

**Program Planning Summary
Clemson University**

Clemson University Inquiry in Motion Institute

A handwritten signature in black ink, appearing to read 'James F. Barker', is positioned above a horizontal line. The signature is written in a cursive style with a long horizontal stroke extending to the right.

James F. Barker
President
Clemson University

February 1, 2008

**Clemson University Inquiry in Motion Institute
Program Planning Summary**

Designation as New Program Proposal or Modification. *This is an application for a new Institute*

Proposed Date of Implementation. *August 2008*

Justification of Need for the Proposed Program.

A Nation at Risk (1983) and *A Report on the Crisis in Mathematics and Science Education* (1984) were published nearly 25 years ago. Both reports articulated a crisis in public education, and they were the catalyst for the educational reform movement that continues today. Further, these reports highlighted the particular problems that the United States faces related to students' preparation in science and math, and consequently, the decrease in the number of students studying science, mathematics and engineering in college. Addressing this problem is critical if we are to meet society's needs for a strong and educated workforce. Research over the last two decades continues to suggest that traditional methods of teaching science and mathematics are not effective in maximizing learning and properly preparing our youth for the future. Since publication of *A Nation at Risk*, books such as the *National Science Education Standards*, *How People Learn*, and *Science for All Americans* have been instrumental in beginning to facilitate the necessary change to more inquiry-based teaching that integrates key concepts (American Association for the Advancement of Science, 1990; National Research Council, 1996, 2000). Despite some significant change, much is still needed to close the gaps in our science and mathematics educational system. Battista identified the situation as worse than just being ineffective; he stated "Numerous scientific studies have shown that traditional methods of teaching mathematics not only are ineffective but also seriously stunt the growth of students' mathematical reasoning and problem-solving skills" (Battista, 1999, p.433). This same criticism applies to science education as well. The crisis identified in the 1980's remains with us today, although research has provided some insights into developing and identifying effective strategies and approaches for teaching both mathematics and science. No longer does memorization of key facts suffice. Though acquiring skill sets remains imperative, inquiry-based learning experiences are necessary to allow students to develop conceptual understanding and critical thinking skills through the application of knowledge in contextually rich settings. Society has changed markedly over the last two decades; computer technology has brought information to our fingertips, so today's students and adults need to be able to process information and be creative and insightful with the use of this information. The process skills that form the foundation for inquiry instruction will help lead our students to success in this new era. Though there are some classrooms throughout the nation where success is evident, the benefits are often minimal because they are conducted in isolation.

The proposed Inquiry in Motion Institute will serve as the cornerstone of a systemic model to transform the mathematics and science pedagogy, and to some extent the curricula, first in the Greenville County School District (GCSD), and then in the region and state. It will combine formal and informal education; host academic and project-based competitions; serve as a research site for investigating innovative changes in STEM education; and provide a vehicle for a rich collaboration among schools, industry, the Eugene T. Moore School of Education, the CU-International Center for Automotive Research, the department of Computer Science, and the CU College of Engineering and Science. As our reach extends to the state and beyond, we anticipate that it will make significant contributions in improving the preparation of our nation's future workforce.

Institute Mission and Goals.

The mission of the proposed Inquiry in Motion Institute is to provide a national model for improving the motivation, potential and achievement of students and teachers through sustained engagement in science, math, engineering, and technology. The goals are to 1) Increase the graduation rate, decrease the dropout rate, and narrow the achievement gap; 2) Increase student interest in and knowledge of mathematics and science; 3) Increase teacher motivation and retention; 4) Increase student and teacher awareness of STEM careers; and 5) Prepare mathematics and science teachers in an environment that promotes inquiry.

Research Objectives

1. Conduct applied research on student and teacher learning using a proposed model adapted from existing educational research.
2. Study the effectiveness of various models of mentoring upon student achievement and attitudes and upon teacher motivation and retention.
3. Evaluate the impact of a combination of formal and informal educational opportunities upon students' knowledge of and attitudes toward STEM disciplines and upon their awareness of careers in STEM disciplines.

Education and Training Objectives

1. Integrate authentic engineering investigations into K-12 science and mathematics classes.
2. Prepare K-12 teachers to lead meaningful Creative Inquiry experiences in STEM disciplines.
3. Integrate science and mathematics objectives in K-12 settings.
4. Prepare K-12 math and science teachers with a research-based, innovative pedagogical model.
5. Develop a mentoring program that will integrate business, teachers, graduate students, undergraduate education students, and K-12 students.

Outreach and Service Objectives

1. Disseminate best practices for preparing teachers to teach mathematics and science in an inquiry-based environment.
2. Provide courses and competitions that will attract teachers and students throughout the area, the state, the Southeast region, and the nation.

Entrepreneur Objectives

1. Establish a collaboration with businesses to develop programs and services that will introduce teachers and students to careers in STEM disciplines.
2. Develop project-based competitions that will engage industry as well as K-12 students and teachers.

Operational Objectives

1. Maintain and develop partnerships throughout the university by recruiting faculty to conduct research through the Institute and engaging students in this faculty research.
2. Maintain and develop partnerships with industry and several colleges and universities.
3. Manage day-to-day operations of the Institute.
4. Plan and sponsor educational symposia for those interested in collaborations of this nature.

Anticipated Program Demand and Productivity

The physical structure of the Institute will house 12 courses per year, along with four academic competitions and one project-based competition each year. In addition, it will be the site of three theme-based exploration areas and three exploration rooms for the study of STEM-based ideas. We anticipate that 200 K-12 teachers and 200 K-12 students will be educated there annually through the formal courses, and approximately 1200 students per year through the informal educational programs established through the Institute. Each of these components will be researched by approximately 14 CU faculty per year, including eight science and mathematics educators, two engineers, two computer scientists, one architect, and one landscape architect, and a minimum of 12 graduate students in the various disciplines.

The proposed Inquiry in Motion Institute will first work on systemic change in STEM education within the Greenville County School District. This will serve as a pilot study as we look to expand the model. During the third year, the efforts will be expanded to the state, in the fourth year to the state and region, and in the fifth and following years, to the nation. The results of the research will provide critical information that will provide a model for how industry, a school district, and a university can collaborate to make a significant difference in STEM education.

Assessment of Extent to Which the Proposed Program Duplicates Existing Programs in the State

The proposed Institute complements, but does not duplicate, the following programs across the state.

Children’s Museum of the Low country: The museum provides interactive, interdisciplinary, hands-on environments and experiences with the arts, sciences and humanities.

EdVenture Children’s Museum: This is an interactive children’ museum for children 12 and younger. Numerous exhibits range from Science to Social Studies

Joe Weatherly Museum, NMPA Stock Car Hall of Fame: The museum features a fine collection of older stock cars.

Florence Museum of Art, Science, and History: The Florence Museum of Art, Science and History was established to promote the Arts and Sciences

Greenwood Museum: The exhibits document ways of life, cultural trends, and technology from prehistoric to contemporary times.

Children’s Museum of SC: This is a hands on museum featuring exhibits on science, technology, humanities, and culture

Museum of York County: The museum has changing exhibits, natural science, hands on projects and other education programs including exhibits on art, science, history, and natural history, as well as a planetarium.

BMW Zentrum Museum and Visitor’s Center: The Zentrum is more than housing space for historical displays. It is a bridge between BMW and the community.

Roper Mountain Science Center: Roper Mountain Science Center is a model of collaboration between public and private resources stressing formal an informal learning linked with SC curriculum standards, particularly in the biological sciences.

USC Center for Science Education: The center assists teachers and schools through in-service workshops and curriculum development.

Relationship of the Proposed Program to Existing Programs at the Proposing Institution

The Inquiry in Motion Institute will build capacity and complement educational outreach efforts currently made by several programs at Clemson. The Institute will work collaboratively with the following:

The South Carolina Center of Excellence in Mathematics and Science Education (CEMSE) provides support, professional development, curricula, instructional materials, and course work to improve the teaching of mathematics and the physical sciences in grades K through 16. CEMSE programs include science content courses for pre-service teachers; graduate courses for education students; professional development programs for in-service teachers; short and longer-term outreach programs for K-12 students; instructional materials development; and presentation of educational issues to university research faculty.

In the life sciences \$3.4 million in funding over eight years from the Howard Hughes Medical Institute Undergraduate Biological Sciences Education Program sponsors a state-wide project, entitled **SC LIFE** that uses natural history as the engaging for engaging pre-college students and their teachers in science and provides research opportunities to undergraduate and high school students. Current SC LIFE Activities include (1) development of SC LIFE- Natural History of South Carolina classroom lessons; (2) workshops and graduate courses for in-service teachers; (3) summer research internships for students at the Governor's School for Science and Mathematics (GSSM); (4) schoolyard ecology programs (5) development of Internet-based Virtual Field Trips (6) increasing participation of under-represented minorities in life sciences enrichment programs; and (7) production of classroom materials such as materials footlockers, CDs, teachers' guides and posters.

The **SC MAPS** Project Office in geological sciences has provided outreach to K-12 teachers since 1994 through numerous grant-funded projects, including NSF grants, to develop instructional materials and offer professional development courses and workshops to South Carolina teachers. The SC MAPS program offers teachers a set of thematic, hands-on interdisciplinary case studies based on South Carolina geology and geography. Students use topographic maps, aerial photography and remotely sensed imagery to obtain a unique perspective on land use concerns and environmental resources throughout the state.

The **South Carolina DNA Learning Center (SCDNALC)** is a consortium involving a number of South Carolina institutions and the Dolan DNA Learning Center (DNALC) at Cold Springs Harbor, New York. The mission of the SCDNALC is to provide outreach education in modern genetics and biotechnology to K-12 teacher, non-formal educators, and K-12 students.

The **Institute for Modeling and Simulation** applications (IMSA) was formed in February 2004 to increase the impact of modeling and simulations by fostering truly interdisciplinary research, linking modeling and simulation of the highest caliber and important scientific and technological problems from to the disciplines and industry. Allied with this mission, the IMSA aims to expand and strengthen the talent base engaged in mathematical research. IMSA works closely with the Shodor Education Foundations, INC., an award-winning, nonprofit education and research corporation dedicated to reforming and improving mathematics and science education by incorporating appropriate computational and communication technologies. Among projects at Shodor are *Project Interactivate*, a suite of award-winning outline resources keyed to the National Standards and *Computational Science Education Reference Desk* (CSERD), a collection of simulations spanning much of the science and engineering. SCERD participates in the Pathways project for the National Science Digital Library. The Institute will also provide a venue for computer science faculty and students interested in creating and researching the effectiveness of educational games, for landscape architects interested in studying the use of space, engineers interested in the preparation of the K-12 workforce, and marketing faculty and students who want to pursue the dissemination of an effective model throughout the nation.

Relationship of the Proposed Program to Other Institutions via Inter-institutional Cooperation

At this point, this area does not apply. However, we have set up an exploratory meeting with faculty from Furman University to discuss the possibility of extending the collaboration.

Total New Costs Associated with Implementing the Proposed Program

The estimated costs for the first five years of Inquiry in Motion total \$17.8 million. Of this, we anticipate that approximately \$150,000 will come as salary for the first two years to allow two professors, one in science education and one in mathematics education, to devote 25% of their time to directing this project and for a graduate assistant for one year to help with the initial pilot courses and to secure additional funding. Of the remaining, we will seek \$7.4 million in corporate grants and funding, largely but not exclusively for capital expenses, and the remaining \$10.2 million in grants from NSF, the Department of Education, and the state of South Carolina.