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A Successful University–School-district Partnership to Help San Francisco’s K–12 Students Learn about Science and Medicine

ABSTRACT

The Science and Health Education Partnership (SEP) is a program at the University of California, San Francisco, established in 1987 to support the San Francisco School District (“the District”) in its efforts to improve science education in grades K–12. A large cadre of active biomedical scientists and health professionals and a core program staff provide support to 90–95% of the District’s schools. The District’s students are from a variety of racial and ethnic groups, including a large percentage from underrepresented minorities (URMs). The SEP program has numerous components, some designed to help teachers (e.g., a clinician or scientist forms an ongoing partnership with a teacher to enrich classroom instruction) and some involving direct work with students (e.g., a contest where teams of students design and present lessons on science or health to their peers; activities related specifically to the encouragement of URM students).

The SEP’s perspective has evolved from an emphasis on assisting individual teachers and students to one of

supporting systemic change throughout the District (e.g., supporting full implementation of hands-on, inquiry-based science instruction throughout the District via professional development). During this evolution, the kinds of issues facing program staff have changed and a great deal has been learned about fostering successful partnership activities. For example, (1) having a coordinator is crucial to make such a program work well; (2) it is easier to find start-up funding than to find continuing funding for ongoing activities that are working; and (3) it is important to work with the volunteering scientists and the teachers to help them understand what each has to offer the partnership and to encourage explicit dialogue about roles and expectations. The author concludes with advice for starting a new partnership: think big but start small, and work toward a long-term association based on communication and trust.

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The Science and Health Education Partnership (SEP) is a program at the University of California, San Francisco (UCSF), established to support the San Francisco Unified School District (“the District”) in efforts to improve science education from kindergarten through high school (grades K–12). The program has numerous components, some designed to help teachers and

some designed for direct work with students. A large cadre of active biomedical scientists and health professionals, together with core program staff, provides support to 90–95% of the schools (K–12) in the District. Since its initiation in 1987, the program’s perspective has evolved from one of trying to assist individual teachers and students to one of supporting systemic change throughout the District. During this evolution, the kinds of issues facing program staff have changed, and a great deal has been learned about how to foster successful partnership activities. In the rest of this article, I describe in detail this program, its history, and what it has done; indicate lessons that we who are involved in the SEP have learned; and give pointers to readers who may be interested in starting similar partnerships.

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PURPOSE, PHILOSOPHY, GOALS

The overall objective of the SEP is to use the extensive resources at UCSF to support the District in its efforts to improve science and health education. We think that all students should have the opportunity to develop a base of experience that will allow them to make informed decisions and choices about their educational pathways, their lifestyles, their own futures, and ultimately, the future of their society. In working toward this goal, which requires scientific literacy for all students, our primary strategy has been to focus on teachers and to facilitate their interaction with UCSF volunteers in a variety of contexts. Program components are structured to engage these two groups in working collaboratively toward a common goal in ways that require their complementary expertise and experiences. The SEP asks its participants to try to create an environment that fosters active learning by students, one in which they create meaningful connections between important science concepts and natural phenomena they are familiar with.

Because UCSF is entirely a health sciences campus with a strong emphasis on research in both clinical and basic science areas, the SEP's major thrust is to provide support for education in health and science in an integrated manner. The varied elements of the program explore ways in which biomedical scientists and health professionals can contribute to the improvement of science education at all grade levels. As a tool to assist institutions in the initiation of partnerships, a former SEP coordinator published a "nuts and bolts" handbook that is a compilation of a great deal of SEP staff members' experience.¹ A reviewer in *American Scientist* noted that "the volume should be required reading for anyone who wants to set up partnerships with local schools or who is already involved in such effort."² Now we are working at the next level in our partnership, refining all program elements and their coordination to provide consistent and coherent support for the District's systemic plan to provide every student access to a challenging and engaging science education.

HOW THE SEP SUPPORTS GOALS OF PROJECT 3000 BY 2000

Project 3000 by 2000, initiated in 1991 by the Association of American Medical Colleges (AAMC), has the goal of in-

creasing the enrollment in medical schools of underrepresented minorities (URMs): students from racial or ethnic backgrounds that are underrepresented in science and medicine. Because the SEP is based at an institution that focuses

on training health professionals, and that has a relatively high proportion of URM students, we on the staff embrace this goal and understand the importance of recruiting URM students into the health professions. Many outreach programs focus their precollege efforts at the high school, or possibly middle school, levels. However, we have found it a challenge to find a dozen such students each year to fill high school student summer research internships, or to interest proportionate numbers of URM students in middle or high school in participating in the SEP Annual Science and Health Lesson Plan Contest (see List 1 for descriptions of these components). This experience is supported by national studies showing that very few URM students have sufficiently strong backgrounds in science to make a science-based career a realistic option.³ Once a student reaches high school, it is usually too late to generate the level of interest and determination needed to

carry him or her all the way through medical or graduate school. To create a strong and lasting interest in science, students must have inspiring and stimulating experiences in science beginning in the first years of elementary school and continuing through middle and high school.

San Francisco's public schools have a wonderfully diverse population of students from whom future health professionals could emerge. Approximately 34% of the students are Asian and Pacific Islanders, 20% are Hispanic, 19% are African Americans, 15% are white, 12% are "other non-white," and 0.6% are Native Americans. Thus, the SEP goal of providing engaging, experience-based science education for all students simultaneously addresses the needs of large numbers of URM students. In addition, the SEP engages in activities that are directly focused on encouraging URM students in particular. As mentioned above, the program provides summer research internship opportunities that are targeted for URM high school students. We also regularly provide representatives from all areas of the health professions for career day presentations in San Francisco high schools. The director of the SEP serves as a member of the UCSF Outreach and Recruitment Policy Board, a forum designed to coordinate all of the outreach and recruitment ef-

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forts of the UCSF schools of medicine, nursing, dentistry, and pharmacy and the graduate division.

San Francisco public schools have an extraordinary need for additional support in providing their students with effective science education. The District, like most school districts in California, has available only half the national average of funding per student. This low level of funding, together with a high proportion of students with special needs on whom much of the funding must be spent, reduces the resources available for core curriculum and staff. The lack of resources and resulting large class sizes make it very difficult to provide students with the hands-on learning experiences that are the heart of a good science program. It is not surprising that students whose only contact with science is through texts that have been characterized as "glossaries masquerading as textbooks"⁴ do not find it an engaging area of study.

HISTORY, STRUCTURAL ORGANIZATION, AND PROGRAM ELEMENTS

In 1987, Bruce Alberts, then chair of the UCSF Department of Biochemistry, established the SEP to bring scientists and clinicians from UCSF together with teachers from the District to improve science and health education for San Francisco students. The partnership between the two institutions was initiated on a small scale through facilitation of individual partnerships between teachers and scientists or clinicians. The personal, ongoing interaction between partners produced a rich variety of results—new hands-on activities for the classroom, channeling of surplus laboratory supplies and equipment to teachers and schools, opportunities for students to get acquainted with people and career opportunities in the health sciences, and professional acknowledgment and encouragement of teachers by UCSF participants.

The institutional partnership is made concrete through SEP staff coordinators who work with university volunteers and District personnel. They rely on a computer database containing information about volunteers from the UCSF community, all District science and health teachers, and other individuals who can provide additional resources. The database permits rapid identification of volunteers for response to a teacher's request (e.g., for a speaker on a given topic), as well as identification of teachers and volunteers who might be interested in particular upcoming activities.

The SEP provides a network of pathways by which teachers and students can benefit from UCSF resources. While the information in List 1 may make it appear as though the SEP conducts a patchwork of separate programs, for the most part they are utilized by teachers and provided by SEP staff members as a continuum of possible ways to connect with UCSF. Over the years, teachers, volunteers, and SEP staff have worked together to create a variety of ways for scientists and clinicians to contribute to improvement of precollege science education.

BENEFITS FOR K-12 PARTICIPANTS

The SEP provides diverse benefits for teachers and students, through the program elements shown in List 1. Teachers rely on the SEP for materials unavailable to them from other sources, which are donated through the SEP or available on loan through the resource center. Teachers also appreciate the access that the SEP provides to expertise in a broad range of biology subject areas. They can bring this expertise into the classroom by asking the SEP to schedule speakers, by requesting an occasional consultation, or by entering into a partnership with a UCSF scientist. Also important, teachers feel supported by the SEP and its volunteers, who acknowledge the critically important work the teachers are doing. On the basis of their partnership experiences, scientists can serve as powerful advocates for teachers, using their influence to draw attention to teachers' accomplishments and needs.

The most intensive benefit for students comes to participants in the SEP Student Internship Program. During a summer in which they participate in research at UCSF, these students develop relationships with their mentors that provide powerful encouragement for their continuing studies in science. We at the SEP have found that it is important that a staff member maintain close contact with the students throughout the summer. The coordinator supports students through weekly group meetings at which students discuss what they are learning and learn more about career options in the health professions and biomedical sciences. In addition, familiarity with individual students and their mentors helps in dealing early with the occasional problems that arise.

Participants in the SEP Lesson Plan Contest gain a great deal from their in-depth study of a particular subject area, and they develop an understanding of and respect for the effort and preparation required for teaching. A current concern is that participants in the contest have included relatively few Hispanic and African American students. The SEP is seeking ways to stimulate more interest among these students. Focusing recruitment on teachers who have large numbers of URM students has already helped to increase their participation.

Students who enjoy classroom presentations or repeated visits from UCSF volunteers have the opportunity to see scientists and health professionals as individuals and to revise widespread stereotypical views of scientists. And the stimulation of their teachers' interest in science that results from their interactions with UCSF volunteers enhances the teachers' work with the students.

BENEFITS TO UCSF AND HIGHER EDUCATION PARTNERS

Many times, people see university-school partnerships as benefiting only the schools, which receive knowledge and resources from the university. However, there are substantive

List 1

Science and Health Education Partnership (SEP) Program Elements		
Program Component	Audience/Grade Levels	Description
SEP Science and Health Lesson Plan Contest (SEP core program)	Middle and high school students	Teams of students design and present lessons on science or health to their peers. All who enter receive t-shirts and certificates; eight of 20 finalist teams selected by UCSF judges in each division receive cash prizes.
Individual partnerships (SEP core program)	Teachers K-12, with emphasis on 6-12	A clinician or scientist forms an ongoing partnership with a teacher, working on a plan they develop to enrich science instruction in the teacher's classroom.
MedTeach (SEP core program)	Sixth-grade classrooms	Teams of first-year medical students work on a weekly basis with a sixth-grade teacher and his or her students on the topic of human body systems.
Outreach by students in the health professions (SEP core program)	Middle and high school students	Fourth-year students in a family and community medicine rotation, pediatrics residents, and nursing students work with students and their teachers on health topics.
SEP Resource Center (SEP core program)	K-12 teachers and UCSF volunteers	A lending library of > 1,000 items including lesson plans, microscopes, specimens, models, and videos supports hands-on, inquiry-oriented science and health instruction.
Classroom presentations (SEP core program)	K-12 students and teachers	UCSF clinicians and scientists are available to give classroom presentations on a wide variety of topics in health and biomedical science, including careers.
Summer research internships (SEP core program)	K-12 teachers and high school juniors and seniors	UCSF scientists provide opportunities for SFUSD teachers and underrepresented minority students to participate in state-of-the-art research for 8-10 weeks during the summer. A core program for students further informs them about opportunities in science and the health professions.
SF Base (District program)	Primarily high school students and teachers	UCSF volunteers provide classroom support for hands-on experiences in biotechnology.
Teacher workshops (District and other projects)	K-12 teachers	SEP staff and UCSF volunteers, often in partnership with experienced teachers, provide hands-on workshops for District teachers to support implementation of hands-on, inquiry-based science instruction.
City Science (NSF-funded Local Systemic Change Initiative)	K-5 teachers	The goal is to support full implementation of hands-on, inquiry-based science instruction throughout the District. SEP Staff and UCSF volunteers in partnership with experienced District teachers provide staff development for elementary teachers through a variety of formats. The project will also identify and establish structures required to sustain the educational reform and teachers' leadership.
Women's Triad Project (NSF-funded Experimental Project for Women and Girls in Science)	Middle school girls, teachers, and young women scientists	Women scientists, teachers, and girls work together in science clubs for girls and the classroom to look at teaching strategies that promote gender equity in the science education environment.

benefits both for the university and for the individual volunteers. Clearly, universities will benefit from outreach activities that improve the academic preparation of the populations from which their students come. Moreover, increased contact of students in the community with the university tends to enhance the interest of their parents in supporting the university. Our volunteers give more personal reasons for their participation and recruitment of their friends to the program. They enjoy the perspective and insights generated by the very fundamental "naive" questions from students.

Scientist volunteers consistently report that they place a high value on what they learn from teachers about teaching and learning. Graduate students and postdoctoral fellows especially appreciate the connection with the San Francisco community that their participation provides. And many say that the immediate positive feedback from students and teachers helps balance the deferred rewards of long-term research projects that don't always go smoothly.

A high level of participation from both the District and UCSF shows that these benefits are recognized. For example,

during the 1994-95 school year, approximately 280 UCSF volunteers and 340 District teachers and principals were active participants and almost 90% of the District's schools had one or more teachers participating in at least one program component. At the secondary level (grades 6-12), approximately 2,200 students have direct exposure to UCSF scientists and clinicians through the SEP's programs; those indirectly influenced by their actively participating teachers add approximately 10,000 students. During the first four years of the City Science project (see List 1 for a description), about 30,000 students at the elementary level received indirect benefits from their teachers' participation in District workshops presented by City Science teachers. The approximately 12,800 students taught during those years by City Science participants benefitted even more.

OUTCOMES AND PROGRAM EVALUATION

The SEP is continually seeking ways to assess the impact of its activities and their value to participants. The effect on students, which is the central focus of our mission, is the most difficult outcome to determine. There are many influences at work, including many other programs aimed at improving science and health education in San Francisco's schools. In addition, our goals are very long-range ones, and the ultimate outcomes in terms of students' attitudes and achievements will be visible only if consistent support can be maintained for several years. For the two SEP programs funded by the National Science Foundation (NSF), City Science and the Women's Triad Project, funds are allocated for an external evaluator to help determine the effectiveness of each of the two projects and their various components. Interviews with teachers, scientist volunteers, and students; surveys; and observations of workshops and classrooms are used to determine whether the program is having the intended impact. The SEP looks for ways to apply what it learns from these projects to its other activities.

There are additional sources of information that help us measure program effectiveness. The increase in use of the SEP Resource Center and in the active program participation by teachers (who tell us that they do not know how they could continue without the support we provide) indicates that the SEP provides services that are valued by teachers. The continued referral of new UCSF volunteers by active participants also attests to the value of the SEP to the UCSF community, and volunteers tell us they gain personal satisfaction from their interactions with teachers and students. Finally, letters from students provide evidence of the value they find in talking with scientists, participating in the Lesson Plan Contest, or spending a summer doing research in a UCSF lab. Currently, we are setting up a mechanism to provide long-term follow-up for SEP student interns in an

effort to determine how their internship experiences influence subsequent career choices.

HOW TO GET STARTED, AND LESSONS LEARNED

Required Bases of Support

Funding. To be successful, partnerships require several types of support. Although volunteers are the heart of a program such as ours, some funding for their coordination is essential. No matter how many eager volunteers are available, if they are to make a contribution that is appropriate and has a lasting impact, their efforts must be coordinated. New volunteers need to be oriented, building on what has been learned from previous volunteers. Thus, the most fundamental funding need is core salary support for one or more coordinators and essential supplies and equipment to support communications and record-keeping.

It was relatively easy to obtain initial start-up funds for the SEP and for new program elements. During the past several years, as the program's success has received increasing acknowledgment, obtaining funding has paradoxically become more of a challenge. Funding sources that are enthusiastic about seeding a new initiative tend to be less enthusiastic about providing ongoing support for an established program. Thus, there is always a certain amount of incentive to continually create new program elements to bring in new funding. Experience has taught us that while it is very important to watch for opportunities to guide program evolution into areas in which the partnership can become more effective, it is also important to continue support and activities that participants value. This is especially important for teachers, who have had a great deal of experience with programs that come and go in response to transient funding; it means a great deal to them to be able to rely on programs that are sustained over time. One of the problems our program has encountered has been to find ourselves engaged in an activity that diverted attention and effort from our major goals, because it was an area in which we were able to obtain funding. It requires continuing effort and confidence to keep our goals focused and to make sure that all activities fit into a coordinated way of addressing those goals.

The SEP has been fortunate to receive support from many different sources, both government and private. Major program components have been supported by federal agencies such as the NSF, the National Institutes of Health (NIH), and the U.S. Department of Education. Recent funding has also come from private foundations—the Howard Hughes Medical Institute, the Genentech Foundation, the Crocker Trust, the American Honda Foundation, and the Noyce Foundation. Currently, core programs are funded by the Howard Hughes Medical Institute, the NIH, the American Chemical Society, the Herbert Boyer Fund of the UCSF De-

partment of Biochemistry, the Genentech Foundation, and the UCSF Office of the Chancellor. Funding for special programs is provided by the NSF and the Office of the President of the University of California.

The ultimate answer to the funding issue is institutionalization of the partnership that provides meaningful core support by the participating institutions. Today in California that is very difficult. Both the District and the university have been under severe fiscal constraints for several years. Nevertheless, for the last two years, the UCSF administration has provided substantive core support that both ensures the SEP's continuation and demonstrates to outside funders the university's commitment to the program. This support is critically important because it helps to generate additional outside funding. It is anticipated that future funding for the SEP will consist of a combination of core support from the university and support from a variety of private and government sources for special projects. Based on our experience, we recommend a strategy of developing support that draws on diversified funding sources of all sizes. This provides flexibility and reduces the reliance on a single source. In addition, although stable support from the parent institution is extremely valuable in providing a measure of security and demonstrating the institution's commitment, competitive grants should still constitute part of the total funding base. The competitive component keeps a program growing and challenges it to take the next steps in meeting its long-term goals.

Volunteers. The other kind of support that is obviously necessary is the availability of volunteers to work with teachers. Once a partnership gets off the ground, if a mutually beneficial collegial atmosphere between teachers and volunteers is established, this type of support tends to be self-perpetuating. The majority of active volunteers gain a great deal of satisfaction and enjoyment from their participation, and when they talk to their friends and colleagues about what they have been doing, this generates a constant source of new volunteers. New volunteers are also recruited through the annual Fall Kick-Off event, publicized through flyers and the campus newspaper, and also through mailings of the *SEP Newsletter* and specific recruitment letters to UCSF personnel on our database. These individuals, who have previously expressed an interest in the program, are extremely helpful in bringing in new volunteers.

It should not be taken for granted that scientists and health professionals know how to work with teachers and precollege students. They are often intimidated at the thought of entering a classroom and trying to talk with students. As we have

learned more about how to orient volunteers, we have increasingly recognized the importance of providing them with as strong a preparation as possible. This includes giving them (1) information about the science and health curriculum in the District; (2) experience as learners through good hands-on, inquiry-based lessons; and (3) strategies for teaching and classroom management. One problem encountered in facilitating individual partnerships between teachers and UCSF volunteers stemmed partly from inadequate preparation. Expectations were raised that in some instances were not realized because these expectations were not made clear. We have found that more explicit dialogue about roles and expectations, plus a structure around which partners can work (specific curriculum units, science clubs in the Triad Project, etc.), helps make more partnerships successful.

On a more practical level, the logistics of communication with teachers and scientists are always a challenge.

Time is precious to all of our participants, and they are so busy that it is sometimes hard to reach them by phone. Sometimes the use of e-mail can facilitate routine communications, but there is no substitute for a direct phone or face-to-face conversation for defining a teacher's needs accurately, gathering feedback about a teacher-scientist partnership, or finding just the right niche for a new volunteer. The communication side of the partnership is one of the more time-consuming and most critical aspects of a coordinator's work.

In addition to funding and active participation, vocal and visible support of the SEP from high-level university administrators and faculty has been very important to its success on campus and its recognition outside the university. Even if faculty members do not have time for close involvement in partnership activities, they can provide important support by encouraging their graduate students, postdoctoral fellows, and other laboratory personnel to participate and by donating surplus supplies and equipment.

Teachers. Preparation of teachers for participation in partnership activities also requires thoughtful attention. Teachers are overworked and overburdened with many challenges that scientists and clinicians have little experience of.

In starting a partnership, it is good to think big but start small. . . . Once established securely, a partnership can build on small successes to address larger goals. And as overall success becomes a reality, it is important to maintain the responsiveness that fostered that success.

Teachers appreciate support in doing their incredibly difficult jobs, but it is important that the support be offered in a collegial manner. Too often, very well-meaning individuals from universities approach precollege education with the attitude that they are coming to "fix the teachers" or "fix the curriculum." Most university faculty have very little practical knowledge about how to foster and support a memorable learning experience in students who have vastly different backgrounds and experiences from their own. Teachers are less likely to think of themselves as having something of value to offer the volunteer scientists and need to understand what these volunteers learn from them. They also need to understand that using a scientist as an expert-at-large is not appropriate. Once the partners understand what each has to offer—the teacher's expertise in creating a learning environment and the scientist's expertise in the concepts of science and the approach to understanding that science offers—their efforts can be truly synergistic.

Early on, we were not explicit about what we expected from teachers. This meant that on occasion, a volunteer would feel as if the partnership was somewhat lopsided. Having teachers and scientists work together to define their expectations and agree on objectives helps avoid this problem.

District administration. Another critical need for any partnership is the support of the school or district administration. The administration has responsibility for anything that affects students and teachers. In order for partnership activities to have a lasting impact on the educational experience of students, there must be an alignment of purpose between the partnering institutions. As our program developed, this alignment was not always clear. Sometimes, because the school or district administration must be concerned with the whole educational process, it may seem to representatives of the scientific institution that science education is not receiving the priority it deserves. However, it may be helpful to remember that schools must operate out of myriad funding sources, each of which carries its own priorities. The single-mindedness of the scientific institution and the more holistic concerns of the school are reflected in the perspectives of individuals from the two types of institutions. Thus, it is very important to create structures that foster sustained communication between individuals in the partner institutions who have responsibilities in areas that the program will affect. A critical task for the USCF-District partnership was to establish a firm basis of trust and reliable communication. This took a number of years, and misunderstandings have on occasion threatened to undo previous work. Maintaining trust and communication demands continuous attention. It requires a commitment to understand-

ing the other institutional partner's priorities and perspectives, together with mutual respect among all of the individuals who are responsible for partnership coordination.

FINAL THOUGHTS

In starting a new partnership, it is good to think big but start small. The abilities to compromise and to rapidly develop an understanding of the procedures and management relationships of the school district are essential. In working with individual participants, the SEP has learned that to establish trust and credibility, it is important to maintain the capacity to meet the expectations that have been raised and to be responsive in some way to all requests and inquiries. Once established securely, a partnership can build on small successes to address larger goals. And as overall success becomes a reality, it is important to maintain the responsiveness that fostered that success. This means setting limits on and prioritizing program activities, planning strategically, and accepting that you cannot do everything. Another thing to remember is that changes in education take a long time. Although the inherent conservatism of the educational system can be frustrating, it helps keep the critical process of preparation of future citizens from being unduly influenced by special interests or transient popular movements. As the partnership and its work evolve, the challenges and issues also change, requiring new perspectives and creative solutions. Thus, partnering institutions need to plan on a long-term association and should work from the beginning to build a strong foundation for communication and trust, the basis for true collaboration.

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