It is all too easy for a scientist of a given discipline to focus on his or her home department and like-minded colleagues. In fact, the organizational design of the university often dictates the collegial relationships that occur on a daily basis. We saw the need to break with academic tradition and more closely model what is now seen in the workplace in many scientific industries. Pharmaceutical companies are a good example. In this industry, work teams of scientists are just that—teams—that are representative of several scientific disciplines. A drug discovery team will partner synthetic organic chemists and analytical chemists with neurophysiologists, computational statisticians, and molecular biologists. In industry, the goal is research and development. The goal in the academic world of a science college is to educate and train the next generation of scientists.

Historically, higher education institutions group their various science and mathematics departments by college or school. Similarly, students pursuing a major in education often reside in a college entirely separate from the science and mathematics college. These academic units (department of biology, department of secondary education, etc.) share an organizational structure that all too often does not afford opportunities for close interactions among the different departments, let alone with departments housed in other colleges. University faculty are required to serve their home departments where they daily see their colleagues, who are likely all of the same discipline (e.g., chemistry, despite having different subspecialties). Furthermore, the undergraduate students of a major housed in a given department are advised to enroll in a handful of courses taken in the other departments within their college, which are needed for their major in order to graduate. Many students in traditional science majors take courses in different subdisciplines of science in a manner that is isolated from the courses taken in their academic major department.

We were afforded a unique opportunity, to create not just a new academic science major, but also a new academic department to house it. The name given this novel entity is the New Jersey Center for Science, Technology & Mathematics Education, and the center is an academic department positioned within the Graduate College at Kean University. The revolutionary elements of this undertaking are threefold.

First, faculty lines from different scientific disciplines are housed in a single academic “unit,” whereby the center’s faculty is an integrative team of scientists and educators who work closely together
to motivate students to excel in science and mathematics. While our faculty are all scientists (PhD and EdD), our expertise spans computational physics, applied mathematics, biotechnology, biomedicine, physical chemistry, and science and math teacher education.

Second, the center operates academically as a department but is expansive in its expectations of the faculty and students in that it is a center of excellence. While our primary focus is our academic program, our curriculum, and our student majors, we require student and faculty service not only to the university, but also to students and teachers elsewhere. We partner with local schools and take our college students there for educational math/science activities, tutoring, etc. Our faculty offer on-site and off-site teacher training workshops in computational mathematics and integrated science curriculum.

Third, the curriculum for the academic major integrates science, mathematics, and technology so closely that many novel courses have been created, without the segmentation traditionally found in an undergraduate degree. Our opportunity to break the traditional mold of organizing the academic unit charged with educating the future generation’s science-competent workforce began five years ago with our university president. This agent of change challenged us to do what so few institutions have done before, create a science major that in a coordinated fashion is trained across the disciplines. Over the span of two years, a team of faculty from various science, math, and education departments worked to create not only the curriculum but also the operational center and gain approval by the university’s Curriculum Committee.

Within a single academic department, we now concentrate on preparing educators of high school biology, chemistry, and mathematics teachers and scientific researchers in biotechnology and computational mathematics. The center offers a five-year combined bachelor/master’s tuition-paid scholarship program with two separate degree tracks: scientist educator and scientist researcher. Our students take mathematics courses with a weekly mathematics problem-solving and computational laboratory session in a linked format with a corresponding science (chemistry, biology, and physics) for each semester of their freshman and sophomore years. This requirement provides the future high school math teacher with college coursework in various science disciplines, and the future high school biology teacher with many semesters of applied calculus and linear algebra in his or her mathematics toolbox. At the end of the fourth year, students are awarded a baccalaureate degree in science and technology. At the end of the fifth year, students in the educator track are awarded a master’s degree in instruction and curriculum and are eligible for state teacher certification in either biology, chemistry, mathematics, or earth science. Students in the research track earn a master of science degree in biotechnology or computational mathematics at the end of year five.
The center is committed to a statewide recruiting effort with special attention to students from the urban and low socioeconomic regions of New Jersey. The students are a reflection of the cultural and economic diversity found throughout the state. The center will graduate its first class in 2008 (B.S.) and 2009 (M.S.). Each fall a class of 30 freshmen are admitted, who, in addition to the Kean University undergraduate application process, go through the center application process involving a supplemental application and interview along with recommendation letters from high school science or math teachers. For four years of student cohorts, we have consistently maintained a mean combined SAT for entering freshmen of over 1100 and a math score mean of 580 or higher. Student retention in the five-year program has improved yearly, from 50 percent for the first cohort to 70 percent for the second cohort to 87 percent for the third cohort. Students who earn a cumulative G.P.A. below a 3.0 for more than two semesters are recommended to the dean for dismissal from the academic major.

While a search of colleges and universities nationwide reveals programs that at first seem similar to our center (i.e., offer a combined bachelor/master of science degree), they are not inclusive of all the center components. Many do not accept incoming freshmen, instead requiring enough credits for junior standing before consideration into an “honors” program, nor afford their students resources to the extent that the center has done to date (in-state full-tuition scholarships and laptops provided for at least the freshman/sophomore years). Other programs tend to focus on coursework in one subject (such as computer science, biology, etc.) and do not require the breadth of academic courses required by their majors spanning multiple science and math disciplines. Finally, our center spends the first two years of the five-year program training future scientists before having the students select their major options to pursue career paths either as a high school educator of science/math or as a researcher of math/science. Our model of undergraduate/graduate science and mathematics education is rare, as it represents a philosophical change in the structure of science departments and their major curriculum.

The authors presented a poster presentation on this work at the POD Network Conference in Pittsburgh, Pennsylvania, in October 2007.

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