

Concept Paper:
Submitted by:

Smith College Center for Science and Engineering Education
Glenn Ellis, Associate Professor, Picker Engineering Program
Susan Etheredge, Associate Professor, Education and Child Study
Linda Jones, Professor and Director, Picker Engineering Program
Al Rudnitsky, Professor, Education and Child Study
Thomas Litwin, Director, Clark Science Center
Gail Scordilis, Director, Educational Outreach

Goal:

- To provide national leadership for the integration of research on the learning and teaching of science and engineering K-16 through the establishment of a **Center for Science and Engineering Education** at Smith College. The Center would encompass Smith's strong vision of a liberal education for women, inclusive of the college's strengths in the sciences, engineering and education, and rooted within the context of the college's tradition of service to humanity and educational outreach to the broader community.

Key Objectives:

- To support the development of a national learning and research community for the professional development of K-16 science and engineering faculty:
 - i. linking educational practices K-16 and supporting sustained research and pedagogical innovation, and
 - ii. promoting the dissemination of effective practices and curricula.
- To integrate research on science and engineering learning into the undergraduate curriculum with the aims of:
 - i. encouraging participation in these fields, particularly of women and underrepresented groups, and
 - ii. promoting an interest in the K-16 teaching profession amongst undergraduates with demonstrated content knowledge in these fields.

National Need: In October 2005, the National Academies of Sciences issued a report calling for the United States to increase its investment in science and technology as a means to securing the nation's strategic and economic security. Number one amongst its recommendations was to "increase America's talent pool by vastly improving K-12 mathematics and science education". Central to this challenge is the lack of in-service teachers with sufficient science content knowledge. This reflects the failure of universities and colleges to engage a significant proportion of students in science study, and the small number of scientifically literate graduates, particularly those who are high performing, entering the teaching profession. Conversely, at the undergraduate level, science and engineering faculty have extensive content knowledge, but very often little formal preparation in understanding student learning and effective pedagogies.

One significant result of the failure of science and engineering education K-16 is the lack of participation by women and underrepresented populations. Currently the National Science Foundation reports that women earn more than 40 percent of the Ph.D.s in the life sciences, fewer than 20 percent of the doctorates in the physical science and mathematics, and only about 17 percent of the engineering doctoral degrees. According to figures released in 2005 by the U. S. Department of Labor, women comprise just 14 percent of the engineering and architectural workforce and 27 percent of the workforce in computers and mathematics. Minority groups are similarly underrepresented. Critical to the sustaining and increasing the United States' educated workforce in engineering and technology, are programs that address the endemic under representation of women and minorities these fields

The Smith Model: Our vision for reforming science and engineering education is a research-based approach with two facets: creating K-16 curricula and programs that are innovative in content and pedagogy, and developing unique K-16 learning communities that support teacher and student growth. The proposed center would be built on the foundation of strong programs in the sciences, engineering and education at Smith as well as the strength of the college's educational outreach. Key elements that would define the center are:

Research-Based Approach

- Educational approaches for the center would be developed through the application of current research in education and the extensive assessment of Smith's pioneering educational programs, including amongst others: the Smith College Campus School – our campus laboratory for inquiry-based learning in the sciences and engineering K-6; the Smith Summer Science and Engineering Program - one of the nation's leading outreach efforts addressing the gender, racial and other biases that determine who successfully navigates the science and engineering pipeline; and the Picker Engineering Program - the only all-female engineering program in the country, integrated within the liberal arts and promoting a vision of engineering in service to humanity.
- Programs and curricula within the center will be developed by multidisciplinary teams of Smith faculty experts in education and child study, science and engineering, in collaboration with K-16 partners.

Innovative Curricula

- Learner-centered pedagogy that is based on the research on how people learn
- Content that engages and prepares young people to actively participate in a changing global society
- Content that integrates the study of science and engineering within a liberal arts context in support of humanity, social justice, and a sustainable world
- An approach to K-12 engineering education that integrates engineering across the curriculum and uses engineering as a pedagogical tool for contextual learning
- Content and pedagogy that draw on Smith's history of excellence in educating women and underrepresented groups in science and engineering

Unique Learning Communities

- Supportive, interdisciplinary K-16 communities in which Smith College serves as a facilitator
- Participants who are engaged and united through an emphasis on serving humanity
- Pre-college and college educators who pool their expertise
- Undergraduates in important roles that attract them to science and engineering majors, while also exposing them to potential teaching careers

Planning and Resources: The initial planning stages for the center would involve a significant self-study process to collect data, and identify faculty collaborations and institutional assets that together would allow for the development of a clear vision for the center. Key resources that would need to be supported in the future are: space that is designed to reflect the innovative thinking of the center; staffing for administration, programming, research and assessment; professional support for curriculum design and writing; fellowships for post-docs, visiting scholars and public school faculty; work-study placements and summer internships for undergraduates; funds for campus workshops, symposia and travel; and, support for web and publications development. The proposed center would be an attractive candidate for federal, corporate and/or foundation support.