November 2006

The Gilbert Elementary Science Program

A Case Study of Developing an Inquiry-based Science Education Program

This evaluation brief is supported by the National Science Foundation as part of its Local Systemic Change Initiative. The brief highlights the current status of science teaching in the Gilbert, Arizona School District. It describes the process used to develop and implement a district-wide, kit-based elementary science program for grades K-6. Eight key questions central to the design and development process are discussed. The findings point out the need for sustained work, solid strategy, and ongoing commitment to maintain the quality of science teaching and learning which resulted from the NSF investment in Gilbert Public Schools.

For more information see www.inverness-research.org.

Introduction

This is the story of a district in Gilbert, Arizona that developed a district-wide science program. The Gilbert Systemic Science Plan (GSSP) began in 1999 with a Local Systemic Change (LSC) grant from the National Science Foundation (NSF). During the past six years, the district has drawn on the LSC model, as well as knowledge accumulated from other districts doing similar work. The district has evolved from a few lead teachers piloting a few hands-on science kits into a fully implemented district-wide science program for grades K-6.

Research studies[1] show that, across the United States, elementary science is taught sporadically and with very uneven quality. Most U.S. school districts are simply lacking the critical capacities needed to develop and support a high-quality science program. They do not have large numbers of teachers with expertise in science teaching; they do not have a coherent curriculum that is well supported with high-quality instructional materials; and they do not have an array of supportive professional development offerings that can help teachers and administrators improve the science instruction in their schools. In addition to lacking these capacities, many districts are feeling pressure from No Child Left Behind and other accountability policies. As a result, they emphasize the teaching of mathematics and reading at the expense of science.

Other districts interested in developing a hands-on, kit-based elementary science program may benefit from hearing the Gilbert story because the project leaders were mindful of the context and priorities of the district when developed key components of the LSC model for elementary hands-on science. First, project leadership stayed closely attuned to the needs of the district and teachers, designing professional development opportunities to meet the needs of teachers (from novice to practiced) in a district which placed literacy skills and mathematics as its top priorities. Second, Gilbert implemented their science program amidst unprecedented district growth. Third, it is the story of a core group of committed individuals who worked tirelessly to build relationships, work across disciplines, and continually refine and build on their program to ensure its success. The project lead's determination in both developing and sustaining the project has been a huge factor in the project's success.

This district's story proves it is possible for a district to design and develop a good program and provides an analysis of the long-term process of developing a sustainable elementary science program. This story also points out the need for sustained work, solid strategy, and ongoing commitment.

A brief history of the development of Gilbert's elementary science program

Gilbert, Arizona is largely a middle/upper class community with very few minorities; it is part of the greater Phoenix metropolitan area. Until the 1990s, Gilbert was primarily an agriculture community, characterized by cattle and pickup trucks; its old downtown area still feels like part of a rural agriculture community. More recently, the area has grown at a phenomenal 410

[1] *The 2000 National Survey of Science and Mathematics Education: Compendium of Tables*. The website for the report is http://2000survey.horizon-research.com/reports/tables/tables_complete.pdf.

percent. High-tech companies have moved into neighboring communities, but the largely residential community lacks a solid industry-supported tax base. The school district, however, has always enjoyed support from the community. In the past, voters have approved school bond issues by wide margins.

The schools in Gilbert have also grown. In 1999, when the district received the LSC grant funds, Gilbert school district had 16 elementary schools, with two under development. Currently, the district boasts 25 elementary schools, six junior high schools, four high schools, two academies, and two alternative education centers. In the past twenty years, the student population has more than doubled. The district's teaching staff is young, the schools are new, and the class sizes are relatively small. The turnover among principals and teachers has been low. The district has enjoyed success on state-mandated assessments, with students consistently ranking in the top three in the state.

Early in the 1990s, Gilbert had a fairly traditional science program in place. Science instruction was hit-and-miss at the elementary level – those teachers with an interest and some background in science taught it more frequently and regularly than those who did not. Teachers tended to teach those science topics that interested them. Some teachers actively had their students participating in science fairs. However, for the most part, science instruction was taught infrequently and most often from a textbook. As one principal said:

> *So much of what we used to do was out of a book. Students would read the chapter, answer the questions, and maybe, just maybe, do an experiment or two.*

Importantly, however, there was a small core group of committed elementary teachers, led by Susan Giesaking, a classroom teacher at Greenfield Elementary, interested in making science instruction more meaningful for their students and more consistent throughout the district.

At this time, Gilbert began an overhaul of its elementary science program. Inspired by the neighboring district in Mesa that had implemented a successful kit-based curriculum in elementary science, Susan Giesaking encouraged the district to purchase Mesa Public Schools science units and helped institute a system for teachers to check out these more hands-on, inquiry-based kits through a materials resource center. Susan also formed a core group of teacher leaders from each of the elementary schools who began to pilot the Full Option Science System (FOSS) and Science and Technology for Children (STC) kits.

Susan Giesaking submitted proposals four times to NSF for LSC funding and was rejected for funding three times. She paid careful attention to feedback from NSF reviewers and kept revising the proposal. Gilbert finally received funding in May of 1999.

The model and key elements from the LSC provided a template of the key elements needed to develop and sustain the program. The LSC initiative[2] was designed to help districts develop the capacities needed to offer high-quality mathematics and science programs to their students. The NSF LSC grants helped local districts pursue improvements based on the following assumptions:

- Student achievement depends heavily upon the quality of instruction to which students have access.
- The quality of instruction, in turn, depends on the supports districts are able to offer teachers.
    - District-wide supports need to include a high-quality curriculum with well-designed materials.
    - District-wide supports need to include knowledgeable and committed leadership to direct the science program.
    - Teachers need ongoing professional development in order to learn to use the instructional materials and better understand the underlying science content.

From 2000-2005, the Gilbert science program grew and developed across all of the key dimensions or elements of the model. The key events and benchmarks for the development of the Gilbert science program are discussed in more detail in the body of the report. Briefly, they include:

- Hiring two Science Resource Teachers (SRTs), classroom teachers who were released full-time from their teaching responsibilities to help lead the program.
- Developing a core group of lead teachers who piloted kits and shared information about the program with their teachers and administrators.
- Developing a core group of teacher leaders who led workshops for teachers.
- Piloting and selecting three to four nationally recognized kits representing earth, life, and physical science at each grade level.
- Developing, staffing, and maintaining a materials resource center where the kits were housed, refurbished, and distributed to schools.
- Development and evolution of three tiers of professional development offerings that ranged from initial trainings on kits, to content workshops specific to the kits, to more advanced workshops focusing on content or pedagogy in more depth.
- Developing a series of specific workshops that developed teachers' skills in using writing in science with their students.
- Developing a process for, and knowledge about, how best to involve scientists from the community in the professional development workshops to help meet the challenge of providing science content to teachers.

[2] The Local Systemic Change model drew on numerous elementary science reform efforts and recommendations from different organizations, such as the National Research Council (NRC), National Science Resources Center (NSRC), etc.

- Ongoing development of broad administrative and district-level support for the elementary science program, including key district-level curriculum coordinators, elementary principals, and the school board.
- Incremental assumption of project personnel's salaries by the district.
- Engineering the transition from a project in the district to the district's elementary science program.

In the present Gilbert elementary science program, at each grade level, teachers teach three to four nationally validated science kits each year. These kits are maintained and distributed from a district-supported science materials center. Teachers have access to a wide variety of professional development courses, from basic introductory kit trainings to advanced courses in how to use notebooks with science instruction. Over the course of the NSF funding, the GSSP served 1,336 teachers. The net result is a standard of consistent, high quality science teaching in the district.[3]

The organization of this case study

How did the district develop the capacity to offer this high-quality program? Eight key questions are central to the design and development process:

- How did the district find, support, and further the leadership necessary to develop a strong program?
- How did the district develop the capacity to provide materials to all its teachers?
- How did the project leadership generate a shared vision among the teachers, administrators, and community of good science teaching?
- How did the district support teachers through professional development in learning how to use the curriculum materials and understanding the key science concepts?
- How did the project leadership position science education within the broader curricular priorities of the district?
- How did the project leadership generate administrative support?
- How did the district use outside resources to aide their effort?
- How did the GSSP move from an externally funded project to a district-owned program?

[3] See *The Gilbert Science Program: Providing Students with High Quality Science Learning*, November 2006, on the Inverness Research Associates web site at http://www.inverness-research.org.

The Key Questions Central to the Design and Development Process

How did the district find, support and further the leadership necessary to develop a strong program?

The Core Leadership Team

The leadership team for the project consists primarily of Susan Giesaking, Kathy Foley, and Sheri Denowh, with the support of staff from the science materials center, lead teachers, and Dr. Susan Sprague, a consultant to Gilbert who had been instrumental in developing neighboring Mesa, Arizona's hands-on science program.

Susan Giesaking has been the key leader of the project since the beginning. A long-time classroom teacher in Gilbert, she had an affinity for inquiry-based science and emerged as a teacher leader. Early on in her teaching in Gilbert, with support from her principal, she began to take on district-wide projects, such as outdoor camps and science fairs, and became a facilitator with Project Learning Tree and Project WILD – all of which raised her visibility in the district. In 1992, she went to work half-time as the elementary science curriculum coordinator. Susan Giesaking had a vision for inquiry-based science education that stemmed from her work in the classroom. She brought this vision with her when she moved to the district office, slowly built upon it, and has worked to create a shared vision throughout the district. Her perseverance in submitting the proposal four times before being funded speaks volumes about her belief in inquiry-based science and her dedication to the cause of reforming elementary science in Gilbert. As one long-time principal in the district said:

> *The drive to place the emphasis on science, and the success the district has experienced, has to be directly carried to the doorstep of Miss Giesaking. Her enthusiasm, her commitment has been what has carried it and I appreciate that and I appreciate her.*

Another principal said:

> *Susan's influence on all of this is huge. She is a dedicated person. She studied Mesa and other districts, she pursued the grants. It is her vision and it has never stopped. Her energy has not gone down. She is always thinking, "What else can I do to make it better?" And then she does it.*

Another key milestone in the area of leadership came when the science resource teachers (SRTs) were hired in the summer of 1999. Classroom teachers Kathy Foley and Sheri Denowh were released full time from their classroom responsibilities and have provided excellent leadership for the project in their work with scientists and classroom teachers. Their primary responsibilities include supporting lead teachers in designing and delivering introductory kit workshops, designing and delivering all other professional development offered by the project, and providing teachers with ongoing support in the classroom. Kathy Foley was active in working with the existing Mesa kits with her students and was involved in science professional development offerings prior to becoming an SRT. Sheri Denowh was a junior high teacher and co-chaired the district's science fairs with Susan Giesaking for

many years. Susan Giesaking was instrumental in selecting these key resource teachers. As Kathy Foley said:

> *Susan and I were driving somewhere and she was asking me why I liked science so much. So I was telling her my background and I remember looking over at her and she had this look in her eye. She said, "I have plans for you." I think that was the point when she already had it in her mind. It was the time where she was trying to get the grant and she was thinking about who would be a teacher on assignment.*

Another key leadership milestone for the project came in 2000 with the involvement of Dr. Susan Sprague. Susan Giesaking met Dr. Sprague from Mesa, who began to invite her to activities. Dr. Sprague provided ongoing leadership, friendship, and advice as the project evolved. She consulted on the overall implementation, worked with the leadership team on the offerings of the project, and helped build a district-wide vision for elementary science education. She also offered an outsider's perspective on the dynamics of the leadership team, helping them work more productively. As Kathy Foley noted:

> *Susan's involvement was key. She has so much experience and she knows what works. But more than that, she listens very well. She asks a lot of questions but she knows just by listening to you what you need to focus on.*

It is important to note that, throughout the life of the grant, the leadership team has continually and actively participated in professional development experiences to further their own learning. They have attended state and regional conferences and workshops, and participated in national-level conferences around inquiry-based science and systemic change in science education. This professional development was instrumental in shaping the project as it evolved. For example, Susan Giesaking and Kathy Foley attended the Exploratorium's Institute for Inquiry in the fall of 2000. As Kathy Foley said:

> *Many of the things I learned at the Exploratorium, about the three types of inquiry, for example, I have used and built into my workshops.*

The leadership team also attended the Next Steps conferences with key district personnel every year they have been offered since 1995; these conferences helped the leadership team build a network of colleagues. As Sheri Denowh noted:

> *At the Next Steps institutes, we were able to have conversations with people in our same position who were facing the same challenges. It helped to hear that they had the same challenges and some of the same successes, that we were on the right track.*

As the project evolved, the leadership team's participation in these conferences evolved from learners to presenters, contributing to the national elementary science reform community. In fall of 2003, Kathy Foley, Susan Giesaking, Dr. Susan Sprague, and several lead teachers presented at a regional National Science Teachers Association meeting about pursuing deeper content understanding for elementary science leaders.

Perhaps the most significant development in terms of leadership occurred recently, as Susan Giesaking was appointed K-12 science curriculum coordinator in 2005. This change in Susan Giesaking's status has brought her center stage with other curriculum coordinators and

marked the official recognition that the GSSP was now the district elementary science program.

The Teacher Leaders

In addition to this core team, the district found and nurtured a group of teacher leaders, up to two from each of the elementary schools. Susan identified this group of teachers prior to receiving the LSC funding; she focused on people who liked science and liked to teach it. Early on, these teachers worked with Susan in offering kit trainings, piloting kits, and helping disseminate information about the evolving science program back at their buildings. Kathy Foley, who had been one of those lead teachers early on, described the pilot process:

> *I was working with a couple of fifth grade units and we were each piloting three kits. We would try them out and get together and talk about where they aligned with the standards and where they didn't; we looked at prices. We even had subs come in so we could go to each other's classrooms and watch each other try the kits.*

The pool of teacher leaders grew as the district grew and more elementary schools were added. The role of the teacher leader also diversified somewhat, with teacher leaders taking on the role of leading introductory kit trainings for other teachers.

In terms of supporting the group of lead teachers, the district held institutes and annual workshops that helped teacher leaders build their skills in working with adult learners and teaching teachers to use the kits effectively. Monthly meetings were held during the academic year throughout the life of the grant. These meetings gave lead teachers the opportunity to reflect on their experiences as well as provided them with professional development. In addition, Kathy Foley and Sheri Denowh developed a detailed training manual for every kit. These manuals are continually revised and contain tips, materials, and notes about activities; they are rich resources for lead teachers conducting kit trainings.

Another milestone came in 2003 when project leadership developed content workshops to give teacher leaders the content they needed to conduct the kit trainings. This teacher leaders' content strand involved two to three teacher leaders working with one of nine content specialists/scientists doing fieldwork and answering content questions through investigations. The following summer, the GSSP offered its first Leadership Institute designed explicitly to develop the knowledge and skills needed to be effective teacher leaders and professional developers. One teacher leader said the following about the Leadership Institute,

> *I was really surprised they selected me as a kit trainer. I feel like there has been growth to be able to teach adults. The Leadership Institute was fabulous. They had people from the state and sessions on teaching adults.*

The role of the lead teachers expanded over the course of the project. It has moved from disseminating information on their campuses to leading professional development workshops. As Susan Giesaking said:

> *When we first started, it was more just them taking information back to their campuses. Since then, we have sort of evolved different levels of leadership. We have kit leaders or kit specialists that do the trainings on the kits. We also have lead teachers working on content pieces that go with the kits.*

How did the district develop the capacity to provide materials to all of its teachers?

When the district began to move its elementary science program to a more kit-based program in the early 1990s, it wisely supported a central materials resource center to serve as the distribution and maintenance point for the science kits. Early on, the center was staffed by one person, and the kits were mainly those from the nearby Mesa public schools, with a few nationally-recognized FOSS and STC kits.

When Susan Giesaking began writing the LSC grant proposal, the grant stipulated that the curriculum be comprised of materials from nationally-recognized sources in support of the national science standards. Susan Giesaking enlisted a group of approximately 20 lead teachers who began to pilot FOSS and STC kits prior to receiving the LSC funding.

It is important to note that, unlike other districts, Gilbert did not follow a model that employed "pilot schools." Rather, they took on all the elementary schools in the district at once, using lead teachers from these schools to pilot kits and communicate information about the new curriculum to other teachers in their schools. Because the district had already been piloting kits, the first kits were adopted at each grade level in the first year of the grant. Before classroom teachers could check out a kit, they had to participate in an introductory kit workshop.

As the second and third FOSS and STC kits were piloted and adopted, and the Mesa kits were phased out through the second and third years of the grant, several key milestones took place that helped secure the all-important buy-in of the district teachers. First and foremost, many of the popular Mesa kits that teachers had been accustomed to using were kept on the materials list as "optional;" teachers could use their old favorites in addition to using the new materials. In addition, the leadership team surveyed the teachers and asked for their input and assistance in helping select the new materials. By 2002, most of the Mesa kits had been phased out or moved to the optional slot. As the following quote from a second grade teacher illustrates, teachers value the kits they now have:

> *I hope we never lose these kits. I pulled out some old texts I stored in my cabinet the other day and I looked through one to see if there was anything in it I might ever use. I thought, Oh no, no! I live in fear of ever having to go back to using science texts.*

With the continuing addition of new kits, the materials center has grown and expanded and now supports materials replenishment and distribution for all elementary classrooms in the district – 1,859 kits to 25 schools. The kits are distributed to schools on a six to eight week rotation schedule. Teacher needs for additional or missing materials are handled by the GSSP staff in collaboration with the staff of four at the materials center.

Having all the kits in a central location where they can be cleaned and refurbished, and having a solid system in place for teachers to get the kits when they need them, has been an essential piece of the project. Ready access to materials removed a major stumbling block; teachers did not have to race around, gathering materials prior to teaching a kit – the staff at the resource center had handled that for them. The following quotes from over the past six years illustrate teachers' appreciation for the warehouse:

> *The kits come self-contained with all resources. In my previous district, I had to do it all on my own.*
>
> *I did my student teaching in another district and I was amazed that kits come with everything [here]. In the other district teachers had to go out and find what they needed and that obviously limits what you can do.*

Perhaps most significantly, the leadership team did not simply get the kits in place and then not pay attention to this facet of the program. When Arizona revised its state standards, the leadership team revisited the menu of kits being offered to teachers in light of the new standards. They shifted a few of the fifth and sixth grade kits to match the revised standards, and then developed supplemental activities and mini-kits, along with training in how to use them, to ensure standards were being met at all grade levels,.

How did the project leadership generate a shared vision of good elementary science teaching among the teachers, administrators, and community?

The vision for the entire Gilbert elementary science program began with Susan Giesaking's teaching. When Susan first began as a sixth grade science teacher in Kansas, she connected with environmental educators who were doing outdoor camps and science experiences for students. As Susan said:

> *I got hired right after I finished my student teaching to teach sixth grade science. At that time, science was my weakest area in curriculum. But it became one of the most interesting things to teach because you had to figure out something different to do than just read the book.*

When she came to Gilbert in 1982, she began to offer outdoor science camps to her sixth grade students, took students to California for an oceanography field trip, and got involved in running the science fairs in Gilbert. She also took Project WILD courses and became a facilitator in 1983. Over the next ten years, with the support of her principal at Greenfield Elementary, Susan Giesaking continued to expand and refine her repertoire of science teaching skills. She began facilitating Project WILD and Learning Tree workshops and was seen as a resource for professional development as well.

Other pivotal steps in developing a broadly shared vision in the district came when Susan and district staff attended the Next Steps conference in 1993 and again in 1995, a LASER workshop offered through NSRC in 1999, and the Exploratorium's Institute for Inquiry in 2000. These workshops helped the project leaders articulate their vision and gave them the tools (specific activities to be used with key groups, videos of exemplary inquiry classrooms) to help build vision and support for the inquiry-based science program in the district. Susan began offering

these "vision" workshops to principals, school board members, and members of the community during the years she was writing and submitting the grant for LSC funding to NSF.

One NSF funding was secured, Susan still needed to disseminate the vision widely throughout the district. During site visits, Inverness Research suggested putting the vision in writing and having additional meetings with principals and with the superintendent to help build support for the program. The leadership team also began offering vision workshops to teachers to ensure that the philosophy behind the kit program was firmly in place.

Another important step came when the project began offering science notebook workshops. The emphasis on using science notebooks helped further "gel" their vision and gave teachers a more concrete way of realizing the vision of the project. (The addition of writing to science is discussed in more detail below.) By the end of the NSF funding, vision workshops had become a standard offering for new teachers entering the district.

Throughout the life of the project, Susan Giesaking continued to meet with principals, her immediate supervisors in the district, the Superintendent, and the school board to share milestones and successes of the project. The presentations to the school board and the meetings with the Superintendent were particularly important because they helped keep the science program on the radar. As Susan Giesaking said:

> *We have met with the school board twice over the seven years, communicating where we were at the time and educating them on what we were working on. The first time we met with them, we showed them a video clip of units with students doing hands-on science. The second time, we did an overview of the different types of classes we offer and where teachers were. We had pictures of teachers in workshops, pictures of the resource center, and pictures of the notebooking and content classes.*

Involving the outside evaluators in those meetings also helped demonstrate the importance of the work to the board and superintendent and spread the vision more widely. Inverness Research met with the Superintendent three times over the course of the project – early on to help support the program in the district, later to share findings from a study of the use of science notebooks during year four of the project, and at the end of funding, to discuss how to sustain the core elements of the program after NSF funding. Susan Giesaking saw Inverness' involvement as key to spreading the vision:

> *I don't know how much of this would have happened if Inverness hadn't been a part of it. When Inverness comes, it shows importance. You have helped me educate the Superintendent. He looks at things from a different perspective because you are an outside group coming in. They don't always want outside perspectives on things, but when it is done about something they are already doing, when it is emphasizing the strengths and allowing him to say what might work better, then I think it gives him the ownership.*

How did the district support teachers through professional development in learning how to use the materials and understanding the science concepts in the kits?

The professional development offered over the course of the project gave teachers support to facilitate hands-on teaching and focus on student conceptual development. A critical component of the professional development effort came when kit trainings were expanded from two to three hours in length to seven hours. When the project first began, professional development workshops in Gilbert were two hours in length, so the leadership team tried to work in that format. During the first year of the grant, Kathy Foley and Sheri Denowh spent hours observing the introductory kit trainings; more importantly, they also visited the classrooms of teachers who had attended those trainings and observed them teaching the kit. They observed kit trainers who only worked through a few of the lessons in the kit saying, "You won't do things this way in your classroom." When they went to the classrooms, they observed teachers teaching the kits in the same way they had been shown them in the workshops – in very didactic ways not aligned with the vision of the project. Sheri Denowh explained what they saw:

> *Kathy and I had so many long discussions after that. We would see the teachers skipping lessons and the ones they were skipping were the ones not being done in the two-hour kit training.*

Changes needed to be made. The kit trainings in the second year were expanded to seven hours, so that trainers could thoroughly cover the lessons in the kits. Foley and Denowh integrated the use of storylines, an idea they borrowed from the El Centro school district in California that also had LSC funding, to help teachers connect the individual lessons with the big concepts in the kits. They also began to incorporate more emphasis on questioning and reflection. These two approaches helped focus the workshops more strongly on developing student conceptual thinking and led to a greater sharing among participants and reflection on their teaching. Teachers appreciated the new approach and the professional development in general. As one kindergarten teacher said:

> *I think they do a great job. They choose experienced teachers (to offer professional development) if they aren't doing it themselves. They are organized and adapt to our schedules. It's the only district program that offers summer hours. It's hands-on so you get to walk through it so you know it. It's so much better than reading a book. It's the best in the district...I disliked science and felt I wasn't good at it. Having the classes and being able to do it hands-on alleviated the stress. It strengthened my teaching. The science notebooking is something I use across other subjects now. I was burned out on texts, videos, and taking tests; I was turned off by that. I love the kits.*

The leadership team also realized that in addition to the kit trainings, teachers needed more content to feel comfortable teaching the kits. Slowly, they began to address more content in the kit trainings. As Kathy Foley noted:

> *In the beginning, content was non-existent. There just wasn't time for content in the kit trainings; we were just trying to do the materials management end of things because we only had two hours. As the trainings got longer, the main focus was still to make sure the teachers were comfortable with the kits, but more and*

> *more, content was being incorporated. In the kit trainings, the content comes out more around questioning – we pick a couple of lessons where we can really show that, by asking teachers to come up with their own questions. And we show the teachers how they can take any one of those questions and build a whole content piece on that question.*

In addition, the leadership team added workshops that targeted specific areas of content, such as life science and food chemistry. During the first workshops, much of the focus was trying to unearth all of the content that pertained to every lesson in the kit. The leadership team quickly discovered these were not successful. As Kathy Foley said:

> *That first workshop was such a bomb! I was trying to go through what the kit was about and build from that. I was trained in high school biology, so a lot of my understanding was factoid content and it was not working.*

The leadership team took a couple of different approaches to address the content issue. Kathy Foley worked closely with a scientist, Dr. Randy Papke, and went back to the Benchmarks, tying the bigger concepts to the kits and focusing more on doing inquiry-based science with the teachers. Sheri Denowh started going into classrooms and looking at where teachers were stumbling over content and where students tended to ask the same questions. Both came to the conclusion that focusing on a few central concepts and tying those back to the kits would help the teachers the most.

The second year of the grant saw another major turning point: the introduction of the series of workshops on science notebooks. These workshops focused on training teachers how to use science notebooks with their students. This concept became a focal point for the work of the project as it evolved. We will discuss this in more detail in the following section.

Thus, as the program evolved, the GSSP moved to a "tiered" structure for its professional development offerings. The first tier of professional development was designed to provide teachers with an overview of the GSSP project and the basic training necessary to implement science kits in their classrooms. This tier included "vision" workshops which explained the how and why of exemplary hands-on science teaching and Science Notebooks I and the introductory kit trainings. The second tier professional development included focus sessions: grade-level forums for teachers to share their experiences of teaching particular kits as well as to discuss current readings on science pedagogy. This tier of professional development also included in-class visits by the SRTs for classroom teachers, content classes, and a second session of science notebooks. The third tier of professional development was designed to provide lead teachers with opportunities to expand their knowledge of pedagogy, science content, and facilitation skills and included a Science Notebooks III Workshop as well.

The professional development offered in the science program has become a model for the rest of the district. District administrators see the GSSP as a model for implementing change in a curriculum area. As one principal said:

> *The quality of the professional development really changes a mindset. I have teachers that don't feel like they are strong in science. I have yet to hear one that comes back from the professional development that doesn't come back with enthusiasm, feeling more competent, ready to go. I have observed them. I have seen some teachers that are very reluctant and I have observed them teaching science now and it is done with enthusiasm and purpose.*

The language art's curriculum coordinator commented:

> *I want to see language arts professional development be like science. There hasn't been the effort put into language arts like science. In science, someone was overseeing the professional development and it was required for the kits.*

How did the project leadership position science education within the broader curricular priorities of the district?

The development of the elementary science program in Gilbert happened in a district where science was not the top curricular priority. In fact, it was tied for last with social studies! This meant that because of the LSC funding, there was a lot of professional development happening in a curricular area that was not highly valued throughout the district. Teachers were attending professional development but finding it hard to "squeeze" science into a crowded school day in their teaching. The project leaders needed to find a way to help teachers use science to reach across disciplines, and to feel good about the time and energy they were putting into their own professional development in science as well as the classroom time going into science. The key vehicle that emerged for doing this was science notebooks.

Dr. Susan Sprague offered the first science notebooks workshop in the fall of 2000. At this point, project leadership realized notebooks could play a major role in connecting science to the larger language arts priorities of the district. Subsequent science notebooks workshops were developed to help teachers delve further into the use of notebooks for assessing their students' conceptual understandings of science. The notebook workshops are based in research about learning theory, and participants have the opportunity to read and think about some of this research. An important aspect of using science notebooks with kits is that they allow students with different abilities to participate and express their learning in ways that do not exist in a classroom without them. These workshops are highly valued by teachers and have been a key resource for teachers using writing in their science teaching. As one first grade teacher said:

> *The notebook classes have had a big influence on how I teach. The notebook classes made me more aware of questions to ask and that helps me be aware of what the students get and don't get.*

Another important development came when Kathy Foley created lists of trade books to go with each kit, helping teachers easily make connections between science and the language arts curriculum. As Kathy said:

> *We won't do a training without having some trade books available so we can model how to use them. And it makes such a rich training, and the classrooms I have been visiting have all used the trade books.*

Another significant milestone came when Inverness Research Associates began to persuade project leaders to use the science program to help teachers meet the district's language arts goals. In 2004, project leaders asked Inverness to conduct a study of how teachers and students were using science notebooks and the extent to which the science notebook workshops influenced teachers' teaching. The study revealed that science notebooks enhance student learning in both science and language arts; writing improves students' learning of science concepts and skills, and science offers a rich and immediate context for developing writing. Inverness presented the findings from the study to project leaders, key principals, and district administrators.[4]

Finally, in 2006, project leadership began to both refine and expand their vision statement for the science program to include the ways in which the science program helps meet the district's language arts and other curricular goals.

How did the project leadership generate administrative support for the program?

The project leadership, and Susan Giesaking in particular, were very successful throughout the project in building widespread administrative support for the elementary science program. This support included elementary principals throughout the district, as well as support from her immediate supervisors, other key district administrators, and the Superintendent. Susan did not simply leave this important detail to chance – she focused a great deal of time and energy on generating positive support for the project throughout the district.

One of the main reasons the elementary science program in Gilbert has been so successful is because of the close working relationship Susan Giesaking has with principals in the district. Over the course of the project, she has provided them with information to make decisions about the professional development needed for their staff and listened carefully to their needs.

Prior to the district getting the LSC funding, Susan Giesaking conducted a vision workshop with all of the elementary principals in the district to help get their buy-in. After she received funding, she spent time with each principal individually, looking at their needs as principals and as schools and how the science program could help them meet these needs. She also took key principals with her to important national conferences, such as Next Steps and NSTA, to show them what was happening in Gilbert was part of a larger, national movement to change the way science teaching and learning was happening in elementary schools.

Perhaps the biggest milestone came in 2000, when, with input from Inverness Research, project staff began to provide data to principals on the number of professional development hours the teachers in each of their buildings had accumulated in science. With this data in hand, program

[4] See *The Gilbert Elementary Science Program: Science for Writing and Writing for Science*, November 2006, on the Inverness Research Associates web site at http://www.inverness-research.org.

staff began conducting meetings with principals in the spring of 2001 and continued these every year of the project. Project staff worked with each principal, discussing which grade levels needed attention, which trainings were being offered when, and how best to accommodate the teachers from each school. In addition to presenting the data, these meetings were also designed to help principals better understand the nature of the science program, the nature of inquiry classrooms, and the work of the LSC.

The principals have found this information invaluable. One principal summarized the way in which Susan works with principals:

> *Susan gives us the list of our teachers and shows us their needs. She shows us which units they have had training on, how many hours they have, what they need. Then she works with me to make a plan to make sure that the teachers get the classes they need.*

This combination of personal relationships and yearly meetings worked very well. Susan Giesaking described her work with principals:

> *I would go to principal meetings and give them their data for their teachers for their hours of science professional development. I got a sense of which principals preferred which model for getting teachers to professional development. I might call up a principal and tell them about a training. "We are having a fourth grade training in two weeks. None of your teachers have this. How many can come?"*

Perhaps most significantly, Susan Giesaking and the project leadership listened to principals as well as gave them information. Susan Giesaking said:

> *We listened to them. Early on in the project, we wanted to take all the teachers from a grade level out from school for one day. The principals didn't like that. We listened. There was one year when we had trouble finding substitutes and we worked one-on-one with the principals. When they said we could have some teachers for one day and some for another, we worked with them. When they asked if this teacher could take a night class because she had been pulled out for classes too much, we tried to accommodate them.*

Another milestone came that same year when Mark St. John from Inverness Research Associates gave a presentation to principals about the important role principals play in elementary science education reforms. The meeting helped principals see the GSSP as part of a national reform effort, and to see themselves as key facilitators in making those reforms happen.

Over the course of the project, project staff periodically attended regularly scheduled meetings for elementary principals to update them on the progress of the science program, but this was difficult and Susan and to fight to get on the agenda of their meetings. Because Susan's position was part of student services, she was not considered a curriculum coordinator. As such, she was not invited to participate in key meetings of principals and district administrators

Thus, Susan had to be both opportunistic as well as strategic in building support for the program within the upper-level district administration. She was opportunistic by bringing key administrators to the science resource center whenever a group of teachers were engaged in professional development that was particularly noteworthy. She strategically provided district administrators with ongoing information about the accomplishments and successes of the project,

particularly about the ways in which the district's need to improve students' reading and writing skills were being addressed by the science notebooks.

Again, Inverness Research played a key role here. During site visits, Inverness interviewed key district administrators, including the Superintendent, about the elementary science program, helping to keep it in the foreground in a district with other priorities.

At the end of the project, Susan became the K-12 science curriculum coordinator, placing her and the elementary science program within the curriculum division of the district where it belongs. This has enabled her to participate more actively in key meetings with both principals and district administrators. Her participation in key meetings is now a requirement of her job.

How did the district use outside resources to aide their effort?

As we mentioned previously, participation by project leadership and key lead teachers in regional and national-level professional development, as well as ongoing consultation with Dr. Susan Sprague, were important sources of ideas and support for the development of the project. Other key outside resources included business and community organizations in Gilbert, local scientists, and the outside evaluator for the LSC grant.

Throughout the project, the leadership team built connections with businesses and community organizations in Gilbert, broadcasting the work of the project to the broader community and involving them in the work of the project. These organizations, including Intel, the Arizona Game and Fish Department, and the Town of Gilbert, have hosted professional development events for teachers, contributed scientists to lead workshops, and generally enriched the elementary science program.

Scientists from the local community also played a key role in the project. The leadership team gained considerable expertise in how best to involve local scientists in the professional development the program offered. Early on, the leadership team tried simply to bring scientists in to conduct content classes. They found that more often than not, the scientists were not teaching in a way consistent with the goals and vision of the project. Inverness Research Associates' observations of early content workshops offered by outside scientists were not highly rated, and we suggested the leadership team work more closely with scientists to bring them into the project before turning them loose with teachers.

As the second year of the grant began, both Kathy Foley and Sheri Denowh began to work more closely with scientists in planning and conducting the content workshops. An early milestone for Kathy Foley came in her work with Dr. Wilson from Mesa Community College on the Desert Dwellers workshop, and with Carol Whitlock on the Nutritional Choices workshop. Foley explained why these relationships were so successful and how they led to more successful content workshop experiences for the teachers participating in them:

> *They both listen very well. When I first approached both of them, I explained what I was looking for. They didn't come in with "This is what I do and I am going to do it." They listened to what we wanted. Carol had more of an idea of things she wanted to try. Dr. Wilson came and served as an observer and expert to ask questions of. Then both of them after that, we changed things based on what they saw. They were both real working partnerships.*

For Sheri Denowh, the revelation came with Dr. Sue Wycoff who helped with a physical science content class. Unable to work with Dr. Wycoff prior to the class, Sheri Denowh planned the course around what she thought the teachers needed, and Dr. Wycoff came in and observed and assisted. As Denowh said:

> *She got so excited about the first experiment we did, where we did a distillation of wood, that she got the teachers into it. And she was a master questioner. So I designed the course, and she could focus on the questioning, which was a partnership that worked well.*

The net result was that by the third year of the grant, the content workshops were well-refined. In addition, many of the teachers in the district had worked with the kits enough times that they realized they needed additional content in order to go deeper with the kits. It was a magical combination that resulted in content classes filling to capacity.

Inverness Research Associates was another significant outside resource that provided assistance to the project as it developed. Inverness Research was hired during the proposal process to serve as the external evaluator for the GSSP. Beyond merely filling out annual forms for the larger LSC evaluation, we served as a critical friend to the project, raising important questions and providing information to the leadership team to help them develop and refine the elementary science program. We were present every year at professional development events and in classrooms, observing and then having important follow-up evaluations with the leadership team.

Inverness Research was knowledgeable and supportive of the overall LSC model, having served as evaluators on several other LSC projects across the nation. We had in mind the larger national reform picture and we were persistent in helping Gilbert move in that direction. Thus, in addition to attending to all of the different components of the LSC model, we used our role as the external evaluator to raise questions and push certain important agendas. As Susan Giesaking said:

> *Each time you came, you gave us more things to think about. You never told us what to do. It was the questions you posed all the time. It was never "That's good." It was always, "What would you do if? How could you think about this differently? Where would you go from here? Have you thought about how this person asks questions?" We realized we always had more work to do. We might have made the same changes but it would have been over time and it would have been a lot slower.*

There were several key milestones in the role of Inverness Research and key developments in the project. In 2000, we encouraged Susan Giesaking to provide the principals with data and to get them to play a more active role in reform efforts. Throughout the project, we encouraged Susan Giesaking to make presentations to the school board and to connect with district-level administrators more frequently so that they would be aware of the program and its successes. Also mid-point in the project, we pushed on the leadership team to more carefully and thoroughly address the issue of content in the professional development offerings. In 2004, we conducted the notebook study to help make the case for the important role the science program, and the emphasis the program had placed on the use of science notebooks, was playing in meeting the district's language arts goals.

Another milestone in the role of the evaluator and the progress in the project came in meetings with the Superintendent and district administrators at several key points over the life of the project. These meetings helped keep the GSSP on the administration's radar. As Susan Giesaking said:

> *Your meeting with the district administrators and the Superintendent helped keep us on the map. I think that once they adopt something, if you aren't making waves or are not in trouble, they don't worry about you. And so every time, when Inverness came and one of the targets was setting up a meeting with the superintendent or key administrators, it put us on their radar in a good way. These meetings were always positive, always highlighting the things that were going on.*

How did the GSSP move from an externally funded project to a district-owned program?

The National Science Foundation (NSF) and others fund projects and programs in school districts which, by their nature, are outside interventions designed to improve the learning opportunities the district offers. They are usually short-term, marginal to the system, and are supposed to be different enough from the system that they provide a catalyst and/or a model for change. In Gilbert, the idea was that NSF LSC initiative would provide funding for the creation of a new and different elementary science program that would ultimately result in better teaching practice and improved learning experiences for students in science. The goal in Gilbert was to serve teachers during the life of the project and to become a program embedded in the district.

When NSF funds heavily the development of the project, project leaders work diligently for the three to five years of the funding. The NSF's expectation is that some components of the innovation will be sustained or institutionalized after the funding ends. On the one hand, NSF wants to see as much evidence as possible that their investment made a difference after funding ends. On the other hand, districts obviously cannot do on their own what they can do with millions of dollars of external funding. It is important for districts to identify those project elements that are most successful and design a new phase of work around those elements using the districts' existing goals and resources.

The GSSP project leadership did not simply wait for the end of the project to begin thinking about sustaining the project when the LSC funding ended. With considerable assistance from Inverness Research Associates, they devoted significant attention to engineering the transition from an external project in the district, to the district program, and finally ensuring that the key components were supported by the district infrastructure.[5] This effort involved both project leadership and the outside evaluator in a joint task beyond fulfilling the requirements of the grant. The project leadership endeavored to develop its program and capacities in such a way that it could fulfill the promises laid out in its proposal to NSF and also best meet the needs of the teachers, students, parents, and administrators in the district. It meant that the leadership, with assistance from Inverness Research Associates, constantly used the data from our

[5] See *The Gilbert Elementary Science Program: The Infrastructure Needed to Sustain High-Quality Instruction*, November 2006, on the Inverness Research Associates web site at http://www.inverness-research.org.

observations and site visits, as well as what they learned from attending professional conferences around the nation, to reflect on, refine, and fine tune their program as it evolved.

The project leadership's efforts to develop a shared vision and broad-based support for the program with district administrators, the board, and elementary principals helped ensure that it would remain as the district program once the funding ended. The project leadership continually made the case for the program with key stakeholders – the community, the administration, and the board. Because the project was successful in making its case, throughout the life of the project, the district gradually took on more of the costs of the project, including fully funding the warehouse materials center and the salaries of the project director and SRTs by the end of the project.

The district took on more of the costs amidst limited state funding, as well as the fact that the district's priorities were reading, language arts, and math. All of these district priorities were competing for the same limited resources. In addition, some administrators held the view that the district had "done" science and that whatever resources existed needed to go into other subject areas which had not received the attention and resources science had.

Perhaps most significantly, about two years prior to the NSF funding ended, Inverness Research and project leadership met with the Superintendent and began a conversation with him about investing in a set of supports that would capitalize on, and leverage, the investments made by the National Science Foundation in the district. We encouraged the program to take on a new piece of work – identifying the elements needed to sustain the high quality science teaching and learning the district had achieved. At the same time, Inverness Research worked with the project leadership to figure out what investment was needed to maintain these elements of the program.

In many projects, program evaluators drop in periodically, collect the data they need, offer their feedback to the project leadership, and leave. In Gilbert, Inverness Research Associates played a broader role. Because we were neither the National Science Foundation nor the district, we could mediate the needs of the two organizations. We also brought a broader, national perspective to the work of the Gilbert district from evaluation work with other NSF-funded districts involved in similar efforts to improve elementary science education.

Throughout the project, we met with the project director, encouraging her to develop leadership, not only for the current needs of the project but for its future needs as well; we also encouraged her to provide data to gain the key support of district administrators and elementary principals so that they would want to see the program continue in its fullest forms. We assisted in collecting data to help the director make the case for the value and high quality of the program not solely for learning science, but also for enhancing the language arts curriculum. Again, we shared the data and findings of this study with key stakeholders.

Even though many in the district had worked hard to build their elementary science program, the district or the community were not fully aware of how unusual it is to find an inquiry-based elementary science program so broadly implemented with such quality teaching. Again Inverness Research was well-positioned to offer a broader perspective and national context, making the significance of Gilbert's achievements more apparent for the key stakeholders. Near the end of the project, we produced this article and a series of reports for the board and local community that highlighted the key elements and accomplishments of the program. In a meeting with the board, we shared the data from these reports with the goal of helping the board realize the unique

nature of the Gilbert elementary science program and to gain their support of the Superintendent in finding ways to sustain it in the future.

The district currently funds the science materials center, as well as the salaries of the director, SRTs, and resource center staff. What remains to be seen is how much of the professional development costs that were being funded by the NSF LSC grant will be picked up by the district. Inverness Research Associates' presentation to the board was well received. While the outcome at this point is not clear, the board and Superintendent expressed a desire to sustain the program as recommended.

Update

As of the fall of 2006, the science program in Gilbert remains strong despite several changes. Perhaps most significant, the two SRTs, Kathy Foley and Sheri Denowh, returned to the classroom. They both accepted teaching positions at the junior high level in Gilbert. Their presence, along with Susan Giesaking's position as K-12 science curriculum coordinator, should help ensure that the successes of the elementary program are built upon at the upper grade levels. One of the SRT positions was filled mid-September of 2006 by Holly Shoop, a long-time classroom teacher with expertise in using science notebooks with her students.

The district is also funding science professional development as well. The district is currently spending $20,000 for professional development: $10,000 of this goes toward night classes for teachers; the other $10,000 is for kit training and workshops for teachers new to the district or new to their grade levels.