Culturally relevant ecology, learning progressions and environmental literacy

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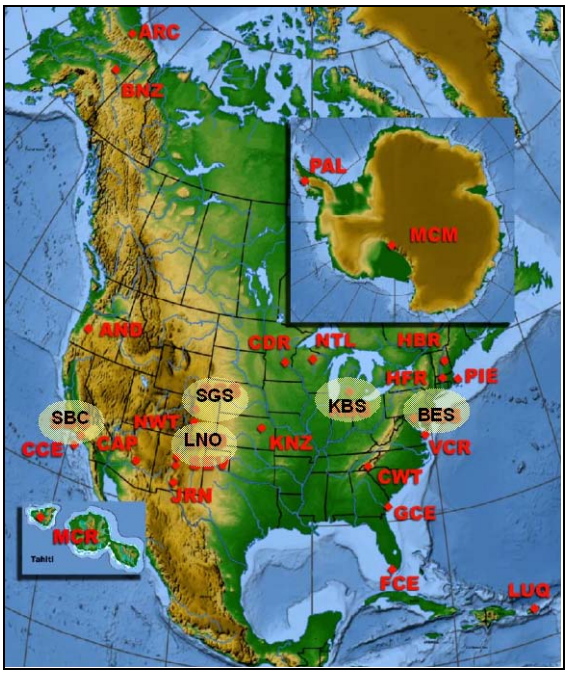
Project Description

Society faces a number of environmental challenges connected to the global and local issues of *biodiversity*, *water*, and *carbon* (e.g., greenhouse gases, climate change, energy development) that will require collective human action on an unprecedented scale. Responding to environmental issues will require greater participation in STEM careers and improvements in the environmental literacy of a diverse public to make informed decisions.

Several factors highlight the nature of this challenge:

- Standardized test scores for middle school and high school students indicate a need for improvement in basic environmental science and related mathematical content
- Surveys of teachers and science educators indicate a desire for more content-based, focused, and locally relevant professional development
- The participation rates in environmental science fields do not reflect the demographics of society as a whole.

To address these challenges, our Mathematics and Science Partnership (MSP) focuses on the critical education juncture of middle school through high school (grades 6-12) with the theme of coupled human-ecosystem interactions in the context of socio-ecological systems as a framework to develop a culturally relevant ecology from both a scientific and educational perspective (ISSE 2007, LTER 2007). We developed a program of teacher professional development in science driven by an environmental science literacy framework around the learning progressions of core science concepts (biodiversity, carbon, and water) complemented with citizenship, quantitative reasoning, and place-based aspects. Our MSP connects the research prowess in the environmental sciences and education of our partner universities and sites within the NSF-funded Long Term Ecological Research (LTER) Network with K-12 teacher professional development in science of our partner schools. We start from the premise that preparation for careers in STEM and for responsible citizenship (including economic, lifestyle, and political choices) are core goals of science and mathematics education. Our MSP relies on a strong foundation of research in the environmental sciences and research in teaching and learning. We address content in a way that resonates with teachers and their students, providing culturally responsive pedagogical approaches grounded in a deep conceptual understanding of content.



Our partnership includes four LTER sites and the LTER Network Office.

Success

- Creation of a national collaboration of Long Term Ecological Research (LTER) network sites, universities, and school district to address goals.
- Creation of learning progression frameworks and initial assessment in the 3 strands (biodiversity, carbon, water).
- Gave presentations at the LTER networks All Scientist Meeting, entitled:
  - Schoolyard study of biodiversity incorporating site specific biodiversity issues and LTER sampling protocols. Wilke, Anderson, Tinghitella, Moore, Berkowitz, Hartley
  - Virtual field trips for LTER sites. Woodmansee, Moore, Vande Castle
  - Pathways to Environmental Literacy: the intersection of science, equity, place, and citizenship. Hauk, Davis, Parker, Moore
  - Culturally relevant ecology, learning progressions and environmental literacy. Moore, Anderson, Berkowitz, Whitmer, Melville-Smith
- Biodiversity Strand
  - Patterns seen in student understanding. Students ...
    - overuse and oversimplify the idea of connectedness among organisms.
    - see competition as a direct conflict between organisms rather than mediated through resources
    - do not recognize death before reproduction as pervasive and therefore do not recognize differential survival as an essential process governing evolution and biodiversity
    - do not understand the concept of “genes” (microscopic scale) which hampers the understanding of heritability of traits

        - view humans as the cause of all change
        - appear to make substantial progress during middle school years (e.g., 6th and 8th graders), yet diminished progress during the early years of high school (e.g., 8th, 9th, and 10th graders).
    - Lessons learned from process of assessing students across sites
        - Patterns in student reasoning about biodiversity appear to be consistent across research sites.
        - Students are not familiar with their local ecosystems.
- Water Strand
    - Designed and administered an assessment of students' ideas about water and substances in water in socio-ecological systems
    - Administered assessment in New York, Baltimore, Michigan, Colorado, and Santa Barbara
- Citizenship Theme
    - How do students use 1st and 2nd hand scientific investigations to inform decisions? We'd like students to engage in these practices with some standards of scientific rigor. However, when interviewed, students' common approaches to evaluating arguments were:
        - generalized distrust (e.g., everyone is biased)
        - unwarranted credulity (e.g., truth is easy to determine based on one's own beliefs)
    - We continue to explore students' practices, and aim to develop educational strategies to support students' use of science in citizenship decision-making.
- Professional Development Theme
    - We had 4 Teachers in Residence (TiR) and 17 Research Experience for Teachers (RET)
    - We worked with over 100 teachers from 19 different school districts during year one
    - We developed Professional Learning Communities (PLC) at each partnering site
- Quantitative Reasoning (QR) Theme
    - We created QR framework and assessment items that support the three strands (Biodiversity, Carbon, Water)

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