The BSCS National Academy for Curriculum Leadership: Contributions and Lessons Learned

An Evaluation Brief

June 2006

This evaluation brief is supported by the National Science Foundation as part of its Instructional Materials Development project (Award No. ESI-9911615). The brief reports on the findings and implications of a study of the SCI Center at BSCS, and specifically of its National Academy for Curriculum Leadership (NACL). The study was conducted by Inverness Research Associates (www.inverness-research.org).

This brief is aimed at audiences interested in designing improvement efforts in math and science at the secondary level. It focuses on using curriculum as a leading edge for improvement of science programs and on building the capacity of districts to engage in productive curriculum improvement efforts. It includes a short discussion of the context for the BSCS NACL, the project's design, its contributions, and general lessons learned.

The brief draws upon and summarizes the findings of the final report on this project. For more information, see www.bscs.org (follow the NACL link within the BSCS Center for Professional Development).

The BSCS[1] National Academy for Curriculum Leadership: Contributions and Lessons Learned

Background

It is widely accepted that improving high school science programs and high school science teaching is an ongoing, persistent need.[2] Few would argue that the status quo is satisfactory. International comparisons do little to comfort the nation, and our own research as well as research by others suggests that high school science teaching is not as robust and rich as it might be (see recent studies by Horizon Research[3] and Inverness Research Associates[4] for examples).

It is instructive to contrast the efforts to improve elementary science education with those at the high school level. One could argue that over the past two decades the nation has found a successful approach to improving elementary science programs.[5] At the high school level, however, there is far less known, and far more doubt about the best approach to improving high school science programs.

The NSF's Instructional Materials Development Program

In 1996, the National Science Foundation (NSF) solicited proposals for the first Implementation and Dissemination Centers to facilitate the dissemination and implementation of curricula developed with Foundation funding:

> *Science and mathematics education reform requires classroom implementation of high-quality standards-based instructional materials, together with a comprehensive program of professional development for teachers…along with the alignment of district policies, practice, and resources. The Instructional Materials Development and Teacher Enhancement Programs seek to establish implementation sites that will provide information and technical assistance to decision-makers who are responsible for selecting materials and ensuring their implementation in those districts that have decided to implement NSF-supported exemplary materials. These sites should*

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[1] Biological Sciences Curriculum Study

[2] *Science and Engineering Indicators*, 2006. http://www.nsf.gov/statistics/seind06

[3] *Report of the 2000 National Survey of Science and Mathematics Education*, 2001. http://www.horizon-research.com/reports/2001/2000survey/full_report.php. *Looking Inside the Classroom: A Study of K-12 Mathematics and Science Education in the United States*, 2003. http://www.horizon-research.com/reports/2003/insidetheclassroom/looking.php

[4] *The Quality of the Teaching of Mathematics and Science in K-12 Classrooms in New York State*, 1999. http://www.inverness-research.org/reports/1999-04_Rpt_NYSSI_MSTinNYState.pdf

[5] *Progress and Pitfalls: A Cross-Site Look at Local Systemic Change through Teacher Enhancement*, 2003. http://www.horizon-research.com/reports/2003/progress_and_pitfalls.php

> *increase awareness of alternatives; identify strategies for selection of materials that are appropriate for local needs; and provide technical assistance necessary for broad scale implementation.*

The BSCS National Academy for Curriculum Leadership (NACL)[6]

BSCS, with its long history of curriculum and professional development in secondary science, seemed a natural agent for facilitating the dissemination and implementation of high-quality instructional materials in science. Believing that secondary science was in particular need of support and improvement, BSCS wrote and received a grant in 2000; and between 2001 and 2005, BSCS supported district teams seeking to improve their secondary science programs through a three-year program known as the National Academy for Curriculum Leadership (NACL).

Our Study of the BSCS NACL

Inverness Research Associates has been involved in the study of math and science education improvement efforts for over two decades. We have studied multiple curriculum implementation centers and have written about the NSF initiative as a whole.[7]

This Evaluation Brief examines the BSCS approach to improving secondary science education, and illuminates some of the lessons learned from its five years of work with districts across the nation. We highlight selected findings from the full study report and discuss the broader implications for the field. For a more complete description of our methodology and findings, the reader is encouraged to see the full report at www.bscs.org (follow the NACL link within the Professional Development Center).

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[6] In May 2000, BSCS received Award No. ESI-9911615 from the National Science Foundation (NSF) to establish a high school implementation and dissemination center. BSCS named that project "The SCI (Science Curriculum Implementation) Center at BSCS," which is the subject of this evaluation brief. The funding for the SCI Center project ended in 2005; consequently, BSCS no longer lists the SCI Center at BSCS on its website. Instead, the work of the SCI Center, specifically the BSCS NACL, continues within the BSCS Center for Professional Development, one of three centers established by BSCS in 2003. To avoid confusion, we refer to the work of the SCI Center in this report as either the BSCS NACL or the BSCS Center for Professional Development, which are current entities at BSCS. For more information about the BSCS Center for Professional Development and BSCS NACL, go to www.bscs.org, and follow the links to the NACL within the Center for Professional Development.

[7] *The NSF Implementation and Dissemination Centers: an Analytic Framework, 2002.* http://www.inverness-research.org/reports/cic_report/cic_report061902.pdf

The Design of the Work of the BSCS NACL

Underlying Assumptions

Through observations of events, conversations with project staff, and our study of alternative approaches by other curriculum implementation projects, we identified the underlying assumptions of the overall strategy of the BSCS NACL for improving secondary science:

- In most districts the process for selecting, adopting, and implementing instructional materials **has been prosaic, minimal, under-appreciated, under-funded, and under-engineered**.

- **Materials-led improvement** (in contrast to professional development-led or assessment-led improvement), when done well, **can be a powerful approach to improving science programs and instruction**. In fact, well-designed instructional materials can facilitate teachers' own content learning and their improved practice. In this sense they can be educative.

- **Quality instructional materials are necessary – but not sufficient – for the improvement of teaching and learning**. Teachers require support to use instructional materials well, even good materials.

- There are well-designed instructional materials funded by NSF that can enhance teaching and learning in secondary science. These and other **well-designed instructional materials are best taught as designed, at least at first**. Adaptation of materials too soon, or without careful reflection, can lead to lesser quality instruction.

- Reviewing, piloting, selecting, and implementing instructional materials are all processes that require time, education, and ongoing support. Thus, **implementation is at least as important as development of good instructional materials**. Or, said in a slightly different way, curriculum adoption and implementation hold the often unrealized potential for overall professional and instructional improvement.

- It is not enough to adopt a textbook or program. **Improving the curriculum in a school or district requires resources, leadership, time and a well-tested and engineered process**. It requires people at all levels of the system with knowledge about the materials change process, skills to work with a range of teachers and others throughout the change process, tools[8] to assist their work with the teachers, and so on. It is possible to develop and support program improvement teams that can work together over time to make positive, system-level changes in curriculum and ultimately in practices and achievement. There are developmental stages to building capacity and implementing improvements across a system. Local teams benefit from the support of a national network and also need autonomy to work in their own systems effectively.

- There are a number of **instruments and processes that support change in business and other settings that can also be applied to support improvement in high school science.**

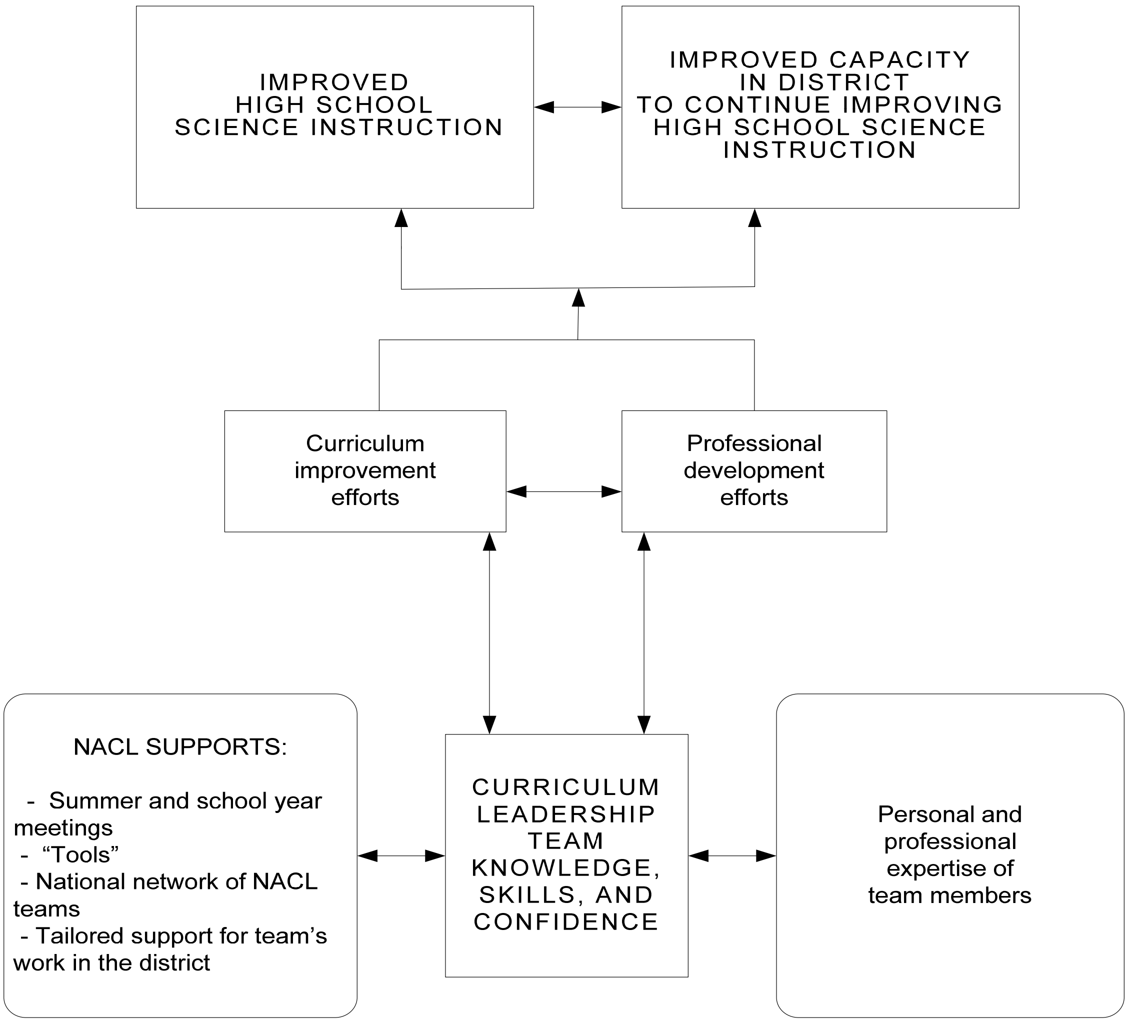
The Strategy and Key Components of the BSCS NACL

The BSCS NACL's **strategy** for the reform of high school science is essentially a **curriculum-centered leadership development project**. It is curriculum-centered in that it believes that a well-designed curriculum can be a focal point for improving instruction. But unlike other curriculum implementation efforts, the NACL strategy focused on building the leadership necessary so that each participating district could implement and sustain its curriculum-centered improvement effort. The science program, it is reasoned, is shaped most strongly by the curriculum that is used, and by the knowledge, skills and attitudes of the teachers who implement that curriculum. To help districts gain the capacity to improve their own curriculum and their own professional development to support curriculum adoption and implementation, the NACL provided structured annual meetings as well as tailored support for teams' work back at home. By thus helping districts move through one curriculum adoption and implementation effort, BSCS sought to create ongoing indigenous capacity for future science program improvement work.

The NACL strategy is illustrated in the figure on the following page:

[8] By "tools" we mean instruments and processes that support improvement in high school science such as structured approaches for reviewing and piloting curriculum or designing high-quality professional development.

The BSCS NACL Strategy



Approaches to Building Curricular Capacity

The BSCS NACL sought not only to help districts implement new instructional materials but also to increase their capacity for continuing curricular improvement and ultimately improved student learning. The capacities fall into two areas: the development of leadership and the productive use of tools by those leaders.

Leadership

The cornerstone capacity that the NACL sought to create is curriculum leadership. The mechanism and form for this leadership was the NACL leadership team – comprised of teachers, district leaders, and school principals. By creating and supporting curricular leadership on both an individual and collective level, the NACL sought to empower districts to have both the initiative and expertise needed to improve their science programs and thereby the quality of the science instruction offered to their students. There were three main components to implementing the NACL strategy for developing curricular leadership:

- working with vertically integrated teams from districts "ready" to improve their secondary science programs;
- providing tools and support through intensive project activities over three years and the skills and strategies necessary for teams to use them back in their schools and districts; and
- providing support for teams throughout the year as they endeavored to improve the teaching and learning of secondary science in their schools and districts.

Twelve leadership teams completed the NACL, while another 13 teams attended at least the first summer institute, but did not complete the Academy. Ten districts from across the U.S. were represented by the teams that completed the three-year Academy. Each team included high school science teachers from one or more disciplines,[9] at least one school or district administrator, and sometimes others (e.g., a university science educator or a science specialist affiliated with an intermediate education agency). Most teams represented a district, but a few represented a single high school or a cross-district LEA or science reform project. Participating teams attended three week-long summer meetings, and three two-day spring meetings that piggy-backed on the NSTA's annual spring conferences.

[9] There was one exception, a district that sent a second team representing middle school science.

Tools

A primary strategy of the Academy was to equip individuals and teams with a set of tools that they could draw upon as they endeavored to improve the implementation of high school science instructional materials in their local settings. Tools introduced at the summer and spring meetings supported the creation and maintenance of effective teams, long-term planning, assessing the concerns of target audiences, selecting and piloting standards-based secondary science instructional materials, conducting effective professional development sessions, communicating the qualities and value of inquiry-rich science, and engaging in data-based decision making. Among the key tools introduced at NACL activities were the following:

- *Concerns-Based Adoption Model (CBAM)*– A model for identifying and providing ways to assess stages of concern experienced by people considering and experiencing change[10]
- *Norms of Collaboration* – Facilitation skills and strategies
- *AIM (Analyzing Instructional Materials)* *© BSCS* – A structured process for group review of instructional materials
- *Professional Development Design Framework* – An approach to professional development design that includes consideration of knowledge and beliefs, context, and other critical issues for professional development
- *Immersion into Inquiry* – A professional development strategy wherein teachers experience inquiry themselves to improve their content knowledge and instructional strategies. It is based on the BSCS "5E" instructional model (engage, explore, explain, elaborate, evaluate).
- *Program Elements Matrix (PEM)* – A tool for long-term planning

[10] Fuller descriptions and references for this and the other tools are provided in the full report, posted on the BSCS website.

THE CONTRIBUTIONS OF THE BSCS NACL

Perhaps more than any other Center, the BSCS Center for Professional Development (via its National Academy for Curriculum Leadership) worked in depth with a few districts over a long period of time. Initially BSCS envisioned a process whereby it would help cohorts of districts move through a three-year process of selecting, piloting, implementing and then refining usage of NSF-funded curriculum. The project's initial vision – of moving from selection through refined usage in three years – proved to be optimistic. Nonetheless, the BSCS NACL and the teams made important contributions to the participating districts.

Below we discuss two different levels of contributions by the BSCS NACL, first the implementation of standards-based instructional materials and then the deeper capacities developed in the participating districts.

1) The Implementation of Curriculum

The majority of districts that completed the three-year program did not have the capacity to undertake the tasks necessary to select, fully implement and refine usage of the NSF-funded curricula district-wide – especially in the allotted three years. There was also huge variation in the capacity of the districts, in the supports and constraints of their local contexts, and in their readiness to pursue a curriculum-centered improvement strategy. Nevertheless, of the 10 districts that completed the three-year program, six districts implemented the standards-based instructional materials noted in the chart below:

Instructional materials implemented with the support of the BSCS NACL[11]

San Diego, CA
Constructing Ideas in Physical Science
Active Physics
Living by Chemistry
BSCS Biology: A Human Approach
Investigating Earth Systems
Science and Life Issues

Boston, MA
BSCS Biology: A Human Approach
Active Physics
Living by Chemistry

Linden, NJ
Active Physics
EarthComm

Cincinnati, OH
Active Physics
EarthComm
Active Chemistry
BSCS Biology: A Human Approach

Pittsburgh, PA
BSCS Biology: A Human Approach
Living by Chemistry

Evergreen, WA[12]
BSCS Biology: A Human Approach

One of the remaining districts had a science adoption scheduled for 2006-07. Two other teams made little progress outside the classrooms of participating teachers.

2) Building Capacity and Promoting Improvements in the NACL Districts

The work of the BSCS NACL was significant because teams first benefited from their participation in the NACL, and then were able to return to their schools and districts and make significant strides toward building local capacity and making improvements in secondary science instruction.

Contributions of the BSCS Center for Professional Development to NACL teams

The opportunities to learn about and experience a set of tools and ways of thinking helped participants envision ways they and their teammates could provide curriculum

[11] The list includes both instructional materials that were implemented in their entirety and those from which one or more modules or units were implemented. It is possible that additional materials were implemented which teams did not inform us about. One district did not respond to end-of-project inquiries.
[12] This district also implemented three modules from compatible series (FOSS and STC-MS) at each middle school grade in connection with its participation in BSCS NACL.

leadership for improvement of secondary science in their own schools and districts. Moreover, team members gained specific skills and knowledge for curriculum leadership. For example, they learned skills and knowledge related to inquiry, leadership skills, team building, selecting instructional materials, using the concerns-based curriculum adoption model (CBAM), engaging in data-based decision-making, and providing effective professional development. In sum, participation in the NACL resulted in enhanced leadership capacity and confidence in both individuals and in teams.

Contributions of the NACL to School and District Capacity for Improvement of Secondary Science

The project stimulated the creation of and district support for teacher-administrator teams charged with guiding and directing improvement of high school science. In many cases, in fact, if it were not for the BSCS NACL, there would not be such a team. Teams used NACL tools productively as they provided formal and informal curriculum leadership in their schools and districts. This enhanced progress toward selection and adoption of standards-based curricula in secondary science contributed to improved quality of teaching and learning science in districts' secondary science classrooms, especially in some team members' classrooms. Moreover, for some districts, the impact was deepened as a result of tailored support that BSCS staff provided to participating schools and districts.

The local work was not easy, but teams were motivated to persist despite barriers to team success. Local contexts within which teams engaged in curricular leadership improved over the life of the project, and at the end of the project there was greater interest in change and agreement about the nature of change needed to improve teaching and learning in secondary science. In sum, participants report that NACL teams have had a substantial impact on the quality of high school science within their districts and that their experiences in the NACL will have a long-term impact on themselves, their team and their schools and districts despite formidable barriers that many still foresee.

The work of the BSCS NACL, then, turned out to be more about building the capacity to select and implement standards-based instructional materials and progressing toward that goal, than it was about supporting quality implementation. Local schools and districts often lack the resources and knowledge to engage in thoughtful and sustained curriculum selection and implementation, so developing this capacity benefits districts after their involvement in the NACL ends.

MORE GENERAL LESSONS LEARNED FROM THE WORK OF THE BSCS NACL

There are three levels of generality to the broader lessons to be learned from the work of the BSCS National Academy for Curriculum Leadership. At the most concrete level, specific to the project, there are lessons about the contextual and personal factors that shape the NACL's effectiveness that may have applicability to similar projects. At a more general level, there are lessons about the use of curriculum as a leading edge for change. Finally, there are broad lessons learned about improving high school science.

Lessons Learned about Factors that Shape the Effectiveness of NACL Teams

Timing and interpersonal relationships proved to be key factors in the efficacy of teams and in their progress.

Timing

- **The timing of the NACL involvement vis-à-vis the district adoption process was critical in determining the overall influence of the NACL work.** In some districts the timing was perfect – the NACL team began its work a year before the official district adoption. In other districts the NACL teams preceded adoptions by a couple of years, in which case their work was more foundational and preparatory. Clearly, the worst case scenario involved the case where a team began work just after an adoption of a traditional set of materials.

- **The NACL model appears to function best when it coincides with existing efforts to make curricular changes and improve high school science programs.** While the mere fact that there was money available for science (e.g., where there is a USP in the district or region) did not necessarily ensure success for the NACL team, some teams from districts that had long histories of reform efforts (e.g., USPs or MSPs or other NSF-funded projects) fared well.

Interpersonal relationships

- **The integration of team work and district work was greatly facilitated by the involvement of a strong leader, a district "champion."** In the best cases the team leader was also a strong administrative leader in the district, able to marshal resources to further team work. In this case the work of the team was more likely to be congruent with district goals and priorities, and the improvement efforts of the district were more likely to draw upon and value the work of the NACL team.

- **The size and locale of the sponsoring agency (school, district or cross-district project or LEA) did not appear to be an important factor in determining which teams functioned well and persevered**. A rural one-high school district and several large districts sponsored teams that made good progress.

- **Strong NACL teams included a vertical slice of participants, from teacher, to teacher-leader, to school administrator to district staff.** Strong teams were also generally good at assigning roles (coach, team member) appropriate to participants' professional experience. Both teachers with classroom assignments and dedicated district-level science staff proved to be effective coaches.

- NACL teams worked well in those districts where there is a **strong centralized district leadership** already pursuing a district-wide reform effort. In this case **the NACL work was seen by district leadership as supporting the goals and approach of the district**, allowing it to give a specific focus on the improvement of high school science. In other districts the **NACL team helped to further the work of a strong group of teacher leaders who shared a vision of and commitment to improvement** of high school science teaching. In these cases, where the project did not receive the full attention of the district, the impact of the participants was more limited. (However, in at least one district, these teacher leaders reported that they were able to use what they gained from the project after it ended, when a change in leadership made their district more open to improvement.)

- **To be effective, teams ultimately had to meld their NACL work with the mainstream of district work**. Often NACL teams started out as a new and marginal element in the district, or included members unknown outside their schools. They needed to work to become the district team rather than a team in the district.

- **As with all human endeavors, the personal chemistry among team members and between the team and the BSCS staff could matter greatly in the ultimate success of the team**. Good relationships between teams and BSCS staff made for good communications and opened opportunities for BSCS to provide local assistance. However, a good relationship with BSCS staff did not always help teams overcome internal personality conflicts. Team progress was not necessarily impeded when there were some changes in team membership or when new team members joined. However, a leader who was too dominating, or a team member who could not get along with his or her peers often put the entire team effort at risk. Several teams that dropped out struggled with internal clashes that reduced their motivation to continue.

Lessons Learned about Using Curriculum as a Leading Edge for Change

The approach of the BSCS NACL might be best described as learning through curriculum – and for curriculum. Good curriculum supports the development of good leaders, and good leaders support the adoption and implementation of good curriculum. The work of the NACL was essentially to build and support an indigenous leadership and knowledge capacity – through consideration of curriculum and curriculum-led change – that could continue to develop and improve the climate and culture of the district into the future.

- **The careful study of new curricula, and the careful consideration of the current program, can serve as a way to get people at all levels to re-examine and further develop their underlying beliefs about teaching and learning in general**. While implementation may seem like the main outcome, the more important outcome of curriculum-led reform might be the expansion of leadership and knowledge capacity.

- **The NACL approach depends upon the existence of both well-designed curricular programs and also processes for productively interacting with such curriculum.** There is a national need for such "educative curriculum." In a recent article Krajcik and Davis[13] describe educative curriculum in this way: "Curriculum materials for Grades K–12 that are intended to promote teacher learning in addition to student learning have come to be called educative curriculum materials." The NSF curricular materials included in the NACL mandate not only are educative for students and teachers but also for curricular leaders. That is, through the AIM (Analyzing Instructional Materials) process team leaders experienced and learned to facilitate a scaffolded approach that offered extensive interaction with the NSF-funded curricula. In this way the leadership teams were led to understand the design elements and principles of well-designed curriculum. This was especially important for administrators on the teams who likely rarely examined curriculum in any way.

[13] Davis, E. A and Krajcik, J. S. *Designing Educative Curriculum Materials to Promote Teacher Learning*, Educational Researcher, Vol. 34, No. 3, pp. 3–14 (April 2005).

- **Actually doing the work of curriculum selection, piloting and implementation is the best way to develop strong curricular leaders.** There can be a strongly symbiotic relationship between the development of a leadership team, the work of curriculum development, and the design of professional development that can best support the implementation of new curriculum.

- **Curricular improvement should be seen as an ongoing and incremental process; it is not a singular event that happens without deep foundational work.** Our data show that it is highly unlikely that a district which is traditional in its thinking will suddenly shift to an inquiry-based curriculum, even in response to a mandate from the superintendent. Thus, we conclude that the NACL is not as much about the adoption of a particular curriculum as it is about using the curriculum adoption process to foster incremental change in overall thinking about the science program and science instruction. Hence, like painting a house, 90 percent of the work is in preparation and only 10 percent in applying the final coat.

- **Efforts to improve high school science can profit from the strong symbiotic relationship between the use of tools (i.e., instruments and processes to support change) and the development of leadership.** Tools for change played a central role in the NACL strategy. They were valuable in the development of the leadership teams, and they then became a valuable resource for leadership teams as they sought to work in their own local districts. Specifically, tools provided the scaffolding and structures that led NACL team members to carefully look at both curriculum and at the process of program change. They helped these leaders to engage in powerful learning processes themselves, and later the same tools helped them carry out their own local professional development and curricular change activities.

Lessons Learned about Improving High School Science Education

The NACL strategy of leadership development and empowerment of individuals and teams is a deep and long-term strategy. The work NACL did with each team represented a considerable investment as it required multiple years and a cumulative development effort to develop and support each team.

- **There may well be no short cuts and no quick fixes in improvement of science programs at the high school level.** The varied scenarios that played out as teams worked in their districts suggests that improvement at the high school level may require this level of investment as well as a long-term perspective.

- **Given the difficulty of making changes in high school science programs, it seems likely that future efforts to improve science education will require national infrastructure that can assist in developing local capacity and in supporting local improvement work.** The NACL support was critical to the success of a curriculum-centered leadership development strategy. Even the strongest teams agreed that without the NACL institutes, the NACL tools, and the NACL on-site support the team approach would never have succeeded. This strategy thus represents an approach where a national network supports local work. The external expertise offered by BSCS and WestEd staff advanced the development of expertise at the district level and it supported customized localized improvement efforts.

Summary Statement

The NSF describes its mission as investing in "people, ideas, and tools." The BSCS NACL is a good example of the fulfillment of such a NSF goal. We see the National Academy for Curriculum Leadership as a unique asset within the NSF portfolio of investments in science education, and we believe it has a clear role in adding to the value of that portfolio. The NACL is an important experiment that explores approaches to improving high school science education. Like most research, it does not provide a comprehensive clear prescription for future efforts. However, the Academy provides a clear example of investing in both national and local leadership. The project also illustrates how professional development tools can support leadership both in its development and in its future work. And, finally, the project illuminates many important ideas – ideas about curriculum, about improvement, and about the capacities needed to bring about processes of improvement.