ARTICLE
The Value of Partnerships in Science Education: A Win-Win Situation

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An editorial in Science (Alberts, 2012) has expressed the need to teach "real science," firmly based on hands-on and inquiry methodology. Also in a recent article, Stevens (2011) highlighted the contrast between the emphasis that federal agencies and professional associations place on science outreach, and the scarcity of support for such activities at the classroom level. To bridge this gap, we have developed a way to redefine science education by involving college students and faculty in "real science" outreach. Incorporating outreach activities into a college science curriculum is an efficient means to affect not only future scientists but also the world at large with which scientists need to communicate.

In this paper we describe a Science Education Partnership Award (SEPA) project. The project has been implemented in a minority setting, at a small college of allied health located in one of the most underserved areas of Los Angeles. Some of its outcomes were presented at two Society for Neuroscience meetings (Gizerian et al., 2009; Ayers and de Lacalle, 2010), before being also discussed as an example of outreach program during the FUN summer workshop in Pomona (California) in 2011. This project entails the development of a working partnership between K-12 institutions and college science students and faculty. Participation was voluntary (but college students could request community service credit) and most importantly built on student interests and connections with the community. The three components are described in terms of efficacy (i.e., impact on college students' communication skills) and community value (i.e., impact on educational outcomes for the partner K-12 institution).

Key words: science outreach; neuroscience education; minorities in science; public policy

The statistic that only 28% of the U.S. adult population is considered scientifically literate (Miller, 2010) has been widely used to highlight the need to advance science education. Although that number has improved slightly (Meinwald and Hildebrand, 2010), it cannot be considered satisfactory. Resistance to certain scientific ideas seem to derive in some part from assumptions and biases that can be demonstrated experimentally in young children and may persist in adulthood (Bloom and Weisberg, 2007). The lack of adequate science education in the K-12 curriculum, as well as the inability of scientists to communicate with the public, are two of the main problems we face.

In 1998 California adopted academically rigorous content standards in science (Bruton and Ong, 2000), the Science Content Standards for California Public Schools, Kindergarten Through Grade Twelve. As stated in the introduction to this publication, the Standards represent "the content of science education and include the essential skills and knowledge students will need to be scientifically literate citizens in the twenty-first century. By adopting these standards, the State Board of Education affirms its commitment to provide a world-class science education for all California students." According to these contents, by the time they reach the 4th grade, California students should know that different types of plants and animals inhabit the earth (K), that plants and animals meet their needs in different ways (grade 1), have predictable life cycles (grade 2), and also that adaptations in physical structure or behavior may improve an organism's chance for survival (grade 3). But standards describe what to teach, not how to teach it. Although the document expresses the desire that science content be taught in such a way that students have the opportunity to build connections that link science to technology and societal impacts -such as community health, population, natural resources, environmental quality, natural and human-induced hazards, and others- these aspects are left to the initiative of the teachers. For example, the Standards contain the word *disease* three times, the word *medicine* is not present, and neither is the word *health*. Therefore, more specific interventions are needed to ensure that the connections between classroom science and individual and societal impacts, such as community health issues, are addressed. In this process, training scientists to communicate their science is crucial, as powerfully described by Friedman (2008). We therefore set out to implement a project, funded by the National Center for Research Resources (NCRR) Science Education Partnership Award program, to engage university students and faculty to contribute to the scientific education of children from inner-city elementary schools, exposing them to the biomedical sciences (including predominantly the neurosciences), and encouraging them early on with the excitement of scientific discovery.

DESCRIPTION OF THE SCIENCE EDUCATION PARTNERSHIP AWARD PROJECT

The outreach program titled "Would you like to be a scientist?" (www.beascientist.org) at Charles R. Drew University of Medicine and Science was designed to achieve two goals. First, to train biomedical science students to become effective communicators in their fields, and involve them in bringing science to children from inner-city elementary schools. This was accomplished through

two interrelated activities: (a) a "reverse" science fair, modeled after the Kids Judge! Science Fairs (Mervis, 2010), to provide children with learning experiences that would establish the foundation for broad understanding of biomedical sciences, particularly how the brain works and how brain functioning relates to behavior; and (b) a mentorship program between fourth grade students and undergraduate and post-baccalaureate students in the biomedical sciences, whereby the college students would provide lessons for the children during the science block of their curriculum. And second, to establish a community outreach program that would educate the general public on biomedical sciences and health-related topics via a film series followed by a discussion by a distinguished scientist.

The project was implemented between the fall of 2006 and the spring of 2011.

Specific Activity 1: Science Fair

The Kids Judge! Los Angeles Biomedical Science Fair, designed in collaboration with Dr. Deborah Colbern (President, BEEMNET Inc.), was held in the fall of years 2007 to 2010 (Table 1). Fourth, and some 5th grade students participated in learning and judging different exhibits presented by undergraduate, graduate students and faculty. Table 1 briefly describes the fair for each year. In year 2007, all the students and faculty who presented exhibits were from Charles Drew University; starting in 2008, students and faculty from other universities (Pitzer College, California State University - Los Angeles, Loma Linda University and UCLA) were invited to participate in creating and presenting exhibits. In addition, students from the King/Drew Magnet High School participated as guides and escorts for the elementary school children as they moved through the exhibits.

Specific Activity 2: Mentoring Program

Students from Charles Drew University served as mentors at different Elementary Schools, visiting 4th and 5th grade classrooms to present labs and hands-on activities in the life sciences (Table 2). Mentors collaborated with one another in preparing lessons and instructional materials to present to the children, and worked with the classroom teachers to align their lessons with state science content areas. Table 2 summarizes the mentoring program from year 2007 to 2011.

Specific Activity 3: Medicine in the Movies Film Series

The "Medicine in the Movies" was a film series organized mostly during the summer (Table 3). Several feature movies with a medical/health theme were screened, followed by a Q&A with a distinguished scientist or physician. The list of movies with detailed information on the theme and the speaker was published online (url: www.beascientist.org/medicineinthemovies). The events took place at Charles Drew University in the first two years and at different locations after year 2009. Table 3 provides brief descriptions of this activity throughout the years.

Year	Date	Location	Elementary Schools Involved	# of Grade Students	# of College Students and Faculty
2007	November 30th	Willowbrook Boys and Girls Club	Flournoy and Carver Elementary Schools	180	28
2008	December 5th	Veterans Sport Complex Gymnasium, Carson, CA	Flournoy and Carver Elementary Schools	164	41
2009	November 20th	Veterans Sport Complex Gymnasium, Carson, CA	Carver and Foster Elementary School	200	38
2010	December 3rd	California State University, Dominguez Hills	Carver and Foster Elementary Schools	200	45

Table 1. Summary of Science Fair from 2007-2010.

Year	# of Mentors	Elementary Schools that Mentors Served	Time Period
2007	3	5th grade students from Lincoln/Drew Elementary School and Sts. Peter and Paul School	Spring 2007 (pilot)
2009	8	4th grade students from Carver Elementary School	February – April 2009
2010	8	4th grade students from Carver Elementary School	February – April 2010
2011	9	4th grade students from Carver Elementary School	February – April 2011

Table 2. Summary of Mentoring Program from 2007-2011.

Year	# of Movies	Locations	Number of Attendees
2006	4	Charles Drew University	25
2007	6	Charles Drew University	49
2008	7	Charles Drew University	56
	1	View Park Preparatory High School	24
2009	5	Charles Drew University Alma Reaves Woods Branch of the Los Angeles library	16
2010	6	Charles Drew University A.C. Bilbrew Library in South Los Angeles King Drew Medical High School	43
2011	5	East Los Angeles Community College	188

Table 3. Summary of Medicine in the Movies from 2007-2010.

Evaluation Methodology

The program evaluation focused on both formative and summative data collection and assessment. It was performed by an external evaluator, Dr. Simeon Slovaceck (PERC Office, California State University, Los Angeles) under a subcontract. Data collection methods for each program activity included several elements, listed in Table 4.

Program Activity	Data Collection Methods
Medicine in the Movies	Attendee surveys Observations of events Interviews with program staff
Kids Judge! Science Fair	Classroom Teacher Surveys Observations, photographs, video documentation Focus Groups Science communication survey
Mentoring Program	Mentor Focus Groups Mentor discussion with project staff and faculty via Google Groups Science communication survey of mentors Performance data on the California Standards Tests (CST)

Table 4. Program Activities and Data Collection.

RESULTS OF THE SCIENCE EDUCATION PARTNERSHIP AWARD PROJECT

A. Science Communication Skills

The science communication survey was administered at two points along the project, during academic years 2009-2010 (Fig. 1) and 2010-2011 (Fig. 2). In both years the survey was given to Charles Drew students at three different points throughout the project year.

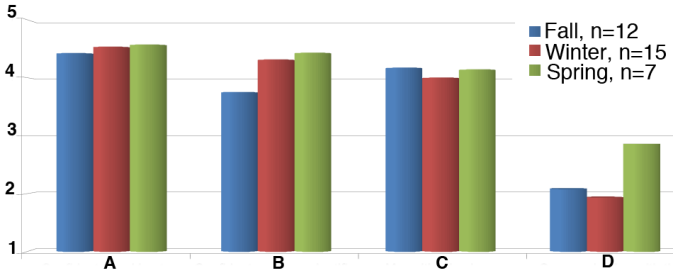

Figure 1. 2009-2010 Science Communication Survey, all participants. We used a Likert scale (1: strongly disagree; 5: strongly agree) to measure changes in the following dimensions: *A*: I am confident speaking to children about science; *B*: I am confident making scientific presentations; *C*: my writing is above average; *D*: communicating with the public does not affect public attitudes towards science. Sample size was too small to allow for statistical analysis.

In 2009-2010 there were 23 unique respondents to the survey, including students and faculty; the 2010-2011 administration only included 14 unique Charles Drew students who participated in either the Science Fair or the mentoring, and 22 students from King/Drew Medical Magnet High School who served as tour guides during the Science Fair.

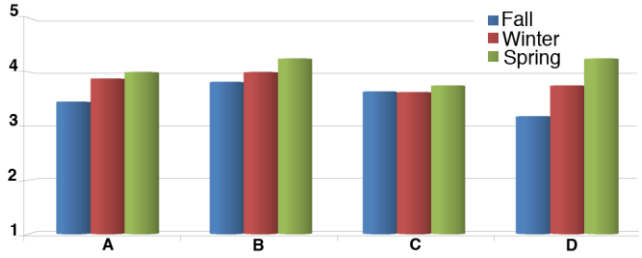

Figure 2. 2010-2011 Science Communication Survey, undergraduate students. We used a Likert scale (1: strongly disagree; 5: strongly agree) to measure changes in the following dimensions: *A*: I feel confident speaking in public; *B*: I feel confident speaking to children about science; *C*: I feel confident speaking to adults about science; *D*: I feel confident making scientific presentations in front of scientists. Sample size: n = 14.

The survey asked a number of questions regarding communicating science to the public, the role of scientists in that communication, and how well the media currently reports on science and issues related to science and medicine.

Responses to the questions regarding public speaking in general were fairly high; respondents at each administration all agreed that they felt confident speaking to children. Respondents during the fall administration were more circumspect about their confidence in making scientific presentations, however by the spring students who had already completed both the Kids Judge! Fair and the mentoring, were more positive in their responses. Those surveyed largely disagreed with the statement that "Communicating with the public does not affect public attitudes towards science," though the students who took the survey during the spring were slightly more neutral. Responses regarding writing ability were stable over time.

Improvements in students' perceptions of science communication over the project year were difficult to determine largely due to the high ratings present during the initial administration. As the majority of students already agreed that they felt confident about their ability to present science to children, there was not much room for change. Refinements to the instrument would be necessary to better capture how participation in SEPA changes students' abilities to communicate science to a broader audience. We decided to apply the instrument only to students in the 2010-2011 administration. Most of the students were enrolled in the post-baccalaureate pre-medical program, with others majoring in the Biomedical Sciences and Child Development. Figures 1 and 2 give the average responses to the items related to presenting and communicating science on the survey across each administration.

All items showed improvement from the first administration to the last, particularly "I feel confident speaking in public," and "I feel confident making scientific presentations in front of scientists," which both increased from the "neutral" range to "agree." The item "I feel

confident speaking to adults about science" had the smallest amount of improvement, though this is perhaps not surprising given that SEPA-funded activities concentrate on communicating science primarily to elementary school students. Notable, but not shown above, were responses to the item "My coursework at Drew University has helped develop my communication skills," which rose from an average response of 3.55 in fall to 4.50 in spring. Not only did students report improvements in their science communication skills, they attributed at least some of that improvement to the work they have done at Charles Drew University. Other responses to the survey items showed minor changes in student attitudes towards their writing ability.

In the fall of 2010, 22 students completed the communication skills survey at King/Drew Medical Magnet. These students later served as guides for the elementary students during the Science Fair, and a number of them also ran an exhibit. Following the fair 20 students completed a second administration of the survey. In both administrations the students were in 11th grade, and a majority of them were female and African American.

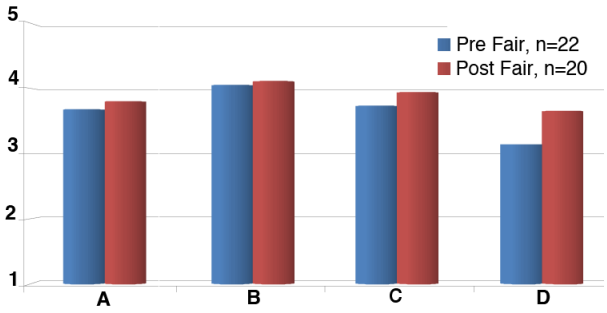

Figure 3. 2010-2011 High School Student Survey. Using a Likert scale (1: strongly disagree; 5: strongly agree) we compared the perceptions of 11th graders before and after participating in the outreach program, with regards to the following items: *A*: I feel confident speaking in public; *B*: I feel confident speaking to children about science; *C*: I feel confident speaking to adults about science; *D*: Communicating with the public does not affect public attitudes about science.

Average responses on each of the administrations did not vary much. Slight improvements in attitudes towards public speaking and science communication are observed, more so in the case of communicating with adults than with children, in contrast to what was observed with the Charles Drew students. The largest change occurred in students' attitudes towards the role science communication plays in shaping public opinion about science. Students were largely neutral on the subject prior to the fair, but rated their level of agreement approximately half a point higher following the fair. On both administrations, all students surveyed expressed a desire to attend college. The small gains, in particular compared to the changes seen with Charles Drew students, are not terribly surprising given that the high school students' involvement in the SEPA project was more limited than that of the university students. Nonetheless, evidence suggests that the project was successful in improving their attitudes towards science and the importance of science communication.

We also conducted a series of interviews with college and high school participants, which were recorded on video. In those, all students were more detailed and explicit describing the perceived benefit they had obtained from participating in this outreach project. These interviews are currently being edited for future dissemination.

B. Elementary School Student Performance

The effect of the SEPA program, in particular the Kids Judge! Science Fair and the mentoring, was investigated by examining the proficiency rates on the California Standards Tests (CST) in English Language Arts, Mathematics and Science at Carver Elementary School for those years directly before and during the implementation of SEPA-funded activities. We are aware that multiple factors (most beyond our control) drive the improvement of school performance, and we do not wish to imply that our outreach project was the only force behind the results presented below.

The initial comparisons centered on whether or not average proficiency rates on the 4th grade California Standards Test (CST) in English language arts, mathematics, and science at Carver improved during the years they participated in SEPA, compared to their previous performance.

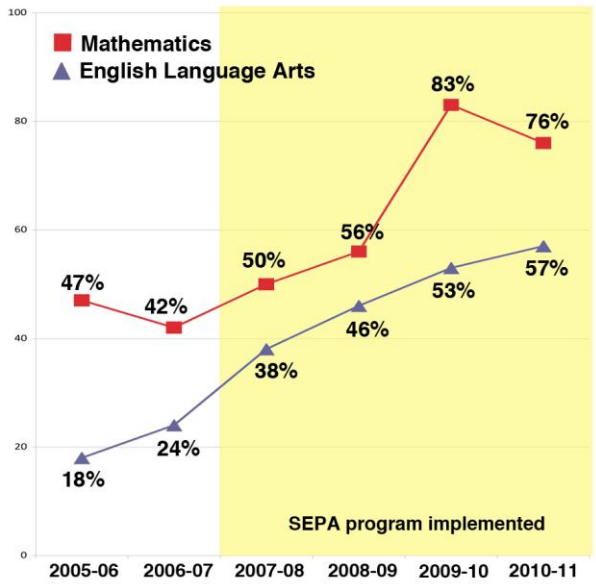

Figure 4. Carver Elementary 4th Grade CST Proficiency Rates: English Language Arts and Math.

Figures 4-5 show the average proficiency rate (the proportion of students whose scores fell in either the "proficient" or "advanced" categories) for those years both before and after SEPA implementation. Since students in the 4th grade are not tested in science, science proficiency rates displayed are for 5th grade students who had participated in SEPA activities as 4th graders the year prior.

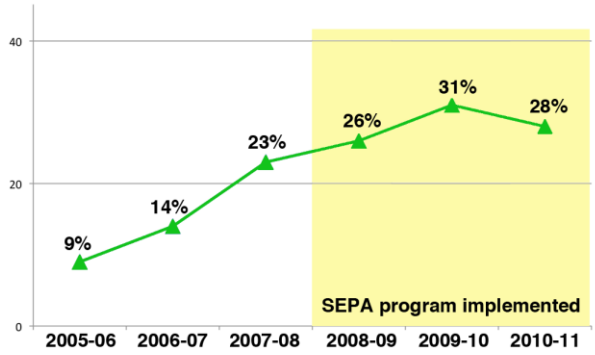

Figure 5. Carver Elementary 5th Grade CST Proficiency Rates: Science.

Proficiency rates rose considerately over the project period; 35% more students tested at "proficient" or above in English language arts 2009-2010 than in 2005-2006, and 36% more tested "proficient" in math, with a sizable increase occurring between 2008-2009 and 2009-2010.

While the increases in science were not as strong as in English or math, nonetheless the percentage of 5th grade students proficient in science more than tripled over those six years, from 9% to 28%.

Each year the California Department of Education selects 100 schools designated as similar to a given school. From that list we selected the 10 closest to Carver Elementary in terms of overall academic performance as of 2005-2006. To better place the performance of students at Carver in context, we compared their results with those of these ten other schools, as well as to the performance on Compton Unified as a whole, to which Carver belongs (Figs. 6-8).

With respect to the English Language Arts test, Carver performed worse than both Compton Unified as a whole and the ten similar schools during the years prior to becoming involved in the SEPA project (2005-2007). For those years in which they participated in SEPA however, Carver's performance first equaled and then surpassed Compton Unified and the average of the ten similar schools.

In mathematics, a similar trend is seen. Before participating in SEPA, the percentage of 4th grade students at Carver who scored proficient or above dropped from 47% to 42% between year 2006 and 2007. In 2007, Carver's proficiency rate was lower than the average of the ten schools in the comparison group and Compton Unified as a whole. During the years they participated in SEPA, proficiency rates grew dramatically; by 2011 the percentage of students proficient in mathematics exceeded that of the rest of Compton Unified by 11 points, and the average of the similar schools by 18 points.

As noted earlier, since there is no standardized test in science for the 4th grade, we used instead the 5th grade CST scores in science, specifically those classes that had participated in SEPA-funded activities as 4th graders the preceding year. Proficiency rates were universally low in those years leading up to participation in SEPA. Only 9% of students at Carver were proficient in 2005-2006, equal to the average of the ten similar schools but trailing the proficiency rates for Compton Unified. Proficiency rates improved gradually at approximately the same pace for Carver, the comparison schools, and Compton Unified, though by the 2011 test Carver had fallen behind the district and the comparison schools.

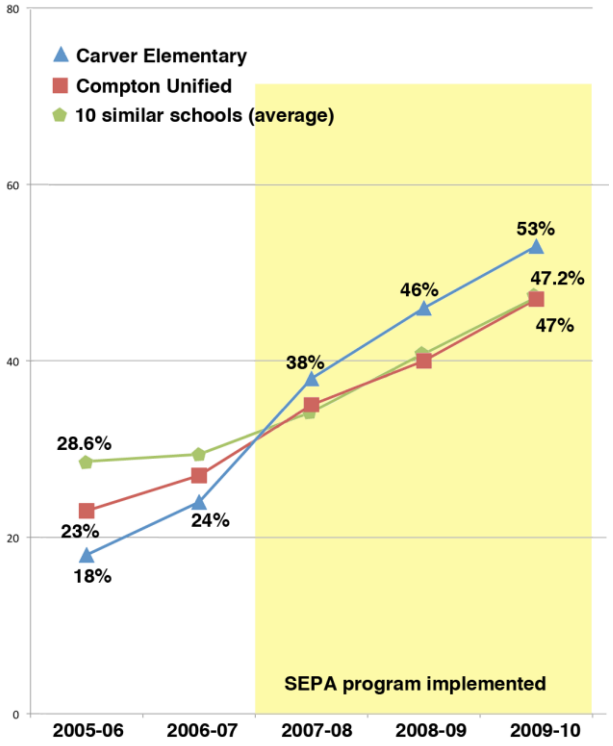

Figure 6. Comparison of English Language Arts CST Proficiency Rates.

C. Reaching the general public with health information

Beginning in 2006, a film and speaker series was held each summer. Attendees were shown a film related to health or medicine, followed by a short presentation by a health professional. Between five and seven films were offered each year (see www.beascientist.org for details).

Originally the series was held on the campus of Charles Drew University, though in later years films were also shown at King/Drew Medical Magnet High School, the A. C. Bilbrew and the Alma Reaves Woods Public Libraries, View Park Preparatory High School, and East Los Angeles Community College as part of efforts to increase the outreach. At the conclusion of each session attendees were given a survey (except in 2006, the pilot year) asking for their impression of the film and speaker, and what they learned regarding the session's topic.

The total attendance at the films series for each year is shown in Table 3. Attendance was highest during the 2011 series, and lowest in 2009. Between 2006 and 2010, the majority of attendees were adults (our original target population), with teenagers and children making up approximately two-fifths of the overall attendance. In 2011

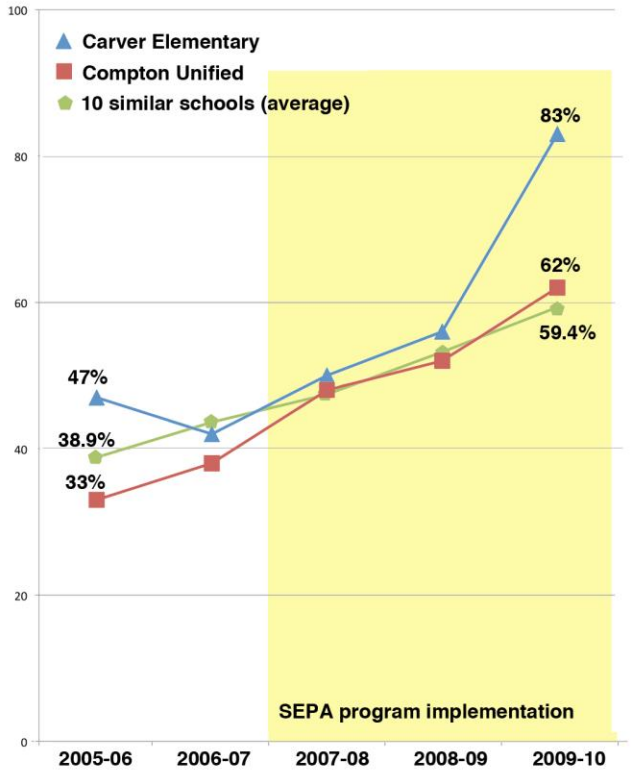

Figure 7. Comparison of Math CST Proficiency Rates.

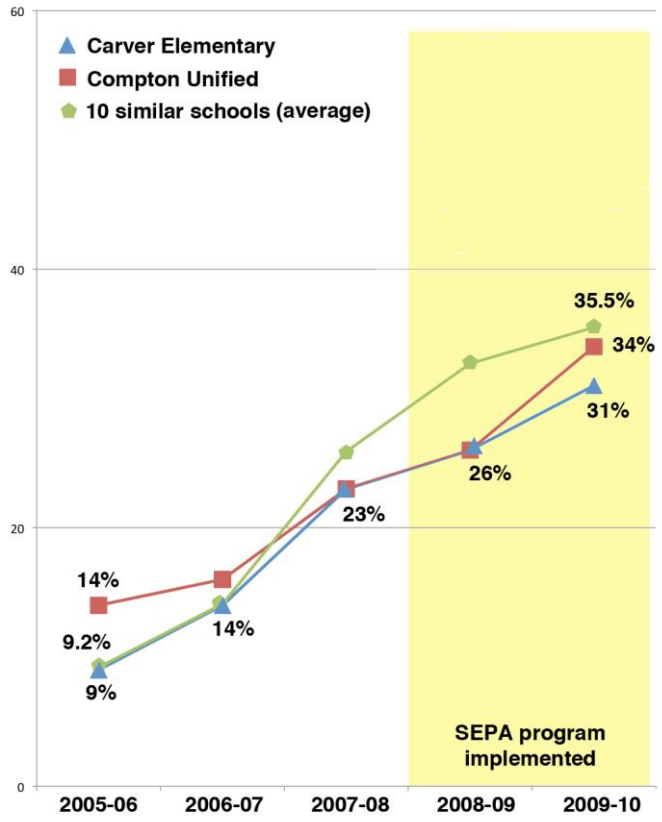

Figure 8. Comparison of Science CST Proficiency Rates.

95% of the attendees were teenagers enrolled in summer programs at ELAC. While those attending sessions at Charles Drew University were frequently affiliated with the university in some way (usually faculty or student), sessions that were held off-campus (usually at a public library) tended to attract members of the local community. Nonetheless, attracting the community at large to the series was a persistent challenge for the project.

The survey asked respondents to rate their impressions of the film and speaker on a 5-point scale in which 1 = didn't like it, and 5 = liked it a lot. Ratings for both the film and the speaker were very high all years; average ratings were between 4 and 5. Likewise, when asked "How comfortable would you feel now discussing medical issues with your own physician" and "How confident are you now in your ability to investigate medical issues on your own" respondents replied very favorably, rating both between a 4 and 5.

The survey concluded by asking attendees what they liked best about the event and whether or not they had any suggestions for future screenings. Generally respondents were very positive in their assessments of both the film and the screenings (echoing results from the Likert-scale items), and expressed that they particularly enjoyed the discussion with the speaker following the film. They also stated that the event was very informative and provided an opportunity to not only learn about a health issue, but also be able to query an expert on that issue. Respondents suggested advertising the events to a broader population (again citing how informative it was), and those who attended the screenings at a library expressed hope that the library would host more similar events.

The survey data indicates that those who attended Medicine in the Movies came away with a very positive impression of the experience. The films and speakers presented useful, valuable information on health-related issues that respondents would like to see shared with the greater population. The two challenges we encountered were reaching effectively to a broad audience, and finding appropriate venues in which to hold the event. The success of the 2011 series does not truly reflect reaching to the community at large, because the participants were mostly students already on campus.

D. Value added of the outreach program

D.1. Classroom activities

The mentoring program grew from four students working at two schools in the 2007-2008 year to six to eight students visiting Carver Elementary in years 2008-2011. The structure of the mentoring also evolved from having Charles Drew mentors serve as tutors and expert resources (original proposal) to having the mentors collaborate in developing a variety of hands-on science activities to bring into the classroom (actual implementation). Information regarding the implementation and impact of the mentoring program was collected primarily via focus groups with mentors and classroom teachers, and through classroom observations. The 2007-2008 mentors also completed a survey regarding their experiences. Students that requested credit for community

service hours were required to write a reflective essay and fill out additional evaluation forms (results not shown).

In the first year of the SEPA project mentors stated that they felt they were of use to the students and that the mentoring program helped the students in their science coursework. Mentors in later years were equally, if not more, positive about their experiences. In focus groups following their experiences as mentors, Charles Drew students all stated that they enjoyed working with the elementary students, and that the kids all responded well to the lessons and activities they conducted. Several also noted that they had developed strong bonds with some of the 4th graders, and that they perceived themselves as role models for them.

During the first year of the program, mentors were concerned about the lack of structure and wished for greater support in designing lessons and activities. They also expressed a desire for a more set schedule in order to balance their new obligations at Carver with those they already had as Charles Drew students. The response was to set aside time each Friday for the mentors to go to the classrooms, which worked also well for the teachers at Carver. In later years mentors also cited lack of skills in (a) classroom management and (b) in designing lesson plans that supported the students' existing curriculum as the main challenges. In response, we provided more guidance to mentors in designing lessons prior to entering the classroom, and created a Google Groups site to facilitate communication between mentors. Classroom teachers were also invited to meet with the mentors at the beginning of the program to discuss what to expect inside the classroom, both with respect to student behavior but also with respect to academic ability.

Those challenges aside, mentors felt they were able to make a difference with respect to teaching students about science and future college and career opportunities. They also believed that the experience improved their communication skills; designing lessons for the children entailed thinking how to present scientific concepts to non-scientists. They were all of the opinion that the experience would help them in the future to communicate science to laypersons.

Information gained from the classroom teachers through focus groups corroborated the feedback received from the mentors. The teachers were all very pleased with the mentoring program and the lessons conducted by the mentors. They stated that the lessons were fun for the children and a great way to get them excited about doing science. In particular, the teachers noted that many of their students were visual learners, and believed that the hands-on activities were more effective at teaching science than more conventional lectures and textbooks would have been. The teachers were also happy with the amount of creativity and passion for science that the mentors brought into the classroom. As science is not emphasized in the 4th grade curriculum (students take the standardized test in science in 5th grade), the mentors' activities provided a valuable addition to the daily lessons.

In the teachers' view, the primary challenge to the mentoring program was time. Given the demands placed on them by the curriculum, teachers must adhere to a rigid instructional schedule. This meant that finding time for the mentors to give their lessons was occasionally difficult. Classroom management could also be an issue at times, as cited by mentors as well.

Teachers proposed starting the mentoring program earlier in the year to give mentors more opportunities to present their lessons as well as allow them to improve their skills in classroom management and instruction. This suggestion dovetailed with the teachers' desire to prolong the mentoring program due to the positive impact they observed on their students. They also suggested expanding the mentoring program to include 5th grade classrooms. Other suggestions included more integration with the Science Fair (which their students already participate in) and other academic intervention programs that were also being implemented at Carver.

In summary, both the classroom teachers and mentors agreed that the mentoring program was a valuable addition to the classroom, and taught the children about science in ways they would not have otherwise been exposed to. The mentors enjoyed working with the children and felt doing so improved their communication skills, particularly when it comes to presenting science to lay audiences. The teachers welcomed the addition of science into their classrooms, given that they frequently had to devote their class time to English and mathematics, and they believed the mentors served as role models to the children.

D.2. The science fair

In 2011, focus groups were held with student presenters at Charles Drew University, and the University of California, Los Angeles, and a survey was sent to student presenters at Loma Linda University. Students from all three universities enjoyed having participated in the fair, and felt it was a great learning experience for all the children. They were impressed at the enthusiasm the children brought to the fair. One presenter remarked at how pleased she was that the kids were excited about learning concepts that she herself had found boring when she studied them in college. Several also commented on the fair providing them with an opportunity to improve communication skills. As some of the exhibits were built around fairly sophisticated concepts (and often employed specific vocabulary), it was a challenge for the presenters to devise ways of explaining the science to children so they would understand.

The fair was also successful in bringing together students and faculty from several universities, and some of the presenters expressed hope that the Science Fair could serve as a hub through which to promote collaboration between universities with respect to informal science education. Since there may be other projects at the partner universities with aims similar to SEPA, there is the potential to form partnerships with these other projects, and in doing so expand both the activities offered and the populations reached.

In the fall of 2010 students from King/Drew Medical Magnet High School, who had always served as guides to the elementary students, were also invited to present an exhibit. Following the fair the evaluation team held a focus

group with those students to obtain their impressions of the fair and how it impacted their attitudes towards science. The high school students were very impressed with the 4th graders and enjoyed working with them both as guides and as presenters. They also thought that the fair was organized well and ran smoothly. As for them, they stated that some of the science that was presented at the fair was new to them, whereas some of it was material they had learned in previous courses. Irrespective of familiarity, they thought that the methods used to explain and present the science were much more fun and engaging than what they had encountered in their own science classes. Several had wished that their science teachers had used more hands-on activities in their instruction.

Throughout the years, teachers and parent volunteers were very positive in their assessment of the science fair. All of those surveyed rated their overall impression as either "extremely valuable" or "valuable," the highest ratings available, and all of them also responded that the fair met or exceeded their expectations. In addition, every year they unanimously responded that they would participate in the fair again. They were interested in seeing more integration with the mentoring program (possibly some classroom activities that build upon the science fair exhibits), and wanted materials to take with them back to the classroom to continue to teach what was introduced at the fair.

Verbatim Comments from Classroom Teacher Surveys
A selection of the responses from classroom teachers from various years is given below.

What was most <u>helpful</u> or <u>useful</u> to you about the Science Fair?

- Instead of just reading about Science, the students got a chance to do hands on, and to see how much fun Science projects are. This Science fair helped them to appreciate that Science is just not all reading and answering questions. There is much, much more to it! Thank you.
- The ability for the students to experience hands-on activities involving the technical parts of science, opens doors of opportunities for our students to access high quality instruction and possibly future interest in the field of science.
- The organization of this event is the most impressive part. It seamlessly flows and students are engaged and active the entire time. Everyone benefits and works so well together. I look forward every year to see how exciting science can be for our students!
- It allowed our students (high school) to act as "mentors" to some extent with the 4th grade students. It was empowering for them. They were excited before the event, and have been very serious about their responsibilities during the event.

What did you like <u>least</u> about the Science Fair (what would you change if anything?)

- We need a PA system to announce information to the kids. It was difficult to hear instructions and that distracted the kids and some of the guides had a hard time relaying the message. It all worked out at the end.
- More kids having the opportunity would be the only recommendation. The changes and improvements that I've seen each year have made it an increasingly more invaluable experience. This is the way to make science real/matter and have a purpose.

Do you have any additional ideas, insights, issues, further comments, concerns or suggestions that you would like to share?

- Follow up activities and lessons on the elementary campuses would be welcomed.
- I would ask that you make a continued effort to include special needs children. Last year we were unaware of this great field trip. I would also benefit from a packet that would help re-teach/pre-teach exhibits. Thank you very much.
- You will exceed expectation if you have professionals (scientists) introduced during the show. The students can ask them questions and also see them and know that they can aspire to become such- e.g., a neurosurgeon- an extension.
- * Outdoors (in Summer) * louder microphone, * ensure that kids get to all stations. * More parents should be allowed to come with their kids – more parental involvement!!! * Bring the Science Fair home – bring it to the school.

In summary, all those queried about the science fair spoke very highly of it, its presentation, and its impact on the children. For teachers, it was an opportunity to help their students become excited about learning science. For university students, it was an opportunity to devise exhibits that were both educational and entertaining, and helped them in learning to communicate science to a broad audience. Suggestions from both presenters and teachers centered on expanding the scope of the fair, either by integrating it into teachers' classroom instruction, or by forming partnerships with science education projects at other universities.

CONCLUSIONS

Year after year we have witnessed the many benefits that this outreach program offers, with its unique opportunity to introduce basic scientific concepts to elementary school children in a memorable way, while simultaneously providing the means for high school and college students to both develop self-confidence in science communication skills and solidify science knowledge. These experiences can easily stimulate interest in, and reduce anxiety towards learning science, and possibly encourage the pursuit of a career in science or medicine. Evidence from the qualitative surveys indicate that the hands-on experience greatly encourages elementary school children to think about scientific concepts, rather than simply recite what is taught in the classroom.

A structured science mentoring program, performed by college students and targeting elementary school

classrooms, with or without a reverse science fair as a "kick-off" event, can significantly supplement science curriculums at all educational stages. When well-structured, elementary school teachers welcome hands-on activities provided by scientists, that engage young active minds, and support the science learning objectives of the particular school. In addition, elementary school children benefit from the interaction with college students (who they perceive as "cool" mentors). On their part, college students also benefit from the experience, through confidence building, consolidating conceptual comprehension in science. And colleges/universities can develop successful pipeline programs by creating these partnerships with K-12 institutions. Building these partnerships enhances not only science education but also increases a sense of community and the value of service.

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