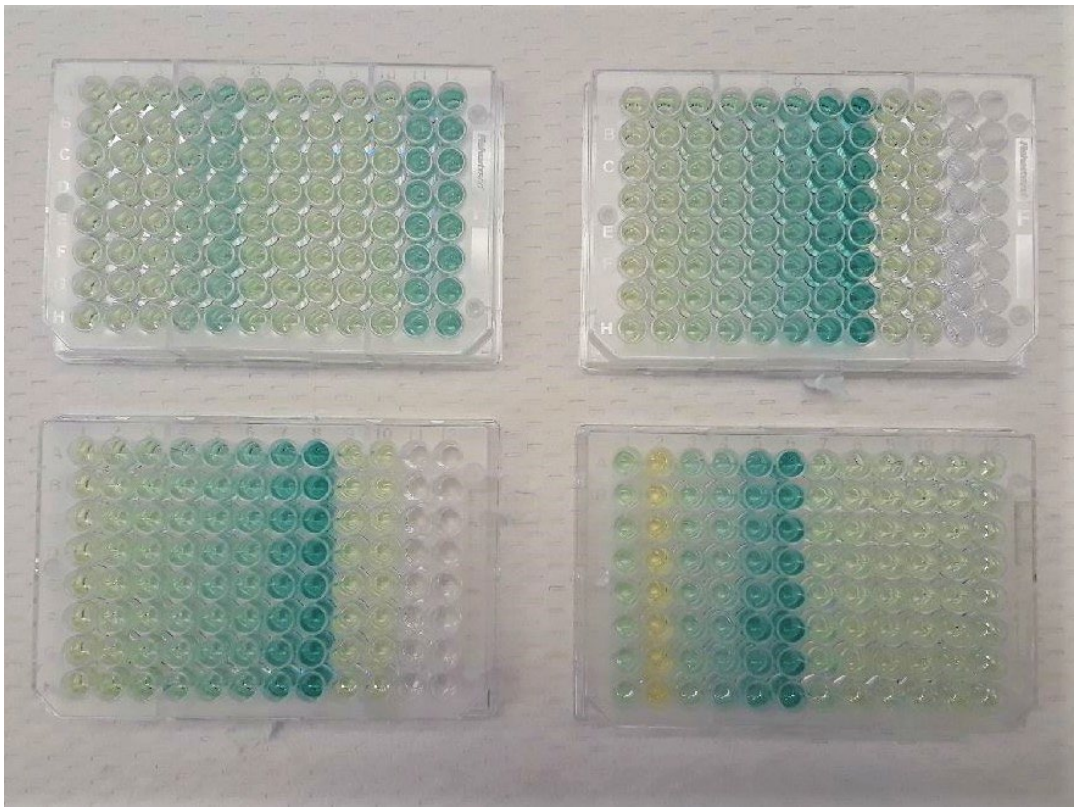
MAPS Highlights 2017-2018, Year 1

Roots and Microbes in Soil

Sharon Billings and Ligia Souza

We have demonstrated the sensitivity of the extracellular enzyme acid phosphatase to ecologically-relevant variation in temperature and solution pH, revealing one set of phenomena driving variation in phosphate availability for roots and microbes in soil.

Quantifying the kinetics of abiotic (i.e. *sans* microbes) acid phosphatase at ecologically relevant temperatures and pH provides baseline behavior of the enzyme; any discrepancy between this fundamental behavior and that in environmental samples is reflective of soil and microbial structure. Thus, the work helps us parse the drivers of extracellular enzyme activities in environmental samples.



Color intensity reveals varying concentrations of phosphate, a plant-available form of phosphorus, in 96-well plates used to assess concentrations of phosphate generated by enzymatic cleavage of organic compounds.

Ecosystem scientists understand that extracellular enzymes generated by soil microbes catalyze the breakdown of organic compounds and the associated release of plant- and microbially-available nutrients. The rate at which this occurs has been measured in many systems under diverse conditions. However, environmental samples' enzymatic activities reflect microbial community size and make-up, microbial resource demands and associated allocation of resources, and abiotic conditions. It thus is difficult to understand why changing environmental conditions often prompt changes in extracellular enzyme activities in environmental samples.

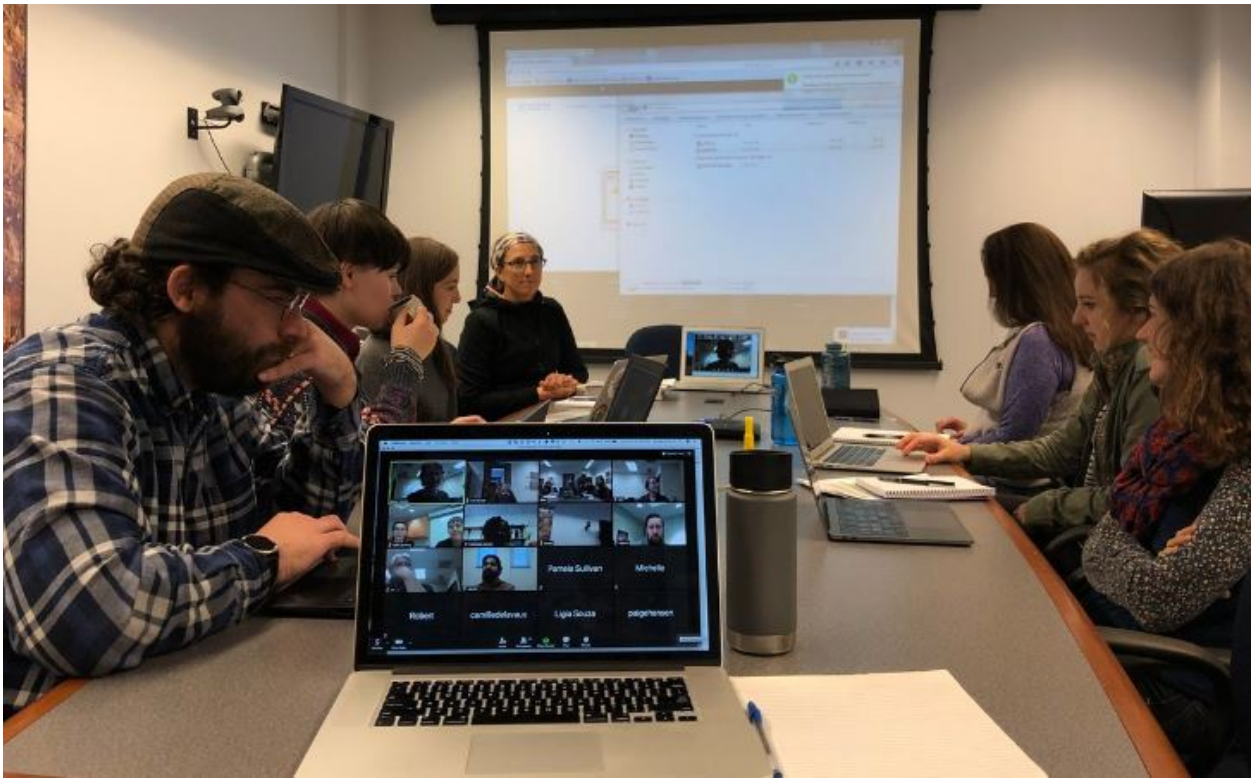
Our approach is to define the fundamental enzyme kinetics to provide an abiotic baseline to which analogous data from environmental samples can be compared. In this way, we can quantify the degree to which microbial community and soil structural responses to environmental conditions drive changes in enzymatic behaviors relative to baseline kinetic responses.

MAPS Collaborative Course

Walter Dodds and Jim Bever

The Kansas NSF EPSCoR research team created and taught a new collaborative course on the Microbiomes of Aquatic, Plant and Soils across Kansas (MAPS) for undergraduate and graduate students across the state. The course, titled *Microbiomes of Aquatic, Plant and Soils Habitat*, involved a total of 19 students from the University of Kansas (KU), Kansas State University (KSU), Wichita State University (WSU) and Fort Hays State University (FHSU). This educational collaboration was specifically designed to study the structure and functions of microbiomes.

In the latter half of the course, students used what they learned from faculty presentations and class discussions to prepare individual reports and lead discussions on the key papers that reflected their personal area of interest. The outcome for the class is to create a collaborative, publication-quality review manuscript to be submitted following the course. All students who contributed to the writing of the manuscript will be listed as co-authors.



Students collaborate across campuses via videoconference on an interdisciplinary course on microbiomes.

Every Tuesday and Thursday, students and professors from all four universities met in a common area on their campus to participate in a ZOOM video conference learning experience. The goal for the class was to review existing information on linkages between and feed backs among plant, soil and freshwater microbiomes. The instructional focus involved the lead Instructors, Walter Dodds, from KSU, and Jim Bever, from KU, facilitating in depth discussions of current and existing literature on this rapidly expanding area of research. In addition, each member of the MAPS research team presented their research and assigned key papers for students to read. The class has proven to be a good tool for a conceptual model as well as a unique opportunity for senior team members to mentor junior team members.

Dual-Language 3rd Graders Learn about Soils

Peggy Schultz

In the spring of 2018 the Kansas NSF EPSCoR *Microbiomes of Aquatic, Plant and Soils Systems Across Kansas (MAPS)* outreach initiative included four visits to Scott Dual Language Magnet Elementary School 3rd grade classrooms in Topeka, Kansas. As a result, Dr. Peggy Schultz, MAPS Outreach Specialist, created and taught four age-appropriate MAPS lessons that addressed Trophic Levels, Soils, Biomes and planting a prairie garden.

Because of state budget issues, the Scott teachers mentioned that they don't always have the resources to create similar experiences for their students. So, they welcomed the opportunity to have Dr. Schultz teach science lessons that encouraged students to make hypotheses, conduct experiments to test their hypotheses and to draw conclusions from their experiments. They also said that the students looked forward to each visit and expressed an excitement for and newfound interest in science.

Mrs. Tita Soberon, Ms. Laura Jimenez and Ms. Claudia Nunez-Penichet facilitating inquiry-based experiments in soil composition.

Dr. Schultz contacted the Scott Dual Language Magnet Elementary School science coordinator to set up an opportunity to teach the MAPS-based lessons to their 3rd grade students. She worked closely with two of Scott's grade teachers to identify the key Spanish vocabulary and MAPS related content that would satisfy some of the curriculum requirements specified in the 3rd grade Next Generation Science Standards.

Dr. Schultz hired and consulted with Mrs. Tita Soberon, an education specialist, to translate the inquiry driven MAPS lessons she created from English into Spanish. Mrs. Claudia Nunez-Penichet, a prospective University of Kansas Biology graduate student, and Ms. Laura Jimenez, a current University of Kansas PhD candidate, joined the team to facilitate small group discussions and lead hands-on experiments.

The 80 students from the four 3rd grade science classes consisted of both native Spanish speakers and native English speakers. In order to maximize understanding of the lesson's content, students worked together to translate and teach the science material to their partner and in their partner's native language.