



## Statewide Science Education Reform: One Foundation's Approach in North Carolina

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## Introduction

*"The future well-being of our nation and people depends not just on how well we educate our children generally, but on how well we educate them in mathematics and science specifically." (Before It's Too Late, National Commission on Mathematics and Science Teaching for the 21st Century, 1999)*

The Burroughs Wellcome Fund (BWF) uses a variety of strategies to help build a quality science education program in North Carolina that extends from students to school administrators to parents to policymakers. This systemic approach extends well beyond the classroom environment. It encompasses informal science education settings, such as museums, summer camps, and after-school activities, and includes providing legislators and the media with information that can inform decision-making on educational issues. We share this work in the hope of encouraging other groups to adopt or support statewide or regional efforts to improve primary and secondary education in science, mathematics, and technology (SMT).<sup>1</sup>

In July 1999, the U.S. Department of Education created the National Commission on Mathematics and Science Teaching for the 21st Century to investigate the quality of science and mathematics teaching across the nation. The commission's findings prompted an urgent call to improve the way that science and mathematics were being taught and learned. Seven years later, this urgency has become a focal point of discussions in classrooms, in boardrooms, and in homes nationwide, as documented by the landmark report *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, issued in 2006 by the National Academy of Sciences' Committee on Science, Engineering, and Public Policy (COSEPUP).<sup>2</sup> The report suggests that by vastly improving science and mathematics education from kindergarten through high school, America can significantly increase its SMT talent pool and thus will be better equipped to compete in the emerging knowledge-based global economy.

A number of national organizations, such as the National Academy of Sciences, the National Science Foundation, and the American Association for the Advancement of Science, are helping to answer pressing questions of how best to produce, at the K-12 level, the next generation of American scientists and mathematicians. But ultimately, North Carolina itself is responsible for implementing the changes that will create real results in how the state's children perform in SMT curriculum.

North Carolina is BWF's home state. Some 8.6 million people live in 100 counties within three distinct regions—coastal, piedmont, and mountains. And the state's demographics are changing; it now has one of the fastest-growing Hispanic populations in the country.

There are 115 county and city school districts to accommodate the state's growing number of students. North Carolina is fortunate to have committed political, business, foundation, and education leaders who are dedicated to working together to improve the state's schools.

In 1993, the North Carolina Education Standards and Accountability Commission established an education accountability system that has provided a stable statewide framework and has guided teacher training and recruitment, curriculum adoption, public policy decisions, and, most importantly, improving student achievement. However, the accountability system had a critical shortcoming: it lacked a program for assessing science education, especially in the primary grades. Since science was not being tested, it remained undervalued and was not rigorously taught. Similarly, the science curriculum was not being selected based on the best examples of how to teach science.

Gaps in student performance became apparent in 1995 when North Carolina examined science and mathematics instruction in schools statewide. This assessment revealed that there was a "disconnect" among the various mathematics and science programs in place across the state. The assessment noted the importance of developing and implementing strategic efforts to continue to improve

<sup>1</sup> BWF has focused on K-12 science education reform and for this reason SMT (science, mathematics, and technology) is used instead of STEM (science, technology, engineering, and mathematics), which is often used in reference to higher education curriculum.

<sup>2</sup> COSEPUP is a joint unit of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. See: [www7.nationalacademies.org/cosepup](http://www7.nationalacademies.org/cosepup).

science and mathematics education, and it called for greater coordination of existing programs to ensure that all children across the state were benefiting from them.<sup>3</sup>

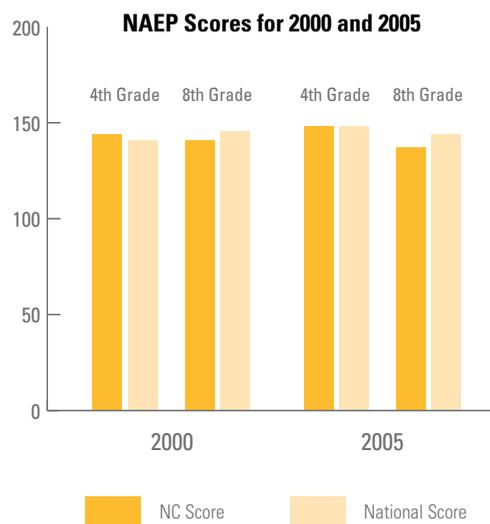
In recognition of the apparent stagnation of science education in North Carolina, as well as the lack of coordination among ongoing science programs, the Burroughs Wellcome Fund made a policy decision to help encourage more of the state's students, especially underrepresented minorities, to take advanced science courses and become involved with informal science education. BWF's Board of Directors decided to target K-12 students, as many board members recalled that they had been enticed into science by some type of early informal science experience. In 1996, the board designed the Student Science Education Program (SSEP) to increase students' interest in science and mathematics and to improve their achievement in these areas by providing them with opportunities to explore science and mathematics in informal settings.

BWF deemed improving informal science experiences for middle- and high school students to be a good starting point. In the board's view, such efforts would address the issue of providing a future pool of U.S. students, especially girls and underrepresented minorities, who are prepared for careers in science and mathematics. The board also believed that strengthening informal science programs at these grade levels made sense because students spend only 14 percent of their time in school.<sup>4</sup> Until schools improve, informal science education experiences, such as those provided through BWF's Student Science Education Program, provide the best opportunities to reduce the state's persistent disparities in student achievement.

The advisory committee formed to oversee the new SSEP decided in fairly short order that BWF, in addition to supporting programs that reach students directly, also needed to support efforts to help in developing informed public policy and research, to help build strong partnerships among the many existing informal science education programs, and to champion change in SMT for all students in

North Carolina. Toward these ends, BWF has made a number of grants not only to support the informal science education community but also to support institutions and organizations that are dedicated to informing state and local policymakers about policy needs, to demonstrating effective models of science education, and to advocating for change in the broader education environment. State-to-state comparisons of how well students are performing in science continue to point to the need for programs in North Carolina—as elsewhere in the United States—that focus on enriching the science and mathematics educational experience for all types of secondary students.<sup>5</sup>

The 2005 National Assessment of Educational Progress found that North Carolina's fourth graders were on par with their national peers in science, but that eighth graders ranked slightly lower than the national average (*see graphic*). The assessment covered two major dimensions: fields of science (earth, physical, and life) and knowing and doing science (conceptual understanding, scientific investigation, and practical reasoning). Further, the 2005 results revealed that neither fourth graders nor eighth



<sup>3</sup> Public School Forum of North Carolina. *A State of Disconnectedness: An Examination of Mathematics and Science Instruction in the North Carolina Public Schools*. 1995.

<sup>4</sup> Bransford, J. D., Brown, A. L., & Cocking, R. R. (eds.). *How People Learn* (expanded ed.). Washington, D.C.: National Academy Press. 2000.

<sup>5</sup> Blank, R. K., Langesen, D. *State Indicators of Science and Mathematics Education, 1999: State-by-State Trends and New Indicators from the 1997-98 School Year*. Washington, D.C.: Council of Chief State School Officers. 1999.

graders in North Carolina had made significant improvements in their science scores from 2000. It should be noted, however, that these data may mask disparities in performance along racial, ethnic, and economic lines.

To help North Carolina's students perform better in science, BWF created a fundamentally new institution, the North Carolina Science, Mathematics, and Technology Education Center (SMT Education Center), to provide a central organization for addressing the needs of K-12 SMT education. In 2005, the SMT Education Center, powered with a \$2.5 million grant from the Burroughs Wellcome Fund, began its mission of change.

## How Informal Science Experiences Improve Student Interest and Achievement in Science

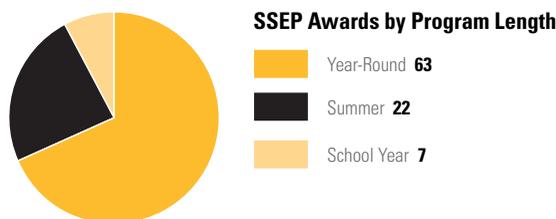
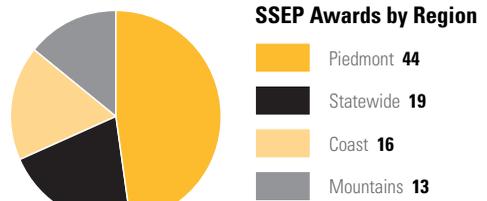
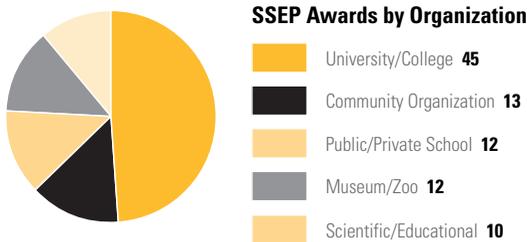
The National Research Council's 2005 report *How Students Learn Science in the Classroom* clearly conveys what can be done to help students learn science in formal settings. Students come to class with preconceptions about how the world works, and good teachers use this as a departure point for their lessons. But students learn much of what they know outside the classroom in informal settings—gaining an estimated 53 percent of their knowledge in the home and community and 14 percent in school. There has been considerably less research to suggest how best to teach science in informal settings.

The Burroughs Wellcome Fund's (BWF) Student Science Enrichment Program (SSEP) provides some insight into the attributes of successful informal science experiences and how such activities can turn students on to science.

### Student Science Enrichment Program

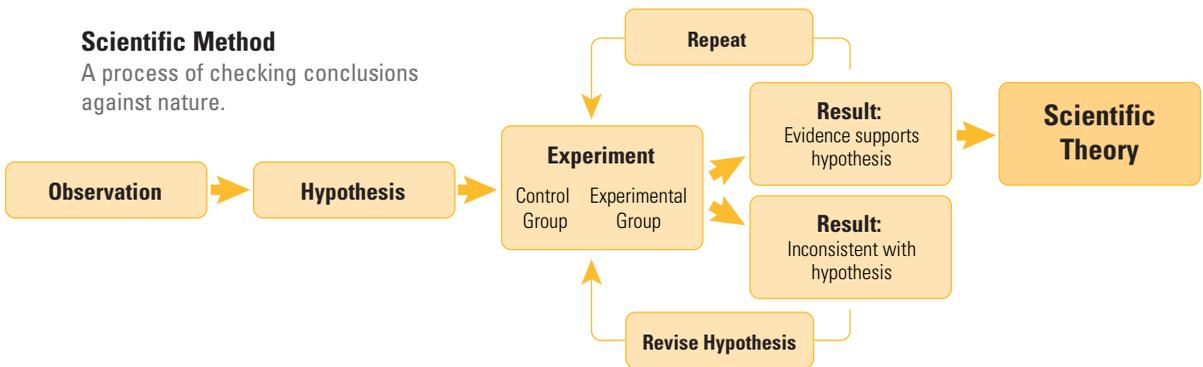
When BWF began funding science education programs in the mid-1990s, this was new territory. In order to better understand the environment of K-12 SMT education, BWF's Board of Directors convened state and national education experts to help spell out what approaches would be most promising for advancing science education in North Carolina. In keeping with BWF's emphasis on promoting the career development of individual scientists, the board decided to establish a competitive award program for science education—the Student Science Enrichment Program. SSEP funds projects that engage students at the middle school and high school levels in hands-on inquiry-based science activities that are aligned with the North Carolina Standard Course of Study. Through a variety of programs funded to date, students have been given opportunities during summer vacations, after school, and on weekends to work with scientists and science teachers who have an interest in making science "real" for them and their parents.

SSEP grants provide up to \$180,000 over three years. Nonprofit organizations, such as public and private schools, universities, colleges, museums, and community organizations, are eligible to apply. BWF makes up to 12 SSEP awards each year. Since 1996, BWF has invested nearly



### Scientific Method

A process of checking conclusions against nature.



\$13 million through 92 awards to more than 50 different organizations across the state, and the programs have reached nearly 24,000 students.

BWF uses an advisory committee of state and national science education experts to review applications and make recommendations for SSEP awards. The committee selects awards based on the following attributes:

- Ability of the program to nurture student learning with innovative, engaging activities.
- Ability of the organization to conduct and sustain enrichment activities.
- Qualifications of the organization’s director and staff.
- Appropriateness of the budget.
- Availability of additional monetary support and other resources.
- Effectiveness of the evaluation plan.
- Manner in which students are identified and selected.
- Plans to reach students who are underrepresented in the sciences, including minorities, girls, and the economically disadvantaged.
- Plans to link students with other science-related activities.
- Plans to sustain the project after SSEP funds expire.

SSEP’s goals are to nurture students’ enthusiasm for science, improve their competence in science, and encourage them to pursue careers in research or other science-related areas. In 2005, BWF evaluated the programs and found that 46 percent of participating students viewed science as a career option after completing SSEP activities. Students are taught the scientific method (*see graphic*)—a way of thinking that is transferable to other subjects in school. More importantly, students learn to do science in ways that affect their schools and communities.

For example, a nonprofit organization in the city of Jacksonville received SSEP funding in 2003 for a summer science institute for rising ninth graders. For the program, the city converted an old wastewater treatment plant into an environmental education center where students could research requirements for reintroducing sturgeon and shellfish into a local body of water called Wilson Bay. The city wanted to restore the bay’s water quality and recruited students to help. More than 1,000 students spent their Saturdays learning about environmental science and its application to improve the quality of water in their local watershed. Although it is too early to know if the students’ efforts have improved water quality in Wilson Bay, it is clear that the students have successfully engaged their families and communities in a dialogue about environmental awareness, civic responsibility, and local issues of substantial scientific and economic interest.

SSEP reaches students who have exceptional skills and interest in science, as well as those who may not have had an opportunity to demonstrate such skills or interest in science but are perceived to have high potential. The program encourages organizations seeking grants to develop nontraditional ways to identify and recruit students for their programs.

"We have found that programs that go the extra mile to recruit students who generally are not targeted for science enrichment programs are diamonds in the rough," said BWF President Dr. Enriqueta Bond. "One such program is Project SEED, which has a dedicated high school science teacher (now university faculty) who has recruited students from the hallways and the cafeteria."

Project SEED, directed by Kenneth Cutler, helps high school students conduct basic research during the summers under the supervision of university scientists. Cosponsored by the American Chemical Society, Project SEED includes instruction on scientific methodology and scientific research, as well as on scientific ethics. Students develop PowerPoint presentations and posters to present their research at national scientific meetings, as well as in more informal settings to their peers and family. Among activities of Project SEED students, two of them discovered an enzyme while working at the Mount Desert Laboratory in Maine, and they went on to become finalists in the Siemens Westinghouse Science & Technology Competition. Seven graduates of Project SEED currently are enrolled in doctoral programs in chemistry, bioinformatics, immunology, mathematics, pharmacology/toxicology, and materials science at leading universities, including Stanford, Tulane, the University of Massachusetts, the University of North Carolina at Chapel Hill, North Carolina State University, and Virginia Commonwealth. This spring, Dr. Ticora Jones became the first Project SEED alumna to obtain her Ph.D.

The students in Project SEED are African Americans. Thus, they not only represent a measure of personal success; they also serve as part of the answer to a pressing national question posed by Dr. Shirley Ann Jackson, president of



A Project SEED student discusses her poster with BWF board member Carlos Bustamante.

Rensselaer Polytechnic Institute. "Who will do science of this millennium?" she asked, going on to note the death of underrepresented minorities selecting careers in science.

**The BWF website ([www.bwffund.org](http://www.bwffund.org)) illustrates other exceptional examples.**

### Evaluation Data

BWF believes it is important to continually monitor whether its programs, including SSEP, are performing as planned. From SSEP's very beginning, BWF has used independent external evaluators to assess progress on an annual basis. The evaluators assess students' competence in science, their attitudes about science, and their interests in pursuing careers in research or other science-related fields. The evaluation captures data from surveys and annual progress reports on the demographics of student participants, their attitudes, and their interests regarding science; on the types of project activities being used; and on progress toward achieving program goals. BWF uses the evaluations to guide program changes and development.

<sup>7</sup> Broad, William J. "U.S. Is Losing Its Dominance In the Sciences." *The New York Times*: May 3, 2004 A1.

SSEP applicants are required to submit a proposed evaluation plan. The plan must define expected outcomes of program activities and spell out efforts to be used to assess outcomes of the activities, including explaining who will conduct the evaluations and how much the evaluation will cost. BWF also contracts with outside evaluation consultants to assess the quality and effectiveness of SSEP awards through data collection and site observations. The consultants provide up to four hours of technical assistance in evaluation to all award recipients.

BWF uses the following assessment instruments and procedures to evaluate the program:

- **Project Profile Surveys** are completed by SSEP directors at the beginning of their funding cycles. The surveys collect data that are used to describe the project's plans for implementation. The outside evaluation team provides annual updates.
- **Student Feedback Surveys** are administered to participating students either at the end of major project activities or at the end of the evaluation year (depending on the timetable for the project). SSEP offers summer camps in addition to year-round programs. This survey provides information regarding students' perspectives on the quality of the project and on how the project affected them.
- **Observations** are conducted at SSEP project sites as needed. The observations provide an independent perspective of the nature of activities and the extent of student engagement.
- **Annual Progress Reports** are completed by SSEP directors and reviewed and rated by the BWF staff and an outside advisory committee to assess the quality of program activities. These reports help identify common project strengths and areas where support or changes are needed. BWF uses this feedback, along with other information, in determining whether or not projects will receive continued funding.

From data collected from survey descriptions provided by SSEP project directors, BWF has found that two types of programs receive funding—career-oriented programs and practical programs. The data also have shown that two types of students—gifted and general-population students—participate in SSEP activities. In reviewing the annual progress reports of SSEP award programs, BWF has determined that all students have been provided access to rigorous hands-on science activities, such as collecting DNA, measuring water quality, creating mathematical models, and growing plants to study nutrition. The only differential among programs has been in the type of curricula offered to the different types of students.

#### Two kinds of programs identified

- Career-oriented programs
- Practical programs

#### Methods used to make identification

- Program descriptions
- Directors' survey results

#### Primary characteristics of both program types

- Similarity: rigorous activities to teach scientific process
- Difference: curricula

#### Two types of students identified

- Gifted students
- General-population students

Based on these evaluations, BWF has determined that there are several critical attributes of successful informal science enrichment programs.<sup>8</sup> Data from 46 organizations, including universities, colleges, public/private schools, museums, and community organizations, were used to identify these attributes, which SSEP program applicants are now required to demonstrate in order to win a grant. By incorporating these attributes into activities, program directors have improved student participation and satisfaction.

<sup>8</sup> Donley and Johnson, *SSEP Evaluation*, August 2000.

These attributes are:

- Programs must use a curriculum that is appropriate for targeted students.
- Programs must offer “minds-on” as well as hands-on inquiry based activities.
- Programs must involve scientists and teachers.
- Programs must provide students with opportunities to discuss their work and present it to others.
- Programs must have a large applicant pool from which to draw, in order to ensure participation by quality students.
- Programs must maintain an on-going relationship with students, as it has been demonstrated that programs that continue throughout the school year make a bigger impact.

BWF disseminates the evaluation findings in a number of ways, including on its website and at conferences and meetings, such as the Grantmakers in Education meeting. As a result of such networking, Missouri and Indiana have expressed interest in replicating the SSEP.

The evaluation program helps sustain the work of SSEP award recipients by providing accountability and outcome data that other funders find useful. Based on the evaluation data, BWF is willing to partner with SSEP award recipients in seeking funds from other sources.

For example, the Shodor Education Foundation, which received SSEP awards in 1997 and 2000, asked for help in applying for a \$2.8 million grant from the National Science Foundation to incorporate its Computational Science Education Reference Desk into the National Science Digital Library. Shodor received the grant—which was a direct outcome of the SSEP-funded project SUCCEED (Stimulating Understanding of Computational Science through Collaboration, Exploration, Experiment, and Discovery)—and is now creating science and mathematics resources to support educational reform efforts. Middle- and high school students helped write the curriculum used for this grant.

In many respects, SUCCEED serves as a model SSEP program. The project connected middle school and high school students with computational scientists who helped the students learn basic computing and communications technologies. The scientists taught students how to survey, retrieve, and evaluate information on the web, how to use research methodology, such as mathematical modeling, and how to conduct scientific computing and data visualization, among other skills. The middle schoolers eventually trained other students, sometimes their siblings, on computational science concepts.

The North Carolina State University Science House Imhotep Academy program called Photonics Xplorers, which won a SSEP award in 2004, serves as another model. This year-round multidisciplinary program for culturally diverse 9th and 10th grade students meets during the summers and after school to investigate optics, laser technology, and electronics. The Imhotep Academy applied for a National Science Foundation grant to scale up its SSEP initiative and received a \$723,000 grant through the Information Technology Experiences for Student and Teachers (ITEST) Program.

### **Convening Award Recipients**

Each year, the Burroughs Wellcome Fund convenes new SSEP award recipients in an orientation meeting to share expectations, address programmatic issues, learn about BWF's history, and hear why they are important to BWF's overall mission. Grant recipients are considered members of the “BWF family.” An annual meeting provides current grantees an opportunity to network with colleagues across the state, to explain their work to others through poster sessions, and to hear presentations from state and national experts on trends and issues in science education. BWF holds the meetings at its headquarters so that SSEP directors can become familiar with the members of BWF's staff, board, and SSEP advisory committee. The meetings also provide an opportunity for BWF's staff and SSEP advisory committee to informally evaluate the program's overall progress.

## Capacity-Development Efforts

Most new SSEP directors who attend the annual meetings say they do not fully understand what data to collect and how to analyze the data to improve program offerings or to help sustain their work. To address this issue, BWF offers annual regional evaluation workshops to review the evaluation process and reporting methods and to teach strategies on how to develop logic models to collect and use quantitative and qualitative data. The directors receive individualized consulting focused on the viability of their programs by using results of the evaluation processes and annual progress reports they are required to generate. This work is done in a three-year cycle to coincide with BWF's program funding.

As BWF has worked with small nonprofit organizations and public and private schools, it has become apparent that many teachers and directors of organizations lack experience in writing grant proposals, a key to securing program funding. In order to help these individuals develop this crucial skill, BWF holds workshops across the state, especially in underserved areas, at which potential SSEP applicants learn the necessary skills.

These workshops have yielded satisfying results. BWF staff tracked workshop participants in the 2005 SSEP award series. Of the 42 applications that BWF ultimately received, 48 percent were from workshop participants; 20 percent were from targeted areas of North Carolina in need of resources, and 35 percent were from minority universities or schools in small towns. Of the 24 SSEP finalists, 13 were workshop participants, and six of the 13 received SSEP awards.

In fact, BWF has found that the workshops, with a bit of creative tweaking, can have benefits beyond increasing the number of quality applicants for SSEP. BWF has redesigned the workshops to address general grant writing training needs, and a number of individuals have used the workshops with great success. For example, Debbie Michael, who is a presidential award-winning science

teacher in rural Catawba County, applied the skills she learned in one of the workshops to apply for—and win—several grants to expand the science program at her school.

"The Burroughs Wellcome Fund grant writing workshop gave me a new perspective about writing grants and taught me what grant reviewers are looking for in a well written grant proposal," Ms. Michael said. "During the 2003-2004 school year, I submitted five grant proposals and was funded for four of the grants. I consider this new knowledge to be very valuable and appreciate you sharing the expertise with me."

To disseminate proposal writing training to other teachers, BWF has presented the workshop at the North Carolina Science Teachers Association Conference, where it was videotaped by the North Carolina Department of Public Instruction for placement on the department's website for all North Carolina teachers to access.

## How Research Guides Education Policy

North Carolina in 1989 adopted a School Accountability and Improvement Act that required the state's schools to assess students in reading, writing, and mathematics. As an unforeseen consequence of this outwardly progressive legislation, science would not be taught in the primary grades for a number of years, unless there were teachers interested in and comfortable with the subject area. The Burroughs Wellcome Fund (BWF) sees such outcomes as evidence that mandatory educational assessments by states drive what is acceptable content for the classroom. Consequently, BWF considers it vital to better understand how education policies are created in North Carolina.

In 1995, the Public School Forum of North Carolina, a research-driven educational organization that focuses on public policy and school reform, conducted a statewide governmental study to look at the status of science and

mathematics education. The resulting report, *A State of Disconnectedness: An Examination of Mathematics and Science Instruction in the North Carolina Public Schools*, declared that the state was rich in experimentation and resources in science and mathematics education, but that these efforts were poorly coordinated and lacked common direction. Promising initiatives operated in isolation, and programs funded by foundations and government sources lasted only a short time, ending when the grants expired. Such “disconnectedness” limited the spread of innovation and contributed to poor sustainability among universities, schools, museums, and student-oriented community programs. In short, the study found no center to provide ongoing, long-term coordinated strategies to improve science and mathematics instruction in primary and secondary schools. In this light, BWF recognized a need to help policymakers obtain sorely needed research and background information to inform their decision-making. As a result, BWF helped the Public School Forum of North Carolina establish the North Carolina Institute for Education Policymakers.

The study also contributed to BWF's decision to support the International Studies Program, which is intended to provide education policymakers with opportunities to learn about best educational practices in countries around the world. The Public School Forum had the leadership and staff to carry out BWF's desire to improve policymaking. In turn, the forum worked with the North Carolina Center of International Understanding to provide logistical support for international study exchanges. BWF partnered with the BellSouth Foundation, the Z. Smith Reynolds Foundation, and the Kenan Trusts to provide the funds to support the Public School Forum in creating these mechanisms for catalyzing change in public policy.

### **North Carolina Institute for Education Policymakers**

Members of the North Carolina General Assembly and the State Board of Education need to be able to navigate the complexities of education decision-making. Policymakers

need to have research-derived data on which to base their decisions, and they need to find opportunities for bipartisan discussions on education. However, policymakers lacked resources on both fronts.

The North Carolina Institute for Education Policymakers, the first such initiative in the United States, strives to remedy this situation. Other states, including Georgia and South Carolina, have since created similar institutes. England has established a similar institution as well, following exchange visits between Dr. Bridget Ogilvie, past director of the Wellcome Trust, an independent charity in the United Kingdom that funds research to improve human and animal health, and John Dornan, president of the Public School Forum of North Carolina.

The North Carolina Institute for Education Policymakers has reinforced the linkage between the state's economic welfare and education while making policymakers aware of the growing gap between the performance of American students and their peers in other countries.

The institute offers educational briefings for all new legislators, members of the State Board of Education, and members of the education media. In the briefings, participants learn about past and current education policies and practices and about the structure of North Carolina's government. By all accounts, the briefings have proven beneficial, and the institute has served to break down communications barriers among policy leaders. The institute has survived leadership changes in the governor's office, the Senate, and the House. Most importantly, the institute's actions have helped to bring about improvements in school policies at the local levels, teacher training at the state and local levels, and improvements in preK-12 student performances.

The institute's effectiveness is due, in part, to the Public School Forum. The forum was established by a group of leading North Carolinians as a “think and do tank” to generate ideas for school improvement and to create the public and political will to turn these ideas into

reality. The forum's work extends well beyond the state—and even beyond national borders. Among its projects, the forum is taking part in a six-state effort to build stronger partnerships between education and the business community, and it is providing assistance to other states, such as New Hampshire, Mississippi, and Ohio, and other countries, such as England, as they work to create similar organizations. The forum's board includes elected officials, business leaders, and educators, and the board provides a neutral and nonpartisan venue for studying problems, generating ideas, and launching new programs.

#### **Key Outcome/Impact of North Carolina Institute for Education Policymakers**

- Working relationships among educational policymakers from different political parties and among officials in different legislative branches or appointed governing boards have improved considerably.
- Policymakers have been informed about an array of educational “best practices,” and this improved knowledge base has been translated into several new educational initiatives.
- A number of local schools systems, including those in Asheville, Guilford, and Wake counties, have created international schools or academies and have developed exchange programs with such counties as Denmark and China.
- Policymakers, who often are relatively unfamiliar with the variety of issues related to school improvement, especially in science and mathematics, have learned about global workforce issues that face North Carolina students, through sponsored visits via the International Studies Program to South Korea and China.<sup>9</sup>

#### **International Studies Program**

International education aims to prepare students to be productive citizens, workers, and leaders in the global economy. Today's basic education ideally should include an international dimension in all subject areas, providing students with a better understanding of other world regions, cultures, and economies. Education programs also should provide students with skills in communicating in languages other than English, in working in crosscultural environments, and in using information from different sources around the world.

With grants from the Burroughs Wellcome Fund and the William R. Kenan Jr. Charitable Trust, the Institute for Education Policymakers created the International Studies Program (ISP) in 1999. The program is intended to broaden the educational frame of reference of elected and appointed officials responsible for setting educational policies that affect the nearly 1.4 million school-aged children in North Carolina. The ISP provides policymakers with opportunities to study school systems in other nations and to learn about educational practices that have proven to be most effective in various settings.

The ISP distributes reports on its various fact-finding trips to all legislators and members of the State Board of Education, in an effort to inform their thinking on such educational issues as school choice; student performance in science, mathematics, and technology; teacher training; and high school reform.

With BWF support, ISP has led trips to England (to study school choice), the Netherlands (to study methods of teaching science and mathematics), Denmark (to study high school organizational structures), South Korea (to study teacher training and strategies to boost student achievement), China (to study education as a economic driver), and India (to study efforts to promote the training of engineers). Lessons from these trips are highlighted in the following sections.

<sup>9</sup> Public School Forum 2003/04 data.

## England

In the late 1990s, North Carolina legislators were dealing with school choice and trying to determine whether or not the state should adopt a school voucher system. In March 1999, the Institute for Education Policymakers took a 29-person delegation, including state senators, members of the House of Representatives, members of the State Board of Education, teachers, and school principals, to England, which had used a voucher system for more than a decade. England had given the board that governed public schools the power to hire head teachers or principals, along with virtually autonomous authority over school budgets. England established, and then curtailed, a national voucher program. All public schools were made “schools of choice.” England’s voucher program proclaimed that it would “even the social scales” by giving low-income families the same private school choices as wealthier parents. However, the country’s officials learned from experience that the offer of vouchers did not guarantee low-income children a better education. Based on experience gained during this trip, the N.C. delegation determined that a voucher system was not appropriate for North Carolina. Instead, state legislators supported parental choice for students by deciding to create up to 100 charter schools across the state. Today, some of these charter schools are performing well and others face major challenges.

## Denmark

For years, North Carolina has experienced a high drop-out rate among high school students<sup>10</sup>, and in October 2003 the ISP led a 22-member North Carolina delegation to Denmark, which had established school organizational structures that were helping to keep students engaged in the educational process. This trip was timely, as North Carolina had just received a grant from the Gates Foundation to revamp its high schools, and the State Board of Education was wrestling with how to improve the high school experience for students. The trip provided the N.C. delegation with models to use in developing strategies

and action plans for encouraging students to stay in school, and the information gathered served as the basis for the state’s New Schools Project. In addition, many North Carolina middle schools and high schools have established exchange programs with Danish schools.

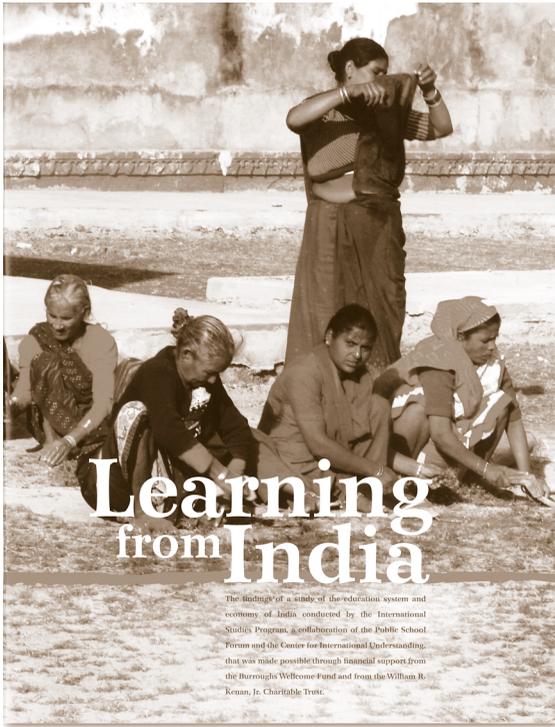
## China

In September 2004, a North Carolina delegation of 27 legislators, school board members, educators, and business leaders headed to Beijing and Shanghai. China offered the opportunity to examine what is possible when a nation makes education a foundation for economic growth. China’s educational system is highly competitive, and students must take examinations that largely determine what schools and colleges they will be able to attend. (All students in China do not attend school.) The educational system places great emphasis on training those students deemed to be most talented. The trip helped N.C. legislators recognize the need to provide all of the state’s children with a quality education and to continue raising standards for learning. As another product, trip participants have helped schools in a number of locations develop study programs to teach students about China and other foreign countries. In addition, some schools are considering developing more specialized programs focused on science and mathematics.

## India

In February 2006, a delegation traveled to Bangalore and Delhi to learn more about current trends in emerging businesses and the transfer of high technology jobs from the United States to India. India realized years ago that engineers, scientists, and technologists would drive the nation’s growing economy—and its educational system reflects that view. From elementary school on, the curriculum is rigorous. Schools introduce mathematical concepts early, and they integrate and reinforce instruction in algebra and geometry throughout the school years, rather than treating them as discrete subjects taught at only one or several

<sup>10</sup> For every 100 students entering high school, only 59 graduate four years later, 38 enter college, and 18 graduate with either an associate degree within three years or a bachelor’s degree within six years.



The International Studies Program visited India in February 2006.

grade levels. The competitiveness of India's system helps to explain why Indian students approach their studies so seriously. They attend school 210 days a year, compared to 180 days for American students. The ease with which Indian firms now operate in the global marketplace is not due simply to their academically talented workers, but also results from a global orientation that begins with languages. The typical Indian student will have mastered three languages before leaving high school, and English is required of all students beginning in elementary school. For both North Carolina and the United States, the exodus of businesses and technology jobs abroad will require increased investments in producing a highly educated workforce.

### Travel Lessons

Beyond providing lessons that policymakers, educators, and others can apply in improving the state's educational system, the various trips abroad have brought other benefits to the state's economy. North Carolina now maintains six international trade offices, in Canada, Mexico, Germany, South Korea, Japan, and Hong Kong. More than 1,100 international firms operate in North Carolina. More than 120 languages are spoken in the homes of the state's school children. Between 1990 and 2000, North Carolina led the nation with the highest percentage growth of its Latino population. The North Carolina Center for International Understanding tracks this data and makes it accessible to the public.

Providing a wealth of experiences to policymakers gives a framework for legislation that supports what is taught in the classroom. Members of the North Carolina State Board of Education, school district superintendents, principals, and teachers are renewed when presented with opportunities for growth. Programs that increase knowledge and study best practices can help North Carolina make informed policy choices.

## Creating a Statewide Science, Mathematics, and Technology Education Center

No reform, or even set of reforms, will suddenly transform the system of K-12 science and mathematics education in North Carolina to ensure that all children will steadily improve their skills. Rather, it will take steady, consistent, and dedicated work by policymakers, educators, students, and parents to build on past improvements in a coordinated and systemic fashion. The Burroughs Wellcome Fund's Science Education Advisory Committee stressed this point several years ago in citing the need for a "champion" for science education—an organization that would take center stage in driving efforts to advance science

education for all children and to coordinate the array of programs and resources available across the state to improve SMT teaching and learning.

Initially, BWF searched for an existing organization or group that could serve as champion for science and mathematics learning in North Carolina. However, after a number of interviews, meetings, and conversations with prominent leaders in education and business, BWF recognized that a totally new entity would be needed. And so BWF stepped forward to catalyze the creation of an institution that, over time, could serve as an honest broker, a neutral venue to foster advances in mathematics and science education.

As the first order of business, BWF hired the Research Triangle Institute to inventory science and mathematics enrichment programs across the state—to learn who was involved in this arena, what the status of the programs was, and whether it would be possible to coordinate efforts to leverage resources. Further investigation led BWF to the National Science Foundation, which had compiled data on the outcome of its regional and statewide systemic initiative grants. Many states that received grants had established centers or academies to ensure that their educational systems focused appropriately on science and mathematics.

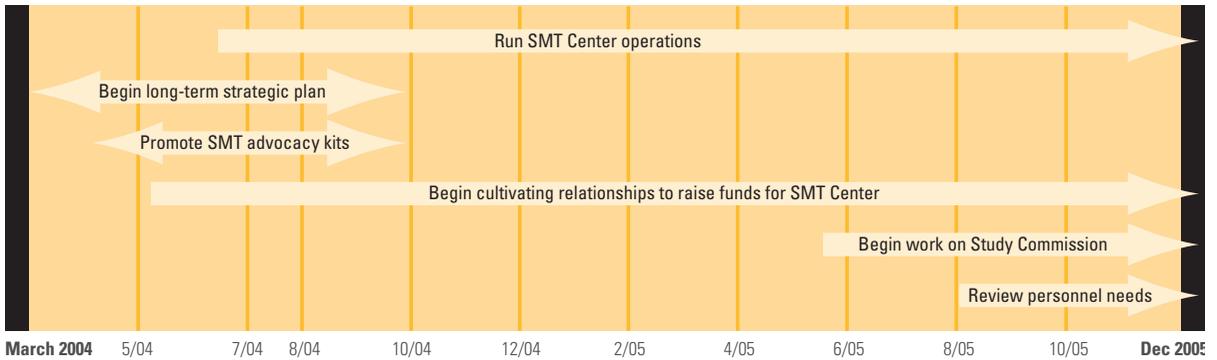
Armed with this information, BWF created the North Carolina Science, Mathematics, and Technology Education Center (SMT Education Center) in 2002, and hired Dr. Sam Houston, a former teacher, school superintendent, university faculty, and policy leader, as its director. The SMT Education Center's mission is to systemically improve the performance of all preK-12 children in North Carolina in science, mathematics, and technology and to equip them with the knowledge and skills needed to have successful careers, be good citizens, and advance the economy of the state. The center's Board of Directors consists of stakeholders who are involved in SMT education programming, business leaders who want scientifically literate workers, legislators who fund education, teachers, education policymakers, and the education media.

The goals of the North Carolina Science, Mathematics, and Technology Education Center are:

- To articulate a vision for science, mathematics, and technology education in North Carolina, to broaden awareness of the need for a scientifically literate workforce, and to solicit support for high quality programs of instruction.
- To work with government, industry, the education community, and parents to connect and facilitate achieving continuously improving level of performance in science, mathematics, and technology by all children in preK-12; and to advocate for equitable and adequate resources for all preK-12 children.
- To mobilize expertise and leverage resources to reach all preK-12 children in each of North Carolina's 115 school systems to foster comprehensive and challenging programs of instruction in science, mathematics, and technology instruction, including the dissemination of effective tools and learning methods and the provision of technical assistance to educational leaders (including principals and teachers).
- To work with existing organizations to research, develop, and disseminate information on the state of science, mathematics, and technology preK-12 education to policymakers and the media in order to improve decision-making and to identify gaps that need to be addressed.

The center's board recommended that the center spend its first year on educating the public on the importance of SMT education for all children, building the aptitude and skill of teachers in SMT education, and recognizing successful schools for their efforts in SMT education. The center partnered with the North Carolina Business Committee for Education to begin a grassroots education campaign—Think Science—that ultimately would include an advocacy tool kit consisting of a DVD program, talking points for

## North Carolina Science, Mathematics, and Technology Education Center 2004-2005 Timeline



### July 2004 – November 2004

- Begin work on long-range plan-September deadline
- Begin training on SMT Advocacy Campaign Kits
- Prepare for September Board of Directors Meeting
- Continue work on the Teacher Link Program
- Implement Inventory Project Plan-website enhancement required
- Convene TLP scientists and teachers

### December 2004 – March 2005

- Seek affirmation from governor or State Board to identify center as SMT champion for North Carolina
- Seek challenge or matching grants for May celebration
- Work with Department of Public Instruction to help prepare elementary schools for new science curriculum and preparation for No Child Left Behind mandate
- Finalize strategic and action plan

### April – July 2005

- Work to re-create a North Carolina Legislative Study Commission to assess the state's needs in science, mathematics, and technology education
- Invite potential donors to the BWF 50th Anniversary celebration May 2005

### August – December 2005

- Identify up to 10 corporate, nonprofit, and governmental sources to begin a silent phase of a fundraising campaign for the SMT Education Center
- Establish personal meetings with these key leaders and secure future funding
- Work with DPI and legislators to change policy governing teacher salaries
- Work with DPI to secure mathematics and science specialists for every elementary school

### January 2006 – December 2006

- Work on SMT Center personnel issues
- Proceed with establishing independence from BWF
- Review composition of SMT Board of Directors and make recommendations

advocates, handouts, and slide presentations. As part of this campaign, more than 60 business leaders have agreed to make four annual presentations to a variety of audiences, such as rotary clubs, parent/teacher meetings, and fraternity meetings. As a result, Think Science is taking hold across the state, and partnerships among science education stakeholders are taking form.

To give teachers a better understanding of science content and increase the involvement of scientists in preK-12 education, the SMT Education Center partnered with Duke University and Sigma Xi, with grant support from the National Science Foundation, to recruit and train scientists

to work with teachers on nationally certified kit-based inquiry-learning science modules. The SMT Education Center is responsible for identifying scientists and pairing them with teachers trained by Duke's Center for Inquiry Based Learning Teachers and Scientists Collaborating Program. In the new initiative, called the Teacher Link Program (TLP), scientists work alongside teachers to break down communications barriers. Primary contact after training with teachers is by telephone and email, but as these relationships evolve, classroom visits and contact with students through emails are taking place. The TLP scientists also worked this past year with the North Carolina Department

of Public Instruction to revamp the science curriculum and supporting documents to comply with the federal No Child Left Behind legislation, which requires assessing the science skills of students at the elementary level.

Another key SMT Education Center effort is a partnership with the New Schools Project, a statewide plan to create small and innovative secondary academies. The project has a \$21 million grant from the Bill & Melinda Gates Foundation, as well as matching funds of \$10 million from a host of state and private sources. The SMT Education Center provides technical assistance for high schools that are being reformulated to focus on science, mathematics, and technology. This New Schools Project also enables high school students to earn college credits in redesigned high schools that have smaller learning environments. A key indicator of the project's success will be raising the graduation rate of high school students and preparing them for work or higher education.

With BWF's assistance, the SMT Education Center is still developing as the statewide coordinator, broker, catalyst, and advocate in keeping SMT education in the forefront. More and more individuals and organizations are turning to the center for advice and guidance. With the James B. Hunt Jr. Institute for Educational Leadership and Policy, the SMT Education Center is providing direction on strategic summits for governors and other key policymakers to explore ways to improve K-12 science and mathematics education. Other states, including Indiana and Missouri, are considering plans to establish centers similar to the SMT Education Center to help in advancing their science and mathematics education efforts.

## Partners for Building Science Education

As a foundation committed to improving science education, the Burroughs Wellcome Fund (BWF) continually searches for ways to form collaborations and partnerships to improve inquiry-based learning and increase access to high-quality education in science, mathematics, and technology. BWF believes in the African proverb, "It takes a village to raise a child." It is the responsibility of students, parents, teachers, community and business leaders, and education policymakers to work together to achieve a scientifically literate workforce. Across North Carolina, many academic and community groups are collaborating to improve science education, with BWF's support. The following sections describe some of these partnerships.

### North Carolina Grassroots Museum Collaborative

Many of the young scientists who receive career development grants from BWF say they developed their love of science through informal interactions at science museums. It is fitting, then, that one of BWF's first partnerships involved the informal science museum community. BWF initially awarded a Student Science Enrichment Program grant to a science museum which suggested that a collaborative of science museums in North Carolina would have a better chance of securing grants from the National Science Foundation than would any single museum. This led BWF to make a \$1 million grant to a collaborative initiative involving more than 25 science museums and aquariums across the state. The North Carolina Grassroots Museum Collaborative is the first such collaborative in the United States. Headed by Dr. Fran Nolan, the collaborative's goals are to:

- Improve the public understanding of science and technology.
- Enhance science education in schools and communities throughout North Carolina.

- Enhance member institutions' efforts to develop exhibits, programs, and scientific collections that focus on the basic sciences and related technological applications.
- Serve as a vehicle for planning and conducting cooperative projects that strengthen services provided by member institutions across North Carolina.

These science museums and aquariums serve millions of citizens each year through general visitation, teacher training, and offsite presentations that reach students in nearly every North Carolina school district. The collaborative has empowered small museums by connecting them to exhibits, resources, and staff at larger museums. The North Carolina General Assembly has now recognized the collaborative's value and provides regular annual funding. The collaborative also has obtained federal funds to enhance hands-on inquiry-based science learning and training and is now organizing venues for North Carolina students to compete in international science competitions. In March 2006, three N.C. students represented the United States with presentations at a science competition in Beijing, China. N.C. State Sen. Kay Hagan joined the students, who also

had an opportunity to dine with Nobel Laureate Dr. Barry Marshall. The success of this exchange has led to other opportunities for North Carolina students to participate in science competitions with China.

### K-12 Outreach Programs at Universities

Dr. Bruce Alberts, past president of the National Academy of Sciences, has advocated for years for more scientists to take part in educating primary and secondary students in the sciences. To facilitate such outreach from universities, the National Science Foundation provides grants for training K-12 science and mathematics teachers and connecting them with mathematics and science departments at various academic and research institutions. Many universities and academic institutions in North Carolina have had such outreach programs, but the opportunity to network and learn from each other has remained fairly limited.

Since 1999, BWF has partnered with the Science House at North Carolina State University to host an annual conference to convene directors of these outreach programs to encourage networking and collaboration. Headed by Dr. David Haase, the Science House is a learning outreach

### North Carolina students representing the United States at a science competition in Beijing, China:

**Samuel E. Wells**

Northwest High School, Greensboro, N.C.  
Project: *Effects of Several Cooling Methods on Computer Processor Overclocking*

**Dr. Fran Nolan**

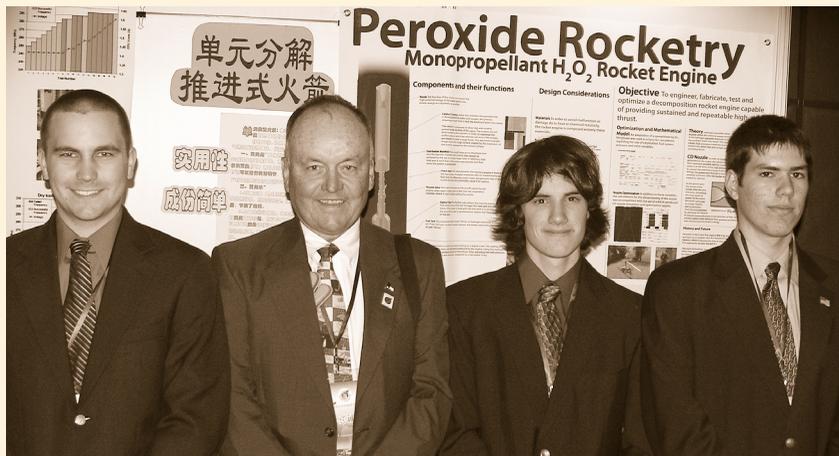
Director of N.C. Grassroots Museum Collaborative

**Justin Crowder**

Northwest High School, Greensboro, N.C.  
Project: *Iontophoresis Powered by Quartz Piezoelectricity*

**Andrew C. Rowland**

Asheville High School, Asheville, N.C.  
Project: *Study of the Principles and Design of Monopropellant Decomposition Rockets*



project dedicated to working in partnership with K-12 teachers to increase the use of and impact of hands-on learning technologies in mathematics and science. Through school demonstration programs, student science camps, teacher workshops, innovative laboratory training, and support projects, the Science House annually reaches more than 5,000 teachers and 25,000 students in 60 North Carolina counties.

For the annual meetings, the Science House staff develops the program, issues invitations to speakers and participants, and coordinates logistics. Attendance at the meetings averages around 60 scientists, primarily from North Carolina, South Carolina, and Virginia. After each meeting, the Science House publishes invited and contributed papers and distributes the document to scientists in academia and industry and to university and policy leaders.

### **North Carolina School of Science and Mathematics**

The North Carolina School of Science and Mathematics (NCSSM), which opened in 1980, is the first school of its kind in the nation. NCSSM is a public, residential high school where students study a specialized curriculum built around science and mathematics. The diverse student body consists of 11th and 12th graders who come from nearly every county in the state. Thirteen states and three foreign countries have since established schools based on the NCSSM blueprint.

BWF provided a \$1 million grant to NCSSM in 1996 to create the Education Future Center, which uses multimedia technologies to connect schools across the state. The center offers teacher training and shares tools and curricula for institutional reform and improvement in science and mathematics education. NCSSM serves as the hub for seven cyber campuses in low-wealth counties across the state, giving teachers and students in these areas access to high-quality science and mathematics curriculum.

Through the cyber campus partnerships, NCSSM has jump-started technology integration in a number of rural schools. The center has evolved into a state-of-the-art distance learning facility, with \$21 million in state and federal funding. NCSSM also provides statewide public service and outreach efforts through distance learning courses and enrichment and mentoring activities, Summer Ventures in Science and Mathematics, and program evaluation. The school, headed by Dr. Gerald Boorman, is an exceptional educational model, and it continually seeks ways to work with others in the education community to support innovative programs designed to improve mathematics and science teaching and technology integration.

### **North Carolina Mathematics and Science Education Network**

BWF funds the North Carolina Mathematics and Science Education Network (MSEN) to enhance teacher-training opportunities. MSEN was officially authorized and funded by the N.C. State Legislature in July 1984, following a key endorsement from a Commission on Education for Economic Growth. Headed by Dr. Verna Holoman, MSEN's mission is to improve the quality of mathematics and science teaching and learning in select North Carolina schools and serve as a conduit to reach students through 11 centers located on public university campuses across the state.

Each MSEN center is an independent organization that offers programs to address professional development of teachers or student preparation, with some centers fulfilling both roles. Offering nearly 300 activities annually, MSEN reaches almost 6,000 teachers each year. Its Pre-College Program, designed for students in 6th through 12th grades, prepares students for advanced mathematics and science at the university level.

### Nonprofit, Business, and National Partners

BWF believes that joining with other foundations and nonprofits is essential in sharing ideas, building projects that achieve critical mass, and recruiting others to address mathematics and science education. Over the years, the nonprofit community in North Carolina has developed a strong voice through vehicles such as donor forums, the North Carolina Network of Grantmakers, and the North Carolina Center for Nonprofits.

To connect organizations in the state to leading thinkers nationwide, BWF has developed various partnerships with a number of national organizations, including the National Academies, the National Research Council, the National Science Resources Center, the National Science Foundation, and the American Association for the Advancement of Science. Dr. Enriqueta Bond, BWF's president, serves on a number of national boards that focus on enhancing the scientific enterprise and developing the scientific workforce. BWF program officers also maintain active relationships with a number of national organizations, in many cases serving on national boards and program review panels.

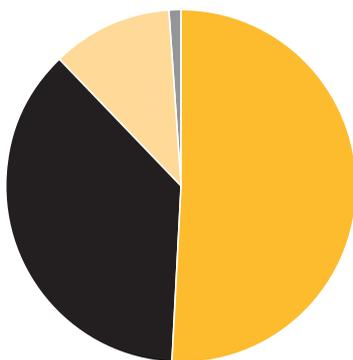
North Carolina's businesses and industries, which employ many of the state's students after they complete school, have an obvious vested interest in promoting reforms in science education. Business leaders have formed a number of associations, including the North Carolina Business Committee for Education (NCBCE) and the North Carolina Citizens for Business and Industry (NCCBI), that drive changes in the public school arena.

NCBCE is a nonpartisan, nonprofit organization of approximately 100 businesses across the state that share a common desire to improve public schools. Among its activities, the group works with the North Carolina Science, Mathematics, and Technology Education Center on the Think Science initiative to engage business leaders as science advocates in their communities and local schools.

NCCBI is the state's largest business group, numbering some 2,000 companies and nonprofits of all types and sizes among its membership. Many of these business associations are now approaching education reform by creating state-of-the-art private schools or adopting public schools in need of resources. BWF is a member of NCCBI, and BWF staff members regularly attend meetings to stay current on workforce needs and demands for students highly educated in science, mathematics, and technology.

### Investing in a Statewide Science Education Program

The Burroughs Wellcome Fund (BWF) has invested nearly \$20 million in science education in North Carolina. Of the total, almost \$13 million has gone to support Student Science Enrichment Program grants. Each year, SSEP receives roughly 51 percent of BWF's grant funding for science education (see *chart*). BWF makes approximately 12 SSEP awards per year, for a total investment of up to \$2.2 million. The awards provide up to \$180,000 over three years.



#### Science Education Program Costs

- Student Enrichment **51%**
- Public Policy **37%**
- Partnership Building **11%**
- Capacity Building **1%**

The rest of BWF's funding in science education goes for ad hoc grants to address public policy issues, develop partnerships, and build the capacity of education stakeholders to improve student learning. As a policy, BWF uses ad hoc grants as catalysts to advance an emerging field, build infrastructure in an area, create venues aimed at producing more young scientists, or support innovations that hold potential for advancing the biomedical sciences or the scientific enterprise in significant ways.

Since 1996, BWF has made catalytic grants of \$1 million or more to create or enhance a number of science and mathematics institutions. Notable grants have gone to the North Carolina Science, Mathematics, and Technology Education Center; the North Carolina Grassroots Museum Collaborative; the North Carolina Institute for Education Policymakers; and the Education Future Center at the North Carolina School of Science and Mathematics. BWF's investments have strengthened the state's ability to provide high-quality K-12 science and mathematics education in schools and communities, as well as on university campuses. Although independent, these programs often work with each other to advance the state's agenda for improving science, mathematics, and technology education.

## Moving Forward

*Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, the influential 2006 report from the National Academy of Sciences' Committee on Science, Engineering, and Public Policy, recommends 10 actions that policymakers should take to help ensure the United States remains globally competitive and prosperous. Four of the recommendations focus on actions in K-12 education and present the Burroughs Wellcome Fund (BWF) with opportunities to explore new strategies to build on its work of the past decade.

One recommendation calls for increasing the nation's scientific talent pool by vastly improving K-12 science and mathematics education. BWF is now shaping catalytic grants intended to foster the development of programs to enable students who obtain bachelor's degrees in the physical or life sciences, engineering, or mathematics to obtain concurrent certification as K-12 science and mathematics teachers. BWF also will support the development of a master of science teaching degree parallel to the current master of arts teaching degree. In addition, BWF is considering supporting fellowships for students to pursue a bachelor's degree in science and then pay back the fellowship by

teaching for five years in North Carolina schools, particularly in low-wealth areas. In this plan, BWF would supplement salaries of such individuals while they teach as an incentive to remain in teaching.

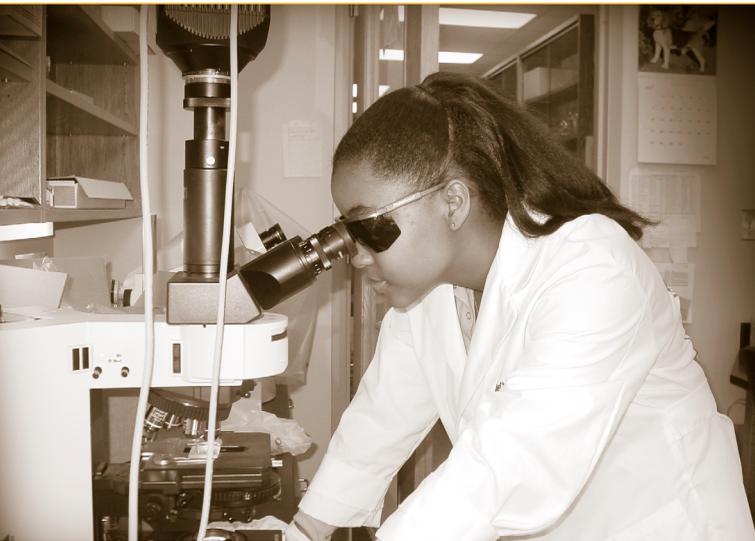
BWF will investigate ways to strengthen the skills of teachers already in the system through training and education programs at summer institutes, in master's programs, and in advanced placement and international baccalaureate training programs.

North Carolina already has in place a Virtual Learning Program, headed by Lt. Governor Beverly Perdue and State Board of Education Chair Howard Lee. The program tries to capture nontraditional learners, including high school students who prefer to study during nontraditional times, workers who would like to upgrade their skills for a career in teaching, and teachers who would like to pursue an advanced degree but have limited time to attend college

classes. The idea is to offer quality education whenever someone wants it, 24/7.

In response to *Rising Above the Gathering Storm*, President George W. Bush announced in the 2006 State of the Union address the American Competitiveness Initiative, which commits \$5.9 billion in fiscal year 2007 to increase investments in research and development, strengthen education, and encourage entrepreneurship in science and technology. BWF supports this national initiative, while at the same time continuing to seek ways to develop and expand model science education programs in North Carolina.

Efforts at all levels are surely needed. By investing in long-term strategies to advance science and mathematics and foster a scientifically literate citizenry in North Carolina, the Burroughs Wellcome Fund can contribute to protecting the future well-being of the nation and all of its citizens.



**The Burroughs Wellcome Fund** is convinced that all children, regardless of their future career path, need basic science literacy to participate fully in civic life. We believe that the best method for achieving the goal of science literacy is to involve students in the scientific process and let them do what comes naturally: ask questions and participate in hands-on activities and experiments that convey basic scientific principles.

## Acknowledgements

This publication reflects the results of a tremendous amount of effort by a number of committed individuals and groups. We begin with the members of the Burroughs Wellcome Fund's (BWF) Board of Directors whose foresight catalyzed BWF's commitment, in 1996, to fund science education, a new area for the foundation. (Current board members are listed on the inside back cover.) These individuals understood the value of investing in ways to improve the state's and the nation's pipeline for producing young scientists. In particular, we thank the members who served as liaisons between the board and the fledgling science education program—Philip Tracy, Stephen Corman, and Dr. Marye Anne Fox.

BWF's efforts also have been enriched by a group of education stakeholders who now serve or have served on the Student Science Enrichment Program Advisory Committee and who have brought the research and knowledge of the field of science education to the table. Individually and collectively, these members have been the experts who guided BWF in building a program we truly believe to be effective. (Current members of the advisory committee are listed on page 24.) We must give special thanks to Dr. John Burris, Dr. Shirley Malcom, and Sally Shuler, each of whom chaired the committee and shared their passion of effective science and mathematics teaching and learning with us.

Capturing the outcome of 10 years of work has been an exciting and exhausting exercise for the BWF staff. We thank Melanie Scott for her tireless contributions to this publication; Russ Campbell for his diligent work in preparing

the copy and marshaling the editorial process; and Tom Burroughs, our science writing consultant, for adding a final touch. We annually convene award recipients and committee members, so I want to give a special thanks to Catherine Voron, Barbara Evans, and Betsy Stewart for making these events successful. In addition, thanks to Dr. Sam Houston, who took on the leadership of the North Carolina Science, Mathematics, and Technology Education Center, and to Lisa Rhoades, who is helping in efforts to develop a more strategic science education system for students across the state.

We applaud the work of the Student Science Enrichment Program directors, who are helping to lay the groundwork for informal inquiry-based science learning. We also applaud John Dornan, leader of the North Carolina Institute for Education Policymakers; Dr. Fran Nolan, head of the North Carolina Grassroots Museum Collaborative; Dr. Gerry Boarman, president of the North Carolina School of Science and Mathematics; Dr. David Haase, head of the Science House at North Carolina State University; and the many others whom we refer to as members of the Burroughs Wellcome Fund family.

This publication, we hope, captures the essence of what the Burroughs Wellcome Fund, along with many other groups, has done and continues to do to improve science education. We also hope it reinforces the idea, which we live with every day, that there is still much to do to ensure that children get the best possible education in science, mathematics, and technology.

**Carr Thompson**  
**Queta Bond, Ph.D.**

## Resources

### **American Association for the Advancement of Science**

[www.aaas.org](http://www.aaas.org)

### **American Competitiveness Initiative**

[www.whitehouse.gov/stateoftheunion/2006/aci](http://www.whitehouse.gov/stateoftheunion/2006/aci)

### **Burroughs Wellcome Fund**

[www.bwfund.org](http://www.bwfund.org)

### **Committee on Science, Engineering, and Public Policy**

[www7.nationalacademies.org/cosepup](http://www7.nationalacademies.org/cosepup)

### **Grantmakers in Education**

[www.edfunders.org](http://www.edfunders.org)

### **James B. Hunt Jr. Institute**

[www.hunt-institute.org](http://www.hunt-institute.org)

### **National Academies**

[www.nationalacademies.org](http://www.nationalacademies.org)

### **National Academy of Sciences**

[www.nasonline.org](http://www.nasonline.org)

### **National Assessment of Educational Progress**

[www.nces.ed.gov](http://www.nces.ed.gov)

### **National Commission on Mathematics and Science Teaching for the 21st Century**

[www.ed.gov/inits/math/glenn/toc.html](http://www.ed.gov/inits/math/glenn/toc.html)

### **National Research Council**

[www.nationalacademies.org/nrc](http://www.nationalacademies.org/nrc)

### **National Science Digital Library**

[nsdl.org](http://nsdl.org)

### **National Science Foundation**

[www.nsf.gov](http://www.nsf.gov)

### **New Schools Project**

[www.newschoolsproject.org](http://www.newschoolsproject.org)

### **North Carolina Business Committee for Education**

[www.ncbce.org](http://www.ncbce.org)

### **North Carolina Center for Nonprofits**

[www.ncnonprofits.org](http://www.ncnonprofits.org)

### **North Carolina Citizens for Business and Industry**

[www.nccbi.org](http://www.nccbi.org)

### **North Carolina Department of Public Instruction**

[www.ncpublicschools.org](http://www.ncpublicschools.org)

### **North Carolina Grassroots Museum Collaborative**

[www.grassroots-science.org](http://www.grassroots-science.org)

### **North Carolina Mathematics and Science Education Network**

[www.unc.edu/dept/msen](http://www.unc.edu/dept/msen)

### **North Carolina Network of Grantmakers**

[www.ncgrantmakers.org](http://www.ncgrantmakers.org)

### **North Carolina School of Science and Mathematics**

[www.ncssm.edu](http://www.ncssm.edu)

### **North Carolina Science, Mathematics, and Technology Education Center**

[ncsmt.org](http://ncsmt.org)

### **North Carolina Standard Course of Study**

[www.ncpublicschools.org/curriculum/](http://www.ncpublicschools.org/curriculum/)

### **Project SEED**

[www.ciit.org/training\\_edu/projectseed.asp](http://www.ciit.org/training_edu/projectseed.asp)

### **Public School Forum of North Carolina**

[www.ncforum.org](http://www.ncforum.org)

### ***Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future***

[www.nap.edu/catalog/11463.html](http://www.nap.edu/catalog/11463.html)

### **Science House at North Carolina State University**

[www.science-house.org](http://www.science-house.org)

### **Shodor Education Foundation**

[www.shodor.org](http://www.shodor.org)

### **U.S. Department of Education**

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