Title V Research & Engagement Grant Executive Summary

Faculty Mentor

Adam Kleinschmit – Associate Professor of Biology

Undergraduate Student Mentees

Julie Starkey and Sam Ogden

Project Status

In Progress – Projected Completion in mid-April 2018

Project Title

Metagenomics Analysis of Local Microbial Communities

Project Abstract

One major issue associated with mining is the production of acid mine drainage (AMD). AMD is produced through chemical and microbial oxidation of exposed sulfide minerals found in mining waste. This process also occurs naturally, producing acid rock drainage (ARD) when volcanic, hydrothermally-altered rock is exposed to the elements. Like AMD, ARD contributes to water quality degradation within a watershed through the leaching of heavy metals that easily dissolve in acidified water. A sustainable approach toward remediating ARD from abandoned mining operations is to utilize microbes that can metabolically reduce heavy metals within a series of small engineered ponds, thus increasing the pH of runoff and reducing the leaching of heavy metals. We would like to understand the naturally occurring microbial communities within an ARD source in the San Luis Valley, so that this data may be applied toward future local bioremediation efforts. The proposed undergraduate research project will investigate an ARD producing source within the Alamosa River Basin extending above Alum Creek and continuing into the Alamosa River. Students will collect water and sediment samples along a pH gradient, extract total DNA, and then send the DNA samples to a collaborator for shotgun metagenomic sequencing. Metagenomic sequencing will provide a large dataset that will be mined by undergraduates to gain insight into the ecological dynamics within environmental microbial communities along a pH gradient in the extreme environment associated with ARD. Specifically, students will filter the sequence data to compare a collection of conserved genes that reveal taxonomic information about the microbial species present to address the question of which microbes are present in each sample along with relative abundance. Additionally, students will further compare the entire genetic composition of the targeted samples to public databases to identify the genetic potential of each microbial community to answer the question of what are the microbes doing metabolically. The raw DNA sequence data will be sorted computationally using bioinformatics algorithms to investigate sequence quality, annotate sequences, investigate the specific questions outlined above, as well as perform statistical analysis on replicates from each sample location. Students will present their research at local and regional undergraduate research conferences to disseminate the resulting data.

Deliverables

Dr. Kleinschmit is currently working with both Julie and Sam on a weekly basis on the bioinformatic analysis portion of the project. Julie and Sam are planning to submit an abstract to ASU's 2018 Student Scholar Days in addition to the 2018 Western-1 Regional Beta Beta Beta Biological Honor Society (Tri-Beta) Undergraduate Research Conference to present their work. After completing their initial data analysis over the 2017/2018 academic year, Dr. Kleinschmit will further work with Julie and Sam to formally communicate their research findings through a research manuscript to be submitted to a peer-reviewed journal.

Alignment to Title V Goals

This project directly aligns to the Title V goal of increasing the percentage of students working with a faculty member on an undergraduate research project. The Research and Engagement Grant has supported Dr. Kleinschmit in mentoring two undergraduates on an independent research project in addition to providing funding for supplies essential for carrying out contemporary research methods. The research experience will also help both mentees to be competitive applicants as they apply to graduate programs in biology in the future.

Artifacts

Below is an image of an environmental river sediment sampling sites from which microbial DNA was extracted for sequence analysis. Note the rust orange iron oxide stained rocks in the river bed from acid rock drainage flowing into the Alamosa River. Dr. Kleinschmit can provide additional images of the undergraduate student presenting their work later this spring.