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BACKGROUND

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Bayer *Making Science Make Sense*[®] Systemic Science Education Reform Programs

At the core of Bayer's *Making Science Make Sense*[®] program is a fundamental change in how science is taught. It involves a shift away from the traditional textbook approach to one that is hands-on, inquiry-based and experiential. Experts agree that when students learn science in this new way, it helps them become scientifically literate and develop important lifelong analytical skills, such as critical thinking, problem solving and team working – all skills that are highly prized in today's workplace.

To this end, Bayer has spearheaded local science education reform initiatives in seven communities where Bayer has (or has had) a major presence. These reform initiatives are based on the five elements of exemplary science programs identified by the National Science Resources Center (NSRC) – hands-on materials, centralized materials support, teacher training, assessment and community support.

Following are highlights of the seven science education reform programs:

- ✓ Pittsburgh, Pa. (Achieving Student Success Through Excellence in Teaching)
- ✓ Bushy Park, S.C. (Project Inquiry)
- ✓ Clayton, N.C. (K-8 Science Infrastructure Project)
- ✓ West Haven, Conn. (Bayer-New Haven Public Schools Partnership)
- ✓ New Martinsville, W.Va. (West Virginia Handle on Science Project)
- ✓ Elkhart, Ind. (Encouraging Technologies Through Hands-On Science)
- ✓ Kansas City, Mo. (Kansas City Science Initiative)

✓ ASSET Inc. (Pittsburgh, Pa.)

Bayer Creates ASSET Inc.

In 1993, Bayer convened a small group of community and education leaders in Pittsburgh, its U.S. headquarters city, to discuss a pressing problem: how to improve science education in the region's elementary schools. At the time, education reform, particularly that of science education, was high on the national agenda. Just a few years before, The National Academies of Science and The Smithsonian Institution had created a joint project – the National Science Resources Center (NSRC) -- for the express purpose of improving science education, and the National Science Foundation had put in place its systemic science reform initiative for that same reason.

Following this initial meeting, Bayer began an intensive research period that took its executives to Washington and elsewhere to learn about best practices in science education. Roughly a year later, in 1994, Bayer created ASSET Inc. (Achieving Student Success through Excellence in Teaching) as an independent 501 (c)(3) organization dedicated to bringing systemic science education reform to Allegheny County elementary schools.

ASSET is based on the NSRC's model of reform, which includes the following five elements:

- Quality curriculum materials
- Teacher training
- Centralized materials support
- Assessment that is aligned to standards and curriculum
- Community and administrative involvement.

The teacher training element provides ongoing professional development that helps teachers bolster their knowledge of science content, as well as methodology, as they shift their teaching styles from one that is textbook-based to one that is standards-based, hands-on and inquiry-centered. This is particularly important for elementary school teachers whose pre-service training often does not provide them with sufficient knowledge of science content.

With the hands-on, inquiry-centered curriculum, students learn science the way scientists do it – by hypothesizing, observing, experimenting, keeping journals, problem solving and working in teams.

ASSET's Remarkable Growth

In the early years, with ASSET beginning as a pilot program in five schools in two local school districts, Bayer provided most of the financial, human and intellectual resources for the project. Bayer scientists and executives accompanied ASSET staff and local teachers and administrators at the week-long training institutes that are both a hallmark and prerequisite of the NSRC program.

In 1995, ASSET garnered the first of what would become \$5 million in National Science Foundation grants, helping it provide its system of teacher professional development and hands-on, inquiry centered curriculum materials to more schools throughout the region.

In 2000, when the NSF grants concluded, Bayer once again helped ASSET transition to a fee-for-service organization (up until then, it was offered to schools for free), allowing it to become completely independent and self-sustaining.

Today, ASSET serves 40 school districts, charter and private schools in southwestern Pennsylvania and directly impacts more than 1,800 teachers and 125,000 students annually.

In addition, the ASSET program is being rolled out to elementary schools across the state of Pennsylvania, thanks to Governor Ed Rendell and his "Science: It's Elementary" initiative.

ASSET Adopted by Governor Rendell for Pennsylvania Schools

In March 2006, Pennsylvania Governor Ed Rendell toured Aliquippa Elementary School in Pittsburgh, where he witnessed first, second, third, fourth and fifth graders donning safety glasses and doing hands-on science experience.

Aliquippa is a longtime ASSET school. At the time, Governor Rendell was well aware of ASSET's track record of success, having proposed \$10 million in his 2006-2007 budget for the "Science: It's Elementary" program, which would help expand ASSET to elementary schools across Pennsylvania.

The Pennsylvania legislature agreed with Governor Rendell and passed his proposed budget, effectively turning ASSET into Pennsylvania's official state elementary science curriculum. "Science: It's Elementary" (SIE) is replicating the Bayer-spearheaded ASSET model by providing participating teachers with high quality professional development and working to increase student achievement in science education. Like ASSET, it gives teachers access to state-of-the-art, research-based curriculum and instructional materials; has students conduct scientific experiments throughout the school

year; and provides intensive training to teachers and administrators to help transform their classrooms into science laboratories.

Since the 2006-2007 school year, ASSET has received a \$23 million budget allocation (\$10 million the first year and \$13 million the second year) to design and coordinate SIE for the Pennsylvania Department of Education. As a result, ASSET has trained 2,600 elementary school teachers in 120 school districts to use the ASSET curriculum to instruct more than 59,000 students in science.

Recently, Governor Rendell announced a new budget allocation of \$15 million more for year three of SIE. This additional funding will expand the program in the current 120 school districts, as well as additional school districts around the state.

Impact on Student Achievement

A growing body of evidence indicates the ASSET/NSRC style of inquiry-centered learning helps to level the playing field among all students and is closing achievement gaps between majority and minority students.

Assessments of ASSET students – both male and female – show they are far outperforming their U.S. counterparts and achieving at the highest international levels, right alongside students from the very countries that consistently produce some of the best and brightest STEM talent like Singapore, Korea and Japan.

Additionally, assessments of students involved in ASSET-like reform programs in Delaware and California are having the same kind of impact on minority students. In Delaware, for example, the achievement gap in science between black and white students has been eliminated in most schools. Where gaps do exist, they're closing. Likewise in El Centro, California, one of the poorest communities in the country where more than 80 percent of the students are Hispanic and many speak English as a second language. In this school district, students perform better on national science tests, such as the Stanford Achievement Tests, than students who are taught science with textbooks.

All of this comes at a particularly critical moment for the U.S., if we are to heed a number of recent national reports that predict a growing shortfall of American scientists and engineers in the near future and call for renewed efforts to bring more women and minorities, including African-Americans, Native Americans and Hispanic-Americans into STEM (science, technology, engineering and mathematics) fields.

For more information, please visit www.assetinc.org.

✓ Project Inquiry (Charleston, S.C.)

Project Inquiry (PI) is a joint project of the Berkeley County School District (BCSD) and Charleston County School District (CCSD). It is designed to improve science literacy and academic achievement in science among K-8 students through the implementation of a rigorous and relevant hands-on, inquiry-based science curriculum that aligns with the *South Carolina Science Frameworks* and the *National Science Education Standards*.

PI was established in 1994 in the BCSD after Bayer expressed its desire to start a science education reform program in the Lowcountry region of S.C. that was similar to reform programs it had spearheaded in other communities. It then sponsored a BCSD team to attend the National Science Resources Center's Leadership Training Institute in Washington, D.C. Bayer also committed funds to help establish the district's materials resource center, a critical component of reform that houses and systematically refurbishes curriculum materials.

In 1996, Bayer sponsored a second team from the CCSD to receive training, and provided funding for its own materials resource center. In 2000, Bayer urged the two school districts to partner to become a strong National Science Foundation (NSF) grant candidate. This resulted in *PI's* receiving a five-year, \$5 million dollar NSF grant earmarked for ongoing professional development of teachers.

Since its inception, Bayer has awarded *PI* more than \$140,000 in grants to further grow the program. In the fall of 2003, Bayer sponsored a *PI* team to attend the Next Step Institute, which helps provide local science education reform programs

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with strategies for continued sustainability and growth so that ultimately all students will excel in science. In addition, Bayer provides *PI* with scientists to work with students and teachers as they fully implement the program in all 96 K-8 schools in both districts, reaching more than 1,113 teachers and more than 70,000 students annually.

In fall 2003, *PI*'s "Fifth Grade Outcome Study," the first of several student and teacher assessments mandated by the NSF, found that the standards-based, inquiry-oriented approach to science education improves student science achievement across the board – in life sciences, earth sciences and physical sciences. In addition, it significantly enhances teachers' attitudes and aptitudes regarding science instruction.

More specifically, the student evaluation assessed the performance of 3,712 fifth-grade students in both districts using multiple-choice questions from both the *National Assessment of Educational Progress (NAEP)* and *Third (Trends in) International Mathematics and Science Study (TIMSS)* tests. Two assessments were administered - one at the beginning and one at the end of the 2001-2002 school year. Researchers found that at the end of one full year of *PI* science curriculum instruction, students in both districts increased their test scores an average of 4.8 percentage points.

Teacher evaluations also are promising. They show that more fifth-grade teachers are instructing students with *PI*'s standards-based, inquiry curriculum and that *PI*'s professional development for teachers is critical to the success of the program. For example, teachers report that the more professional development they receive, the more likely it is that they are teaching more science units and science lessons during the school year and that those lessons tend to be longer.

For more information about Project Inquiry, please visit the Web site at www.berkeley.k12.sc.us/curriculum/science/inquiry/inquiry.

✓ K-8 Science Infrastructure Project (Clayton, N.C.)

In October 2000, Bayer and the Johnston County Schools (JCS) announced a partnership that would bring science education reform to Clayton students, and make JCS one of 20 forward-thinking school districts in the state to join the North Carolina Department of Public Instruction's "K-8 Science Infrastructure Project."

Since then, Bayer has awarded five consecutive annual grants totaling \$165,000 to JCS. Each grant has served to further support the district in its efforts to implement the reform program in all of its K-5 classrooms by providing ongoing professional development for teachers and high quality, *National Science Education Standards*-based curriculum materials.

To date, this support has helped JCS implement the program in 14 of its 19 elementary schools by purchasing 148 curriculum kits that represent 23 different science topic areas, and by providing training in both teaching methodology and science content to 170 of the 900 K-5 teachers in the district.

For the 14 schools currently in the program, JCS will use the latest grant to purchase 34 new curriculum kits and refurbishment materials for the 2004-2005 school year and train the remaining 730 teachers. JCS strategy calls for the 170 teachers now proficient in inquiry science instruction to train the others. In addition, JCS will use part of the grant to purchase an extra 50 curriculum kits for the 2005 – 2006 school year. This will give JCS a major jump start for next year when full implementation of the program is expected to be achieved in all 19 elementary schools and the two middle schools that house fifth grades.

In the five years since the Bayer-JCS reform partnership was announced, North Carolina has undergone some changes with its statewide science education efforts – changes that have catapulted the Bayer-JCS program to a leadership position within the state. First, it developed and then adopted new state science education standards as part of its overall education standards, called the "North Carolina Standard Course of Study."

Second, the North Carolina Department of Public Instruction transformed its "K-8 Science Infrastructure Project" into the North Carolina-Infrastructure for Science Education of "NC-ISE," designed to help other school districts meet the new state science standards.

In addition to Bayer's financial support, the company has provided human resources. In 2000, at the time the JCS partnership was announced, Bayer also launched a "Science Volunteers in the Schools" program in Johnston, Wake, Durham and Orange counties with 75 employee-volunteers. Today, that number has more than doubled, with more than 150 Bayer employee volunteers committed to working with students and teachers on hands-on science learning at local elementary and middle schools. Many of those employees have provided much-needed help to the JCS teachers who are tasked with implementing reform in their classrooms.

Finally, recent JCS assessments illustrate that the reform initiative is making real progress. The assessment asked both Johnston County teachers and principals to rate their schools on a number of reform activities.

Across the board, both groups assigned higher ratings after the project implementation than before:

- Implementation of curriculum reform
 - Teacher ratings increased from 1.5 to 2.1
 - Principal ratings increased from 1.7 to 2.5
- Availability of professional development activities
 - Teacher ratings increased from 1.5 to 1.9
 - Principal ratings increased from 1.5 to 2.5
- Development of a centralized materials support system
 - Teacher ratings increased from 1.4 to 2.1
 - Principal ratings increased from 1.7 to 2.8
- Development of new student assessments
 - Teacher ratings rose from 1.6 to 3.8
 - Principal ratings increased from 1.4 to 2.3
- Level of partnership activities
 - Teacher ratings increased from 0.9 to 1.1
 - Principals rose from 1.5 to 2.0

✓ Bayer-New Haven Public Schools Partnership (West Haven, Conn.)

In 1999, Bayer formed a partnership with the New Haven Public Schools (NHPS) and Southern Connecticut State University (SCSU) that significantly expanded Bayer's *Making Science Make Sense (MSMS)* program throughout the greater New Haven region.

The Bayer-NHPS-SCSU partnership centered on a five-year \$250,000 *Making Science Make Sense* grant for the implementation of a new science curriculum, changing from a traditional textbook, memorization-based approach to one that is inquiry-based and hands-on. Designed by the National Science Resources Center, the curriculum, called *Science and Technology for Children (STC)*, is aligned with the *National Science Education Standards*, *Connecticut's Science Education Standards* and the *NHPS District Science Standards*.

Since 1999, the Bayer-NHPS-SCSU partnership has:

- Purchased more than 700 *STC* curriculum kits.
- Established a teacher training program at SCSU that trains teachers on how to teach other teachers to use the hands-on, inquiry-based science kits.

- Trained 790 teachers in all 39 NHPS schools that house grades K-6 to use the new curriculum and implement it in their classrooms. More than 12,000 students each year are using the new curriculum.
- Created a Science Resource Center at SCSU to refurbish and provide K-6 *STC* curriculum kits to the 39 NHPS schools and to 11 schools in the neighboring North Branford and Hamden school districts.
- Co-sponsored the *Bayer-Olin Corporation-Yale University-New Haven Public Schools Citywide Science Fair*, which showcased 2,400 students representing 228 science projects. In 2001, the program received the *Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring*.

✓ West Virginia Handle on Science (New Martinsville, W.Va.)

The Bayer Foundation and Bayer's New Martinsville site have donated funds to West Virginia to develop the *WV-Handle on Science Project*, a science education reform program that implements the National Science Resources Center curriculum in elementary school classrooms.

This project is providing quality hands-on science curriculum materials along with extensive professional development for teachers in 46 schools in five West Virginia northern panhandle counties, including Brooke, Hancock, Marshall, Ohio and Wetzel. All of the approximately 575 K-6 teachers receive professional development focusing on inquiry-based teaching strategies, science content and alternative assessment relating to exemplary instructional materials. These materials consist of a combination of units from *Science and Technology for Children (STC)*, *Full Option Science System (FOSS)* and *Insights*. The modules that the teachers use are housed and refurbished at the Materials Resource Center located at West Liberty State College's SMART-Center.

An expansion project, *WV Reach Out*, has been funded as a pilot Local Systemic Change project to provide leadership and science content enhancement and materials for 11 seventh-and eighth-grade science teachers from seven West Virginia counties. This project utilizes distance-learning technologies, and provides science curriculum kits for teachers to pilot in their classrooms. *WV-Handle on Science Project* staff serve on the advisory board.

The *WV-Handle on Science Project* has established strong links with West Liberty State College, particularly with the instructor of the Materials and Methods course, who is utilizing the Project's pedagogy and instructional materials. The instructor also serves as a *WV-Handle on Science Project* mentor and classroom observer. Students from the course are required to fulfill volunteer hours in the college's Materials Resource Center and are performing internships with many of the project's teachers one day per week. The project's teachers have commented that the pre-service teachers now are more comfortable and competent at teaching science and are familiar with the methods used in the curriculum materials.

✓ Encouraging Technology and Hands-On Science (Elkhart, Ind.)

Bayer HealthCare LLC and the Elkhart Community Schools spearheaded ETHOS Inc. (Encouraging Technologies Through Hands-On Science), a science education reform initiative that will bring National Science Resources Center curriculum modules to elementary school classrooms. The goal is to:

- Enhance the schools' science and math curriculum;
- Have laboratory equipment, materials and other supplies donated; and,
- Make Bayer scientists available to serve as consulting resources for individual teachers.

For more information about ETHOS Inc., please visit the Web site at www.ethosinc.org.

✓ Kansas City Science Initiative (Kansas City, Mo.)

In October 2004, Bayer HealthCare LLC and Bayer CropScience LP partnered with the Kansas City Missouri School District (KCMSD) to create the *Kansas City Science Initiative (KCSI)*.

KCSI's mission is to create confident, life-long learners who have the critical thinking and problem solving skills, particularly in science, to be contributing citizens and leaders within their communities. The partners envision all KCMSD kindergarten through fifth-grade students having the opportunity to participate in a rigorous, grade-appropriate, multi-sensory curriculum that allows for and fosters the development of science literacy through inquiry-based instruction. The goal also is to have all teachers properly trained in this type of instruction.

Currently, *KCSI* is being piloted at five elementary schools in the district. To help *KCSI* continue to grow and meet its ultimate goal of expanding into all 46 elementary schools, Bayer has provided financial, human and educational resources, including:

- \$250,000 in grants to KCMSD for teacher training, the KCMSD team's attendance at the National Science Resources Center's weeklong LASER (Leadership and Assistance in Science Education Reform) Conference, and the purchase of curriculum kits and materials;
- Employee volunteers who assist teachers and students as they shift away from textbook-based teaching and learning styles toward experiential instruction; and,
- Ongoing strategic counsel to the pilot schools from ASSET Inc., Pittsburgh's science education reform program spearheaded by Bayer in 1992 that has dramatically improved student achievement in science in southwestern Pennsylvania.

In addition, the Kansas City Area Life Sciences Institute (KCALSI) recently signed on as a key partner in *KCSI*. As a partner, KCALSI will house the reform program's headquarters and help galvanize support from other local corporations, foundations and individuals.

For more information about Bayer's *Making Science Make Sense* program, please visit www.BayerUS.com/MSMS.

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