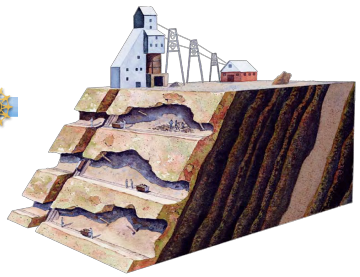
Testing the critical potential role of earth system science classes for STEM success in middle and high schools: A new NSF MSP effort

William I Rose, Jacqueline Huntoon, Bradley Baltensperger and Kedmon Hungwe
Michigan Technological University, Houghton, Michigan 49931

We made earth system science the focus of a math and science partnership research proposal to NSF, something that apparently has not been tried before. Earth Science focus is a quite appropriate focus in our opinion because man's motivation to develop math and science came originally from man's desire to understand the earth and earth processes (eg Aristotle, Ptolemy) and because the central issue of the environmental future and sustainability of life on earth depends on earth system science investigations. Earth Science education has a badly neglected role in middle and secondary schools, but we believe it is now so critically needed that effective educational attention to it could result in more students that will see clearly that math and science are desperately needed to solve urgent and vital environmental problems. As the first course most students get in real science, if its focus can holistically address global warming and environmental quality and be made vital and compelling through inquiry based teaching, we believe it can motivate students to math and science.

Lead Partner: **Michigan Technological University**
Core Partner: **Grand Rapids Public Schools (GRPS)**

Supporting Partners:
Grand Rapids Area Pre-College Engineering Program (GRAPCEP),
Midwest National Parks (NPS),
Cass Technical High School,
American Geological Institute (AGI),
Grand Valley State University Geology Department,
Kalamazoo Area Mathematics and Science Center



http://mitep.mspnet.org

Michigan Teaching Excellence Program (MITEP) is a multi-year program of teacher leadership development that empowers middle-grade science teachers to lead their schools and districts through the process of systematically improving science teaching and learning. The project uses **Earth Systems Science (ESS) content** and **inquiry-based instructional practices** to emphasize themes that unite all sciences and mathematics. MITEP includes both summer and academic-year components, and uses a variety of on-site, residential, field, distance, and in-service delivery methods. Components promote leadership skills, collaboration, urban place-based inquiry, access to cutting-edge data and materials, technology, engagement of diverse learners, study of key scientific concepts that cross disciplinary boundaries, pedagogical innovation. The project will also implement and test lessons and units that challenge students and prepare them for further science study. Teachers receive stipends and credit as incentive for participating in the project and testing its approach to reform.

The project is based on the premise that **successful reform depends on the full involvement of teachers who have the skills to lead their colleagues through the process of developing and implementing new instructional approaches**. MITEP teacher-leaders and research university faculty are full partners in the process. Teacher-leaders are at the forefront of their schools' and district's efforts to evaluate, design, implement, and test new inquiry-based instructional programs. MITEP teacher-leaders help develop common pacing schedules and course assessments. They assist with planning professional development activities and providing ongoing assistance to colleagues. MITEP teacher-leaders are encouraged to disseminate information about the project through presentations at state and national conferences, to submit papers for publication.

Teacher-led reform is strongly supported by the administration of the core school district partner as an innovative way to generate enthusiasm for curricular and instructional change. To encourage development of leadership skills, school administrators give teacher-leaders progressively increased responsibility for strengthening curriculum, improving instructional strategies, and designing assessments. District administrators are providing the resources required for teachers' success in implementing and coordinating the project by assisting with the selection of teachers with exceptional leadership qualities for participation in MITEP; assisting in the design of professional development activities that meet the needs of teachers and their students; providing flexibility in teachers' schedules; utilizing middle-grade teachers' expertise in the dissemination of information to primary and high-school teachers; recognizing, rewarding, and encouraging teachers who serve as leaders; fostering growth of a teacher network; and creating a district-wide atmosphere that nurtures teacher-led reform efforts.

Intellectual Merit: The ultimate goal of MITEP is to improve the quality of K-12 students' science learning by increasing access to, participation in, and successful completion of challenging courses and curricula. MITEP focuses on 8th-grade earth science, typically the first full science course taken by students. Middle school earth science teachers are in an ideal position to conceptualize and lead longitudinal curriculum reform efforts because they have the perspective necessary to ensure that childrens' science education is appropriately scaffolded from the primary through the high school grades. MITEP is a potential model for nationwide science education reform because the evaluation results will provide data needed to demonstrate that teachers who have access to high-quality curricular materials, are skilled in inquiry-based instruction, and have collegial and collaborative relationships with content-area and pedagogical experts can be successful in leading change that results in improved student outcomes. Although this project focuses on earth science, the results of evaluation will serve to inform efforts in other disciplines because the basic structure of the project is not discipline-specific.

Broader Impacts: Over the five project years, three cohorts of GRPS teachers (45-60 total) as well as 50-65 other teachers who are not cohort members will be trained by MITEP. In year three, scale-up activities will begin as teachers associated with the Kalamazoo Area Mathematics and Science Center will join the GRPS teachers, forming a "double" cohort. Upon completion of the project, MITEP teachers will impact over 2,900 predominantly minority, middle-grade students each year. MITEP focuses on urban educational reform in an effort to address achievement gaps that exist in urban and predominantly minority or low-income school districts. Results will be disseminated widely through the Michigan Earth Science Teachers Association, the Michigan Science Teachers Association, the National Science Teachers Association, and the National Science Foundation's dissemination network.