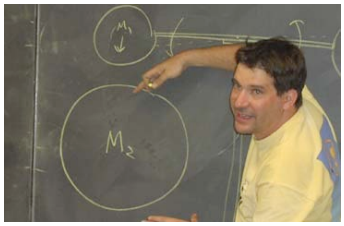
The University of California
California State Summer School for Mathematics and Science

COSMOS

Developing Future Scientists, Engineers, and Mathematicians: The Evaluation of COSMOS, Summer 2003

March 2004



Rena Dorph, Ph.D.
Center for Research, Evaluation & Assessment
Lawrence Hall of Science
University of California, Berkeley

David Goldstein
Teacher Education & Professional Development
University of California Office of the President

Developing Future Scientists, Engineers, and Mathematicians:
The Evaluation of COSMOS, Summer 2003

March 2004

Executive Summary

SUMMARY OF FINDINGS

The evaluation team has concluded that the COSMOS program is of exceptionally high quality, resulting in a summer experience likely to help participants realize their full academic and career potential in science and mathematics.

COSMOS reaches a cross section of students. COSMOS achieves regional, ethnic, gender, and economic diversity. Further, COSMOS does a good job of making it possible for qualified applicants to attend, whether or not they have the financial resources.

COSMOS students learn a great deal while in the program. Through clusters that combine labs and classes, students are able to pick an area of interest and focus in on it. The teaching is excellent; the cluster work is supplemented by enriching field trips and a strong and supportive community of peers and scholars that promotes both intellectual and social growth. The *Discovery Lecture Series* provides students with a window into the possibilities that await them in science and mathematics-related careers.

COSMOS helps participants refine and sharpen their own career and educational goals. Through COSMOS, students are able to formulate a much more concrete impression of what university life is like—an experience that tends to reinforce their interest in pursuing university study and their confidence in their capacity to succeed. Since participants are clearly already talented, motivated, and smart, COSMOS helps students focus on how to achieve their high aspirations. COSMOS participation enables students to hone in on a specific and attainable area of interest or to discover a previously unexplored area of interest. The overwhelming success of and demand for the COSMOS program led COSMOS leaders to plan for a site at an additional campus. A fourth campus site will enable more eligible students to participate in the COSMOS experience.

Many COSMOS participants and alumni are well on their way to a career in mathematics and/or science as evidenced by related benchmarks: they uniformly convey high motivation, include science and math in their goals, have demonstrated high academic performance in the past, have been connected to a university through their COSMOS experience, have high future academic and career aspirations, have a realistic

sense of how to prepare themselves for university eligibility, and enjoy science and/or mathematics. In addition, many have begun to develop leadership skills that would be crucial to their ability to become leaders in their fields.

COSMOS may prove to have an institutional impact that supports the development of future leaders in mathematics and science. Specifically, COSMOS would be more likely to have a lasting institutional impact if it met the goal of developing models for excellence in science and mathematics education. While there are no institutional structures in place to explicitly promote the development of new models for use by others, models for excellence in both higher education and high school are beginning to emerge as an outcome of faculty and Teacher Fellow participation in COSMOS.

RECOMMENDATIONS

Programmatic Recommendations

- *Restrict eligibility to students who have already begun high school.*
- *Provide positive female role models.*
- *Recruit more high-achieving African American students.*
- *Rethink the writing/communication class.*
- *Expand opportunities for alumni engagement.*
- *Define Teacher Fellows role more strategically.*
- *Ensure that COSMOS develops "models for excellence in science and mathematics education."*

Organizational Recommendations

- *Expand the COSMOS program.*
- *Seek additional funding.*
- *Develop and fill an Executive Director position.*
- *Maintain a high quality Advisory Board.*
- *Invest in longitudinal program evaluation.*

Developing Future Scientists, Engineers, and Mathematicians:
The Evaluation of COSMOS, Summer 2003

March 2004

BACKGROUND

The California State Summer School for Mathematics and Science (COSMOS) takes place at three campuses of the University of California (Irvine, Davis, and Santa Cruz). Established by the California legislature, COSMOS was first offered in the summer of 2000, with the goal of providing an opportunity for highly talented and motivated students (who have completed eighth through twelfth grades) to engage in an intensive program of study, experimentation, and activities that permits them to pursue their talents and interests in mathematics and science. Participants form a community that includes like-minded peers, outstanding university faculty, and distinguished scholars. During a one-month summer residential program, students take courses, work in labs, design and complete individual projects, and present their results. Their work occurs within subject-specific clusters focused on particular content areas across advanced mathematics and science. The COSMOS experience bolsters students' efforts to delve deeply into subjects of interest and to prepare for university study and/or careers in these areas.

Mission and Goals

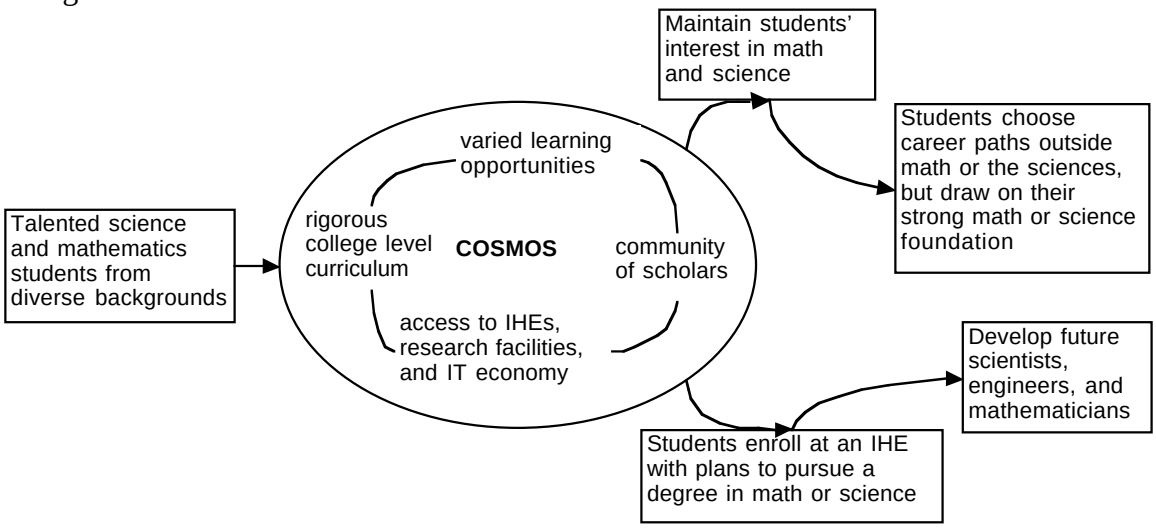
The mission of COSMOS is to motivate the most creative minds of the new generation of prospective scientists, engineers, and mathematicians who will become state, national, and international leaders in research and practice in these fields. The program aims to create a community of students who participate in and contribute to an intensive academic experience delivered by distinguished educators and scholars. COSMOS goals as articulated by the California Legislature and refined by the COSMOS leadership include:

- Engage talented students in high-level teaching and learning.
- Establish a community of scholars that fosters analytical thinking and experimentation.
- Connect students to institutions of higher learning and research facilities.
- Develop models for excellence in science and mathematics education.
- Enhance the state's economic climate by developing future scientists, engineers, and mathematicians.
- Ensure that the COSMOS student body reflects the geographic, economic, and cultural diversity of California's high school student population.

Evaluation findings presented in this report are organized to address the degree to which the COSMOS program has met the goals of the program as articulated above.

Theory of Action

Implicit in the COSMOS program design is a theory of action that proposes a model in which outstanding high school students in mathematics and science from diverse backgrounds enter COSMOS.



Through the program, participants gain access to high-level teaching at California's finest Institutions of Higher Education (IHE) and research facilities, resulting in a highly motivated community of scholars and peers. They have the opportunity to engage in challenging, hands-on learning opportunities designed to develop and nurture their talents and interest in advanced study to prepare them for careers as scientists, engineers, and mathematicians. COSMOS provides a fertile ground for development of models of excellence in science and mathematics education. Ultimately, this model posits the notion that the challenging environment and enthusiasm for mathematics and science generated by COSMOS will enhance California's economic climate by increasing the pool of talented, experienced, and energetic young mathematicians, scientists, engineers, and others who understand these subjects and have worked with them at advanced levels.

Program Description

In order to achieve their program objectives, COSMOS leaders developed a residential academic experience for outstanding high school students in mathematics and science. Each student's COSMOS schedule is built around a cluster consisting of two or three science or mathematics-based courses and a science writing or communications course. The COSMOS course clusters address topics not traditionally taught in high schools such as astronomy, aerospace engineering, biomedical sciences, computer science, wetlands ecology, ocean science, robotics, game theory, and more.

On a typical day, COSMOS students attend special lectures, take courses, and participate in labs or course-related field trips. Recreation and study groups are built into the evening and weekend schedules. Special activities and supervised field trips are planned for the weekends. While participating in COSMOS, students live in campus residence halls under the supervision of resident assistants who have been recruited and trained specifically to provide appropriate guidance and support to high school students living away from home, many for the first time. COSMOS participants have ample

opportunities to form friendships with peers who share an interest in mathematics and science. In addition to study and work on their projects, students are encouraged to engage in a full complement of social and cultural activities, such as attending theatrical performances, participating in friendly chess competitions or a few rounds of COSMOS *Jeopardy*, dance lessons, and a student-organized talent show.

During the COSMOS day, participants have opportunities to study an array of compelling topics from the physics of stars and galaxies to studies in neuroscience. Students gain conceptual understanding through science and mathematics-based courses that instructors develop with the goal of providing hands-on experience in cutting- edge fields such as astronomy, neuroscience, biotechnology, marine mammal biology, and engineering design, among others. Each campus offers mathematics and science course clusters that address different disciplines. Course clusters focus on current topics related to efforts of scientists working in their campus labs and research centers. For certain clusters, applicants must have completed prerequisite coursework, such as algebra or biology.

In addition to the university faculty, instructors, and lab assistants who teach and supervise the courses and labs, each cluster works with an outstanding high school mathematics and science teacher. Known as Teacher Fellows, these teachers join the COSMOS instructional team for the summer. Their roles vary somewhat from campus to campus, and even from cluster to cluster, and are further described later in this report and in *Appendix F*. The Teacher Fellows support COSMOS staff and students in several important ways. For university staff, they are an excellent resource for information about high school mathematics and science courses, curriculum, and instruction. They often attend classes and labs, so are available to help students that have questions about material covered. They support students directly by providing guidance and support in the development of the required program projects and related presentations.

At each campus, the COSMOS programs offer a special feature known as the *Discovery Lecture Series* during the course of the program. Every week, COSMOS participants listen to these *Discovery Lectures* delivered by distinguished scientists. These scientists provide a contextual reference for students who want to know who is doing the kind of advanced academic work and scholarship for which COSMOS participation prepares them. The lectures also offer students examples of how the work of these scientists and mathematicians contributes to society. The COSMOS faculty itself consists of accomplished practicing University of California scientists, mathematicians, researchers, and high school teachers. The COSMOS staff at each campus includes a program manager, an academic director, a residential director, and professional live-in staff.

Participants are selected on a competitive basis. Eligible students demonstrate exceptional academic achievement in science and mathematics and are completing grades eight through twelve in California public and private schools. Students are admitted based on standardized test scores, grade point average, achievement in science projects and/or competitions, teacher recommendations, demonstrated motivation, and community service. The legislation that established COSMOS permits a limited number of students from outside California to be admitted for each year's programs. Parents are encouraged

to discuss with their child his or her maturity and readiness to participate in a month-long residential program on a public research university campus.

Access to high-level teaching and learning in a university setting for high school-aged participants is a hallmark of the COSMOS program. COSMOS staff and faculty take seriously their charge to establish an academically focused community of like-minded students that share both a high degree of motivation and the academic guidance to explore subjects of interest during an intensive summer of study and related activities.

Funding

Total State funding for COSMOS in 2003-04 is $1.6 million, a reduction of twenty percent (20%) over the funding level in 2002-03. The establishing legislation indicated that state funds account for at least fifty percent (50%), but not more than seventy-five percent (75%) of the actual costs for each year's COSMOS program. The Legislature expected that a combination of participant fees and private support, such as foundation grants and both individual and corporate donations, would provide the balance of the operating costs. The Legislature limited annual increases in tuition to five percent (5%).

The cost for a full COSMOS program of 150 students at one campus during the summer of 2003 was $800,000. There are currently fully funded and fully enrolled programs on three UC campuses. Due to high demand and interest, COSMOS leadership hopes to launch a fourth campus program in summer 2005. In it's first year, a campus may expect to offer 80 student slots at a cost of $550,000. The number of students increases to 120 students at a cost of $650,000 in year two, and to 150 students at approximately $850,000 in year three. Private funding is being pursued to launch the new campus site.

COSMOS students pay tuition to participate in the program. The tuition for 2003 was $1,155. Tuition for 2004 will be $1,212 for California residents. This comprehensive fee provides a portion of the funding for room and meals in university residence halls, academic program costs and transportation (during the program session), as well as other expenses associated with field trips. Non-California residents pay the full tuition cost of $6,200 as required by the enabling legislation. Through the beneficence of private gifts, COSMOS awards full or partial scholarships to qualified applicants, on the basis of need.

Management

The University of California Office of the President (UCOP) administers the program, with leadership provided by an Assistant Vice President within the Educational Outreach Department, who includes COSMOS as one of many leadership responsibilities. UCOP COSMOS staff includes a program coordinator and a development officer. In addition, each COSMOS campus office includes a COSMOS Director and a coordinator, and additional support staff. Each campus develops and implements its COSMOS program with relative autonomy; however, student recruitment, evaluation, overarching policy guidance, public information, and program-wide Website management services are provided by UCOP and members of the COSMOS Advisory Board, in consultation with campus leadership. UCOP staff and COSMOS Advisory Board members are wholly responsible for private fundraising efforts for COSMOS.

EVALUATION

In March 2003, the COSMOS Management Team and Advisory Board selected a new evaluation team to conduct the COSMOS program evaluation. Dr. Rena Dorph, Director of the Center for Research, Evaluation, and Assessment (REA) at the Lawrence Hall of Science, University of California, Berkeley, leads this evaluation team. The team includes David Goldstein, from the University of California Office of the President, and REA Center staff.

The long-term goals of the COSMOS program lend themselves to a multi-year evaluation plan that allows us to both learn about participants' COSMOS experience while it is underway and track the impact of COSMOS into the future. We developed an evaluation design that focuses on the following questions using related methodology.

Question	**Related Methodology**
Who are COSMOS participants? In what ways do they reflect California's diverse student body?	• Participant demographic analysis. • Participant surveys & interviews *(program-wide & campus specific).*
What are COSMOS participants learning? How are they learning it?	• Participant surveys & interviews *(program-wide & campus specific).* • Program observations
How does the COSMOS experience contribute to participants' academic development and career trajectory?	• Participant tracking *(longitudinal).* • Participant surveys & interviews *(program-wide & campus specific).*
What impact does COSMOS have on creating future leaders in mathematics and science?	• Participant tracking *(longitudinal).* • Case studies of participants.

Accordingly, data collected for this evaluation include:

- Pre/post survey data from summer 2003 participants designed to collect 2003 evaluation data and establish a baseline for future alumni surveys.
- Alumni surveys (2000-2002).
- Demographic data for program participants (all years of the program).
- Interviews with a sample of university professors, Teacher Fellows, and COSMOS 2003 participants.
- Observations of the classroom, lab, and the Distinguished Lecture series during summer 2003.

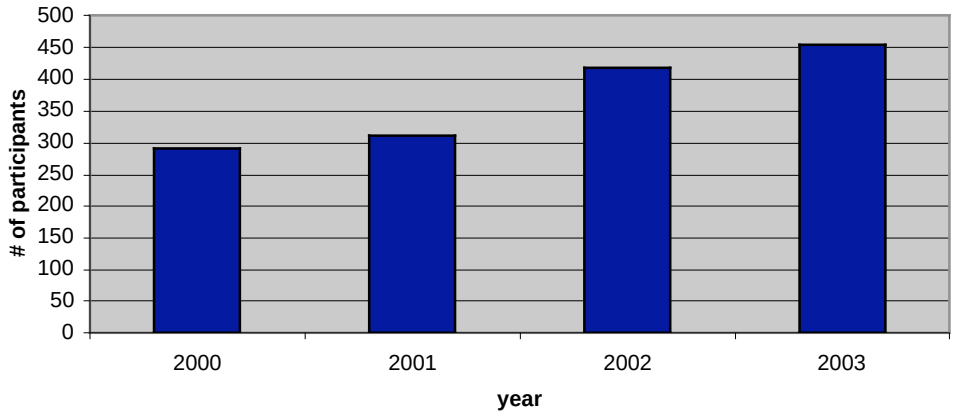
Site visit and interview protocols as well as survey instruments are provided at the end of this report in the *Appendicies*.

Our long-term evaluation plan will include collection of linked longitudinal data regarding COSMOS participants. However, to date we have collected one year of data, and previous evaluation methodology did not enable the linking of individual level records across years. Hence, quantitative data collected has lent itself to descriptive analyses only. We anticipate that as we gather multiple years of linked data, more sophisticated analyses will be possible.

Who are COSMOS participants? In what ways do they reflect California's diverse student body?

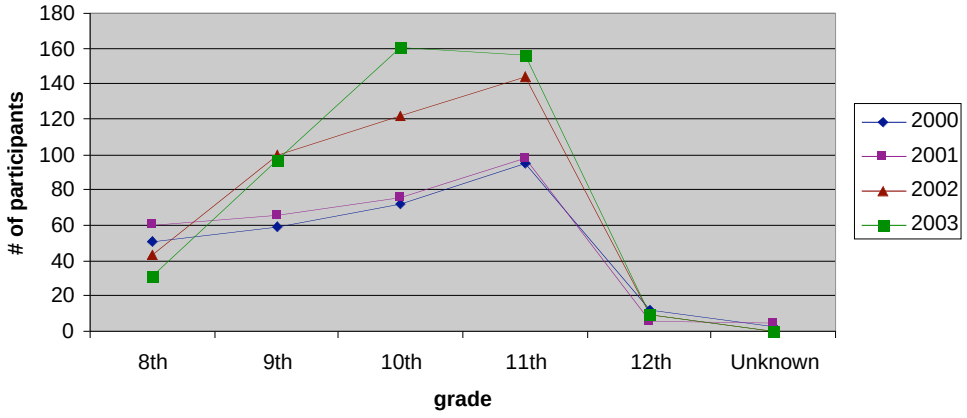
Data displayed in the following graphics indicate a steady upward trend in the number of participants from 2000 to 2003 from 292 to 454.

COSMOS Participants by Year



Not only have the numbers of participants risen, but the numbers of applications have also increased from 420 in 2000, when COSMOS was offered at only two University of California campuses, to 887 for the 2003 sessions available at three campuses. This steady increase of academically high-achieving students has permitted COSMOS staff to be selective regarding their admissions. As mandated by the authorizing legislation, COSMOS participants can apply as early as the eighth grade, for attendance during the summer prior to entering high school. The distribution of students by grades, presented in a graphic format below, portrays the reality that most of the participants who attend COSMOS do so in the summer following the tenth or eleventh grade.

COSMOS Participants by Grade



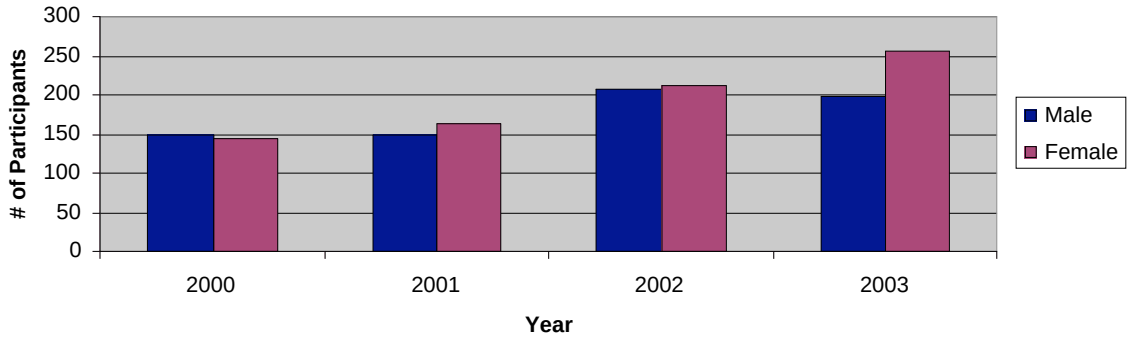
It is not surprising that the typical COSMOS participants are students entering grades ten and eleven. Students of this age are likely to gain the most from their participation because they are likely to have already taken advanced mathematics and science courses and are in a position to alter their high school schedules as a result of the new skills and/or interests they develop during their COSMOS experience. They are also still in a position to modify their post-secondary educational aspirations based upon the information they gain through their COSMOS community, a group of peers and mentors who are knowledgeable about the educational and professional environment COSMOS promotes. COSMOS programs leverage the impact of the academic and university-centric focus of the summer experience by providing group academic counseling sessions at all three campuses, and one-on-one college counseling at one campus.

The inclusion of entering ninth grade students in the program is a topic of ongoing discussion among students, staff, and faculty. Several people raised this issue during site visits. Several faculty and staff wonder if the entering ninth grade students (those who have not yet been to high school) are sufficiently academically prepared and socially mature to attend COSMOS. Students, too, notice the difference in maturity level. An entering eleventh grade student explained to evaluators that while some entering ninth graders were mature enough so that it was "hard to tell their age," many of the younger students held back the older ones both academically and socially. He explained that in high school he had already taken A.P. biology, and that being in a COSMOS cluster with younger students who did not have that background made the program less challenging than he had hoped it would be. He also explained that socially, the fact that the policies and procedures were developed with younger students in mind, rendered the social aspects of the program more restrictive than he would have liked.

At the same time, the entering ninth grade students describe having a positive COSMOS experience and articulate its importance in shaping their attitudes towards achievement in high school. An entering ninth grade female participant, whose teachers and professors described as an exceptionally bright and mature student for her age, explained that her experience in COSMOS had been engaging, challenging, and eye-opening. When asked how "the academic program (classes, lectures, field trip) [in COSMOS] compare with your school-based science and mathematics program" she responded "totally different—this is so much better—here they already assume that you know what you know, there is not as much review, and if you need help, someone will help you." An entering ninth grade male explained that COSMOS helped him become more motivated to get good grades in high school, more interested in going to a university, and raised his future career aspirations. In his words, COSMOS "inspired me most because it told us what we need to do and that we can get good jobs and I don't want to be poor." Thus, while there is no question about whether the COSMOS experience is a positive one for entering ninth grade students, there are very compelling reasons for changing the eligibility requirements so that the youngest students the program would serve would be students who had already completed their first year of high school.

Not only do COSMOS participants range in age, but the COSMOS program also achieves a gender balance. It is well-known that women are underrepresented in the fields of mathematics, science, and engineering. COSMOS is well-positioned to help turn that tide. With respect to participant gender, COSMOS participation has tended to be fairly evenly split among males and females, but the 2003 record indicates a slightly higher percentage (56%) of female participants.

COSMOS Participants by Gender



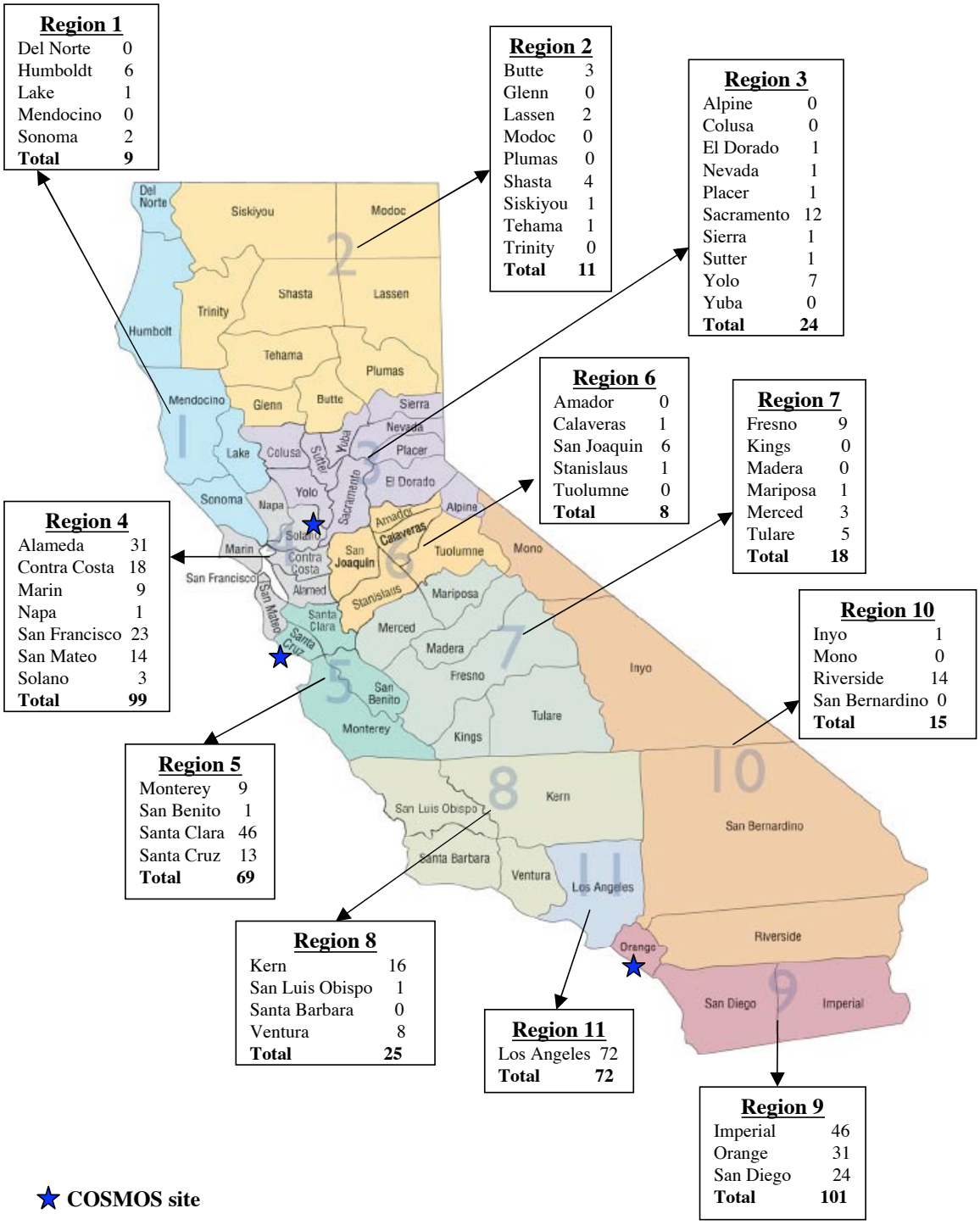
Once in the COSMOS program, female students have many opportunities to interact with positive female role models who allow them to see that a science or mathematics career may be an accessible option for them. One Latina student explained to evaluators that the fact that one of the Teaching Assistants in her lab was Latina helped her feel like her goal of going to graduate school in a science field was within her reach. COSMOS staff should continue to recognize the importance of providing opportunities for students to engage with female scientists and mathematicians. Two students' conversation prior to one of the discovery lectures provides additional evidence of how important it is to have female faculty, scientists, and graduate students engaged in the COSMOS program.

Female Participant:	"It's actually a woman—that's amazing"
Male Participant:	"Why?"
Female Participant:	"Because every other *Discovery Lecture* has been done by a man."
Male Participant:	"Really?"

In addition to their efforts to recruit and engage girls in the study of mathematics and science, COSMOS recruiters make every effort to encourage applications from academically motivated students representative of California's geographic and cultural diversity. These recruitment efforts have been quite successful. Since 2000, 46 of California's 58 counties have sent students to COSMOS; in 2003, COSMOS participants hailed from 42 counties. The regions delineated on the following map are based on the California County Superintendents Educational Services Association (CCSESA) regional designation that divides the state into eleven distinct regions.

COSMOS Participants by County

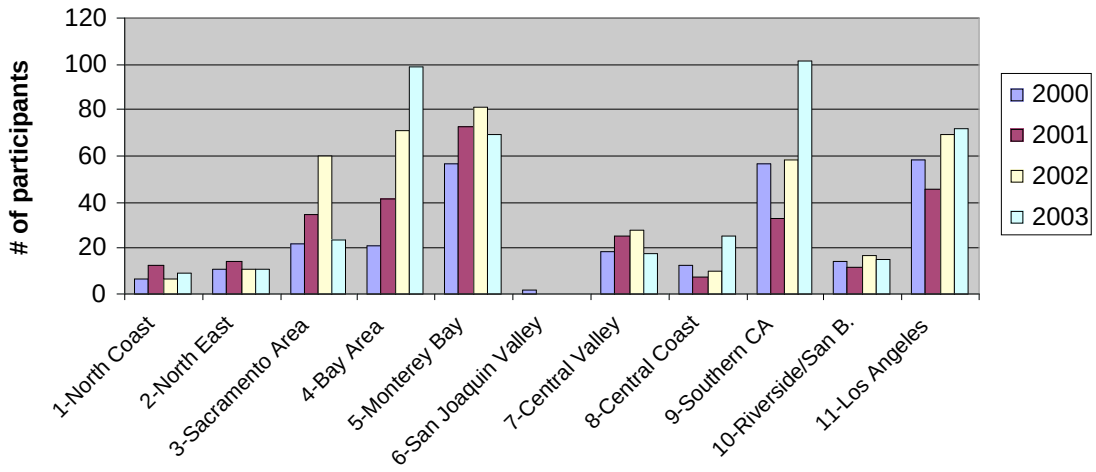
Summer 2003



The regional distribution of COSMOS participants displayed above is relatively proportional to regional population, with higher representation (as compared to the total population of eighth through twelfth grade students) occurring in Regions Four and Five and in Imperial County.

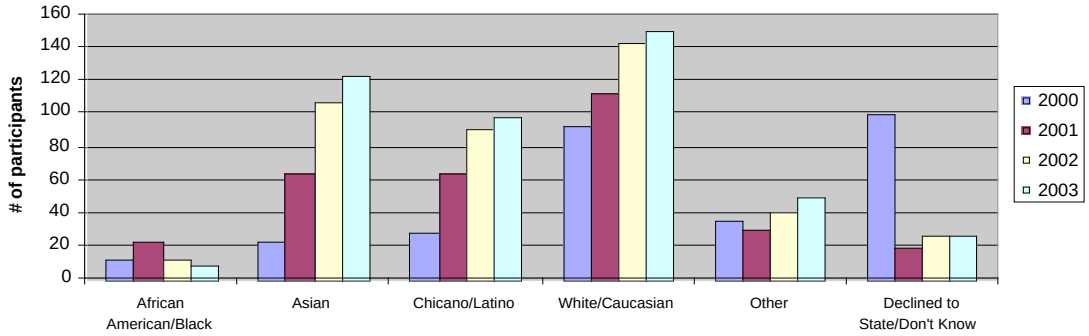
The graph below portrays the participation rates by region across the four years, offering an interesting picture of trends over time. The graph highlights the growing number of participants from the Bay Area and Southern California, and the declining number from the Sacramento Area and Monterey Bay (interesting given the presence of sites in Davis and Santa Cruz). Two reasons may account for this trend. First, as COSMOS becomes better known, admissions become more competitive and less local. Second, COSMOS recruiters have made concerted efforts to reach out to diverse California communities in order to promote broad representation of the demographics of California's student population in the COSMOS program.

COSMOS Participants by Region



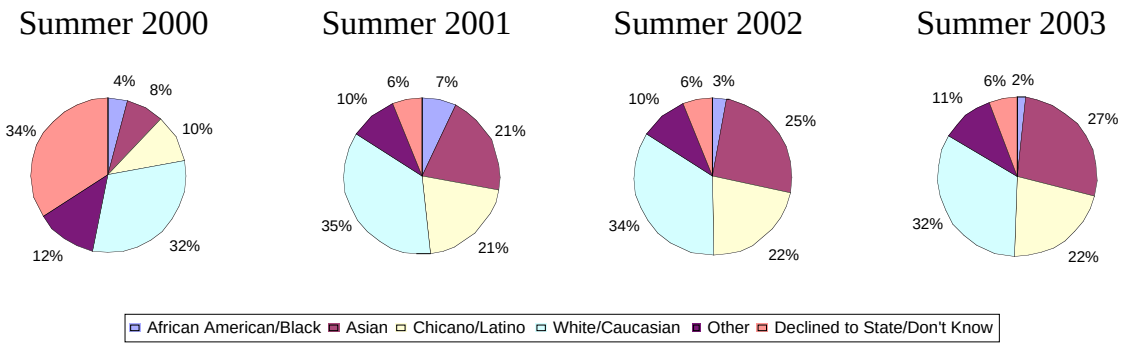
Data on the ethnicity of COSMOS participants demonstrates a consistent increase (throughout the history of the program) in the number of Asian, Latino, and Caucasian students, in accordance with the total increase in participants.

COSMOS Participants by Ethnicity



However, African American participation has declined slightly since 2000 despite efforts to reach out to the high-achieving African American student community and to increase their awareness of the program.

Proportionally speaking, representation of Asian, Latino, and Caucasian participants has remained relatively steady since summer 2001[1] with the overall population balance among these three groups and "other" over the years.



Recruiters have done an exceptional job of reaching out to some communities that are typically under-represented in similar programs. For instance, efforts to inform low-income students in the Imperial Valley, a semi-rural region of the state, have yielded impressive numbers of qualified applicants and attendees among high-achieving students from this community. The diversity of the applicant pool benefited from outreach and recruitment in the Valley, a region that is home to a high number of youth typically under-represented in programs like COSMOS. Despite the successful recruitment efforts in the Latino community of the Valley, the decline in both the number and the percentage of participating African American students to COSMOS stands out as a disappointment. While COSMOS staff has successfully tapped into the high achieving Latino population, it has yet to yield similar results with African American students. Efforts to develop a cadre of African American spokespeople (university staff, teachers, community leaders) to engage in the successful outreach efforts like those that have succeed in Imperial Valley high schools have not yet been able to create a high demand or large applicant pool. The COSMOS leadership is aware of this, and is redoubling efforts in 2003-2004 to meet this challenge by seeking to provide information to community leaders and academics with links to high-achieving African American students and teachers.

The COSMOS program enrolls students from diverse linguistic backgrounds. While the majority (77%) of COSMOS students report that English is the primary language spoken in their home, twenty-two percent (22%) report use of an Asian language and fifteen percent (15%) report Spanish as the primary language spoken in the home. While this is not proportionally representative of the linguistic diversity of California's high schools[2], it is a highly diverse group when compared to California's high-achieving high school students.

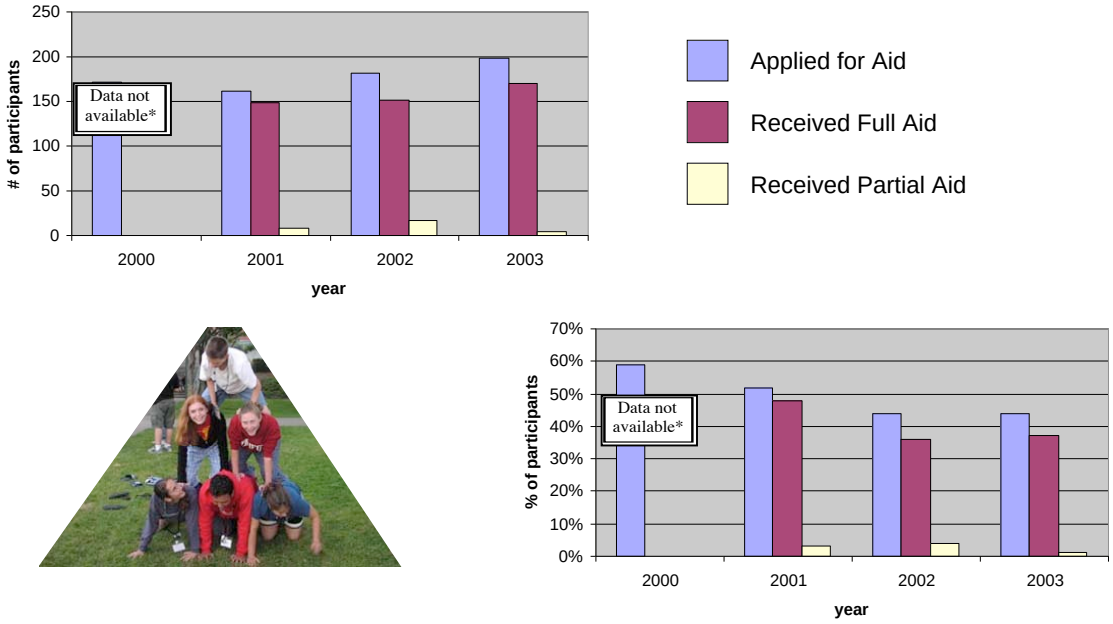
[1]Summer 2000 data is difficult to interpret due to the high percentage of students for whom we do not have ethnicity data.

[2] California's grade 8-12 student population includes 26% Spanish speaking Limited English Proficient (LEP) and Fluent English Proficient (FEP) students and 5% Asian language speaking LEP and FEP students.

In addition to engaging students from geographically, ethnically, and linguistically diverse backgrounds, COSMOS draws students from across the socioeconomic spectrum. One indicator of a student's socio-economic background is parents' educational level. More than half of COSMOS participants come from homes where parents attended college, and, in about one-third of the cases, also engaged in post-graduate studies. More specifically, thirty percent (30%) of COSMOS participants' mothers and thirty-six percent (36%) of participants' fathers earned a Masters, professional or doctoral degree and about twenty percent (20%) of parents held a college degree. Thirty-five percent (35%) of participants' mothers and thirty-three percent (33%) of their fathers had earned less than a bachelor's degree. Since educational research has found that students' mothers' level of education frequently correlates with students' academic achievement, we are interested in tracking whether COSMOS students deviate from the trend by pursuing advanced degrees in mathematics and science.

COSMOS provides considerable financial aid to students who would not be able to attend absent such assistance. This has been an important factor in successfully attracting talented students from across the socio-economic spectrum. According to the data displayed below (incomplete data available for 2000), almost all eligible financial aid applicants received full financial aid; eligible students who did not receive full financial aid packages received at least partial assistance. Full financial aid means that the student attends COSMOS without paying any fees (except the $20 application fee, which, when circumstances warrant, may be waived).

COSMOS Financial Aid



Almost fifty percent (50%) of the COSMOS student body received full or partial aid in 2001. In 2002, approximately forty-five percent (45%) received aid, and thirty-seven percent (37%) were provided such aid in 2003. Given the increase in the total number of participants, this represents an increase in the number of students receiving financial aid. In order to optimize the number and diversity of the students that COSMOS can admit, COSMOS leadership needs to strategically plan program growth, balancing the numbers of those students who require financial aid with the numbers who do not.

What are COSMOS participants learning? How are they learning it?

The philosophical foundations and basic structure of the COSMOS approach remains constant across all three campuses, but there is some degree of variation and distinct "personality" evident from site-to-site. Each COSMOS campus designs stimulating and challenging course clusters. These clusters are the organizational structures that permit COSMOS to appeal to a variety of students and faculty. Campus leadership develops cluster topics based upon both their perceived interest to students and the existence of expertise at the respective campuses. Cluster offerings are bolstered through the engagement of local resources including labs, professors, and other facilities in the vicinity, otherwise inaccessible to high school students.

Clusters

In order to provide students with the chance to experiment with state-of-the-art technology within the context of a cutting-edge scientific discipline, each campus develops a menu of clusters designed to appeal to students who are interested in pursuing careers in mathematics and science.

2003 Course Clusters		
Davis	**Irvine**	**Santa Cruz**
Bio & Materials Science	Aerospace Engineering	Astrophysics & Logic: From the Mind to the Skies
Biomedical Sciences: Medical and Veterinary Responses to Infectious Diseases	Astronomy & Astrophysics	Chemistry & Mathematics: From Life to Thought
Biotechnology	Biology: Exploring the Human Brain	Ecology & Behavior on Land and in the Sea
Computer Applications in Mathematics & Engineering Mechanics	California Ecosystems: The Living Laboratory	Lab Science in the Everyday World
Computers in Physics and Robotics	Computer Game Development: The Power of Programming	Marine Mammals in the Past, Present, & Future
Earth's Dynamic Environment & Global Change: Water on Earth	Mathematics: Combinatories and Discrete Probability	Oceanography & Marine Animals
Mathematics: Geometry of Surfaces	Mathematical Engineering: Powering the Automobile	Secret Coding: Cryptography & Programming
Optical Science: Great Physical Science Ideas Since Galileo		Starts, Sight & Science: Astronomy Today
		Wireless 'Bots: Robotics & Wireless Communication

The scope, rigor and exposure to advanced research techniques that characterize the COSMOS experience is, perhaps, best illustrated by examining one sample cluster. The *Lab Science in the Everyday World* Cluster at UC Santa Cruz provides a good example of the cluster-driven COSMOS experience.

The *Lab Science in the Everyday World* Cluster at UCSC includes three major components: chemistry class, toxicology class and a science communication class. In chemistry class, students explore different aspects of everyday chemicals grounded by an emphasis on organic chemistry through lectures. They put these lessons to the test in the laboratory that is tightly linked to the coursework. Their toxicology class takes them out into the field through trips to the (nearby) Younger Lagoon and fieldwork on a boat in the Monterey Bay. The toxicology lab gives students the chance to experiment with liver cells taken from mice. The science communication class provides guided practice in the art of communicating the results of experiments and analysis, a skill-set that will prove critical to their educational and professional success. Students discuss and engage in scientific writing and public speaking in preparation for their COSMOS presentations and their future careers. They also learn to use Powerpoint and other "tools of the trade" that enhance their ability to present their findings.

Courses

Each cluster includes several different related courses. In the end-of-program participant surveys students were asked to evaluate their courses. Data from this survey indicate that students tend to agree that their science and mathematics courses were well organized and interesting to them. There was some variation in responses to a question about pacing in the classes, with a general consensus that pacing was fine most of the time. However, as might be expected given the wide variation among students—some of whom attend schools with advanced mathematics and science foci and others who attend schools that are less targeted—the responses reflected somewhat mixed opinions. There was a consensus that students liked their classes and became more interested in the area of study. Students also reported that COSMOS classes had provided them the opportunity to gain knowledge that would be useful to them in their high school classes as well as when they apply to the university. When examining the results of the writing/science communication classes, however, students evaluated these courses much less favorably.

Students in classes observed for this evaluation participated enthusiastically and professors did not simplify the course content. In fact, professors consistently spoke of their satisfaction with the rigor they were able to maintain despite the fact that these are high school students. Professors did not expect students to merely take notes, but encouraged them to participate fully during the lectures. Often, Teacher Fellows and teaching assistants circulated among the students during labs to offer suggestions and answer questions. This level of support allows the professors to maintain the high level of discourse the program offers, regardless of whether all students arrive with the same preparation. Students also recognized, as evidenced in surveys and interviews, the value of the class rigor, access to college level material and high quality lab equipment, and the high level of academic support they received in their classes.

The Bugs

Students from the *California Ecosystems: The Living Laboratory* cluster at the UC Irvine campus were asked to think and behave as scientists do, in order to gain a scientist's perspective on the work of science, both in the field and in the laboratory. On a fairly typical COSMOS day, students had planned to return to a small grove of bladder pod plants that they had previously tagged and numbered on the bank of a creek located in a marsh preserve bordering the university campus.

As they wait for a sudden rain shower to end, these students gather in a lab to check in with their professor, a University faculty member who directs this particular lab and cluster. Upon arrival, he asks about their experiment, suggests refinements to their design, and helps them locate the materials they will need to conduct the insect census they plan and store specimens.

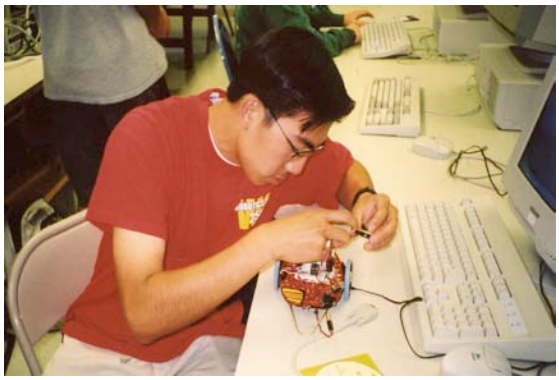
Three girls have developed expertise in the identification, counting and collection of an insect known as the Harlequin beetle. Through prior observations they noted that the Harlequin lives on the bladder pod. They have observed that the bladder pod grows near the sage plant and that proximity to sage appears to influence the bladder pod's capacity to flower, which in turn attracts the Harlequin. The group had decided to conduct an experiment on bug settling behavior and plans to collect their samples today.

Before leaving for the marsh, the girls refined their research question, noting that they hoped to determine whether the insects were attracted to the plants by odor. Discussion with the professor lead to the formal identification of their experimental paradigm, a situation known as "associated resistance," whereby a plant avoids a herbivore by using another species as a bodyguard: perhaps the odor of sage allows the bladder plant to avoid being consumed by the Harlequin. It was obvious that these students, who may have never before considered spending the summer handling bugs, had become expert at differentiating nymphs, from babies, to mature Harlequins as well as indifferent to the fear of touching these critters. They showed no squeamishness and offered the untrained observer, cogent explanations of how the insects inject their stickers into the vascular tissue of the plant to obtain the nutritional material they eat.

After completing the specimen collection, the girls observed that the earlier rain showers had led to an increase in the snail activity. Prior to returning to the lab, they examined and discussed the snails that had appeared all around them, hypothesizing that the unusual snail behavior, an observable movement of the membranes, was the response of their antennae to atmospheric changes. By now the professor had returned in a van. He appeared content as they briefed him on the activities and concurred with their observations. Before leaving the preserve, the professor suggested that they collect branch samples for another planned experiment.

July 30, 2003

The ‘Bots



Today, the *Computers in Physics and Robotics* cluster at UC Davis spends the morning class, Computational Physics, in the computing lab. Students sit at desktop workstations writing code that builds on prior programs they had written. The code they are writing gives them an opportunity to practice the language C, which is the basis for their robot design lab that follows this class and challenges them to solve complex mathematical problems.

They are moving quickly, typing, and engaging in constant conversation with their neighbors and with the professor who is half-seated at a stool and terminal in the front of the room. After spending some time working, they spend the second half of the class, reviewing their work. The professor explains why one approach makes sense and how another can be modified, or why it might not work. His dialogue is peppered with phrases such as, “I urge you to keep a copy of this program before altering it,” and “I’ll share these amazing facts about this,” and “this is easier for those who have already had calculus.” It is clear that this is a challenging assignment and that some students have been successful and some are confused. Although this class appears to push the limits of many students’ understanding of the material, it is clear that students have access to strong peer support, a professor willing to address individual questions, a teaching assistant, and a Teacher Fellow to help them as they struggle to complete the assignment.

Later, the students attend a robotics class. The professor begins the day’s lessons by removing a simple robot out of a plastic box. He demonstrates how the ‘bot responds to a series of commands. He then leads an interactive discussion about the code students would need to write to duplicate and expand on this demonstration. The students are relaxed and engaged. They enthusiastically share ideas and argue about approaches. The professor enjoys the conversation and allows students to work out their disagreements. Most of the students participate in the discussion, with the professor chiming in, only occasionally, with a suggestion or an explanation.

The students’ next several hours are a follow-up lab in a nearby building that houses the campus mathematics department and many of its faculty offices. In a long hallway, the professor from the previous robotics lecture has created an obstacle course with colored duct tape on the floor. The students, all of whom have laptops that are networked and can beam the programs they write to receptors on their Lego-like robots for use during the program, find their boxed robot and begin to write programs that will guide their ‘bots as they navigate the obstacle course in the hallway. Students work alone and in pairs, actively engaged and excited about applying what they have been studying. Again, there is a teaching assistant, a professor and a fairly constant stream of COSMOS staff or faculty dropping by the hallway to observe and answer questions.

July 14, 2003

Field trips
Field trips, an integral part of all three COSMOS programs, connect students to both non-university research facilities and to the larger scientific and information technology (IT) economy. Though each program offers some trips that are purely recreational, each cluster includes field trips that allow the students to visit sites that are particularly relevant to the subject matter they are studying. For example, students have access to the resources within the geographical region of the host UC campuses. At Irvine, excursions may include the Palomar Observatory, NASA Jet Propulsion Laboratory, Catalina Island, San Joaquin Freshwater Marsh and Laguna Tidepools. At Santa Cruz, the Monterey Bay Aquarium, kayaking in Elkhorn Slough, Joseph M. Long Marine Laboratory, and UCO Lick Observatory enrich course content. At Davis, students may visit Genentech, the Lawrence Livermore National Lab, Aerojet, and McClellan Air Force Base.

Teachers
Our observation clarified that, within the COSMOS program, students come to identify with two overlapping and integrated "communities:" the larger, overall community of a campus COSMOS program as a whole (described below) and the smaller, cluster community where the students spend much of their classroom, lab, project and field trip time. Within the cluster, the students work closely with one another, with University faculty who teach their classes, with teaching assistants who lead their labs, and with a Teacher Fellow, whose role varies from campus to campus. The variation among faculty and other staff contact with students offers one example of this local variation. At two of the three campuses, the faculty that worked with clusters were exclusively drawn from the ranks of full university professors, while at a third campus, the faculty included lecturers or university instructors. Future annual reports will examine the impact that this modification has on the program, as data are not yet able to discern any overarching findings. It will be interesting to consider the question of whether lecturers who are currently conducting research as part of post-doctoral programs or university instructors provide different classroom experiences as compared to ladder-rank faculty.

Results from the end-of-program participant survey indicated that, with only a few exceptions, COSMOS 2003 participants found their instructors to be knowledgeable about the subjects they taught, well prepared during class, and interested in student learning. Students also indicated that they "gained a lot from interacting with instructors." Class observations and student interviews yielded similar findings. Through classes, labs, and field trips, COSMOS students establish direct collegial relationships with professors, COSMOS staff, and Teacher Fellows. Evaluators observed students meeting with professors in their offices and at lunch. In these ways, COSMOS students have unprecedented access to faculty.

Discovery Lectures
During a typical COSMOS session, each campus hosts weekly or bi-weekly *Discovery Lectures*. This lecture series brings students and staff from all clusters together to learn about research from acclaimed scientists or mathematicians. During the Summer 2003, COSMOS participants at several campuses enjoyed a *Discovery Lecture* by Professor of Chemistry and Earth System Science (Nobel Laureate in Chemistry, 1995), E. Sherwood

Rowland. Dr. Rowland gave a timely and content-rich talk entitled, "The Rapidly Changing Atmosphere: Ozone, the Greenhouse Effect and Global Warming." Dr. Rowland, the Donald Bren Research Professor of Chemistry and Earth System Science at UCI, discussed his research regarding how the gases mankind has introduced into the atmosphere have changed it and continue to have an impact on our planet. He focused on stratospheric ozone depletion, smog, and global warming. In addition to explaining his technical findings, Dr. Rowland shared humorous anecdotes about some of his early sample collection techniques and offered practical explanations for the phenomena he discovered. High school students rarely have the opportunity to join an informal talk or ask questions of such a world renowned and accomplished scientist, but at COSMOS, this is just another afternoon activity. Dr. Rowland has generously delivered similar lectures each year at the UCI campus and, in 2003, at UC Davis as well.

At UCI, Jay Smith III, the chairman of *Play-It-Now*, an electronic media and content company that develops and distributes games using interactive technologies of cable and satellite television, delivered a *Discovery Lecture*. An inventor holding more than 40 patents, a product developer, and former Mattel Toy Company executive, Mr. Smith holds a Master of Science from the California Institute of Technology and describes himself as "an engineer gone wrong." In his talk, Mr. Smith demonstrated some of the products that he had brought to market through a highly interactive and enjoyable presentation. He described what it takes to create some of the toys and electronic games that dominate the entertainment market today. More importantly for the COSMOS students, though, were Mr. Smith's slides and explanations of the highly advanced mathematical modeling required for the development of today's games—like the popular DVD that simulates the swing of golfer Tiger Woods. Students were surprised to learn about the level of detail required for this simulation, which drew upon physics to calculate how the dimples on the golf ball impact the distance it travels after it is hit and the advanced mathematics used to precisely simulate the golfer's swing. He then turned to an application of chemistry that one of his companies worked on, a system for inkless thumb printing at check cashing venues. His lecture also referenced the impact of economics on the production and manufacture of toys as he explained the cost structure for toy development and production influences under which toys are produced. This lecture successfully demonstrated how advanced mathematics, science, computer science and economics led to Mr. Smith's successful career in two fields that were of great interest to the students in attendance: electronic toy development and media.

At UC Santa Cruz, students enjoyed a lecture entitled, *The Milky Way, Schroedinger's Cat & You: The History of Galaxies and Where You Fit In*, by Dr. Parugra (Raja) Guha Thakurta and Dr. Sandra Faber. Through an interactive, multimedia performance that took place in the campus theater/media arts center, these two distinguished astrophysicists were able to command the attention of the crowd as they linked the topic of the formulation and life of galaxies to the students and their place in the universe. They began by reminding students that carbon, nitrogen and oxygen atoms, the building blocks of life on earth, originated on other stars in the Milky Way and M3 (Andromeda). Their visual aides helped them convince students that a galaxy does, in fact, look much like a frisbee. They employed graphics that required the very latest developments in the

field of astrophysics in order to demonstrate the patterns they described. It is not every day that high school students can watch 3-D movies that illustrate galaxies moving, or learn about the process of galaxies clustering and attracting more galaxies to increase their size. At the conclusion of the lecture, each of the scientists offered a personal testimonial about how they enjoyed their work and what they thought it meant to the field, providing a very human face on what could seem like the distant world of cutting edge scientific research to some students.

Community

One of the goals of the COSMOS program was the establishment of a community of scholars. The survey responses from current participants reveal that not only do students feel that they have gained access to academic role models through their contacts with professors and lecturers, but they place a great deal of importance on the peer relationships they develop through COSMOS. For example, when asked whether the desire to live on a university campus was an "important" or "very important" factor in their decision to apply to COSMOS, 209 of this year's students said "yes" before coming, but 327 said "yes" after, proving that this interaction was an important part of their COSMOS experience. Similarly, in surveys prior to COSMOS, students place little value on living away from home as a reason for their decision to apply to the program; post-program surveys revealed that it was an "important" or "very important" aspect of their experience. Further, in pre-surveys students reported that spending time with other students interested in mathematics and science was not a very important reason for applying for many participants, but it was overwhelmingly ranked as an "important" or "very important" aspect of their experience in post-surveys. Interviews with participants revealed that students valued the opportunity to work with peers in formal and informal teams. Students frequently praised the opportunity to engage with professors and with one another. Their comments and survey responses highlight the value of this community of scholars and its role in fostering not only analytic thinking and experimentation, but also in promoting excitement about science and mathematics. One entering eleventh grade student articulated the importance of this community when asked if he would recommend COSMOS to a friend. He replied, "Yes, [because the students here are] more like you...they are of higher intelligence and academically smarter." He said that being around "intelligent people [with whom you] spend the whole day and get to know academically and personally" was a highlight of the program for him.

The COSMOS community is not limited to student-to-student or student-to-professor contact, but includes the relationships among Teacher Fellows and professors. This relationship seems to reflect two distinct models (described in greater detail in the Teacher Fellows report in *Appendix F*). In one model, the Teacher Fellows and professor establish contact and work fairly closely in planning and implementing the cluster course work. For instance, at one campus, the Teacher Fellows plans and supervises all field trips. Another type of relationship between Teacher Fellows and professors appeared to offer the Teacher Fellows less opportunity to participate in the development of the courses, less contact with the professor, and more of a support role in working with students. We cannot comment on which of these is preferable, but will continue to examine this issue.

Our alumni data indicate that COSMOS students continue to maintain contacts established during the program, and these alumni are interested in remaining in contact with others via listservs and follow-up academic and social events as portrayed on the table below:

Would you be interested in participating in any of these activities after completing COSMOS?

	Yes	No	I'm not sure
Attending a COSMOS alumni reunion near my home.	75%	9%	16%
Attending lectures/events near my home.	74%	8%	18%
Serving as a mentor for future summer COSMOS programs.	69%	13%	18%
Giving presentations about COSMOS to high schools and/or community groups near my home.	49%	25%	26%
Attending an all-day alumni event during a COSMOS summer program.	73%	9%	18%
Participating in an online alumni network.	59%	10%	31%

COSMOS alumni also return to the program as resident assistants and lab technicians. Campus leaders are currently engaged in efforts to establish internships for students following their participation in the program. As we are able to add to our understanding of the non-academic reasons students are attracted to COSMOS, we think it will become clear that while students apply primarily for academic reasons, once they enter the COSMOS program, they find the community to be a very important part of their experience.

The COSMOS Learning Experience

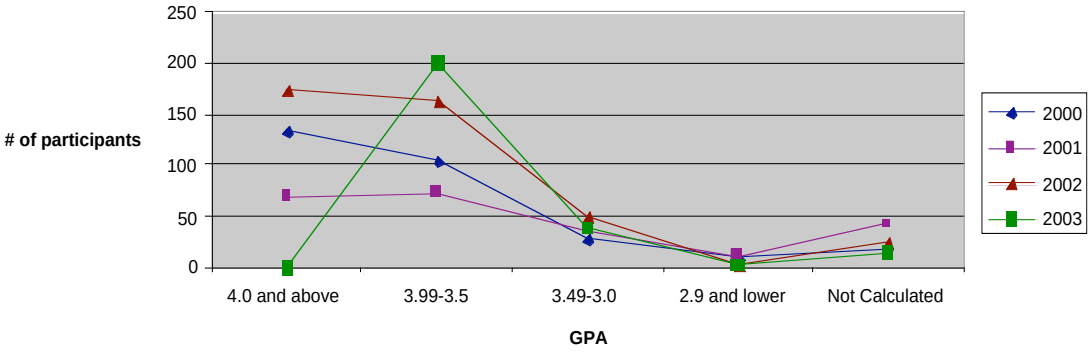
COSMOS is meeting the challenge set forth by the Legislature to provide promising students with extraordinary learning opportunities to advance in mathematics, science, and engineering. COSMOS has created an effective program. Refinements continue, and are a necessary part of the program. The current combination of intensive academic coursework, opportunities to conduct experiments in labs and to observe facilities used by professional scientists and researchers, field trips, the opportunity to live on campus among a group of peers and mentors, and access to highly accomplished professionals willing to share their experiences through informal conversations and semi-formal lectures is an excellent formula for nurturing and supporting these already talented high school students. The participants themselves strongly endorse this observation through their responses to survey questions. Overall, ninety-seven percent (97%) of both 2003 participants and alumni agree that the COSMOS experience was a positive one for them, with eighty-four percent (84%) of respondents indicating that they "strongly agree" with the sentiment. The evaluation team completed its summer with the impression that COSMOS participants are learning something of lasting value to their own academic and professional careers, and are doing so in a way that is both effective and enjoyable.

How does the COSMOS experience contribute to participants' academic development and career trajectory?

Achievement and Motivation

A review of the data on students accepted to COSMOS leaves little doubt that COSMOS applicants and those accepted to the program are not only talented students with outstanding records of academic achievement, but they are also exceptionally highly motivated. This is confirmed through conversations with the professors who have taught COSMOS students dating back to its inception. Professors report a steady improvement in the quality of students attending COSMOS. Virtually all professors credit the recruitment efforts and the selection committees' success at identifying high quality students. These efforts result in cohorts of top-notch students entering their classrooms and labs each summer. Interviews with faculty confirm the conclusion that we glean from a review of the data: COSMOS has been very successful in its efforts to attract students who are both motivated and accomplished in the fields of mathematics and science. The professors' comments are confirmed by trends for participants' GPA that demonstrate a consistent upward movement since COSMOS began in 2000. COSMOS students compare favorably with freshmen admitted to the University, according to faculty members who teach both groups.

COSMOS Participants by G.P.A.*



**Note: G.P.A. is self-reported by the students as part of the application process*

Students' level of motivation is also confirmed by survey data. Summer 2003 participants' responses to pre-program and post-program surveys indicate that typical COSMOS participants enter the program with high aspirations and educational goals that they had established prior to starting COSMOS. Almost half of the participants had previously attended a residential summer program on a college or university campus. Over eighty percent (80%) of the students who responded indicated that one of the important reasons that they decided to attend COSMOS was because they wanted to explore mathematics and science as a possible career or as a major in college. Ninety-

two percent (92%) began the summer indicating that they were motivated to learn more science and at the same time eighty-nine percent (89%) indicated they were motivated to learn more mathematics. Among this diverse group of students, only nine individuals thought they would attend a California Community College prior to beginning the program. At the same time, more than eighty percent (80%) were already planning to attend graduate or professional school prior to attending the program.

For many, motivation to learn science increased over the course of the month. For example, of the 109 students that marked "somewhat agree" with the statement "I am motivated to learn more science" during the pre-program survey, 52 (almost 50%) of them marked "strongly agree" with this statement by the time they completed the post-program survey four weeks later. And 18 out of 27 (66%) students changed their response to this statement from "neither agree or disagree" to either "somewhat agree" or "strongly agree" by the end of the program.

Survey data also reveal that only a small number of students became less motivated to learn science over the course of the program. For instance, of the 270 students who marked "strongly agree" with the statement at the outset of the program, only 29 (11%) changed their response—28 to "somewhat agree" and 1 to "neither agree or disagree" by the end; of the 109 students who marked "somewhat agree" with the statement prior to the program, only 2 of them marked "somewhat disagree" and 7 marked "neither agree or disagree" at the end of the program.

The companion question regarding mathematics yields different trends. In this case, while many of the students became more interested in mathematics as a result of their COSMOS experience, a significant number became less so. For example, of the 225 students who marked "strongly agree" regarding the statement "I am motivated to learn more mathematics" at the outset of the program, 63 (25%) of those students were less motivated to learn more mathematics by the end-of-the-program survey. Of the 142 students who "somewhat agreed" with this statement prior to the program, only 36 (25%) students became more interested by the end of the program. These trends remain constant when you look at the results from students only participating in the mathematics-related clusters. Among the 66 students who responded to the pre-post surveys who were in the mathematics clusters, 13 out of 50 students (26%) changed their response from "strongly agree" at the outset of the program to either "somewhat agree" or "neither agree or disagree" by the end. At the same time, only 4 out of the 14 (28%) students changed their response from "somewhat agree" to "strongly agree."

On their own, these mathematics results would be expected as the goal of the program is to help students shape and define their interests. However, reviewed alongside the results for the companion question regarding science, it leads us to ask why the program is not as successful in fostering, building, and maintaining student interest in mathematics as it is in science. Future evaluation efforts will examine this issue in greater depth. The cases in which students became less motivated or interested in mathematics and or science that were revealed by the survey data can be illuminated through the interviews conducted with COSMOS students. From these interviews we learned that COSMOS helped

students both further their intellectual curiosity and learn what they were not interested in. For most participants, this meant that students were able to refine and focus their educational and research goals. The experience introduced them to disciplines of science and mathematics of which they may not have been previously aware, or at least fields that they had not considered to be future career options. For others, it enabled them to realize that the technical nature of advanced study of science or mathematics might not interest them as much as the high school version of science or mathematics.

Furthermore, COSMOS provides information, resources, and contacts that energize and direct the students' own efforts to improve their preparation for college and careers in fields related to mathematics and science. Our observations underscore the capacity of the program to provide an opportunity to hone subject area interest and participate in experiences that, if not for the COSMOS program, students might never have been exposed to through a typical high school college preparatory curriculum. Examples of this kind of hands-on experience abound across the COSMOS subject clusters, for example: participants in a robotics cluster build and write the operating programs for their *'bots*; in a marine biology cluster, students work in labs and out in the field with active marine researchers; computer game designers are challenged to understand the advanced mathematics required to write programs that power today's computer game industry; clusters focused on astrophysics have access to some of the world's most advanced facilities; biomedical sciences cluster participants have the opportunity to observe cutting-edge genetics research tools and techniques or to witness veterinary surgery in progress.

Given the fact that COSMOS students are, generally speaking, exceptional in their talents, motivations, and orientation towards advanced educational goals, it is clear that the impact COSMOS will have on them is not merely to stimulate them to further their educational goals. Rather our data suggest that perhaps the most notable impact of COSMOS is through the nurturing and exposure to the elements of the COSMOS program. Therefore, it seems clear that since students arrive with high interest and motivation in science and mathematics, the objective of COSMOS is not to pique students' interest or increase their motivation, but to serve as an instrument that focuses, fosters, maintains, and stimulates the curiosity, interest and motivation that students already bring to the study of mathematics and science.

Academic Development and Career Trajectory

While prior academic experience and student motivation are crucial aspects of shaping students' academic and career trajectories, so too is the degree to which students see the University as accessible to them. Through student responses to surveys, comments made to researchers observing the program, and observations of daily student activities, it is clear that participation in COSMOS enables program participants to establish a connection to the university that, if not unique, is a rare opportunity for aspiring scientists and mathematicians. The opportunity to live on a campus and use the same facilities that university students use for study and leisure provides these high school students with a preview of university life. The connection that COSMOS students make to the university allows them to develop the capacity to be more actively engaged and informed

consumers and unlikely to be intimidated when the time comes for them to choose and apply to postsecondary institutions.

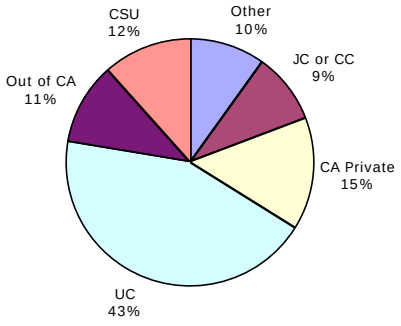
For seventy-three percent (73%) of participants, COSMOS is their first time attending a summer residential program on a university campus. Linking the student to the University in this intensive way at a particularly formative time during the development of their academic and career aspirations is especially critical given that forty-three percent (43%) of COSMOS participants do not have a sibling or close relative who has attended college.

Not surprisingly, the COSMOS experience seems to make the University of California (UC) feel more accessible to those for whom it was not at the outset of the program. While sixty-six percent (66%) of COSMOS participants were already planning to attend UC prior to their participation, many were not. The fifty-three respondents who said they were planning to attend a CSU prior to the program, forty-six students (87%) of them changed their minds so that they were planning to attend UC *after* the program. Interview, observation, and survey data suggest that an important aspect of this accessibility is that COSMOS students leave the program more prepared to apply for, and be admitted, to future academic programs, thus more prepared to meet their aspirations.

While COSMOS 2003 helped most students focus or confirm their academic aspirations, a few remained uncertain of their direction by the end of the program. Thirty-four respondents were "not sure yet" about their post high-school plans when they began the program. By the end of the program, eighteen (53%) planned to attend UC, twelve (35%) remained unsure, 11 (34%) planned to attend a private California college or university, 9 (26%) planned to attend an out of state college or university, 6 (18%) planned to attend a CSU, and 5 (15%) planned to work part-time.

According to alumni surveys conducted in the Fall of 2003, only one respondent was not currently enrolled in some form of post-secondary educational program. Of the remainder, forty-three percent (43%) of the surveys that were returned were from COSMOS alumni who had subsequently enrolled in the University of California. Other enrollment rates are displayed on the chart below.

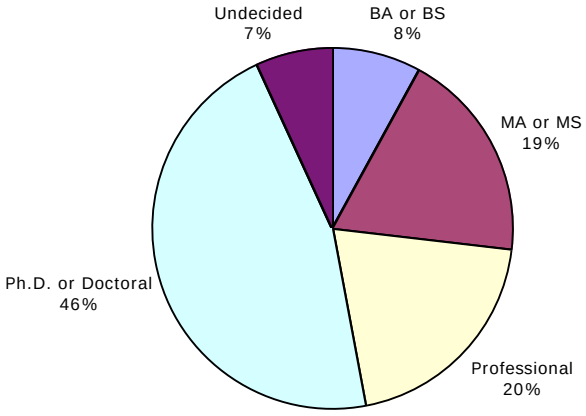
Alumni Survey
Current Enrollments of Non-High School Students



We cannot determine the extent to which participation in COSMOS affected their decisions to attend the University of California, but interviews indicate that while participating in COSMOS, these students were considering application to the UC and were actively seeking information about which campuses had programs that matched their academic interests. Students told interviewers that they had changed or planned to change their high school course schedules in order to better position themselves for acceptance to a UC campus. Overall, Summer 2003 participants' long-term academic aspirations remained constant for many. Some shift in academic aspirations is expected, given the discussion above.

By the end of the COSMOS 2003 summer program, about fifty-two percent (52%) of participants planned to pursue a Ph.D. or doctoral degree, with an additional thirty-three (33%) planning on pursuing a Masters or professional degree. When we look at the alumni responses to the same question, we see a relatively consistent trend with forty-six (46%) of alumni planning on a Ph.D. or doctoral degree and an additional thirty-nine (39%) planning on a Masters or professional degree.

Alumni Survey
Highest Degree Plan to Pursue



An examination of survey items addressing participants' career aspirations, 2003 participant and 2000-2002 alumni survey data reveals that COSMOS had a positive influence on students' career aspirations in mathematics and science. In general, the number of students who had doubts about whether they were suited for mathematics and science careers decreased over the course of the program. Notably, ninety-three percent (93%) of 2003 participants and eighty-five percent (85%) of alumni respondents agreed that, "The experience I had with COSMOS will benefit my future career."

More specifically, seventy-two percent (72%) of 2003 participants and fifty-two percent (52%) of alumni respondents agreed that, "as a result of participating in COSMOS, I am more likely to choose a science career." In keeping with the differing trends between

mathematics and science highlighted above, thirty-nine percent (39%) of 2003 participants and twenty-four (24%) of alumni respondents agreed that, "as a result of participating in COSMOS, I am more likely to choose a mathematics career."

Thus, while the COSMOS experience helps shape, define, and encourage students' interests in science and mathematics, it remains to be seen how lasting this effect will be. While current alumni data may indicate a waning effect of the experience as time passes, only longitudinal data collection and analysis of students' academic and career trajectories will enable us to learn the answer to the next, and final question that this report addresses.

What impact does COSMOS have on creating future leaders in mathematics and science?

Individual Impact

COSMOS provides a foundation for meeting the state's need to develop future scientists and a generation of young people with the mathematics and science skills that will be critical for the high technology jobs of the future. As described above, COSMOS participants and alumni responses to survey questions about their interest in science demonstrate that they are not only interested in science as a subject, but they are confident that they are on track to become scientists if they so choose. Their COSMOS experience seems to have helped them sharpen their ideas about the direction of their academic careers and is likely to have an impact on their educational goals. For those who enter the program with a clear sense of their educational and career goals, this program helps them narrow down and focus on specific areas of study that interest them as well as those which do not. This process helps them focus their academic and career pursuits.

Thus, many participants and alumni seem well on their way to a career in mathematics and/or science as evidenced by related benchmarks: they uniformly convey high motivation, include science and mathematics in their goals, have demonstrated high academic performance in the past, have been connected to a university through their COSMOS experience, have high future academic and career aspirations, have a realistic sense how to prepare themselves for university eligibility, and enjoy science and/or mathematics. In addition, many have begun to develop leadership skills that would be crucial to their ability to become leaders in their fields. For instance, the end-of-program student project presentations attended by peers, faculty, and parents demonstrate that students leave the program not only with academic experience and new perspectives about careers in mathematics, science and engineering, but also with an understanding of the importance of effective communication. Sharing the results of their investigations with peers and an audience reinforces the idea that communication is a crucial skill that they must develop in order to become future leaders in their field. Only time and systematic study will tell if the COSMOS experience and subsequent academic endeavors actually contribute directly to creating future leaders in mathematics, science and

engineering. Accordingly, our evaluation design includes ongoing, longitudinal data collection regarding COSMOS participants.

Institutional Impact

In addition to the impact that COSMOS may have on individual participating students, COSMOS may prove to have an institutional impact that supports the development of future leaders in mathematics and science. More specifically, COSMOS's institutional impact could be realized by meeting its goal of developing models for excellence in science and mathematics education. While there are no institutional structures in place to explicitly promote the development of new models for use by others, models for excellence in both higher education and high school are beginning to emerge as an outcome of faculty and Teacher Fellow participation in COSMOS.

University faculty members who are involved with COSMOS describe their involvement in glowing terms. As a group, they typically remain with the program for a sustained period of time (more than two years--some as many as four years), and are strongly committed to the work they do with COSMOS. They see COSMOS as contributing not only to the development of the students, but also as a way to refresh their own instructional strategies and recharge their enthusiasm for working with undergraduate students. In discussions with the COSMOS Advisory Board, some faculty members have suggested that more tenure track faculty members could be recruited to work with COSMOS if University-wide policy rewarded faculty for public service, such as teaching in COSMOS as part of the portfolio of work required for advancement.

Faculty members from several campuses who have worked closely with COSMOS acknowledge that they are sympathetic to this idea because they understand the pressure on colleagues to publish. However, while they understand the rationale of rewarding young professors by facilitating their efforts to apply time invested in COSMOS to their own efforts to achieve tenure, faculty members interviewed for this report did not favor that idea. Instead, they see work with COSMOS as valuable in its own right; they want future faculty to participate because of a commitment to the goals COSMOS program itself, not other benefits that might accrue as a result of participation. This is a complex issue that extends beyond the COSMOS program and warrants further investigation. It is of interest to the COSMOS leadership, whose efforts to grapple with it will be examined in subsequent annual reports.

When asked to explain how COSMOS has affected them, professors uniformly begin by saying that they believe that their COSMOS students are top notch and, that these students provide them with a hopeful alternative to the portrayal of high school students in the media. Professors from all three campuses praise the quality of the students. Another common theme in their comments is that their work with COSMOS serves to renew their academic spirit and, in many cases, is changing the way they think about their (non-COSMOS) teaching. Professors described their own inner struggles to design or in some cases revamp the way they teach retaining the high level, but increasing its accessibility to students with a variety of training and/or background in the area of study. They do say that their work with COSMOS carries over to their work with

undergraduates and believe that this is an unexpected benefit for them. In this way, COSMOS is beginning to have an institutional impact on university teaching that has the potential to impact the development of future leaders in science and mathematics currently enrolled in related university courses.

The Teacher Fellows program offers teachers of mathematics and science from high schools the opportunity to join the COSMOS instructional team during the summer. The Fellows gain exposure to the latest developments in mathematics, science and mathematics by working with the university faculty and the students participating in COSMOS. They, like the COSMOS participants, gain access to state-of-the-art computing facilities, laboratories, biomedical research centers and even the telescopes and physics labs. This access to tools of the trade and the relationships Teacher Fellows form with the university faculty expands the capacity of Teacher Fellows to share advanced ideas with students upon returning to the high school setting. A full report regarding the Teacher Fellows program is provided in *Appendix F*.

At one campus, Fellows not only develop but also submit to the COSMOS leadership at least one lesson plan that they could incorporate into their own classroom instruction based on work they have done during the COSMOS session. These lesson plans represent a tangible link to their own students. The COSMOS leadership encourages the Fellows to share their lesson plans with peers in their schools and districts. In this way, cutting-edge technology and state of the art science and mathematics will begin to trickle into California high schools. COSMOS is beginning to have an institutional impact on high school that has the potential to stimulate and support the development of future leaders in science, mathematics, and engineering currently enrolled in related high school courses.

The responsibilities, recruitment, and opportunity for substantive involvement in course design by Teacher Fellows vary across campuses. This variability is in keeping with the freedom campuses have to manage their programs. In the course of interviews conducted for this report, members of the Teacher Fellows corps and faculty commented on the Teacher Fellows program, some noting that it may be appropriate to clarify or modify it. There was not consensus around this issue (see *Appendix F*); however, as the Teacher Fellows Evaluation report suggests, this may be an element of COSMOS that the leadership will want to formalize and standardize in the future. If the decision is made to move in this direction, guidelines for a new model Teacher Fellows program might address issues such as whether the Teacher Fellows should work with faculty to plan programs or serve in student support roles, whether Teacher Fellows should plan field trips or lead writing classes, and whether each location should require Teacher Fellows to develop a lesson plan based on their work/observations of COSMOS classes for dissemination to peers at the high school level. If COSMOS program leadership aspires to reach the program's potential for institutional impact on both high school and university teaching and learning, they should consider how to formalize efforts to create and disseminate these models.

CONCLUSION

The evaluation team has concluded that the COSMOS program is of exceptionally high quality, resulting in a summer experience likely to help participants realize their full academic and career potential in science and mathematics. COSMOS reaches a cross section of students. While not truly representative of the high school population in general, COSMOS does achieve regional, ethnic, gender, and economic diversity. Further, COSMOS does a good job of making it possible for qualified applicants to attend, whether or not they have the financial resources.

COSMOS students learn a great deal while in the program. Through clusters that combine labs and classes, students are able to pick an area of interest and focus in on it. The teaching is excellent and the cluster work is supplemented by enriching field trips, and a strong and supportive community of peers and scholars that promotes both intellectual and social growth. The *Discovery Lecture Series* provides students with a window into the possibilities that await them in science and mathematics-related careers.

COSMOS helps participants refine and sharpen their own career and educational goals. Through COSMOS, students are able to formulate a much more concrete impression of what university life is like—an experience that tends to reinforce their interest in pursuing university study and their confidence in their capacity to succeed. Since it is clear that participants are already talented, motivated, and smart, COSMOS adds value by clarifying a pathway to achieve their high aspirations. COSMOS participation enables students to hone in on a specific and attainable area of interest or to discover a previously unexplored area of interest. The overwhelming success of and demand for the COSMOS program have led COSMOS leaders to plan for an additional campus location. A fourth campus will enable more eligible students to participate in the COSMOS experience.

RECOMMENDATIONS

Programmatic Recommendations

Restrict eligibility to students who have already begun high school. While there is no question that the COSMOS experience is a positive one for entering ninth grade students, there are very compelling reasons for changing the eligibility requirements so that the youngest students the program would serve would be students who have already completed their first year of high school. These reasons include: investing resources in those students best able to take advantage of them based on their maturity and level of preparedness, and ensuring high levels of teaching and learning for those who do attend.

Provide positive female role models. The number and proportion of female participants in COSMOS, coupled with the dearth of female scientists and mathematicians underscores the importance of providing opportunities for students to engage with female scientists, mathematicians, and engineers from diverse backgrounds and renewing efforts to recruit female role models in mathematics and science.

Recruit more high-achieving African American students. The decline in both the number and the percentage of participating African American students to COSMOS stands out as a disappointment. While COSMOS staff has successfully tapped into the high achieving Latino student population, it has yet to yield similar results with African American students. Additional and deliberate attention needs to be paid to recruiting high-achieving African American students if COSMOS is to achieve its goal of reflecting California's diverse population.

Rethink the writing/communication class. The writing/communication class has not been sufficiently integrated into the rest of the COSMOS experience as the rest of the program. Efforts are currently underway to rethink this aspect of the COSMOS program.

Expand opportunities for alumni engagement. Evaluation results show some preliminary evidence that as COSMOS students get further away from their experience, their aspirations in science and mathematics may wane. Alumni survey results also indicate than many alumni would participate in ongoing alumni activities if they were offered. It is important for COSMOS to establish ways of keeping alumni engaged in the COSMOS community in order to achieve the full benefit of the program and to support the goal of developing future mathematicians and scientists.

Define Teacher Fellows role more strategically. While many Fellows gained much (see *Appendix F*) from their experience, some felt underutilized. Those who spent more of their time "observing" and "supporting students" and less of their time in a leadership role were more likely to feel that way. Some faculty members easily incorporated the Fellows, while others had little sense or guidance in making the best use of Fellows' expertise. Thus, the program would benefit from a more defined Teacher Fellow role and a more systematic approach to orienting COSMOS university faculty to the role of the Teacher Fellows.

Ensure that COSMOS develops "models for excellence in science and mathematics education." If COSMOS program leadership aspires to reach the program's goal and potential for institutional impact on science and mathematics education, they need to consider ways to formalize efforts to create and disseminate these models. While some changes will happen opportunistically, systemic change will require proactive attention.

Organizational Recommendations

Expand the COSMOS program. The program should be expanded in order to serve more interested and eligible students. Due to high demand and interest, COSMOS leadership plans to launch a fourth campus program in summer 2005. Evaluation findings support these efforts to expand the program by adding a campus. Attention should be given to ensuring proportional representation of students from across California.

Seek additional funding. In order to enable COSMOS to both expand its reach and further support achievement of program goals, the program should develop outreach to program alumni and create a more robust central office to realize system-wide efficiencies as well as program growth and improvements. Such efforts will require additional funding. Both public and private sources should be sought to provide these funds.

Develop and fill an Executive Director position. The current leadership and coordination roles provided by the University of California Office of the President are understaffed to fully realize the program's goals. While the caliber of UCOP staff is high, the amount of time that they have to devote to COSMOS is inadequate. An Executive Director for COSMOS would provide the coordinated leadership that COSMOS needs to achieve its potential for developing future leaders in mathematics and science. An Executive Director could also be instrumental in determining whether to initiate program-wide changes, such as refining the Teacher Fellows program and establishing faculty participation in the program as a criterion for advancement.

Maintain a high quality Advisory Board. The COSMOS Advisory Board plays a key function in program support and fundraising. The current high quality Advisory Board has played an exceptionally important role in the development and success of COSMOS. Every effort should be made to continue to include excellent members from diverse backgrounds and stakeholder groups as Advisory Board members and to empower them as program advisors and advocates.

Invest in longitudinal program evaluation. It will take several years to determine if participants' COSMOS experience and subsequent academic endeavors actually contribute directly to creating future leaders in mathematics and science. Accordingly, longitudinal data collection and analysis regarding COSMOS participants must be sustained in order to understand the impact of COSMOS on developing future leaders in mathematics and science. A sustained investment in longitudinal evaluation must accompany related investments in annual formative and summative evaluation efforts.

University of California Office of the President
M E M O R A N D U M

To: COSMOS Directors and Coordinators
From: Rena Dorph, *Director of Research, Policy, and Technology*
David Goldstein, *Data Collection and Analysis Coordinator*
Re: Site Visits
Date: July 9, 2003

We are very much looking forward to visiting your campus during the next few weeks. In preparation for that visit we have developed the following site visit protocol.

Day 1: Rena Observes Student A's daily activities
Rena Interview's Student A (see attached student interview protocol)
Rena Interview's one of Student A's faculty instructors
David Observes Student B's daily activities
David Interview's Student B (see attached student interview protocol)
David Interview's one of Student B's faculty instructors

Day 2: Rena Observes Student C's daily activities
Rena Interview's Student C (see attached student interview protocol)
David Observes Student D's daily activities
David Interview's Student D (see attached student interview protocol)

Prior to our arrival, please select four students for us to interview while we are on our site visits. If at all possible, we would like to observe each student's daily activities prior to interviewing him/her. Please select the students based on the following criteria:

a. At least two of the students from an underrepresented minority and/or educationally disadvantaged background.
b. At least one of the students should have been accepted with a GPA that was higher than the average applicant.
c. At least one of the students should have been accepted with a GPA that was lower than the average applicant.
d. We would like to interview students who are in different grades.
e. We would like to hear from students who are having diverse experiences…that is to say, from 4 different clusters/strands, are having differential levels of success and/or engagement in the program, etc.

In addition, during the course of the visit, David and I would each like to interview at least one of the instructor's whose class we observed during the course of our visit. We have recommended that the faculty interview occur on Day 1 of our visit, however, it may occur on Day 2 if that is more convenient.

Feel free to contact either one of us if you have any questions.

University of California Office of the President
COSMOS Site Visit

Student Interview Questions

1. Please tell me a bit about yourself and what made you decided to apply for COSMOS.

2. So far, in what ways has your experience in COSMOS compared to the expectations you had for the program? In what ways has it exceeded those expectations? In what days has it not met them?

3. What aspect or aspects of the program are you finding most interesting?

4. What aspect or aspects of the program are you finding most enjoyable?

5. What aspect or aspects of the program would you change if you could?

6. Has your thinking about science and/or mathematics changed over the course of your COSMOS experience? If so, how?

7. How does the academic program (classes, lectures, field trip) compare with your school-based science and mathematics program?

8. In what ways, if at all, will COSMOS affect your experience in school?

9. Has your COSMOS experience affected your thinking about your future (professional? Personal?)? If so, how?

10. Would you recommend COSMOS to a friend? If so, why? If not, why not?

11. Anything else?

University of California Office of the President
COSMOS Site Visit

Faculty Interview Questions

1. Please tell me a bit about your background and what motivated you to become an instructor for the COSMOS program. How long have you been working in COSMOS?

2. So far, in what ways has your experience in COSMOS compared to the expectations you had for the program? In what ways has it exceeded those expectations? In what days has it not met them?

3. What aspect or aspects of the program are you finding most interesting?

4. What aspect or aspects of the program are you finding most enjoyable?

5. What aspect or aspects of the program would you change if you could?

6. Has your thinking about science and/or mathematics teaching and learning changed over the course of your COSMOS experience? If so, how?

7. Compare and contrast the teaching the teaching you do in COSMOS with the teaching you do during the rest of the year?

8. In what ways, if at all, will COSMOS affect your teaching in the future? How might it affect your research?

9. Has your COSMOS experience affected your thinking about your future (professional? Personal?)? If so, how?

10. Would you teach in COSMOS again? Would you recommend it to your colleagues? If so, why? If not, why not?

11. Anything else?

University of California Office of the President
COSMOS Site Visit

Event Observation Protocol

Site: Campus Name
Event: Observation
Date of event:
Subject of Observation:
Title/Role:
Researcher:
Date of file:
File Name:
Focus student name:
Cross-referenced files:
Attachments:

Context/Background

Description of Setting

Overview

Organization of time and activities:

Tone and engagement:

Role taken by teacher and students:

Nature of focus of student's participation:

Fieldnotes

Discussion

COSMOS

California State Summer School for Mathematics and Science

Summer 2003

Beginning-of-Program Student Questionnaire

Please respond to these questions in a way that expresses how you feel <u>now</u>. There are no right or wrong answers, just give your honest opinion. All of your responses will be kept confidential.

1. What is your name? _____ _____
   first *last*

2. What is your mother/female guardian's highest level of education? ***Please check one.***

- ☐ Did not attend high school
- ☐ Attended some high school, but did not graduate
- ☐ High school graduate
- ☐ Attended some college, but did not complete a degree.
- ☐ Associate's degree (2 year college degree)
- ☐ Bachelor's degree (4 year college degree)
- ☐ Master's degree
- ☐ Professional degree *(for example, teaching, accounting, law, medicine, veterinary science)*
- ☐ Ph.D. or other Doctoral degree
- ☐ I don't know
- ☐ Not applicable

3. What is your father/male guardian's highest level of education? ***Please check one.***

- ☐ Did not attend high school
- ☐ Attended some high school, but did not graduate
- ☐ High school graduate
- ☐ Attended some college, but did not complete a degree.
- ☐ Associate's degree (2 year college degree)
- ☐ Bachelor's degree (4 year college degree)
- ☐ Master's degree
- ☐ Professional degree *(for example, teaching, accounting, law, medicine, veterinary science)*
- ☐ Ph.D. or other Doctoral degree
- ☐ I don't know
- ☐ Not applicable

4. Do you have a sibling or relative who is close to you who has completed college or is in college right now?

- ☐ No
- ☐ Yes

5. What is the primary language(s) spoken in your home? ***Check all that apply.***

- ☐ English
- ☐ Spanish
- ☐ Asian language
- ☐ Other non-English:_____

6. Is COSMOS the first program you have attended at a University during which you lived in campus housing while attending the program?

☐ No *(if no proceed to question 7)* ☐ Yes *(if yes, skip question 7 and proceed to question 8)*

7. Please list other programs you have attended at a university during which you lived in campus housing while attending the program: ***Fill in all that apply.***

Name of Program #1:	
Location of Program #1:	
Dates of Program #1:	
Name of Program #2:	
Location of Program #2:	
Dates of Program #2:	
Name of Program #3:	
Location of Program #3:	
Dates of Program #3:	

8. The list below includes reasons students decide to apply to COSMOS. Please indicate the degree to which each of these was an important reason for your decision:

Check one response per statement.

		A **very** important reason for my decision	An important reason for my decision	A reason, but not an important one	Not a reason for my decision	I'm not sure	Not Applicable
a.	I wanted to explore math and science as a possible career or as a major in college.	☐	☐	☐	☐	☐	☐
b.	The courses seemed interesting to me.	☐	☐	☐	☐	☐	☐
c.	I wanted to live on a university campus.	☐	☐	☐	☐	☐	☐
d.	I wanted to be away from home	☐	☐	☐	☐	☐	☐
e.	I wanted to be with other students who are interested in math and science.	☐	☐	☐	☐	☐	☐
f.	I wanted to be with my friends.	☐	☐	☐	☐	☐	☐
g.	The program was recommended to me by a former COSMOS participant.	☐	☐	☐	☐	☐	☐
h.	My teacher(s) encouraged me to apply.	☐	☐	☐	☐	☐	☐
I.	My parent(s) or guardian encouraged me to apply.	☐	☐	☐	☐	☐	☐
j.	Other *(please specify)* _____ _____	☐	☐	☐	☐	☐	☐

9. What are your plans upon graduating from high school? ***Check all that apply.***

- ☐ Not sure yet
- ☐ Not planning to attend college
- ☐ Work part time
- ☐ Work full time
- ☐ Go into the military
- ☐ Attend out of state college/university *name:* _____
- ☐ Attend a California private college/university *name:* _____
- ☐ Attend a University of California *name:* _____
- ☐ Attend a California State University *name:* _____
- ☐ Attend a California Community College *name:* _____
- ☐ Other (please specify) *name:* _____

10. What is the highest educational degree you think you would like to pursue? ***Check one.***

- ☐ High School Diploma
- ☐ Associate's degree (2 year college degree)
- ☐ Bachelor's degree (4 year college or university degree)
- ☐ Master's degree
- ☐ Professional degree *(for example, teaching credential, CPA, law, medicine, veterinary science)*
- ☐ Ph.D. or other Doctoral degree
- ☐ I don't know
- ☐ Not applicable

11. What are the subject areas that you are seriously considering studying or pursuing as a job or career after you finish high school?

Fill in the subject area(s) and then <u>check all</u> responses that apply for each subject area you specify.

	I plan to study this in college	I plan to study this in graduate school	I plan to work in this field	I'm not sure	Not Applicable
a. _____	☐	☐	☐	☐	☐
b. _____	☐	☐	☐	☐	☐
c. _____	☐	☐	☐	☐	☐
d. _____	☐	☐	☐	☐	☐
e. _____	☐	☐	☐	☐	☐

12. Please indicate the degree to which you agree or disagree with the following statements:

Check one response per statement.

		Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	I'm not sure	Not Applicable
a.	Science is very interesting to me.	☐	☐	☐	☐	☐	☐	☐
b.	Math is very interesting to me.	☐	☐	☐	☐	☐	☐	☐
c.	I am motivated to learn more science.	☐	☐	☐	☐	☐	☐	☐
d.	I am motivated to learn more math.	☐	☐	☐	☐	☐	☐	☐
e.	I enjoy learning about science.	☐	☐	☐	☐	☐	☐	☐
f.	I enjoy learning about math.	☐	☐	☐	☐	☐	☐	☐
g.	I could be a scientist if I wanted to.	☐	☐	☐	☐	☐	☐	☐
h.	I could be a mathematician if I wanted to.	☐	☐	☐	☐	☐	☐	☐
I.	I enjoy reading about science.	☐	☐	☐	☐	☐	☐	☐
j.	I enjoy reading about math.	☐	☐	☐	☐	☐	☐	☐
k.	Attending college is not an option for me.	☐	☐	☐	☐	☐	☐	☐
l.	I have strong doubts about whether I am suited for a career in science.	☐	☐	☐	☐	☐	☐	☐
m.	I have strong doubts about whether I am suited for a career in math.	☐	☐	☐	☐	☐	☐	☐
n.	I feel comfortable speaking in front of a group.	☐	☐	☐	☐	☐	☐	☐
o.	I feel comfortable presenting scientific information to a group of people.	☐	☐	☐	☐	☐	☐	☐
p.	I have a lot of friends who share my interests in math and science.	☐	☐	☐	☐	☐	☐	☐
q.	Being interested in math or science makes me feel like an outsider.	☐	☐	☐	☐	☐	☐	☐
r.	I know mathematicians or scientists that I can go to with questions.	☐	☐	☐	☐	☐	☐	☐

Please write any additional comments you would like to share here:

Thank you for taking the time to answer these questions!

COSMOS

California State Summer School for Mathematics and Science

Summer 2003

End-of-Program Student Questionnaire

Please respond to these questions in a way that expresses how you feel <u>now</u>. There are no right or wrong answers, just give your honest opinion. Some of these questions are similar to those that you answered at the beginning of COSMOS. We will compare your responses before and after COSMOS in order to measure the impact of COSMOS on your life. All of your responses will be kept confidential.

1. What is your name? _____ _____
   first *last*

2. What are your plans upon graduating from high school? ***Check all that apply.***

- ☐ Not sure yet
- ☐ Not planning to attend college
- ☐ Work part time
- ☐ Work full time
- ☐ Go into the military
- ☐ Attend out of state college/university *name:* _____
- ☐ Attend a California private college/university *name:* _____
- ☐ Attend a University of California *name:* _____
- ☐ Attend a California State University *name:* _____
- ☐ Attend a California Community College *name:* _____
- ☐ Other (please specify) *name:* _____

3. What is the highest educational degree you think you would like to pursue? ***Check one.***

- ☐ High School Diploma
- ☐ Associate's degree (2 year college degree)
- ☐ Bachelor's degree (4 year college or university degree)
- ☐ Master's degree
- ☐ Professional degree *(for example, teaching credential, CPA, law, medicine, veterinary science)*
- ☐ Ph.D. or other Doctoral degree
- ☐ I don't know
- ☐ Not applicable

4. What are the subject areas that you are seriously considering studying or pursuing as a job or career after you finish high school?

Fill in the subject area(s) and then <u>check all</u> responses that apply for each subject area you specify.

		I plan to study this in college	I plan to study this in graduate school	I plan to work in this field	I'm not sure	Not Applicable
a.	_____	☐	☐	☐	☐	☐
b.	_____	☐	☐	☐	☐	☐
c.	_____	☐	☐	☐	☐	☐
d.	_____	☐	☐	☐	☐	☐
e.	_____	☐	☐	☐	☐	☐

5. Below is a list of some of the aspects of the COSMOS program. Please indicate the extent to which you valued each of these aspects.

Check one response per statement.

		Very important to me	Important to me	Only a little bit important	Not important at all.	I'm not sure	Not Applicable
a.	I was able to explore math and science as a possible career or as a major in college.	☐	☐	☐	☐	☐	☐
b.	The courses were interesting to me.	☐	☐	☐	☐	☐	☐
c.	I was able to live on a university campus.	☐	☐	☐	☐	☐	☐
d.	I lived away from home.	☐	☐	☐	☐	☐	☐
e.	I spent time with other students who are interested in math and science.	☐	☐	☐	☐	☐	☐
f.	I was able to be with my friends.	☐	☐	☐	☐	☐	☐
g.	I was able to make new friends.	☐	☐	☐	☐	☐	☐
h.	I was able to study with interesting teachers.	☐	☐	☐	☐	☐	☐
I.	I made contact with professors in a field that is of interest to me.	☐	☐	☐	☐	☐	☐
j.	Other *(please specify)* _____ _____	☐	☐	☐	☐	☐	☐

6. Please indicate the degree to which you agree or disagree with the following statements:

Check one response per statement.

		Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	I'm not sure	Not Applicable
a.	Science is very interesting to me.	☐	☐	☐	☐	☐	☐	☐
b.	Math is very interesting to me.	☐	☐	☐	☐	☐	☐	☐
c.	I am motivated to learn more science.	☐	☐	☐	☐	☐	☐	☐
d.	I am motivated to learn more math.	☐	☐	☐	☐	☐	☐	☐
e.	I enjoy learning about science.	☐	☐	☐	☐	☐	☐	☐
f.	I enjoy learning about math.	☐	☐	☐	☐	☐	☐	☐
g.	I could be a scientist if I wanted to.	☐	☐	☐	☐	☐	☐	☐
h.	I could be a mathematician if I wanted to.	☐	☐	☐	☐	☐	☐	☐
I.	I enjoy reading about science.	☐	☐	☐	☐	☐	☐	☐
j.	I enjoy reading about math.	☐	☐	☐	☐	☐	☐	☐
k.	Attending college is not an option for me.	☐	☐	☐	☐	☐	☐	☐
l.	I have strong doubts about whether I am suited for a career in science.	☐	☐	☐	☐	☐	☐	☐
m.	I have strong doubts about whether I am suited for a career in math.	☐	☐	☐	☐	☐	☐	☐
n.	I feel comfortable speaking in front of a group.	☐	☐	☐	☐	☐	☐	☐
o.	I feel comfortable presenting scientific information to a group of people.	☐	☐	☐	☐	☐	☐	☐

6. *Continued...* ***Check one response per statement.***

		Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	I'm not sure	Not Applicable
p.	I have a lot of friends who share my interests in math and science.	❑	❑	❑	❑	❑	❑	❑
q.	Being interested in math or science makes me feel like an outsider.	❑	❑	❑	❑	❑	❑	❑
r.	I know mathematicians or scientists that I can go to with questions.	❑	❑	❑	❑	❑	❑	❑

7a. Please reflect on each of your **COSMOS classes** this summer. Please indicate the frequency that each of following occurred in each of your classes: ***Check one response per statement.***

Course #1 Title: _____ **Name of Instructor:** _____

		Always	Mostly	Some-times	Hardly ever	Never	I'm not sure	Not applicable
a.	Class activities kept my interest.	❑	❑	❑	❑	❑	❑	❑
b.	It seemed to me that the instructor had a good understanding of subject area they taught in this class	❑	❑	❑	❑	❑	❑	❑
c.	The instructors showed concern for how well I learned the material.	❑	❑	❑	❑	❑	❑	❑
d.	The instructors were well prepared for the classes.	❑	❑	❑	❑	❑	❑	❑
e.	The pace of the classes was too slow for me.	❑	❑	❑	❑	❑	❑	❑
f.	Class activities were organized.	❑	❑	❑	❑	❑	❑	❑
g.	Instructions for class activities were clear.	❑	❑	❑	❑	❑	❑	❑
h.	I liked my classes.	❑	❑	❑	❑	❑	❑	❑
I.	I didn't understand a lot of what was presented in the classes.	❑	❑	❑	❑	❑	❑	❑
j.	I gained a lot from interacting with my instructors.	❑	❑	❑	❑	❑	❑	❑
k.	As a result of being in a class, I became more interested in the area we studied.	❑	❑	❑	❑	❑	❑	❑
l.	I learned something in a class that I think will help me with my high school courses.	❑	❑	❑	❑	❑	❑	❑
m.	I learned something in a class that I think will help me with my college/university courses.	❑	❑	❑	❑	❑	❑	❑

Comments:

7b. Please reflect on each of your **COSMOS classes** this summer. Please indicate the frequency that each of following occurred in each of your classes: ***Check one response per statement.***

Course #2 Title: _____ **Name of Instructor:** _____

		Always	Mostly	Some-times	Hardly ever	Never	I'm not sure	Not applicable
a.	Class activities kept my interest.	❑	❑	❑	❑	❑	❑	❑
b.	It seemed to me that the instructor had a good understanding of subject area they taught in this class	❑	❑	❑	❑	❑	❑	❑
c.	The instructors showed concern for how well I learned the material.	❑	❑	❑	❑	❑	❑	❑
d.	The instructors were well prepared for the classes.	❑	❑	❑	❑	❑	❑	❑
e.	The pace of the classes was too slow for me.	❑	❑	❑	❑	❑	❑	❑
f.	Class activities were organized.	❑	❑	❑	❑	❑	❑	❑
g.	Instructions for class activities were clear.	❑	❑	❑	❑	❑	❑	❑
h.	I liked my classes.	❑	❑	❑	❑	❑	❑	❑
I.	I didn't understand a lot of what was presented in the classes.	❑	❑	❑	❑	❑	❑	❑
j.	I gained a lot from interacting with my instructors.	❑	❑	❑	❑	❑	❑	❑
k.	As a result of being in a class, I became more interested in the area we studied.	❑	❑	❑	❑	❑	❑	❑
l.	I learned something in a class that I think will help me with my high school courses.	❑	❑	❑	❑	❑	❑	❑
m.	I learned something in a class that I think will help me with my college/university courses.	❑	❑	❑	❑	❑	❑	❑

Comments:

7c. Please reflect on each of your **COSMOS classes** this summer. Please indicate the frequency that each of following occurred in each of your classes: ***Check one response per statement.***

Course #3 Title: _____ **Name of Instructor:** _____

		Always	Mostly	Some-times	Hardly ever	Never	I'm not sure	Not applicable
a.	Class activities kept my interest.	❑	❑	❑	❑	❑	❑	❑
b.	It seemed to me that the instructor had a good understanding of subject area they taught in this class	❑	❑	❑	❑	❑	❑	❑
c.	The instructors showed concern for how well I learned the material.	❑	❑	❑	❑	❑	❑	❑
d.	The instructors were well prepared for the classes.	❑	❑	❑	❑	❑	❑	❑
e.	The pace of the classes was too slow for me.	❑	❑	❑	❑	❑	❑	❑
f.	Class activities were organized.	❑	❑	❑	❑	❑	❑	❑
g.	Instructions for class activities were clear.	❑	❑	❑	❑	❑	❑	❑
h.	I liked my classes.	❑	❑	❑	❑	❑	❑	❑
i.	I didn't understand a lot of what was presented in the classes.	❑	❑	❑	❑	❑	❑	❑
j.	I gained a lot from interacting with my instructors.	❑	❑	❑	❑	❑	❑	❑
k.	As a result of being in a class, I became more interested in the area we studied.	❑	❑	❑	❑	❑	❑	❑
l.	I learned something in a class that I think will help me with my high school courses.	❑	❑	❑	❑	❑	❑	❑
m.	I learned something in a class that I think will help me with my college/university courses.	❑	❑	❑	❑	❑	❑	❑

Comments:

7d. Please reflect on each of your **COSMOS classes** this summer. Please indicate the frequency that each of following occurred in each of your classes: ***Check one response per statement.***

Course #4 Title: _____ **Name of Instructor:** _____

		Always	Mostly	Some-times	Hardly ever	Never	I'm not sure	Not applicable
a.	Class activities kept my interest.	❑	❑	❑	❑	❑	❑	❑
b.	It seemed to me that the instructor had a good understanding of subject area they taught in this class	❑	❑	❑	❑	❑	❑	❑
c.	The instructors showed concern for how well I learned the material.	❑	❑	❑	❑	❑	❑	❑
d.	The instructors were well prepared for the classes.	❑	❑	❑	❑	❑	❑	❑
e.	The pace of the classes was too slow for me.	❑	❑	❑	❑	❑	❑	❑
f.	Class activities were organized.	❑	❑	❑	❑	❑	❑	❑
g.	Instructions for class activities were clear.	❑	❑	❑	❑	❑	❑	❑
h.	I liked my classes.	❑	❑	❑	❑	❑	❑	❑
I.	I didn't understand a lot of what was presented in the classes.	❑	❑	❑	❑	❑	❑	❑
j.	I gained a lot from interacting with my instructors.	❑	❑	❑	❑	❑	❑	❑
k.	As a result of being in a class, I became more interested in the area we studied.	❑	❑	❑	❑	❑	❑	❑
l.	I learned something in a class that I think will help me with my high school courses.	❑	❑	❑	❑	❑	❑	❑
m.	I learned something in a class that I think will help me with my college/university courses.	❑	❑	❑	❑	❑	❑	❑

Comments:

7e. Please reflect on each of your **COSMOS classes** this summer. Please indicate the frequency that each of following occurred in each of your classes: ***Check one response per statement.***

Course #5 Title: _____ **Name of Instructor:** _____

		Always	Mostly	Some-times	Hardly ever	Never	I'm not sure	Not applicable
a.	Class activities kept my interest.	❑	❑	❑	❑	❑	❑	❑
b.	It seemed to me that the instructor had a good understanding of subject area they taught in this class	❑	❑	❑	❑	❑	❑	❑
c.	The instructors showed concern for how well I learned the material.	❑	❑	❑	❑	❑	❑	❑
d.	The instructors were well prepared for the classes.	❑	❑	❑	❑	❑	❑	❑
e.	The pace of the classes was too slow for me.	❑	❑	❑	❑	❑	❑	❑
f.	Class activities were organized.	❑	❑	❑	❑	❑	❑	❑
g.	Instructions for class activities were clear.	❑	❑	❑	❑	❑	❑	❑
h.	I liked my classes.	❑	❑	❑	❑	❑	❑	❑
I.	I didn't understand a lot of what was presented in the classes.	❑	❑	❑	❑	❑	❑	❑
j.	I gained a lot from interacting with my instructors.	❑	❑	❑	❑	❑	❑	❑
k.	As a result of being in a class, I became more interested in the area we studied.	❑	❑	❑	❑	❑	❑	❑
l.	I learned something in a class that I think will help me with my high school courses.	❑	❑	❑	❑	❑	❑	❑
m.	I learned something in a class that I think will help me with my college/university courses.	❑	❑	❑	❑	❑	❑	❑

Comments:

8. Please reflect on your **overall COSMOS experience** this summer. Please indicate the extent to which you agree or disagree with the following statements:

Check one response per statement.

		Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	I'm not sure	Not Applicable
a.	My COSMOS experience has increased my interest in taking science classes in high school.	☐	☐	☐	☐	☐	☐	☐
b.	My COSMOS experience has increased my interest in taking math classes in high school.	☐	☐	☐	☐	☐	☐	☐
c.	Overall, my COSMOS experience has helped me feel more confident as a science student.	☐	☐	☐	☐	☐	☐	☐
d.	Overall, my COSMOS experience has helped me feel more confident as a math student.	☐	☐	☐	☐	☐	☐	☐
e.	I have a better understanding of what is required for me to succeed in college than I did before coming to COSMOS.	☐	☐	☐	☐	☐	☐	☐
f.	I have a better understanding of what majors will be available to me in college.	☐	☐	☐	☐	☐	☐	☐
g.	I have a better understanding of what careers are available to me.	☐	☐	☐	☐	☐	☐	☐
h.	As a result of participating in COSMOS, I am more likely to choose a science career.	☐	☐	☐	☐	☐	☐	☐
I.	As a result of participating in COSMOS, I am more likely to choose a math career.	☐	☐	☐	☐	☐	☐	☐
j.	The experience I had with COSMOS will benefit my future career.	☐	☐	☐	☐	☐	☐	☐
k.	Overall, my experience in COSMOS was a positive one for me.	☐	☐	☐	☐	☐	☐	☐

9. Would you recommend the COSMOS program to your friends?

☐ Yes ☐ No

Please write any additional comments you would like to share here:

Thank you for taking the time to answer these questions!

COSMOS
California State Summer School for Mathematics and Science
Alumni Survey
Fall, 2003

Please respond to these questions in a way that expresses how you feel <u>now</u>. There are no right or wrong answers, just give your honest opinion. All of your responses will be kept confidential.

1. Please indicate what you are doing during Fall 2003?

- ☐ I work full-time — *indicate type of job:* _____
- ☐ I attend high school — *indicate grade:* _____
- ☐ I attend technical school/college program — *please specify:* _____
- ☐ I attend community or Junior College — *name:* _____
- ☐ I attend a military training program — *please specify:* _____
- ☐ I attend an out of state college/university — *name:* _____
- ☐ I attend a California private college/university — *name:* _____
- ☐ I attend a University of California — *name:* _____
- ☐ I attend a California State University — *name:* _____
- ☐ I attend a California Community College — *name:* _____
- ☐ Other (please specify) — *name:* _____

2. If you are currently in high school, what are your plans upon completion? ***Check all that apply.***

- ☐ Not sure yet
- ☐ Not planning to attend college
- ☐ Work part time
- ☐ Work full time
- ☐ Go into the military
- ☐ Attend an out of state college/university — *name:* _____
- ☐ Attend a California private college/university — *name:* _____
- ☐ Attend a University of California — *name:* _____
- ☐ Attend a California State University — *name:* _____
- ☐ Attend a California Community College — *name:* _____
- ☐ Other (please specify) — *name:* _____

3. What is the highest educational degree you think you would like to pursue? ***Check one.***

- ☐ High School Diploma
- ☐ Associate's degree (2 year college degree)
- ☐ Bachelor's degree (4 year college or university degree)
- ☐ Master's degree
- ☐ Professional degree *(for example, teaching credential, CPA, law, medicine, veterinary science)*
- ☐ Ph.D. or other Doctoral degree
- ☐ Currently undecided/I don't know
- ☐ Not applicable

4. What are the subject areas that you are seriously considering studying or pursuing as a job or career?

Fill in the subject area(s) and then <u>check all</u> responses that apply for each subject area you specify.

		I plan to study this in college	I plan to study this in graduate school	I plan to work in this field	I'm not sure	Not Applicable
a.	_____	☐	☐	☐	☐	☐
b.	_____	☐	☐	☐	☐	☐
c.	_____	☐	☐	☐	☐	☐
d.	_____	☐	☐	☐	☐	☐
e.	_____	☐	☐	☐	☐	☐

5. Please indicate the degree to which you currently agree/disagree with the following statements:

Check one response per statement.

		Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	I'm not sure	Not Applicable
a.	Science is very interesting to me.	☐	☐	☐	☐	☐	☐	☐
b.	Math is very interesting to me.	☐	☐	☐	☐	☐	☐	☐
c.	I am motivated to learn more science.	☐	☐	☐	☐	☐	☐	☐
d.	I am motivated to learn more math.	☐	☐	☐	☐	☐	☐	☐
e.	I enjoy learning about science.	☐	☐	☐	☐	☐	☐	☐
f.	I enjoy learning about math.	☐	☐	☐	☐	☐	☐	☐
g.	I could be a scientist if I wanted to.	☐	☐	☐	☐	☐	☐	☐
h.	I could be a mathematician if I wanted to.	☐	☐	☐	☐	☐	☐	☐
I.	I enjoy reading about science.	☐	☐	☐	☐	☐	☐	☐
j.	I enjoy reading about math.	☐	☐	☐	☐	☐	☐	☐
k	I have strong doubts about whether I am suited for a career in science.	☐	☐	☐	☐	☐	☐	☐
l	I have strong doubts about whether I am suited for a career in math.	☐	☐	☐	☐	☐	☐	☐
m	I feel comfortable speaking in front of a group.	☐	☐	☐	☐	☐	☐	☐
n	I feel comfortable presenting scientific information to a group of people.	☐	☐	☐	☐	☐	☐	☐
o	I have a lot of friends who share my interests in math and science.	☐	☐	☐	☐	☐	☐	☐
p	Being interested in math or science makes me feel like an outsider.	☐	☐	☐	☐	☐	☐	☐
q	I know mathematicians or scientists that I can go to with questions.	☐	☐	☐	☐	☐	☐	☐

6. Below is a list of some of the aspects of the COSMOS program. Looking back on your COSMOS experience, please indicate the extent to which you valued each of these aspects.

Check one response per statement.

		Very important to me	Important to me	Only a little bit important	Not important at all	I'm not sure	Not Applicable
a.	I was able to explore math and science as a possible career or as a major in college.	☐	☐	☐	☐	☐	☐
b.	The courses were interesting to me.	☐	☐	☐	☐	☐	☐
c.	I was able to live on a university campus.	☐	☐	☐	☐	☐	☐
d.	I lived away from home.	☐	☐	☐	☐	☐	☐
e.	I spent time with other students who are interested in math and science.	☐	☐	☐	☐	☐	☐
f.	I was able to be with my friends.	☐	☐	☐	☐	☐	☐
g.	I was able to make new friends.	☐	☐	☐	☐	☐	☐
h.	I was able to study with interesting teachers.	☐	☐	☐	☐	☐	☐
I	I made contact with professors in a field that is of interest to me.	☐	☐	☐	☐	☐	☐
j	I discovered that I was interested in a field that I first learned about in COSMOS.	☐	☐	☐	☐	☐	☐
k	Other *(please specify)* _____ _____	☐	☐	☐	☐	☐	☐

7. Please reflect on your **overall COSMOS experience**. Please indicate the extent to which you agree or disagree with the following statements:

Check one response per statement.

		Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	I'm not sure	Not Applicable
a.	My experience in COSMOS inspired me to take more science courses in high school.	☐	☐	☐	☐	☐	☐	☐
b.	My experience in COSMOS inspired me to take more math courses in high school.	☐	☐	☐	☐	☐	☐	☐
c.	Overall, my COSMOS experience helped me feel more confident as a science student.	☐	☐	☐	☐	☐	☐	☐
d.	Overall, my COSMOS experience helped me feel more confident as a math student.	☐	☐	☐	☐	☐	☐	☐
e.	The COSMOS program helped me develop a clear understanding of what to expect in college.	☐	☐	☐	☐	☐	☐	☐
f.	I developed a better understanding of what majors will be available to me in college.	☐	☐	☐	☐	☐	☐	☐
g.	I developed a better understanding of what careers are available to me.	☐	☐	☐	☐	☐	☐	☐
h.	As a result of participating in COSMOS, I am more likely to choose a science career.	☐	☐	☐	☐	☐	☐	☐
I.	As a result of participating in COSMOS, I am more likely to choose a math career.	☐	☐	☐	☐	☐	☐	☐
j.	The experience I had with COSMOS will benefit my future career.	☐	☐	☐	☐	☐	☐	☐
k.	Overall, my experience in COSMOS was a positive one for me.	☐	☐	☐	☐	☐	☐	☐

8. Would you be interested in participating in any of these activies after completing COSMOS?

Check one response per statement.

		Yes	No	I'm not sure
a	Attending a COSMOS alumni reunion near my home.	☐	☐	☐
b	Attending lectures/events near my home.	☐	☐	☐
c	Serving as a mentor for future summer COSMOS programs.	☐	☐	☐
d	Giving presentations about COSMOS to high schools and/or community groups near my home.	☐	☐	☐
e	Attending an all-day alumni event during a COSMOS summer program.	☐	☐	☐
f	Participating in an online alumni network.	☐	☐	☐

9. Please respond to the following questions and comment on your answers in the area provided.

Check one response per statement.

		Yes	No	I'm not sure	
a.	Did participating in COSMOS influence your decision about what major to pursue in college/university?	☐	☐	☐	comments:
b.	Did participating in COSMOS influence your choice of science and/or mathematics courses in high school and/or college?	☐	☐	☐	comments:
c.	Has participating in COSMOS inspired you to join a professional organization(s)?	☐	☐	☐	comments:
d.	Has participating in COSMOS inspired you to do more scientific reading?	☐	☐	☐	comments:
e.	Did participating in COSMOS inspire you to participate in science- and/or mathematics-related activities in your school or community (e.g. clubs, conferences, internships, presentations, jobs, special projects, other)?	☐	☐	☐	comments:
g.	Have you maintained contact with any other COSMOS students?	☐	☐	☐	comments:
h.	Have you maintained contact with other COSMOS faculty?	☐	☐	☐	comments:

10. Have you recommended the COSMOS program to friends?

☐ Yes ☐ No

11. Are you currently receiving e-mail as part of the COSMOS listserv?

☐ Yes ☐ No

12. Have you pursued any of the opportunities listed in the alumni e-newsletter?

- ☐ Yes *if yes please specify:* _____
- ☐ No
- ☐ I do not receive the alumni e-newsletter

15. How useful have you found the COSMOS listserv?

- ☐ Very Useful
- ☐ Somewhat useful
- ☐ Not at all useful
- ☐ I do not use the COSMOS listserve

16. Any additional comments?

Thank you for taking the time to answer these questions!

COSMOS

California State Summer School for Mathematics and Science

Summer 2003

Teacher Fellows Post-Program Survey

Please respond to these questions in a way that expresses how you feel now. There are no right or wrong answers, just give your honest opinion. All of your responses will be kept confidential.

1. Please indicate the school where you work during the year. _____

2. Please indicate the summer(s) and campus(es) that you worked as a COSMOS Teacher Fellow. ***Check all that apply.***

Year enrolled	*Campus enrolled*		
☐ 2000	☐ Davis	☐ Irvine	☐ Santa Cruz
☐ 2001	☐ Davis	☐ Irvine	☐ Santa Cruz
☐ 2002	☐ Davis	☐ Irvine	☐ Santa Cruz
☐ 2003	☐ Davis	☐ Irvine	☐ Santa Cruz

3. What is the highest educational degree you think you would like to pursue? ***Check one.***

- ☐ I already have the highest degree I'd like to pursue
- ☐ Master's degree
- ☐ Professional degree *(for example, teaching credential, CPA, law, medicine, veterinary science)*
- ☐ Ph.D. or other Doctoral degree
- ☐ I don't know

4. Has your participation in COSMOS influenced your future educational plans?

☐ Yes ☐ No

5. If the opportunity exists, would you want to return to COSMOS as a Teacher Fellow?

☐ Yes ☐ No

6. Would you recommend COSMOS to your teaching colleagues?

☐ Yes ☐ No

7. The list below includes reasons teacher fellows apply to COSMOS. Please indicate the degree to which each of these was an important reason for your applying:

Check one response per statement.

	A **very** important reason for my decision	An important reason for my decision	A reason, but not an important one	Not a reason for my decision	I'm not sure	Not Applicable
a. I wanted to learn new things about science and/or mathematics.	☐	☐	☐	☐	☐	☐
b. I wanted to work with University faculty.	☐	☐	☐	☐	☐	☐
c. I wanted to work with motivated high school students.	☐	☐	☐	☐	☐	☐
d. I needed summer income.	☐	☐	☐	☐	☐	☐
e. I wanted to spend time on a college campus.	☐	☐	☐	☐	☐	☐
f. I wanted to use university labs and facilities.	☐	☐	☐	☐	☐	☐
g. The program was recommended to me by a teaching colleague.	☐	☐	☐	☐	☐	☐
h. COSMOS staff contacted me and asked me to apply.	☐	☐	☐	☐	☐	☐
I I wanted to work with other high school teachers interested in math and science.	☐	☐	☐	☐	☐	☐
j Other *(please specify)* _____ _____	☐	☐	☐	☐	☐	☐

8. Below is a list of some of the aspects of the COSMOS program. Looking back on your COSMOS experience, please indicate the extent to which you valued each of these aspects.

Check one response per statement.

	Very important to me	Important to me	Only a little bit important	Not important at all.	I'm not sure	Not Applicable
a. I learned new things about science and/or mathematics.	☐	☐	☐	☐	☐	☐
b. I worked with University faculty.	☐	☐	☐	☐	☐	☐
c. I worked with high-achieving students.	☐	☐	☐	☐	☐	☐
d. I earned summer income.	☐	☐	☐	☐	☐	☐
e. I got to spend time on a college campus.	☐	☐	☐	☐	☐	☐
f. I had access to university labs and facilities.	☐	☐	☐	☐	☐	☐
g. I enjoyed working with the COSMOS staff	☐	☐	☐	☐	☐	☐
h I enjoyed working with other high school teachers interested in math and science.	☐	☐	☐	☐	☐	☐
I Other *(please specify)* _____ _____	☐	☐	☐	☐	☐	☐

9. Please indicate the amount of time you engaged in each of the following activities during your experience as a COSMOS teacher fellow:

Check one response per statement.

	Over 20 hrs/week	10-20 hrs/week	5-10 hrs/week	Fewer than 5 hrs /week	0 hrs/week	I'm not sure	Not Applicable
a. Teach writing/communication class	☐	☐	☐	☐	☐	☐	☐
b. Plan field trips	☐	☐	☐	☐	☐	☐	☐
c. Go on field trips	☐	☐	☐	☐	☐	☐	☐
d. Lead field trips	☐	☐	☐	☐	☐	☐	☐
e. Observe lectures(Discovery, classroom, etc.)	☐	☐	☐	☐	☐	☐	☐
f. Give lectures	☐	☐	☐	☐	☐	☐	☐
g. Observe labs	☐	☐	☐	☐	☐	☐	☐
h Lead labs	☐	☐	☐	☐	☐	☐	☐
l Advise individual students	☐	☐	☐	☐	☐	☐	☐
j. Curriculum development/planning	☐	☐	☐	☐	☐	☐	☐
k Staff planning meetings	☐	☐	☐	☐	☐	☐	☐
l Assist students with projects	☐	☐	☐	☐	☐	☐	☐
m Other_____	☐	☐	☐	☐	☐	☐	☐

10. Please indicate the extent to which you agree or disagree with the following statements.

Check one response per statement.

	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	I'm not sure	Not Applicable
a. COSMOS will be influential in students' future choices of academic subject areas.	☐	☐	☐	☐	☐	☐	☐
b. COSMOS was a positive experience for me.	☐	☐	☐	☐	☐	☐	☐
c I learned a lot about the subject area upon which my cluster focused.	☐	☐	☐	☐	☐	☐	☐
d COSMOS was personally rewarding for me.	☐	☐	☐	☐	☐	☐	☐
e COSMOS was professionally rewarding for me.	☐	☐	☐	☐	☐	☐	☐
f The COSMOS program was well organized.	☐	☐	☐	☐	☐	☐	☐
g I was adequately prepared for my COSMOS role.	☐	☐	☐	☐	☐	☐	☐
h My COSMOS experience was of better quality than other summer employment activities.	☐	☐	☐	☐	☐	☐	☐
l My COSMOS experience was of better quality than other professional development activities.	☐	☐	☐	☐	☐	☐	☐
j My COSMOS experience was less valuable to me than other summer employment activities.	☐	☐	☐	☐	☐	☐	☐
k My COSMOS experience was less valuable to me than other professional development activities.	☐	☐	☐	☐	☐	☐	☐
l My COSMOS experience will benefit my teaching practice.	☐	☐	☐	☐	☐	☐	☐

11. What were the primary contributions that you made to the University instructional team during COSMOS? What was your overall experience? What changes could be made?

12. Are there specific changes that you think should be made in the role of the Teacher Fellow?

13. Please describe the ways you feel that participating in COSMOS will benefit your teaching practice and your professional life?

14. COSMOS is very interested in continuing to develop partnerships with teachers in the future. Are there particular kinds of involvement and/or activities that you think teachers would find professionallybeneficial and personally rewarding?

15. Please provide any additional comments:

Thank you for taking the time to answer these questions!

California State Summer School
for
Mathematics and Science

COSMOS

EVALUATION REPORT:
TEACHER FELLOWS PROGRAM

January, 2004

Dr. Rena Dorph
Center for Research, Evaluation & Assessment
Lawrence Hall of Science
University of California, Berkeley

David Goldstein
Teacher Education & Professional Development
University of California Office of the President

California State Summer School for Mathematics and Science (COSMOS)

Evaluation Report: Teacher Fellows Program

The COSMOS experience broadened my awareness and knowledge of computational physics and robotics. I learned how to use new software for programming solutions to physics problems and for programming robots, both of which will be shared with my own classes in the high school.

--Teacher Fellow, Summer 2003

The California State Summer School for Mathematics and Science (COSMOS) takes place at three campuses of the University of California. The California legislature established COSMOS in order to provide an opportunity for highly talented and motivated 8-12 grade students to engage in an intensive program of study, experimentation and activities that promote further interest in pursuing their talents and interests in mathematics, science and/or engineering. Participants form a community that includes like-minded peers, outstanding university faculty and distinguished scholars. During the summer students take courses, work in labs, design and complete individual projects and present their results. Their work takes place in subject-specific clusters that focus on particular content areas within the overall fields of advanced mathematics and science. The COSMOS experience bolsters students' efforts to delve into subjects of interest and to prepare for university and/or careers in these areas. More information about the COSMOS program in general is available in a full-length evaluation report.

One aspect of the COSMOS implementation design is the employment of Teacher Fellows. The Teacher Fellows are high school mathematics and science teachers who join the university faculty, distinguished scholars, and campus teams leading the COSMOS participants through an academically challenging and, according to participants, fun summer experience on the campuses. The following document describes the role of the Teacher Fellows within the program and the impact of the program on the Fellows.

Data for this report was collected in several ways. First, evaluation staff conducted site visits at each of the three COSMOS campuses. During these visits, evaluators observed Teacher Fellows' participation in COSMOS and interviewed at least two Fellows per site. Second, several months after the COSMOS 2003 programs concluded on the three host campuses of the University of California (Davis, Irvine and Santa Cruz), COSMOS evaluators sent surveys out to 25 Teacher Fellows. The purpose of the Teacher Fellows survey was to collect valuable information about the Teacher Fellows' experience. The information below reflects responses from 15 of the 25 (60%) Teacher Fellows who participated in COSMOS during the summer of 2003.

Teacher Fellows participate in COSMOS for many reasons

Teacher Fellows learn about COSMOS in a number of different ways and decide to participate for several, often interrelated, reasons. Approximately one quarter of the Teacher Fellows reported that a colleague's recommendation of the program was a reason

they decided to participate while half indicated that being contacted by a COSMOS staff member who asked them to apply was an important factor.

Teacher Fellows were attracted to COSMOS for a number of reasons. All Teacher Fellows who responded to a question about whether they hoped to learn new things during their summer with COSMOS indicated that this was "important" or "very important" to them. Eighty percent (80%) of respondents noted that the opportunity to work with university faculty was "important" or "very important" in their decision to join the COSMOS staff. Approximately one-third of respondents said that the opportunity to use university labs and facilities was an important factor in their interest in serving as a Teacher Fellow. Similarly, four out of five (80%) Teacher Fellows were attracted to the prospect of working with other high school teachers interested in math/science. The chance to work with high achieving students also appealed to 80% of the respondents. Many (approximately 70%) of the survey respondents also indicated that spending time on a university campus and using university labs and facilities were "very important" factors in their decision to participate; almost a third of participants reported that use of the university labs was an "important" part of their decision to join COSMOS. Slightly more than half of the respondents said that the extra income they earned through COSMOS was "important" or "very important."

Teacher Fellows play an important role in the COSMOS program

> *In a typical answer, one Fellow described his primary contribution as "help[ing] professors understand the learning style of students (H.S.) and clear[ing] up material for the students."*

Evaluator observations and interviews with COSMOS professors indicated that Teacher Fellows contribute important expertise to the COSMOS program. Because of their experience working with high school students throughout the year, Teacher Fellows have an understanding of the learning needs of high school math and science students, state academic standards and K-12 curricula. This expertise is often crucial in supporting students to make connections between the COSMOS curriculum and their pre-existing science and mathematics knowledge.

Teacher Fellow duties vary slightly from campus-to-campus and from cluster-to-cluster. Generally, a Teacher Fellow primarily works with students, supporting them in the math/science communications (an intensive writing component of the program) and guiding their preparations of final projects. Many Teacher Fellows also collaborate with University faculty, staff and lab technicians, providing them with guidance about adapting elements of their instruction to the needs of high school students. Observation, interview, and survey data indicate that, with a few exceptions, Fellows spend most of their time observing classes, lectures, labs, and field trips alongside students and then assisting and advising students regarding COSMOS assignments. Thus, Teacher Fellows are crucial facilitators of student work. Fellows tend to spend a minimal amount of time, less than 5 hours/week actually giving lectures or leading labs or field trips.

While many Fellows gained much (described below) from their experience, some felt underutilized. Those who spent more of their time "observing" and "supporting students" and less of their time in a leadership role, were more likely to feel underutilized. Some faculty members easily incorporated the Fellows into the leadership of the experience, while others had little sense or guidance in making the best use of Fellows' expertise. Thus, the program would benefit from a more defined Teacher Fellow role and a more systematic approach to orienting COSMOS university faculty to the role of the Teacher Fellows.

COSMOS' impact on Teacher Fellows was both personal and professional

> *In general, this served as a recharging of my academic and professional interest in science and education.*

We asked Teacher Fellows how their work with COSMOS this summer affected their personal and professional lives. "The mere ability to observe. The outstanding professors and educators that participated in COSMOS have benefited my career as an educator. Being able to watch and learn changed my style and quality of teaching for the better."

COSMOS was professionally rewarding for me

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Agree nor Disagree	1	4.0	6.7	6.7
	Somewhat Agree	2	8.0	13.3	20.0
	Strongly Agree	12	48.0	80.0	100.0
	Total	15	60.0	100.0	
Missing	System	10	40.0		
Total		25	100.0		

Eleven respondents noted that employment with COSMOS was of "better quality" than other summer options available to them and other professional development activities. One Fellow commented that "COSMOS is one of the few opportunities for teachers to network with college professors and staff. In education we speak of building bridges for our students but COSMOS includes high school teachers." Approximately eighty-five percent (85%) of the respondents said that they had learned much about the subject area of their cluster. Six out of fifteen (40%) respondents indicated that participation in COSMOS influenced their future academic plans.

There was a consensus among Teacher Fellows that they improved content-specific knowledge in their fields (science or mathematics) during their COSMOS experience. Over 80% noted the importance that they associated with having the opportunity to work with university faculty and 13 of the Fellows noted the importance of having access to university facilities and labs. As one Fellow explained "I have benefited by gaining ideas for labs and topics to cover in [my high school] class. [I also had the opportunity to]Network with UCI faculty." Another Fellow explains "I have more contacts at the university and will use some of the labs in my classroom."

In addition to the professional benefits teachers reaped from their COSMOS experience, over 80% of the survey respondents found their experience to be personally rewarding.

COSMOS was personally rewarding for me

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	4.0	6.7	6.7
	Neither Agree nor Disagree	1	4.0	6.7	13.3
	Somewhat Agree	2	8.0	13.3	26.7
	Strongly Agree	11	44.0	73.3	100.0
	Total	15	60.0	100.0	
Missing	System	10	40.0		
Total		25	100.0		

Personal rewards included the interpersonal relationships that they developed with COSMOS faculty. As one Fellow noted, "the biggest gain for me was the friendship of the four [university] professors [whom I worked with in my cluster]."

Teacher Fellows' COSMOS experience had a direct impact on their work in their year-round, high school classrooms

> *I learned some awesome new things about marine science that I have used in my high school classes.*

One of the benefits that could be reasonably expected to accrue from the participation of Teacher Fellows in the COSMOS program is that teaching strategies, access to state-of-the-art concepts, and the opportunity to work with university scholars might have a positive impact on the teachers who serve as Teacher Fellows, and that these opportunities might impact the way they conduct their year round high school classroom instructional activities in mathematics and science. "Teaching astronomy will be greatly enhanced by using equipment to gather astronomical data."

Over 80% of the survey respondents felt "strongly" or "very strongly" that their experience as a Teacher Fellow would provide benefits for their teaching practice. "My experience gave me great insight to share with students about what pre-medicine and pre-veterinary-medicine training is all about. I teach honors science students so this experience was invaluable to me. It allows me to counsel my own HS students about what their future will be like, in veterinary school especially."

Measuring further impact on year-round classroom practice would require follow-up surveys, interviews, and year-round classroom observations that were beyond the scope of this evaluation, but subsequent reports on the Teacher Fellows will address this issue.

Teacher Fellows were satisfied with the program implementation

> *Regular planning time between faculty, teacher and lab techs to allow a more integrated experience.*

One of the critical factors in a successful enrichment program, like COSMOS, is the implementation of the program itself. Unless the program functions smoothly, it cannot achieve its desired impact. Teacher Fellows were asked to share their views on elements of the implementation of the program. Virtually all of the Teacher Fellows who responded to the survey said that COSMOS was well organized.

The COSMOS program was well organized

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Agree nor Disagree	1	4.0	6.7	6.7
	Somewhat Agree	5	20.0	33.3	40.0
	Strongly Agree	9	36.0	60.0	100.0
	Total	15	60.0	100.0	
Missing	System	10	40.0		
Total		25	100.0		

Interview and observation data confirmed these survey results. In addition, more than eighty percent (80%) said they were adequately prepared for their role as a Fellow.

The one aspect of COSMOS program implementation that Teacher Fellows felt had been lacking was the writing class. Most Fellow comments, both in person and in writing, suggested that the writing class was not sufficiently integrated into the rest of the COSMOS experience and was not as well thought out as the rest of the program.

Conclusion

The results of interviews, observations and surveys of the Teacher Fellow experience from the Summer of 2003 offer a consistently positive and supportive impression of COSMOS. When asked whether COSMOS had been a positive experience for them, eleven out of fifteen (73%) "strongly agreed" that it had, with another 2 respondents indicating that they "agreed."

COSMOS was a positive experience for me

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	4.0	6.7	6.7
	Neither Agree nor Disagree	1	4.0	6.7	13.3
	Somewhat Agree	2	8.0	13.3	26.7
	Strongly Agree	11	44.0	73.3	100.0
	Total	15	60.0	100.0	
Missing	System	10	40.0		
Total		25	100.0		

Perhaps the most telling responses are those to the questions about whether the Teacher Fellows would return for another summer if they were permitted, and whether they would recommend COSMOS to their colleagues. In both cases, 80% of the Teacher Fellows from 2003 who returned the surveys said they would return again and would recommend working at COSMOS to a colleague.