

The Agriculture Microbiome Program: A Non-Formal Education Program

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Introduction/Need for Innovation or Idea

Microbiomes represent specific collections of hundreds of microbe species that are associated with every living multicellular organism (Cao et al., 2017). Microbiome characterization requires the use of next generation DNA sequencing which is a technology that is critical to ongoing agriculture research (Cao et al., 2017). Microbiome research promises to develop approaches deemed critical by the USDA to improve crop productivity and cattle production and health and reduce the environmental impact of agriculture (Rexroad et al., 2019). The investigation of microbiomes captures the interest of students due to its innovative nature, extensive ramifications, personal relevance, and an opportunity for integrating Next-Generation Sequencing into educational settings (Wang et al., 2015).

Thus, the Agricultural Microbiome Program (AMP) aimed to train participants in techniques used to study microbiomes that can be applied to numerous science disciplines important to agriculture. The AMP was designed to nurture critical thinking skills, problem solving skills, and communication skills, all of which were grounded in STEM, hopefully leading to increased interest in STEM and STEM- related careers (Eck et al., 2024). In addition, program participants were guided and trained on how to develop outreach presentations and present complex science content to the general public, in addition to evaluating the perceptions of their audiences in non-formal learning forums. The overarching goals of the AMP was to increase participant knowledge related to science and technology used to characterize and study microbiomes, produce and evaluate presentations for public audiences, and be more agriculturally literate consumers understanding how microbiome science improves agriculture.

How it Works

A one-week summer camp was hosted at Oklahoma State University, from June 1- 6 2025, which introduced ninth and tenth grade students to microbiome sciences and specific agricultural microbiome models using immersive experiences. Participants engaged in scientific inquiry and authentic research experiences. Watson et al. (2022) identified a correlation between established and supported interest in STEM content and completion rates of K-12 student, therefore, the AMP was designed to produce youth who were literate in agricultural microbiome sciences and to increase the interest of participants to pursue science related disciplines represented. Through the microbiome communities of wheat, cattle, and the American burying beetle, participants learned about the importance of microbes in our world and engaged in exciting scientific activities, such as streaking microbial plates, performing Polymerase Chain Reaction (PCR), and sequencing DNA (deoxyribonucleic acid). Participants developed communication skills to make science more accessible to their community, interacted with Oklahoma State University students and faculty, experienced campus life, and made new friends. Participating students took part in immersive experiences in the wheat field, cattle production and research facilities, the entomology lab, and a BSL1 microbiology lab.

Participants were put in partner pair groups for the duration of the AMP, each of which had a STEM teacher who served as a mentor and resource throughout the program. These purposeful groupings helped to facilitate the exchange of ideas, team building, and reflective opportunities

as they worked through the AMP activities. All AMP instructors and the STEM teachers also helped to facilitate learning and promoted positive youth development, enticing youth to seek additional training to help build the future STEM and agriculture workforce.

Each day included field, laboratory, and classroom activities related to production agriculture, collect samples, analyze specimens, engage in research, and prepare outreach presentations. At the end of each day, participants reflected on their experience using Swivl M2 technology, a generative AI based platform, helping the AMP team make adjustments as needed throughout the program. Two focus group interviews with the STEM teachers served as both a formative and summative assessments to continually improve the AMP. Apart from daily academic activities, participants enjoyed a tour of the Oklahoma State University campus, engaged with faculty and university recruiters, built collaborative relationships, and participated in recreational activities.

Results to Date/Implications

Program recruitment generated positive interest with over 80 applicants, of which a selection committee was tasked to choose 20 applicants based on the materials provided. Cohort One ($N = 20$) successfully completed the AMP in June. Pre and post assessments resulted in an increase in agricultural microbiome knowledge, agricultural literacy, and STEM interest across participants. The final component for AMP participants was to deliver a 10-minute presentation to an adult audience in their community, of which multiple students have already completed, resulting in an increased understanding of the agricultural microbiome by community participants.

Future Plans/Advice to Others

The AMP team will evaluate the data from cohort one to make the necessary adjustments for the second cohort. Data collection includes pre- and post-test assessments, authentic assessments through laboratory practicums, outreach presentation evaluations, and community perception data from student delivered community presentations. In addition, a formal program evaluation will impact future plans, based on the results from an external evaluator. Overall, the AMP was a success based on data from cohort one, the key takeaway thus far is the need to be flexible in planning and delivery, as circumstances arise (i.e., weather) that are out of our control.

Costs/Resources Needed

While the overall scope of this project would require external funding to support in most cases, the concepts are scalable to be used as resources allow. The AMP project team was comprised of six faculty members, two graduate students, and four undergraduate assistants. In addition, access to a BSL1 laboratory space with microbiology equipment, classrooms, and student housing facilities are necessary. The AMP team developed curriculum and lesson plans for content delivery. The immersive nature of this project also required access to ongoing burying beetle, cannulated cow, and wheat research projects. Participants received a Chromebook, polo, lodging, meals, recreational activities, and a stipend as a part of the AMP.

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