**Project WiCCED Undergraduate Internship**

Dates of internship: Fall 2023 – May 2024

Location: Virtual/Ammon Pinizzotto Biopharmaceutical Innovation Center, 590 Avenue 1743, Newark, DE 19713

Number of positions available: 1

Faculty Mentor: Dr. Eric Wommack

Graduate Student Mentor: Emily Morgese

Professional Staff Mentor: Barbra Ferrell

**Overview:** Project WiCCED is a multi-institutional project in partnership with National Science Foundation and the State of Delaware aimed at assessing major threats to Delaware’s water quality, and developing viable technological and policy solutions for meeting the challenges imposed by them. Research will involve a combination of laboratory, outdoor field work and/or computational environments. We seek a diverse group of undergraduate students to join our team in a welcoming, collaborative environment.

**Project Title:** Genome to Phenome Connections in Bradyrhizobium Lytic Phage

**Research Description:**

Soybeans are one of the largest crop exports of Delaware, and the U.S. as a whole. These leguminous plants require large amounts of nitrogen to produce high yields, which farmers supplement through commercial fertilizers. Unfortunately, these chemical fertilizers are prone to leaching from agricultural soils and ending up in nearby waterways. Excess fertilizer in an aquatic environment causes eutrophication and leads to toxic algal blooms, posing a major threat to both the ecosystem and human health. Delaware is one of six watershed states that drain into the Chesapeake Bay, and nutrient pollution has been an on-going threat to the health of the bay. Studies inoculating soybean crops with *Bradyrhizobium* species have shown an increase in crop yield and demonstrate the potential to replace synthetic fertilizers, therefore greatly reducing the impact of agriculture on waterways. *Bradyrhizobium* is a genus of bacteria that forms a symbiotic relationship with leguminous plants where it fixes nitrogen into bioavailable forms that plants can directly take up in exchange for a portion of its photosynthetic products. The Viral Ecology and Informatics Lab (VEIL) at the University of Delaware has a culture collection of 352 soybean-nodulating *Bradyrhizobium* strains, consisting of 340 Delaware isolates from 31 farms and 12 USDA reference strains. Previous work in the lab has included identifying *Bradyrhizobium* strains that are more effective nitrogen-fixers than others, leading to higher crop yields. In addition to the bacterial strains, VEIL also has a collection of 16 Delaware lytic phage isolates that infect a range of *Bradyrhizobium* strains. *Bradyrhizobium* lytic phages influence the bacteria–soybean symbiosis by impacting host population dynamics, nutrient cycling, and the exchange of genetic material between hosts. The overall objective is to gain an understanding of *Bradyrhizobium* phages by analyzing their genomes, host range, morphology, and infection dynamics. Increasing our understanding of these viruses contributes to future applications like phage therapy, in which phages are utilized to favor nodulation of soybean roots by only the most effective *Bradyrhizobium* strains. Optimizing biological nitrogen fixation processes is a critical step in the push toward the use of naturally-derived nitrogen as opposed to synthetic fertilizers, and could be a key step toward ensuring the health and safety of our aquatic ecosystems.

**Research Question:**

1. What are the connections between the genome and phenotypic characteristics (morphology, host range, and biogeography) of Bradyrhizobium lytic phage isolates from farms throughout Delaware?

**Student Learning Objectives: Professional and Research Skills**

This internship focuses on the development of the following professional and scientific skills.

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| **Broad Professional Skills** | **Specific Skills** |
| Planning and time management | Ability to set and complete specific goals of varying scope |
| Work independently | Independent work ethic - work independently to problem-solve |
| Collaborative skills | Learning to complete tasks efficiently and effectively with others |
| Express ideas in writing and verbally | Communicate with diverse audiences - Development of impactful poster and oral presentations. Honing ability to deliver scientific results/impacts to people of multidisciplinary backgrounds. |
| **Broad Scientific Research Skills** | **Specific Skills** |
| Understand scientific terms  | Correctly use terms and concepts from the fields of microbiology and molecular biology |
| Literature analysis | Ability to find and use scientific manuscripts related to environmental microbiology and computational data analysis. |
| Use scientific tools | Microbial cultivation, bioinformatics |
| Recognize simple patterns in research data | Applying environmental microbiology concepts to qualitative and quantitative data. |
| Apply research tools and techniques in research experiments  | DNA isolation from environmental samples and isolates, PCR, and microbial growth assays to investigate Delaware soil microbial communities.  |
| Analyze research data  | Excel, bioinformatics programs and instrument-specific software utilization to form effective figures and tables. |
| Understand, apply, and explain scientific concepts and theories | Freedom to form questions and plan methods for addressing challenges. Learning to communicate results through oral presentations and posters. |

**Prerequisites:**

Introductory experience with biology

**Work Environment and Expectations:**

Laboratory environment:

Plant and Soil Sciences Lab in Worrilow Hall, University of Delaware

Computational environment:

Ammon Pinizzotto Biopharmaceutical Innovation Center, University of Delaware

The internship is part time during the academic year. The exact hours and expectations are established between the student researcher and mentor.

**Stipend:**

$5,000 - Direct deposit is required.

**Funding Source:**

National Science Foundation EPSCoR Project WiCCED

**Application deadline:**

September 15, 2023

**How to apply:** https://ugresearch.udel.edu/PUB\_Program.aspx