

DENIN Environmental Scholars Internships

Dates of internship: January 7, 2018 – May 10, 2019

Location: University of Delaware, Newark, DE 19711 (Replace with another location as needed)

Number of positions available: 1-2

Faculty Mentor: Donald L. Sparks

Graduate Student Mentor: Kathryn Daria Szerlag

Professional Staff Mentor: Elizabeth K. Coward

Project Title: The chemistry of legacy phosphorus in US Mid-Atlantic agricultural soils

Research Description:

Phosphorus (P) is an essential plant nutrient and is applied to agricultural soils as fertilizer or animal manure to promote optimal crop yield. Due to crop need and complex P soil chemistry, decades of repeated additions have led to agricultural soils with a very high buildup of legacy P. Unfortunately, phosphorus loss to both fresh and salt water ecosystems can be extremely detrimental to aquatic life, human consumption/recreation, and overall water quality due to eutrophication, which is an algal bloom caused by nutrient enrichment whose decomposition depletes the water of oxygen and leads to fish kills. By determining phosphorus solubility and speciation in soils, we will be able to better understand phosphorus availability to plants and environmental susceptibility to nutrient enrichment. Through P release experiments from soils called desorption, we will use different desorbing agents to investigate P release over time from various Delmarva soils with high levels of legacy P. The results from the desorption experiments are part of a larger research objective that utilizes novel synchrotron technologies (micro X-ray fluorescence (μ -XRF) maps and micro X-ray absorption near edge structure (μ -XANES) spectroscopy) to directly speciate the solid forms of P in the soil.

Research Questions:

1. What is the solubility of legacy phosphorus from agricultural soils located on the Delmarva peninsula?
2. What legacy phosphorus species are present in these agricultural soils?
3. What impact will speciation have on the mobility of phosphorus in soil and water?

Student Learning Objectives: Professional and Research Skills

Broad Professional Skills	Specific Skills
Express ideas in writing	Learn how to properly use a laboratory notebook. Write descriptions of research procedures, write a lab report to practice technical writing complete with a literature review (to practice locating and understanding scientific articles), and create a poster of your research.
Express ideas verbally	Discuss research activity with your mentor, other members of the lab, and present a poster at the symposium.
Work independently	Conduct phosphorus desorption experiments using various P desorbing agents.
Maintain professional attitude and work principles (i.e. integrity, responsibility, diligence, following ethical standards)	Be on time, wear appropriate PPE at all times in the lab, learn procedures, ask questions if unsure, respond to emails, complete assigned readings, and respect everyone you work with.

Broad Scientific Research Skills	Specific Skills
Understand scientific terms	Demonstrate an understanding of the role of phosphorus in agriculture and the environment through random verbal “quizzes” and writing a lab report. Understand the issues that arise from decades of phosphorus addition to agricultural fields. Develop more knowledge of soil and phosphorus chemistry.
Locate scientific articles and resources	Conduct searches for relevant literature about soil chemistry, phosphorus chemistry, and environmental chemistry.
Use and apply scientific tools and techniques in research experiments	Basic tools for wet chemical soil extractions (solution preparation, pipette, centrifuge tubes, balance, pH electrode, shaker, filters) and inductively coupled plasma atomic emission spectroscopy (ICP-AES) for supernatant analysis. Students will also learn about X-ray absorption spectroscopy (XAS) through looking over data (with their mentor) collected at various beamlines at the synchrotron.
Recognize simple patterns in research data	Understand phosphorus sorption and desorption curves.
Understand research questions	Posed by research articles and our own research.
Read and understand research articles	In environmental, soil, and phosphorus chemistry.
Analyze research data	Use Excel and Origin to analyze data.
Understand, apply, and explain scientific concepts and theories	With lab personnel, with the general public, and during the research symposium.
Identify appropriate research methods	Design experiments for phosphorus sorption and desorption in the lab.

Prerequisites:

Introductory chemistry, attention to detail, patience, persistence, and a good attitude!

Work Environment and Expectations:

Laboratory environment: The lab is located in Harker ISE Lab on the 4th floor. Hours are flexible and the schedule best suited for the undergraduate and graduate student mentor will be determined.

Students will work part time during the fall and spring semesters, and full time during UD Winter Session, January 7-February 8, 2019. Students will also participate in a retreat, communications workshop and end of internship spring symposium.

Stipend:

\$3,500 Direct deposit is required.

Funding Source:

National Science Foundation, Delaware EPSCoR Track I

How to apply:

https://ugresearch.udel.edu/PUB_Program.aspx