), costs associated with the Soil Kitchen, and contribution to Urban Roots’ educational program for youth interns with the donation of testing equipment for measurement of soil fertility.

Project Goals

The goals of this project for the next grant period are

- A. To make soil toxicity assessment available to Urban Roots at no cost to them.
- B. To work with Urban Roots to develop a phytoremediation project for soils that have lead contamination.

- C. To provide Urban Roots with funding for appropriate soil enhancement and remediation for tested sites.
- D. To provide a research opportunity for Environmental Science students at Metropolitan State University, giving them analytical skills and experience in soil testing.
- E. To provide hands-on science-rich learning experiences for Urban Roots' youth gardeners about the nature of soil, and the hazards of soil contamination through their "Greening your Mind" program.
- F. To create an opportunity for east side residents to bring their garden soils to a one-day "Soil Kitchen" event in April 2019, for rapid identification of any contaminants.

Project Description

The project will be accomplished through six components.

1. Metropolitan State Students - Independent Study on Urban Soils

To date, eleven Metropolitan State University students have been engaged in this project through participation in ESCI489 Senior Research in Environmental Science. In this FDIS, students learn basic soil formation, soil structure, and soil chemistry, with an emphasis on the pathways of soil contamination, the toxicology of Lead and other metals, and the options for soil remediation.

ESCI 489 will be offered again during Summer 2018 and Spring 2019, and will enroll 3-5 students in each term. We are grateful to have the capacity, through collaboration with Urban Roots, to have such a relevant problem to contribute to. Each offering of ESCI 489 builds on the work of previous students, and our work has gained more depth and relevance each semester.

2. Soil fertility testing at Metropolitan State University

We have the capacity to do routine soil fertility testing, testing for soil nutrients (Phosphorous, Nitrogen, and Potassium). Using existing sampling tools and test kits, we will test up to 50 soil samples from Urban Roots sites for soil nutrients and soil pH.

3. Soil contamination testing

We will take two approaches to measuring soil contamination. For lead testing, we will continue to use the Natural Science Department's portable X-ray Fluorometer (pXRF) to test soils for Lead. This instrument is field-portable, and can be used to efficiently determine the presence of metal contamination in dozens of samples at a single site in a few hours. The instrument is particularly adept at measuring Lead concentration in soils, and we are able to provide Urban Roots with detailed maps of soil lead measurement for their garden sites. We have currently worked on four of six of their gardens, and will complete Lead measurements on the remaining two garden sites (at Swede Hollow Café and Dellwood Gardens).

The pXRF is less useful for measuring soil Arsenic levels. Although it can measure the presence of Arsenic, the precision of these measurements is low: we typically get measurements of, for example 8 +/- 5 ppm or 10 +/- 7 ppm. During the 2014 grant period, we sent samples to a testing lab for more accurate results. We propose to do this again in

FY19, with costs for this testing to be borne by the College of Science rather than through this funding request.

4. Recommendations for soil use by Urban Roots

As a result of our testing and of our understanding about pathways for Lead into urban soils, the capacity for plants to phyto-remediate lead contamination, and the capacity for various edible plants to take up Lead differentially in leaves and fruits, we will work with Urban Roots staff to determine which of these four planting scenarios is most appropriate:

- A. Un-restricted use of native soils (in the case of no contamination)
- B. Avoidance of root crops and use of soils for selected, fruiting plants that do not transmit soil lead to fruits. Other studies have found that berry plants are ideal for soils with minimal contamination.
- C. Phytoremediation of soil lead using plants that are specifically known to remove lead from soil. Members of the sunflower family have been shown to extract soil lead over time.
- D. Avoidance of native soil use and construction of raised beds.

A key outcome of this collaboration to date has been the identification of lead contamination in the garden at 3rd and Maria Streets. Students in the Spring 2018 section of ESCI489 have found lead levels of 260-280 ppm, approaching the EPA limit of 300 ppm for growing food in soils. Fortunately, the soils with this level of contamination are in a fairly restricted part of the garden. We have worked with Urban Roots on an appropriate plan for these soils. The current plan is to plant sunflowers, which have been shown to extract lead from soils over time. An on-going part of this project will be to monitor soil lead levels in this area through at least the next two growing seasons, to evaluate the efficacy of the sunflowers in removing soil lead. Because these plants concentrate lead in the stems and leaves, the flowers themselves will contain very low lead levels. The flowers can be included in Urban Roots' CSA shares in late summer of 2018 and 2019.

5. Science of the Garden curriculum for Urban Roots youth gardeners

Part of Urban Roots' programming with their youth interns is a weekly education session called "Greening Your Mind." This program is led by Jaclyne Jandro, former biology teacher and now Urban Roots' Market Garden Program Coordinator. During summer 2017 I worked with Jaclyne on several Greening Your Mind sessions. During Summer 2018, I will contribute a lesson on Soil Contamination and Remediation.

To support other soil science lessons led by Jaclyne, we will be loaning a set of soil test kits for use by the Urban Roots interns to make their own measurements of soil fertility throughout the summer.

6. Soil Kitchen

"Soil Kitchen" events were originally conceived and created at the University of Pennsylvania in Philadelphia. Soil scientists there invited residents of the low-income neighborhood where the university is located to bring their garden soils for testing during a one-day event. Using a portable XRF similar to ours, the researchers were able to provide residents with rapid evaluation of their soil for lead contamination, and to make

recommendations for use of their soils for gardens. An unexpected result has been that over time, the researchers have been able to identify contamination patterns throughout the city.

Nic Jelinsky, a soil scientist at the University of Minnesota, has brought Soil Kitchen events to the Twin Cities. He currently holds these events in North Minneapolis and at Frogtown Farms. I have planned to create Soil Kitchen events for east side residents after the opening of the Growlt Center. After conversation with Jaclyne Jandro, we plan to get a jumpstart and create a Soil Kitchen event during April 2019, likely before the Growlt Center opens. I anticipate that this will be an ongoing program in the Growlt Center.

Dean Kyle Swanson has agreed to contribute the costs associated with publicity for and hosting of the Soil Kitchen event in FY19.

Timeline

The new timeline for ICES funding, to span an entire fiscal year, will enable much better coordination of the work of ESCI 489 research students with Urban Roots' growing season. In the past, Spring semester students have had to wait for snow to melt to begin sampling – it has been extremely difficult for us to provide data to Urban Roots in time for them to plan their growing season. The new July 2018 start date will ensure that we have ample time for sampling and analysis prior to the 2019 growing season.

- June 2018 - Summer offering of ESCI 489. Sampling and analysis at Dellwood and Swede Hollow gardens, investigation of soil drainage problems at Rivoli Bluff. Though this work does not fall within the grant period, it is relevant to our continued collaboration with Urban Roots.
- July 2018 - Work with Jaclyne Jandro to plan and deliver a "Greening your Mind" session for Urban Roots youth interns.
- Fall 2018 - Soil sampling for more detailed analysis and mapping based on our Summer 2018 work. We have learned that fall sampling, prior to snowfall, is essential to getting results to Urban Roots in time to develop a growing season plan for the following spring.
- Jan-Feb 2019 - ESCI 489 students will run samples collected in fall. Begin planning Soil Kitchen Event.
- March 2019 - Data and recommendations to Urban Roots for the 2019 growing season.
- April 2019 - ESCI 489 students will present at the Metropolitan State Student Research poster session. Soil Kitchen event in late April or early May
- June 2019 - Review of Program and planning for future collaborative events in the Growlt Center

Budget Request

- \$2,000.00 Total
 - \$1850.00 - Materials for soil enhancements or soil remediation for Urban Roots
 - 100.00 - Materials and supplies related to use of the portable XRF
 - 50.00 Materials and supplies for poster session presentation by ESCI 489 students

Additional costs not included in this request

Dean Kyle Swanson has committed to cover the following expenses from the College of Sciences budget:

\$300 for arsenic testing at the University of Massachusetts soil research lab

\$300 for costs associated with developing, advertising, and hosting the

Soil Kitchen event

Up to \$600 for Soil Test Kits for Urban Roots and the GrowIt Center