

CALIFORNIA INSTITUTE OF TECHNOLOGY

Summer Undergraduate Research Fellowships

SURF

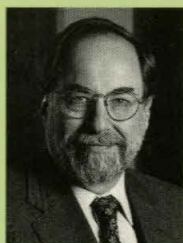
Annual Report

1998



20

Celebrating 20 years



Congratulations to SURF on its 20th program!
When I began my tenure as president a year ago, I became acquainted with the outstanding individuals, projects, and programs that make Caltech a world leader in research and education. SURF is one of those programs. Through SURF, students join the community of scholars in exploring nature's secrets

or creating new devices or processes. Participants learn the skills and techniques of their disciplines. Students enter the realm of professional scientists and engineers. They sink their research roots in the environment of inquiry and analysis and scientific ethics. The joys and struggles of solving new problems deepen their understanding of the process of science and engineering. They are introduced to the importance and value of communicating their work.

I am impressed with the supportive, enthusiastic community that ensures that SURF remains a rich and dynamic program. The mentors and their research groups, the SURF Board, the SURF Administrative Committee, donors, alumni, volunteers, corporate and foundation representatives, and administrative staff — all of these individuals and groups contribute to the success of SURF. The commitment of almost 1000 people to SURF and the undergraduate research experience builds strong bridges among constituencies that are very important to Caltech. Thank you for your leadership, your support, your hard work, and your loyalty to SURF and to the Institute.

As SURF enters its third decade, we look to the future with optimism. We will work hard to ensure that all Caltech students who choose to participate in research have the opportunity. We will continue to move toward our goal of fully endowing the SURF program. We are committed to maintaining continuity while encouraging vision and responsiveness to the changing requirements of our faculty and the undergraduate researchers with whom they work. SURF's future is bright with the creativity and synergy generated in the community of researchers and scholars. Excelsior!

David Baltimore
President

The 1998 SURF program is dedicated to Dr. Thomas E. Everhart, President Emeritus, in honor of and with great appreciation for his strong commitment to SURF, his enthusiastic support, and his efforts to strengthen the program. His advocacy for the program during his presidency built a legacy that will benefit students and their mentors far into the future. Through this dedication, we are proud to honor his significant contributions to SURF and to undergraduate research at Caltech.



his year we celebrate SURF's 20th birthday! Even the original founders of the Summer Undergraduate Research Fellowships had no idea of the phenomenal success the program was going to enjoy. Founded in 1979 with 18 students and 17 faculty, SURF has served over 2,475 students and has become a model for similar programs at universities throughout this country and abroad. This year 293 students, including 99 from other institutions, participated in SURF. To date, over 19% of all living Caltech alumni who received their bachelors degree from the Institute have SURFed. Close to 17% of SURF students become co-authors of peer-reviewed articles, present at conferences, or contribute to technical reports.

SURF has passed through its infancy, childhood, and adolescence, and has now come of age. Unlike biological phenomena, SURF has many parents — each one giving birth to a new dimension of SURF. This growth has greatly expanded the opportunities for each SURF student to grow personally as well as professionally. An important aspect of SURF is the encouragement of each student to believe that she or he can accomplish tasks that others have not. SURF students not only interact with brilliant researchers, but also with local and national leaders in society.



SURF has also enabled Caltech and JPL to strengthen its learning community which is centered around bright and enthusiastic students being coached by mentors, alumni, and concerned members of the greater Caltech/JPL family. SURF will survive as long as young people and leaders at Caltech and JPL wish to work together in expanding our knowledge of the universe. SURF has helped Caltech/JPL maintain the model of a community enthusiastically endorsed by the late Ernest Boyer of the Carnegie Foundation. He stated that a campus community should be purposeful, open, just, disciplined, caring, and celebrative.

As suggested by Derek Bok, former president of Harvard University, "Research is an expression of optimism about the human condition — that a deeper and more complete understanding is possible, and that things can be better."

Robert P. Sharp, Robert P. Sharp professor of geology, Emeritus, has enthusiastically stated, "There is room for energetic young people working at the edge of human knowledge." This is especially true if



Fredrick H. Shair

students are assisted by leading researchers who are also interested in the students' personal and professional development.

Those of you who have been involved with SURF know that it has taken a family and an extended family to bring SURF to where it is today. Congratulations to you all!

Undergraduate research did not begin with SURF. It has always been a part of Caltech, but it was institutionally fragmented. For example, Ernest Swift pointed out to me that Arthur Noyes introduced undergraduate research into the chemistry curriculum upon his arrival in 1920. I asked Ernest his advice. He thought a bit, and came up with three suggestions; first, make it campus wide so that students in one field can do research in another discipline; second, help them understand that people outside of Caltech are interested in their development; and finally, raise an endowment! Although not yet to the desired level, the SURF endowment will help the program survive even during times of financial difficulty.

SURF is deeply indebted to the Caltech faculty, the JPL technical staff, the Caltech alumni, the SURF Administrative Committee, the SURF Board, the SURF Student Advisory Council, and our donors — the program would not be what it is without their support. Special thanks go to Susie Clark, Carol Casey, Cherri Brown, Bill Whitney, and Terry Cole. Reflecting on the early days of SURF, I recall the profound contributions made by Ed Baum, Art Adams, Hugh and Audy Lou Colvin, Samuel and Frances Krown, Bill Lang, and Ed Posner.

Finally, let me say that of all the people who helped give birth to SURF and felt all the growing pains, Carolyn Merkel stands at the very top for providing creative and sustained leadership, patience, and love. Without her vision, SURF would have become history, rather than help to make it.

TWENTY YEARS OF SURF

...e celebrate 20 years of SURF this year! The program has grown, developed, and matured over these years, as the accompanying timeline attests. More than 2,475 students have participated, working with close to 700 mentors. Through undergraduate research they have gained important insight into possible careers. Their self confidence has grown as they asked new questions and applied classroom

knowledge to unsolved problems. Many students tell us that SURF was the most outstanding experience of their Caltech careers. How did it all begin?

The history of undergraduate research at Caltech goes back to the beginnings of Caltech itself. Undergraduate research was introduced into the curriculum by Arthur A. Noyes after his arrival in 1920 as first chairman of the Division of Chemistry. According to Ernest Swift, professor of chemistry, this was probably the first extended use of undergraduates in scientific research anywhere, with about a dozen students spending a summer conducting chemical research at Caltech's Marine Biology Station at



Murph
Goldberger



Edward Baum, Carolyn Merkel, and SURF founder
Fred Shair



SURF students Ken Libbrecht
and Julia Kornfield



Samuel and Frances Krown

SURFing through the ages: An historical timeline

1	2	3	4
<p>1979 SURF is founded by Caltech Professor of Chemical Engineering Fred Shair. With staff support from Carolyn Merkel, the summer program starts off with a budget of \$36,000 to fund 18 students for a 10-week research period.</p> <p>Caltech President Marvin L. Goldberger praises the new program, which has in its first class senior Kenneth G. Libbrecht, now a Caltech professor of physics, working under the sponsorship of Professor of Physics Steven E. Koonin (currently Caltech vice president and provost).</p>	<p>1980 Senior Development Officer Edward Baum joins the SURF team and launches SURF's successful fundraising component, introducing corporate representatives and members of The Associates and the Alumni Association to the SURF program.</p>	<p>1981 Caltech junior Julia A. Kornfield, currently a Caltech associate professor of chemical engineering, SURFs during the summer under the auspices of professor of physics Jerome Pine.</p>	<p>1982 Associates Samuel and Frances Krown become SURF's founding donors, contributing the first gift to SURF.</p>

Corona del Mar. One of these investigations led to a publication by then-students Edwin McMillan and Linus Pauling, "An X-ray Study of the Alloys of Lead and Thallium," in the *Journal of the American Chemical Society*, Vol. 49, p. 666, 1927. Both authors later won Nobel Prizes in Chemistry. In the mid-1930s the original summer undergraduate research program disappeared for lack of financial support and campuswide participation. Undergraduate research was evidently quite feasible and highly desirable, but without institution-wide involvement and assured financial support, even a good program disappeared.

Thomas A. Tombrello, William R. Kenan, Jr. Professor, and professor of physics and the new chair of the Division of Physics, Mathematics and Astronomy, began working with undergraduate students when he became a faculty member in 1965. Tom recognized that for many students hands-on research was the best way for them to learn, integrating their classroom experiences with real-life research problems. He received funds from then-President Harold Brown, and raised monies from the Paul K. and Evalyn Elizabeth Cook Richter Memorial Funds to support student stipends.

With the establishment of the first program during the summer of 1979, Professor Fred



Betty Nickerson



Lew Allen, director of JPL, and Terry Cole bring SURF to the Lab



Jeannie Cass, creator of the SURF communications program, chats with SURF students



Hugh Colvin, SURF friend



SURF '84



SURF '86

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1983

Samuel and Frances Krown establish the first SURF endowment. Samuel enthusiastically and tirelessly recruits new friends and donors, and with Fred Shair establishes the SURF Board, a voluntary support organization consisting of individuals dedicated to the educational values of undergraduate research at Caltech, and who contribute their advice, encouragement, and financial support to the fledgling SURF program.

Associate Betty Nickerson organizes the first annual SURF Kickoff Dinner at the Athenaeum, featuring SURF students presenting their research to faculty, staff, and donors.

Lew Allen, director of the Jet Propulsion Laboratory (JPL), and Terry Cole, JPL chief

technologist, bring SURF to the Lab, where two students do projects. The JPL undergraduate research experience differs from the campus projects in that students become team members and often have a deliverable component at the summer's end. The program flourishes and grows each summer.

Jeannie Cass creates a communication program to help students prepare for their final oral presentations. Now an integral part of SURF, the communications component has grown and evolved over the last 15 years, with Mary Ann Smith, a communication consultant, now leading the effort.

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1984

The SURF Administrative Committee is formed by President Murph Goldberger, with representation from each academic division and JPL. Charged with the planning and administration of the SURF program, the committee also advises on long-term planning and development of the program and possible related programs.

Roundtable Discussions become part of the SURF experience, giving small groups of students the chance to meet with leaders in academia, industry, or government to discuss topics of interest to the students.

Special seminars on career planning and graduate school applications are held for the first time.

Samuel Krown introduces fellow Associate Hugh Colvin to SURF. Hugh becomes an enthusiastic supporter and provides strong financial leadership by establishing nine endowments. Actively involved, he attends seminars and other gatherings of students and mentors, and introduces SURF to several others who also became good friends and strong supporters.

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1985

The 1985 program is dedicated to Caltech emeritus professor Ernest Swift, in recognition of his early participation in undergraduate research during the 1920s with Arthur Amos Noyes. A new tradition is born; each year at the Kickoff Dinner the program is dedicated to an individual, usually emeritus faculty, in recognition of his/her commitment and contributions to undergraduate research and education.

For the first time three SURF students are invited to speak at Alumni Seminar Day. Subsequently the Alumni Association assumes the task of providing session chairs for SURF Seminar Day.

Shair's original vision for SURF was born: to encourage professional creativity, to enhance the interaction between undergraduates and the faculty, to help our students in their career decisions, and to provide a program involving faculty (including emeritus professors), admissions, alumni, donors, JPL, and even other institutions to help Caltech achieve its institutional goals. The key element for an excellent SURF experience—enthusiasm of the mentor for working with a particular student on a problem of mutual interest—remains the essence of the student-mentor interaction.

The first SURF program contained the essential elements of today's program. Students collaborated with their mentors to define and develop a project. The students wrote proposals. A faculty committee reviewed the proposals and made recommendations for awards. Students worked during ten weeks in the summer, gave an oral presentation, and wrote a technical paper at the conclusion. They attended weekly seminars by faculty to broaden their awareness of the



SURF Board



Thomas E. Everhart



Jack Roberts with SURF group

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The Alumni Association appoints a liaison to the SURF Board, and the Association starts a tradition of providing one SURF student stipend each summer.

The first non-Caltech student, Cornell student Leila Belkora, does a SURF project with Drs. Alan Harris and Steve Ostro at JPL.

Two Caltech students do off-campus SURF projects under the auspices of a Caltech faculty mentor and a mentor at another university for the first time.

1987

SURF emerges on the national front at the first National Conference on Undergraduate Research, held at the University of North Carolina at Asheville. Three SURF students attend the conference, and Fred Shair becomes a member of the Governing Board. For the first time, many university faculty realize that undergraduate research is becoming an important academic experience at colleges and universities nationwide. While most students work informally with faculty at their institutions, SURF stands out as an excellent and unique model of an institutionalized program: at Caltech

- all students receive stipends rather than a mix of academic credit and wages;
- stipend support is raised from private, external sources;
- SURF is responsive to the particular needs and interests of its participants;
- the research experience is enhanced with other programmatic activities—seminars, discussions, a communications program, social and cultural activities—and has written and oral reporting requirements;
- with 19 percent of the eligible student body participating, it is proportionally the largest of the undergraduate research programs.

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1988

Thomas E. Everhart becomes Caltech president. "I am pleased to have joined an institution where the hard work and support of so many dedicated people have resulted in a superb program such as SURF," he said. "I look forward to being a part of SURF's continued growth."

SURF administration becomes a line item in the Institute budget.

SURF celebrates its 10th anniversary!

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1989

Northern California Associates establish a SURF endowment.

Fred Shair leaves Caltech to become Dean of Natural Sciences at Cal State Long Beach and Carolyn Merkel becomes director of SURF.

Terry Cole becomes chair of the SURF Administrative Committee.

work carried out at Caltech. Some students published papers.

The growth of the SURF team has mirrored the growth of all aspects of the program. For each SURF student, at least three other individuals work hard to ensure that the student can participate and has a good experience. Fred Shair's vision and unbounded enthusiasm were valuable as he built a team of individuals to ensure the growth and health of SURF. Faculty mentors observed the often-remarkable contributions their students made to the ongoing work in their laboratories. Many students actually became co-authors of articles in the

refereed scientific literature and sometimes made presentations at professional conferences. The Caltech research community became enthusiastic supporters of the SURF concept. Within a few years, SURF was accepted, indeed expected, by students and faculty alike.

The SURF program is unique in the country in that close to 50 percent of the stipend budget comes from private, external sources. SURF was initially funded from the Prize Fund administered by the Scholarships and Financial Aid Committee. SURF grew rapidly, and it became clear that for this fledgling program to



First MURF group



Caltech hosts "EUREKA" conference



Ray Owen, SURF Board chair 91-92



Fred Shair receives an asteroid

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1990

Dr. William M. Whitney, a Caltech alumnus, JPL division technologist, and a member of both the SURF Administrative Committee and the SURF Board, creates the Monday Evening Career Discussions to help students make short-term educational and professional decisions in the context of long-term life and career goals. The program becomes a dynamic, interactive, seven-session series that addresses a range of issues that students face as they complete their undergraduate degrees, apply to graduate schools, or commence careers.

Susie Clark joins the SURF staff.

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1991

Caltech hosts "EUREKA," the 5th annual National Conference on Undergraduate Research (NCUR); close to 1,100 students, faculty, and administrators from colleges and universities across the country attend to hear student presentations and a panoply of superb plenary speakers.

David Van Essen, then a Caltech professor of biology, organizes the Minority Undergraduate Research Fellowships (MURF) program to increase the number of underrepresented students in biology and chemistry. Nine students participate the first year.

SURF becomes an international program when two students from the United Kingdom participate in SURF at JPL.

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1992

Institute agrees to underwrite SURF stipends against future fundraising.

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1993

SURF founds, and Caltech hosts, the first annual Southern California Conference on Undergraduate Research (SCCUR). Modeled on NCUR, SCCUR is multidisciplinary, including the sciences, mathematics, engineering, humanities, and the fine and performing arts. It is a unique opportunity for students to discover how research is done in the various disciplines.

The SURF Board votes to increase the endowment and other sources of revenue and not to seek agency funding because federal sources remain uncertain from year to year.

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1994

Caltech hosts second annual SCCUR.

For the first time, all funds for student stipends are received by March 1, when applications are due!

Robert C. Perpall creates the Doris S. Perpall SURF Speaking Awards to recognize the best oral presentations given on SURF Seminar Day. Students receive cash awards: \$500, first prize; \$300, second; \$200, third. The purpose is to provide an incentive for students to develop the excellent communication skills that will benefit them in their future careers.

succeed, other means of support had to be found. When Ed Baum joined Fred Shair's SURF team in 1980, Ed recognized the need to raise funds to ensure the future of this new program. His expertise in fundraising and his knowledge of Caltech contributors and their particular interests were very important during those early days, and he helped to build a fundraising base that has enabled SURF to grow and mature. SURF is now funded from many sources, including gifts from individuals, corporations, and foundations, faculty grants, JPL, and other Institute sources. Generous long-term support from private foundations has been

especially critical: contributions from the Paul K. and Evalyn Elizabeth Cook Richter Memorial Funds have funded 278 students over 14 years, and grants from the Howard Hughes Medical Institute have permitted many students to do SURF projects in biology and chemistry. Faculty are expected to pay half their students' stipends, and funds contributed from other sources are used as matching funds for Caltech students working with faculty. Indeed, the last 20 years have seen the establishment of a robust financial foundation.

1998

For the first time, Caltech Merit Scholars may participate in SURF in the summer preceding their freshman year. Twenty-two frosh SURFs join the 1998 SURF class.

Marcella Bonsall establishes the Marcella and Joel Bonsall SURF Prize for Technical Writing, to recognize and encourage excellent technical writing of research results. The first prizes will be awarded in 1998, with cash awards of \$500 for first prize; \$300, second; and three \$200 third prizes.

The Beckman Scholars Program is created by a generous grant from the Arnold and Mabel Beckman Foundation. The program in the Divisions of Biology and Chemistry and Chemical Engineering gives students the extraordinary opportunity to work on a research project with a mentor for two summers and the intervening academic year.

The MURF program has grown to 20 students. Through grants from the James Irvine Foundation, the Ford Motor Company, and General Motors, MURF is expanded into the Divisions of Physics, Mathematics and Astronomy and Engineering and Applied Science.

The SURF endowment now provides about 12 percent of the funds required for annual stipends. Since 1983, 30 individual endowments have been created that support one student in perpetuity; students supported by endowments bear the endowment name, just like named professors.

Approximately 25 percent of the eligible Caltech students now participate in the program each summer; 100 non-Caltech students are part of the 1998 program, with students representing US institutions as well as countries in Europe, Eastern Europe, and Asia. Twelve Caltech students worked in Turkey, Czech Republic, Hong Kong, England, Scotland, Singapore, Russia, Denmark, China, and Switzerland.

Student stipends are now \$4,000 each for a total budget of close to \$1.2 million for 293 students.

SURF celebrates its 20th year!



David
Baltimore



Marcella Bonsall establishes
award for technical writing

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1995

Phyllis Hosey and her colleagues from Caltech's corporate relations staff create the Small Business Industrial Associates (SBIA) program, whereby small local companies join the Industrial Associates program. The fee supplies one SURF stipend and a contribution to the Caltech library. While this program gives students the experience of doing research in an industrial environment with a deliverable at the end of their project, it also helps build bridges with small companies, most of which have alumni founders or officers.

Carol Casey joins the SURF staff.

SURF Student Advisory Council (SURFSAC) is formed to provide a student voice in planning and implementation of the program, to gain on-going feedback on activities, and to coordinate social and cultural events for SURF students during the summer.

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1996

SURFSAC publishes the first *Caltech Undergraduate Research Journal (CURJ)*.

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1997

David Baltimore becomes president of Caltech.

Teaching and Interdisciplinary Education (TIDE) program is created to employ the creativity and expertise of students and faculty working together to develop educational opportunities, materials, methods, or curriculum.

JPL Undergraduate Scholars (JPLUS) program is formed. Fred Shair, now manager of educational affairs at JPL, creates the program to recognize the top students at southern California community colleges. JPLUS scholars have the opportunity to compete for a SURF award at some time during their undergraduate careers.

FROM THE SURF ADMINISTRATIVE COMMITTEE

Terry Cole



Terry Cole

The SURF Administrative Committee joins the Caltech community in celebrating the 20th anniversary of the SURF program. One of the hallmarks of the strength of the program in this twentieth year is the affiliation of related undergraduate research and teaching programs with SURF. In 1997 the Teaching and Interdisciplinary Education (TIDE) program was affiliated. Also the AdComm is pleased to welcome the JPL Undergraduate Scholars (JPLUS) program as a new affiliate to SURF. This program, sponsored through NASA, provides for top science and engineering students from 25 southern California community colleges the opportunity to participate in the SURF program. It seems most appropriate that JPLUS is dedicated to the memory of the late Prof. Robert Leighton of Caltech. In 1998 the Freshman Merit Scholar SURF program was launched. Finally the Minority Undergraduate Research Fellowships has this year grown from a biology and chemistry program to include the Physics, Math, and Astronomy and the Engineering and Applied Science divisions. We wish to express our deep gratitude to Dr. Marcella Bonsall for her generosity in establishing the Marcella and Joel Bonsall Prize for technical writing, which will be inaugurated this year.

The SURF Administrative Committee sets the academic policies of the SURF program, oversees the intellectual standards, and advises the Caltech Administration on long-term plans for development of SURF and programs relating to SURF. The committee consists of faculty from each of the Institute's academic divisions, senior members of the JPL technical staff, student representatives, and members of the Caltech administrative staff, including the SURF director. All of the faculty members of the committee are or have been SURF mentors.

In addition to overseeing and planning, the committee participates in SURF directly. Its members review all of the students' research proposals—more than 300 this year. Members of the committee participate in judging the competitors at the Doris S. Perpall Speaking Awards and will assist in reviewing the students' final reports for the Marcella and Joel Bonsall Prize for Technical Writing. SURF has become a robust program over its 20-year history. We look forward to building on its strength as we plan for the third decade.

The SURF Student Advisory Council (SURFSAC) serves as a liaison between the students, mentors, and the SURF office. To help students maximize their summer learning experience we endeavored to bring together the community of mentors and the community of students. In this environment, active communication between the students and their mentors was highly encouraged.

SURFSAC planned and organized several events throughout the summer to allow students to interact with each other. Some examples included a beach trip, a Magic Mountain trip, and sports events. The success of these events was an important aspect of the summer, because it allowed students from different cultural, academic, and social backgrounds, brought together by the common interest in science, to spend time sharing dreams and a fun day outside of their busy research schedules.

We organized weekly student-mentor dinners. Two or three professors dined with approximately ten students at an off-campus restaurant. These dinners gave students and mentors an opportunity to get to know each other in a casual setting. Professors were eager to know what student life was like, and what students aspired to do after college. The students were also very willing to talk about various aspects of college life with the professors and to learn about the life of a research scientist. Personally, I enjoyed an extremely pleasant experience dining with Professors Masakazu Konishi and Sunney Chan, and learned a great deal about Chinese cooking. SURFSAC would like to thank Professor Steven Frautschi, Dr. Fredrick Shair, and Dr. and Mrs. John Roberts for providing us with the funding to organize eight student-mentor dinners this summer, almost twice the number held last year.

SURFSAC also edits and publishes the *Caltech Undergraduate Research Journal*, a collection of the best technical papers written by students on their summer research at Caltech. This year there will be a technical writing prize from an endowment given to SURF by Dr. Marcella Bonsall.

Throughout the academic year, SURFSAC will dedicate its efforts to building a strong community of researchers by speaking to incoming freshmen, high school teachers, and prospective students. Working with SURFSAC has been a rewarding experience for all of us, and we are pleased to have been able to contribute to the SURF program.

FROM THE SURF STUDENT ADVISORY COUNCIL

Minoree Kohwi



*Minoree Kohwi, Paul Kim,
and Candace Chang*

DIRECTOR'S REPORT



Carolyn Merkel

We mark an important milestone as we march from SURF's second decade into the third. Over the 20 years, SURF has matured into a rich and dynamic program. The creativity generated when students and faculty work together on problems of mutual interest gives SURFers an unparalleled introduction into the life of the research scientist or engineer. Students learn research skills and techniques, ask new questions at the forefront of science and technology, communicate the results of their efforts, and gain confidence in their abilities. SURF students have a strong advantage as they apply to graduate schools or enter jobs in industry. To date, more than 2,475 students have participated in SURF with close to 700 mentors. We have much to celebrate!

1998 SURF Highlights

This summer was the largest SURF program ever with 293 students participating.

We are delighted to announce the establishment of the Marcella and Joel Bonsall SURF Prize for Technical Writing. Dr. Marcella Bonsall established the prize as an incentive for students to write excellent technical papers and to encourage them to develop writing skills that will benefit

them throughout their careers.

Students will receive cash awards: \$500, first prize; \$300, second; and three \$200 third prizes; five honorable mentions. The prizes will be awarded in December 1998. The winning papers will be published in the *Caltech Undergraduate Research Journal*. Our deepest gratitude to Marcella for creating this prize!

I want to express my deep personal gratitude to Carl and Shirley

Profile of the 1998 Participants

Division	Total Number of Students	Number of Caltech Students	Number of Non-Caltech Students	Number of Research Mentors
Biology	59	38	21	32
Chemistry and Chemical Engineering	35	22	13	22
Engineering and Applied Science	51	38	13	26
Geological and Planetary Sciences	14	13	1	10
Humanities and Social Sciences	7	4	3	4
Physics, Mathematics, and Astronomy	57	40	17	31
Jet Propulsion Laboratory	43	12	31	25
Small Business Industrial Associates	7	7	0	5
Off-Campus	8	8	0	8
International	12	12	0	12
	293	194	99	175

Larson for the establishment of the Carolyn Merkel SURF endowment. I am honored and profoundly moved by their generous gesture of support of the SURF program and their confidence in me as director of SURF. This endowment will support a student each year, and I look forward to following the progress, joys, and struggles of these students. On behalf of the future Merkel SURF students: Thank you!

We are delighted that Professor of Physics Lee Smolin from Pennsylvania State University gave the first SURF seminar day plenary address on "Why Is the Universe Hospitable to Life?" This presentation was a capstone to SURF seminar day and a fitting celebration of 20 years of SURF.

The SURF Student Advisory Council held eight mentor-student dinners this summer to encourage informal interaction and strengthen the community of researchers and scholars. We thank Professor Steven Frautschi, Dr. Fred Shair, and Dr. and Mrs. John Roberts for the generous contributions in support of these dinners.

This year we began several new programs based on the SURF model of faculty and students working together on problems of mutual interest. To reflect the diversity of programs, we changed our name to the Student-Faculty Programs (SFP) office to better describe its changing nature. The new programs

include:

Beckman Scholars: Through a generous grant from the Arnold and Mabel Beckman Foundation, Candace Chang, Ming Chen, Brent Kious, and Daniel Levy, all students in biology, chemistry, and chemical engineering, were awarded Beckman Scholarships. These grants allow them to undertake research over the course of two summers and the intervening academic year with faculty mentors. We applaud the Beckman Foundation's initiative in encouraging and supporting innovative, in-depth undergraduate research experiences for our students. These students also receive funds to travel to conferences or meetings, and they will attend a special symposium in July 1999 when Beckman Scholars nationwide will report on their projects. The Beckman Scholars will be recognized in the commencement program when they graduate.

Caltech Merit Scholars: The Institute initiated a new program for its Merit Award-winning entering freshmen. For the first time this summer, they were offered the chance to do a SURF project with a faculty mentor preceding their freshman year. We welcomed 22 Frosh SURF students. Students and faculty alike expressed great enthusiasm for this program.

MURF: For the past seven years, the Minority Undergraduate Research Fellowships (MURF)



"IN MY PROJECT, EVERYTHING WAS SUBJECT TO CHANGE, FROM EXPERIMENTAL CONDITIONS TO COMPUTER PROGRAMS TO THE VERY EQUATIONS THE PROGRAMS WERE BASED ON. MY SURF TAUGHT ME TO CHALLENGE ASSUMPTIONS — TO INTERPRET DATA RATHER THAN JUST COLLECTING IT."

— Christopher E. Kurtz, Sidney R. and Nancy M. Petersen SURF Fellow

program has encouraged under-represented students to pursue careers in biology and chemistry. Grants from the Howard Hughes Medical Institute and Amgen have supported MURF during this period, allowing it to develop and mature. This year, through generous grants from The James Irvine Foundation, General Motors, and Ford Motor Company, we expanded MURF into physics and engineering. With this growth and diversity, the administration of the program moved into the Student-Faculty Programs office under the coordination of Carol Casey.

JPLUS: Fred Shair, manager of educational affairs at JPL, created the JPL Undergraduate Scholars (JPLUS) program to recognize and encourage outstanding potential in community college students majoring in engineering, math, computer science, and physical science. The program awards scholarships during the students' community college years and gives them the opportunity to compete for a SURF during their undergraduate careers. We were very pleased that two JPLUS scholars, Guy Genevier from Pasadena City College, and Scott Kemp from Moorpark College, applied for and were awarded SURFs this summer.

TIDE: This summer was the second for the Teaching and Interdisciplinary Education (TIDE) program. Sixteen students worked with Caltech faculty and JPL staff to

develop computer-based teaching tools for the Caltech courses or work on educational curriculum.

SURF students broadened their horizons this summer. Twelve students worked with mentors in foreign countries including Turkey, Czech Republic, Hong Kong, England, Scotland, Switzerland, Singapore, Russia, Denmark, and China. The experience of applying for and conducting undergraduate research in a foreign country, as well as having the opportunity to live in a different culture for a summer, expands students' perspectives and broadens their experiences. Parandeh Kia, director of the Office of International Programs, Kevin Austin, director of the Counseling Center, and Ivana Nikolic, a former international SURF student, held a special program addressing the issues and questions that students will face as they establish themselves in other countries for the summer period.

Eight students worked with faculty in various fields at other US colleges and universities. The opportunity for our students to spend a summer in a laboratory at another institution gives them new experiences to enrich their Caltech careers and broaden their views of the academic culture. These students are able to participate off campus through cost sharing arrangements for their stipends.

1998 Funding Profile

Faculty grants, mentors, and Institute sources	41%
Individuals, Corporations, Foundations	28%
JPL	13%
Endowment	12%
Minority Programs	6%

SURF Funding

Each year we depend upon the generous contributions of SURF's many donors—individuals, foundations, and corporations—to help us build a robust financial base. All gifts are used to support student stipends. The stipend this summer was \$4,000. With 293 students in the SURF program this year, the total stipend budget for 1998 was close to \$1.2 million. The gifts from our loyal and committed friends ensure that students can continue to have the unparalleled opportunity to engage in undergraduate research. SURF is unique in the country in that over 60% of the funds are raised from external, non-federal sources.

Donors contributing the amount of a student stipend, or more, by annual gifts or through endowment, are listed in all SURF materials and other references with the names of the students supported. They receive a written introduction to the student and may have the opportunity to meet him or her at special events. The donor-student dinner is a popular, informal event to

give contributors the opportunity to meet students supported by their gifts. All donors are listed on page 39 of the annual report.

1998 SURF PROGRAM AND ACTIVITIES

Professional Development Series

Dr. William M. Whitney, BS '51 Ph and member of the SURF Administrative Committee and SURF Board, started the professional development series in 1990. This informal, interactive series addresses issues students will encounter as they begin their careers in industry or attend graduate school. The purpose of the sessions is to help students make their long-term career decisions in the context of their life and career goals. We are deeply indebted to Bill for having conceived, planned, and executed this highly successful program. Many students have expressed their gratitude for the discussions as they begin to make the decisions that will impact the next few years of their lives. Bill has been invited to present the core of this message at the National Conference on Undergraduate Research, the Southern California Conference on Undergraduate Research, and at the University of California at Irvine Undergraduate Research Symposium. This summer's sessions and their participants were:

Thinking About Careers:

Decisions! Decisions! Decisions! Bill Whitney and Julia Kornfield, Associate Professor of Chemical Engineering

Communication in Careers Mary Ann Smith, communications consultant, and Carolyn Merkel

Scientists as Speakers David L. Goodstein, Professor of Physics and Applied Physics; Frank J. Gilloon Distinguished Teaching and Service Professor

Want to Start Your Own Business? Talk With Some People Who Have Done It! Edward Lambert, BS '82 ChE, Managing Director, Meridian Ventures, Inc., and Lawrence Gross, BS '83 Eng, President/CEO of Knowledge Adventure

Power in the Workplace: Its Use and Abuse Bill Whitney and Carolyn Merkel

What Is It Like to Do Research for a Living? A Discussion of Research Environments in Academia, Industry, and National Laboratories Thomas Tombrello, William R. Kenan, Jr. Professor of Physics; Louise Wannier, Chairman and Chief Executive Officer, Enfish Technologies; Dr. François Auzerais, Senior Scientist, Schlumberger-Doll Research; and Bryan Balazs, Staff Scientist, Materials Aging and Compatibility Group, Lawrence Livermore National Laboratory



"DOING A SURF WITH A LITERATURE PROFESSOR HAS GIVEN ME THE OPPORTUNITY TO BROADEN MY EDUCATION. AFTER HAVING BEEN SO HEAVILY FOCUSED IN MATH AND SCIENCE SINCE I CAME TO CALTECH, I REALLY ENJOYED SPENDING A SUMMER RESEARCHING VICTORIAN ENGLAND AND ITS CONTEMPORARY LITERATURE."

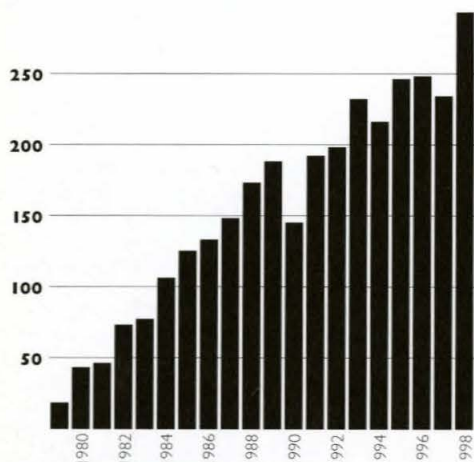
— Stavroula Otis,
The Associates SURF Fellow

Profile of the 1998 Participants

Frosh SURFers	8%
Sophomores	21%
Juniors	33%
Seniors	38%
Women	35%
Minorities	10%
Median Grade Point Average	3.5/4.0*
Average Grade Point Average	3.4/4.0*

* Caltech students only, excluding freshmen

Number of SURF Students



Graduate School: The Nuts

and Bolts of the Application Process

Amy Malak, Associate Director, Caltech Career Development Center with graduate student participants Anthony Kwasnica, Michelle Rojas-Soto, Claude Seywert, and Martha Kirouac

Seminar Series

Each Wednesday at noon, members of the Caltech faculty or JPL staff presented seminars giving an overview of their areas of research. Speakers and their topics were:

Frances H. Arnold, professor of chemical engineering, *Unnatural Selection: Enzymes of the Future*

Paul M. Bellan, professor of applied physics, *Laboratory Simulations of Eruptive Solar Plasma Dynamics*

Roger D. Blandford, Richard Chace Tolman Professor of Theoretical Astrophysics, *Black Holes-The Ultimate Energy Sources*

Marianne Bronner-Fraser, professor of biology, *Riding the Crest: How the Neural Crest Forms and Migrates*

Michael E. Brown, assistant professor of planetary astronomy, *Exploration of the Outer Solar System: The Search for Planets and Super-Comets Beyond Neptune*

Charles Elachi, lecturer in electrical engineering and planetary science, *Seeing the Unseen From Space, in 3-D*

Torrence V. Johnson, Galileo

Project Scientist, JPL, *Europa: Oceans and Life?*

Thomas J. Meade, senior research associate in biology, *Seeing is Believing: Monitoring in vivo Gene Expression by Magnetic Resonance Imaging*

Cindy Weinstein, associate professor of literature, *A Sort of Adopted Daughter: Family Relations in Antebellum Literature and Law*

Each Friday, members of the JPL staff presented seminars giving an overview of their research to the JPL SURF students. Speakers and their topics were:

Patricia M. Beauchamp, Center for *in situ* Science and Sample Return, *CISSR: Establishing Outposts in the Solar System*

Robert J. Calvet, Mechanical Systems Engineering and Research Division, *Stellar Interferometry for the SIM Program: Challenging Science and the Instrument That Will Accomplish It*

Sarah A. Gavit, Mars Micro-probe Project, *Deep-Space 2: Probing the Subsurface of Mars*

Eleanor F. Helin, Earth and Space Sciences Division, *The Impact of "Deep Impact:" NEAT vs. Armageddon*

Margie L. Homer, Observational Systems Division, *The Electronic Nose: Surveying for Life on Other Planets*

Lute Maleki, Telecommunications Science and Engineering,

*Atomic Clocks and Deep Space
Exploration*

Kenneth H. Nealson, Earth and
Space Sciences Division, *Astrobiology
at JPL: Searching for Life on Earth and
Elsewhere*

Grace H. Tan-Wang, Lead
Mission System Engineer, *Deep
Space-4/Champlain: Sample Return
From a Comet*

Brian H. Wilcox, Avionic
Systems and Technology Division,
Nanorovers for Solar System Exploration

Technical Presentations

SURF requires that each participant deliver an oral and a written report at the conclusion of the project. Clear communication of work undertaken is critical to the research process, and for many students, this requirement is their first chance to give a technical presentation.

In 1994, Robert C. Perpall, BS '52 ME and member of the SURF Board, established the Doris S. Perpall SURF Speaking Award in memory of his late wife as an incentive for students to prepare excellent oral presentations on SURF seminar day. The students giving the best presentations advance to a second round of the competition. Winners are selected from a final round held in January. Last year's winners were David Tytell, Kartik Srinivasan, and Keri Ryan.

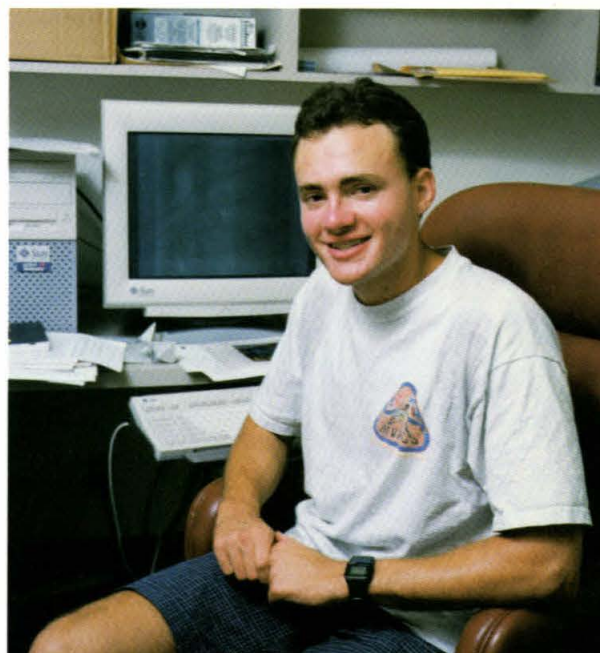
Excellent, clear writing is another critical skill students will employ throughout their careers.

This year the Marcella and Joel Bonsall SURF Prize for Technical Writing will be awarded for the first time to recognize the best technical papers written by Caltech SURF students. Mentors will nominate the papers to be reviewed by a faculty committee. Papers must be a clear, concise description of the work and results and should be intelligible to readers in various disciplines. The papers will focus only on the student's work and how it fits into the related work in the research group. The winning papers will be published in the *Caltech Undergraduate Research Journal*.

Conferences

SURF Seminar Day: The 20th SURF seminar day was held October 17, 1998. Patterned after a professional technical meeting, this symposium gives students the chance to present the results of their research. Seminar day attendees include mentors, students, JPL staff, donors, alumni, parents, and other friends of the SURF program.

All SURF students are required to give this presentation. Preparing the talk helps the student review the details of the work and determine the aspects of it that make it intelligible and interesting to others. Clearly communicating the nature and substance of one's work is critical, and this requirement gives students experience that will be useful throughout their lives.



**"THE HIGH-RESOLUTION IMAGES FROM
MARS GLOBAL SURVEYOR THAT I
ANALYZED FOR MY SURF WERE THE NEXT
BEST THING TO BEING THERE. IT WAS A
JUMPSTART BOTH INTO LIFE AT CALTECH
AND TOWARD THE RED PLANET."**

— Derek M. Shannon, Caltech Merit Scholar

SURFers Win Awards at Commencement 1998

50% of the students receiving their BS degrees had completed a SURF

55% of the students graduating with Honor were former SURFers

58% of the students receiving prizes at Commencement were SURF students

Congratulations SURFers!

National Conference on Undergraduate Research (NCUR) Sudipta Bardhan, Teo Der-Stepanians, Mary L. Mosier, Keri L. Ryan, Kartik A. Srinivasan, and David E. Tytell represented Caltech at the twelfth NCUR held at Salisbury State University in Maryland in April. More than 2,000 students, faculty, and administrators from colleges and universities nationwide attended this conference which features the students' presentations of their research. All disciplines that students study in college are represented at the conference, and students discover how research is carried out and reported in fields other than their own. Caltech hosted NCUR in 1991.

Southern California Conference on Undergraduate Research (SCCUR) California State University Los Angeles hosted the fifth SCCUR in November 1997. More than 400 students, faculty, and administrators from institutions in the region participated in the conference, including several from Caltech. The SURF team started the conference in 1993 to enable local students to attend a multidisciplinary conference of their peers. Caltech hosted the first two SCCUR conferences.

Special Event

We again thank Dr. and Mrs. George Boone for arranging a VIP tour enthusiastically attended by 25 SURF students at the Huntington Library and Art Museum and for hosting a lovely reception in their beautiful sculpture garden following the tour.

THE SURF TEAM

SURF could not have become the vigorous and dynamic program it has become without the dedication and loyalty of almost 1,000 people each year. For each SURF student, there are many other individuals working to ensure he or she has the unparalleled chance to do undergraduate research.

Mentors coach their students in the process of science or engineering; postdoctoral scholars and graduate students, and other laboratory staff and technicians work side-by-side with our students to teach them the skills and techniques they need to carry out their work. The SURF Board provides wise counsel and generous support to maintain the vigor and quality of the program. We deeply appreciate their commitment to the excellence of this program. The SURF Administrative Committee oversees the academic and pedagogical aspects of the program. They also review an ever increasing number of student pro-

posals every year. The SURF Student Advisory Council is charged with helping to strengthen the community of researchers. They brought together students and mentors for informal dinners, coordinated social and cultural events, and helped create a SURF student network. Staff in many departments work behind the scenes on the administrative details necessary to allow students to live and work on campus. SURF could not succeed without the generous and committed support of its many financial sponsors. This large cadre of loyal friends has helped SURF to develop and mature.

Thank you, one and all!

I also want to extend my personal thanks to the Tiffany team in the SFP office—Carol Casey, Susie Clark, and Cherri Brown. Their hard work and dedication to SURF and to the students are the backbone of the administrative operation. They demonstrate unfailing good humor and perseverance in the midst of the chaos engendered by the questions, forms, phone calls, e-mail, and paperwork of 293 students. Their caring and creativity make the office a comfortable environment for students, mentors, and staff.

I am extremely pleased that Terry Cole has agreed to continue as chair of the SURF AdComm following his retirement from JPL in June. He continues as a Senior Faculty Associate in Chemistry. We

all appreciate Terry's leadership of and loyalty to SURF, and his boundless enthusiasm for science, technology, and undergraduate research.

Special thanks to Bill Whitney for his continuing commitment to SURF. Each year, Bill spends countless hours developing and coordinating the professional development series, serving as SURF's JPL point of contact, reading SURF proposals, counseling students, arranging the JPL seminars, and coordinating the JPL orientation session. He has even driven students back to campus when they missed the scheduled bus! He serves on both the SURF Board and the AdComm. Such volunteers are rare, and we all deeply appreciate Bill's hard work and energy.

I am delighted that Fred Shair agreed to chair the SURF Board this year. It is particularly fitting that SURF's founder return to lead this important group! SURF evolved from Fred's vision and creativity, and the seeds he sowed 20 years ago have matured into a program that has reached far and touched many. Caltech and SURF will always benefit from Fred Shair's rich legacy.



**"I THINK THE MURF PROGRAM IS
GREAT! I HAD THE CHANCE TO GET A
REALISTIC PICTURE OF WHAT IT
TAKES TO BE A GRADUATE STUDENT."**

*— Ramona S. Cervantes, Howard Hughes
Medical Institute MURF Fellow*

STUDENT	TOPIC	MENTOR
Francisco Acevedo Embry-Riddle Aeronautical University Senior, CS/Ma	Non-Gaussian Noise in the LIGO Interferometer	Kenneth G. Libbrecht <i>Professor of Physics</i> Dennis Coyne <i>Member of the Professional Staff in Physics</i>
Samuel J. Adlen Oxford University Junior, Physics	PMIRR Calibration Data Analysis	John T. Schofield <i>Research Scientist, JPL</i>
Nasim Afsarmanesh Senior, Bi/Art History Dr. and Mrs. George N. Boone SURF Fellow	The Influence of Broadway on John Singer Sargent: <i>Mrs. William Playfair and Pauline Astor</i>	Amy R.W. Meyers <i>Curator, American Art; The Henry E. Huntington Library, Art Collections, and Botanical Gardens; Lecturer in History</i>
Yuri Agrawal Harvard University Senior, Neurobiology Howard Hughes Medical Institute SURF Fellow	Local Dendritic Protein Synthesis: A Model for Synaptic Plasticity	Erin M. Schuman <i>Assistant Professor of Biology; Assistant Investigator, Howard Hughes Medical Institute</i>
Orkun Akin Sophomore, Bi Howard Hughes Medical Institute SURF Fellow	The Expression of p15, a Potential Tumor Suppressor Gene, in TGF- β Treated Hepatocellular Carcinoma Cell Lines	Mehmet Ozturk <i>Professor of Molecular Biology, Bilkent University</i> Raymond Deshaies <i>Assistant Professor of Biology</i>
Viktor Y. Alekseyev Junior, Ch Howard Hughes Medical Institute SURF Fellow	Recognition of Single Base DNA Mismatches in Restriction Fragments by Metallointercalator Δ -[Rh(bpy) ₂ (chrysi)] ³⁺	Jacqueline K. Barton <i>Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry</i>
Maritza Alvarado University of California at Berkeley Sophomore, Bi/Neurology Howard Hughes Medical Institute SURF Fellow	Studies of Electrollocation in <i>Apterionotus albifrons</i>	James M. Bower <i>Professor of Biology</i>
Shindel Anderson California State University, Los Angeles Junior, EE Ford Motor Company MURF Fellow	The Spectral Properties of the Skin for Laser Doppler Velocimetry	Morteza Gharib <i>Professor of Aeronautics</i>
Valerie L. Anderson Senior, Ph Class of '36 Endowment Fund	A High Resolution Thermometry System for Use in High-Precision Measurements of the Physical Properties of Helium	Nai-Chang Yeh <i>Professor of Physics</i>
Abraham K. Ankumah Sophomore, EE/CS	Annotation Layer for the Digital Light Table	Herbert L. Siegel <i>Member of the Technical Staff, JPL</i>
Tewdar T. Ansell Oxford University Senior, Ph	Planetary Atmospheres in the Outer Solar System	Glenn S. Orton <i>Senior Research Scientist, JPL</i>
Charles M. Atkin Senior, Ph/EAS	Spontaneous Firing in Networks of Neurons	Ivan Havel <i>Associate Professor, The Institute of Advanced Studies at Charles University and the Academy of Sciences of the Czech Republic</i> Pietro Perona <i>Professor of Electrical Engineering</i>
Michael J. Baier Senior, APh Dr. Chandler C. Ross SURF Fellowship	A Hybrid Two-Dimensional Schwarz Coupling Algorithm for the Simulation of Low Pressure Gases	David G. Goodwin <i>Associate Professor of Mechanical Engineering and Applied Physics</i>

STUDENT	TOPIC	MENTOR
Xiaoyan Bao Junior, Bi Howard Hughes Medical Institute SURF Fellow	Characterization of a Novel Slow Inward Current in the rP2X7 Receptor	Henry A. Lester <i>Professor of Biology</i>
Zhaosheng Bao Freshman Caltech Merit Scholar	A Maximum Weight-Degree Constrained Subgraph Algorithm for Bipartite Matching and the Construction of a New Scoring Function for the Classification of Martian Rock Samples in Computer Vision	Rebecca Castaño <i>Member of the Technical Staff, JPL</i>
Amy C. Barr Junior, PlSc	Europa/Vostok Cryobot Testing	Joan C. Horvath <i>Europa/Vostok Task Manager, JPL</i>
Mark O. Barrett Sophomore, PlSc Mr. and Mrs. Fred M. Wells SURF Fellow	Magnetic Fields and Anomalies on Mars	David J. Stevenson <i>George Van Osdel Professor of Planetary Science</i>
Robert Barrett Morehouse College Junior, Ma/EE The James Irvine Foundation MURF Fellow	Optimization of Synthetic Aperture Radar (SAR) Image Processing Software	Herbert L. Siegel <i>Member of the Technical Staff, JPL</i>
Jeffrey E. Barrick Sophomore, Ch Ernest H. Swift SURF Endowment Fund	<i>In vitro</i> Selection of RNA-Peptide Fusions of Arginine-Rich Motif Proteins	Richard W. Roberts <i>Assistant Professor of Chemistry</i>
Nathan Becker University of California, San Diego Senior, Ph	Theoretical Properties and Fundamental Limits of Electrostatic Actuators for Use With LIGO	Kenneth G. Libbrecht <i>Professor of Physics</i>
Peter J. Beemiller University of Rochester Junior, Molecular Genetics	Culture of Microorganisms for Trace Metal Analysis	Kenneth H. Nealson <i>Senior Scientist, JPL; Faculty Associate in Environmental Engineering Science and Geobiology; Lecturer in Environmental Engineering Science</i>
Vidya Bhalodia Junior, Bi Howard Hughes Medical Institute SURF Fellow	REM Sleep and Visual Learning	James M. Bower <i>Professor of Biology</i> Gabriel Kreiman <i>Graduate Student in Biology</i>
Jamie A. Bishop Purdue University Junior, History/Political Science	Public Policy and Education Finance	D. Roderick Kiewiet <i>Professor of Political Science</i>
Florian Bohn Sophomore, EE	Arsenic Mobility in Sediments	Janet G. Hering <i>Associate Professor of Environmental Engineering Science</i>
Tanja Bosak University of Zagreb Senior, Atmospheric Science	Planetary Meteorology in the Outer Solar System: Simultaneous Cloud-Temperature Retrieval	Glenn S. Orton <i>Senior Research Scientist, JPL</i>
Micah Boyd University of Arizona Senior, Ph/Ma	Making an Improved Optical Spectrometer	Kenneth G. Libbrecht <i>Professor of Physics</i> William P. Kells <i>Senior Research Fellow in Physics</i>
Kevin B. Bradley Senior, PlSc/SES Richter Scholar	Asymmetric Spreading of the South Pacific Mid-Ocean Ridge	Joann M. Stock <i>Associate Professor of Geology and Geophysics</i>

STUDENT	TOPIC	MENTOR
Nicholas F. Breen Junior, Ch	Mars Pathfinder – Rock Analysis	Albert Haldemann <i>Member of the Engineering Staff, JPL</i>
James A. Bresson Junior, ChE Richter Scholar	Ejected Flows in Spin Coating	Julia A. Kornfield <i>Associate Professor of Chemical Engineering</i>
Katherine A. Brown Reed College Junior, Ch Howard Hughes Medical Institute SURF Fellow	The Conformational Equilibria of 1,2 Disubstituted Ethanes as a Function of Solvent and pH	John D. Roberts <i>Institute Professor of Chemistry, Emeritus</i>
Scott S. Bruce Junior, CS Richter Scholar	The Proof Editor	James R. Arvo <i>Associate Professor of Computer Science</i>
Gina M. Buccolo Junior, PISc	Synthesis and Analysis of Long Carbon Chains From Diacetylene: Potential Carriers of the Diffuse Interstellar Bonds	Geoffrey A. Blake <i>Professor of Cosmochemistry and Planetary Science</i>
James F. Buckwalter Senior, EE Arthur E. Lamel Memorial SURF Fund	A 500 Watt Half-Bridge Power Converter for Communication Applications	David B. Rutledge <i>Professor of Electrical Engineering</i>
Danijela B. Cabric University of Belgrade Senior, Telecommunications Howard Hughes Medical Institute SURF Fellow	Locating Blood Vessel Boundaries in MR Images	David H. Laidlaw <i>Member of the Professional Staff in Biology</i>
Joel E. Carranza Freshman Caltech Merit Scholar	Exploring Methods for Integration of Two Dimensional Interfaces and Three Dimensional Visuals	James R. Arvo <i>Associate Professor of Computer Science</i>
Janet Casperson Whitman College Sophomore, Ph	Evaluating the Long-Term Performance of the LIGO Pre-Stabilized Laser	Kenneth G. Libbrecht <i>Professor of Physics</i> Richard Savage <i>Member of the Professional Staff in Physics</i>
Emilio Castaño Freshman Caltech Merit Scholar	Electromagnetic Levitation for Wind Tunnel Testing	Morteza Gharib <i>Professor of Aeronautics</i>
Ramona S. Cervantes Mount Saint Mary's College Senior, Bioch Howard Hughes Medical Institute MURF Fellow	Crystallization of Δ -Ru(phen) ₂ dppz ²⁺ With Oligonucleotide Duplexes	Jacqueline K. Barton <i>Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry</i> Eric D.A. Stemp <i>Visiting Associate in Chemistry</i>
Candace C. Chang Junior, Ch Beckman Scholar	Time Dependence of an Electronic Nose	Nathan S. Lewis <i>Professor of Chemistry</i>
Joseph Y. Chang Sophomore, EE General Motors SURF Fellow	Dilatometry on Ferroelectric Ceramics	Ersan Üstündag <i>Assistant Professor of Materials Science</i>
Kevin Z. Chao Sophomore, Bi Richter Scholar	A Mosaic Floral Organ Mutant From a T-DNA Mutagenesis in <i>Arabidopsis</i> : Genetics Made Simple	Elliot M. Meyerowitz <i>Professor of Biology</i> Carolyn K. Ohno <i>Research Fellow in Biology</i>
Petru N. Chebeleu Senior, EAS Richter Scholar	Computer Simulation of Ciliary Movement	Alan H. Barr <i>Professor of Computer Science</i>

STUDENT	TOPIC	MENTOR
Ming M. Chen Junior, Ch Beckman Scholar	Exploring the Structure of the Enzyme Oligosaccharyl Transferase via a Novel, Localized Cross-Linking Reaction	Barbara Imperiali Professor of Chemistry
Andrew M. Childs Junior, Ph Arthur R. Adams SURF Fellowship	Measurement of Classical Parameters Affecting Quantum Evolution	John P. Preskill Professor of Theoretical Physics
Jit Kee Chin Sophomore, CS	Visualization of Windscaeterometer Data Using Painterly Techniques	David H. Laidlaw Member of the Professional Staff in Biology
Peter A. Chizever University of California at Berkeley Junior, Ph/Astroph	The Visual Orbit of 12 d Boo	Andrew Boden Member of the Technical Staff, JPL
John D. Chodera Senior, Bi Xencor SURF Fellow	Computer Simulations of Liquid Systems	Jerry E. Solomon Member of the Beckman Institute
Ryan T. Chornock Senior, Ph	Cosmological N-body Simulations	Charles C. Steidel Professor of Astronomy
Vivian F. Chow Sophomore, Bi	Purification of Respiratory Nitrate Reductase From <i>Paracoccus denitrificans</i>	Hung Kay Lee Assistant Professor, The Chinese University of Hong Kong Sunney I. Chan George Grant Hoag Professor of Biophysical Chemistry
Jason H. Chua Sophomore, Bi Thomas Hunt Morgan SURF Endowment Fund	Isolation of Novel bHLH Sequences From Vertebrate Genomes	Barbara J. Wold Professor of Biology
Samuel H. Chung Junior, APh	Visualization of Flow and Characterization of Temperature by Schlieren Imaging	David G. Goodwin Associate Professor of Mechanical Engineering and Applied Physics
William I. Clarkson Oxford University Junior, Ph	Mars Pathfinder Data Analysis	Albert Haldemann Member of the Engineering Staff, JPL
Andrew J. Coe Freshman Caltech Merit Scholar	Classification and Computer Modeling of the Neutral Hydrogen (HI 21-cm) Profiles of Spiral Galaxies	Barry F. Madore Director of NED, IPAC
Brian A. Collins Senior, Ge William H. and Helen Lang SURF Endowment Fund	Analysis of Depth-age Relationships on the Pacific-Antarctic Ridge	Joann M. Stock Associate Professor of Geology and Geophysics
Aryn A. Conrad Stanford University Senior, Bi Howard Hughes Medical Institute MURF Fellow	An Investigation of the sna Subfamily Gene(s) in the Chicken (<i>G. gallus</i>)	Marianne Bronner-Fraser Professor of Biology Meyer Barenbaum Postdoctoral Scholar in Biology
Kristen L. Cook Freshman Caltech Merit Scholar	Acquiring Optimal Diffusion Weighted Images for Calculating Diffusion Tensor Images	David H. Laidlaw Member of the Professional Staff in Biology
Alice R. Coppock Freshman Caltech Merit Scholar	Time Variation of Signal and Noise Content in Broadcast From JJY	David B. Rutledge Professor of Electrical Engineering
Elizabeth R. Cutler Sophomore, EAS Richter Scholar	Animated Algorithms Project	Glen A. George Lecturer in Computer Science and Electrical Engineering

STUDENT	TOPIC	MENTOR
Karl J. D'Adamo Senior, ChE Hugh F. and Audy Lou Colvin SURF Endowment Fellowship	Using Single Particle Tracking to Measure Diffusion Coefficients and Other Transport Coefficients for Particles in Lipid Bilayer Vesicles	Denis Wirtz Johns Hopkins University Julia A. Kornfield Associate Professor of Chemical Engineering
Matthew W. Dawson Senior, Ge Mr. and Mrs. Richard M. Rosenberg SURF Fellow	A Stratigraphic Study of the 610 A.D. Eruption of the Mono Craters	Kerry E. Sieh Professor of Geology
Michael E. De Salvo Sophomore Richter Scholar	A Performance Analysis of the Objectivity/DB Database Management System and Its Application to the Digitized Palomar Sky Survey and Digital Sky Projects	Thomas A. Prince Professor of Physics
Heather L. Dean Senior, EE Mr. and Mrs. Robert L. Noland SURF Fellow	Olfactory-Dependent Behavior of the Locust	Gilles J. Laurent Associate Professor of Biology and Computation and Neural Systems
Micah T. Dedmon Senior, APh	Variable Frequency-Offset Locking of Diode Lasers Using Beat Frequencies	Keith Burnett Professor of Atomic Physics, Oxford University Noel R. Corngold Professor of Applied Physics
Oliver E. Dial Senior, Ph	Fabrication of Optical Switches Using Electron Beam Nanolithography	Axel Scherer Professor of Electrical Engineering, Applied Physics, and Physics
Sheng Ding Senior, Ch/Bi Samuel P. and Frances Krown SURF Endowment Fund	Design of New Photolabile Caging Groups Based on Benzoin by <i>ab initio</i> Quantum Simulation and Synthetic Approach	Sunney I. Chan George Grant Hoag Professor of Biophysical Chemistry
Ronald C. Dollete Junior, EE AstroTerra SURF Fellow	Laser Detection and Error Minimization on TerraLink Networks	Glen A. George Lecturer in Computer Science and Electrical Engineering
Steven C. Drasco University of California, Irvine Senior, Ph	Data Analysis and Visualization Software for LIGO Data	Kenneth G. Libbrecht Professor of Physics Roy D. Williams Senior Scientist, CACR
Benjamin S. Driggs Senior, APh	Fabrication of Integrated Photodetective Devices for Optical Fluorescent Detection of Biological Materials	Stephen R. Quake Assistant Professor of Applied Physics
Rachel J. Drummond University of Kent at Canterbury Junior, Ph	Studying Dust Marks on the Sojourner Camera Images	Albert Haldemann Member of the Engineering Staff, JPL
Réjean Dupuis Mount Allison University Senior, Ph/Ma	Searching for Gravitational Radiation From Pulsars	Kenneth G. Libbrecht Professor of Physics Stuart Anderson Senior Research Fellow in Astrophysics
Serena M. Eley Freshman	Microbial Characteristics of Mono Lake	Kenneth H. Nealson Senior Scientist, JPL; Faculty Associate in Environmental Engineering Science and Geobiology; Lecturer in Environmental Engineering Science
Dirk R. Englund Freshman Caltech Merit Scholar	Modeling of Movement of Charged Particles	Melany L. Hunt Associate Professor of Mechanical Engineering

STUDENT	TOPIC	MENTOR
Cedric D. Fairbanks Tennessee State University Senior, EnvEng General Motors MURF Fellow	Synthesis of the Lanthanum Chromites for Neutron Diffraction Studies	Sossina M. Haile <i>Assistant Professor of Materials Science</i>
Rui Fan Junior, CS/Ma Richter Scholar	A Proof Editor in Common Lisp	James R. Arvo <i>Associate Professor of Computer Science</i>
David C. Fang Sophomore, EE Richter Scholar	Investigating the Effects of Atmospheric Contaminants on the Growth and Morphology of Snow Crystals	Kenneth G. Libbrecht <i>Professor of Physics</i>
Vladimir D. Fedorov Sophomore, CS Richter Scholar	Simulation of Evolution of Cooperation	James R. Arvo <i>Associate Professor of Computer Science</i> Richard D. McKelvey <i>Professor of Political Science</i>
Michael A. Fisher Senior, AMa Samuel P. and Frances Krown SURF Endowment Fund	Numerical Analysis of Electromagnetic Scattering Equations	Oscar P. Bruno <i>Professor of Applied Mathematics</i>
Michael P. Fitzgerald Junior, EAS Dr. and Mrs. Michael J. Callaghan SURF Fellow	Interfacing With Autonomous Systems Exhibiting Complex Sensorimotor Behavior	John Hallam <i>Senior Lecturer, University of Edinburgh</i> Stephen R. Quake <i>Assistant Professor of Applied Physics</i>
Nathan E. Flowers-Jacobs Sophomore, EE Ford Motor Company SURF Fellow	The Quality Factor in Micro to Nanometer Scale Mechanical Oscillators	Michael L. Roukes <i>Professor of Physics</i>
Christina L. Folsom University of California, Davis Senior, Ma	The Role of Fatigue Fracture and Erosion on a Cometary Surface in Support of Deep Space 4/Championion	Jacklyn R. Green <i>Member of the Technical Staff, JPL</i>
Charless C. Fowlkes Junior, CS/CNS	Mining for Image Content	Michael C. Burl <i>Member of the Technical Staff, JPL</i>
E. Marie Fox Junior, Ch Mr. and Mrs. Robert L. Noland SURF Fellow	Using NMR to Determine the Conformational Preferences of 3-Mercaptopropionic Acid	John D. Roberts <i>Institute Professor of Chemistry, Emeritus</i>
Kevin M. Franklin Junior, APh Applied Materials SURF Fellow	Low Temperature Photoluminescence Using a FTIR Spectrometer	Harry A. Atwater, Jr. <i>Associate Professor of Applied Physics</i>
Margaret A. Gabriel Senior, Ch	A Comparison of Trends in the Rate Constant of Charge Transfer Across P-Doped and N-Doped Silicon in Electrochemical Cells	Nathan S. Lewis <i>Professor of Chemistry</i>
Martha K. Gamble University of California, Davis Sophomore, Bioch Howard Hughes Medical Institute SURF Fellow	<i>In vivo</i> Inhibition of Gene Expression With Bioconjugates	Thomas J. Meade <i>Senior Research Associate in Biology</i>
Luis A. Garcia University of North Carolina at Pembroke Senior, Ch The James Irvine Foundation MURF Fellow	Characterization of Wild-Type and 8G8 Para-Nitrobenzyl Esterases	Frances H. Arnold <i>Professor of Chemical Engineering</i> Anne Gershenson <i>Postdoctoral Scholar in Chemical Engineering</i>

STUDENT**TOPIC****MENTOR****Jane Garrity**

Sophomore, Bi
Mr. and Mrs. Downie D. Muir III
SURF Fellow

Construction of a BAC Library for the Study of
Magnetosome Formation in *Magnetospirillum* sp. AMB-1

Stephen R. Quake
Assistant Professor of Applied Physics
Bruce A. Hay
Assistant Professor of Biology

Guy Y. Geneviev

Pasadena City College
Sophomore, Ma/Ph
JPLUS SURF Fellow

Astrometric and Photometric Follow-Up
Observations of Near-Earth Asteroids at NASA/JPL
Table Mountain Observatory (0.6 Meter Telescope)

Eleanor F. Helin
Research Scientist, JPL

Dipasri Ghosh

Junior, Ch
Howard Hughes Medical Institute
SURF Fellow

The Investigation of Electron Transfer Through
a Four-Way DNA Junction

Jacqueline K. Barton
Arthur and Marian Hanisch Memorial Professor
and Professor of Chemistry

Catelyn M. Gifford

Junior, EAS
Howard Hughes Medical Institute
SURF Fellow

Motion Extrapolation: Attentional vs. Transmission
Delays?

Beena Khurana
Visiting Assistant Professor of Psychology

Kimberly D. Gold

Tennessee State University
Senior, EE
The James Irvine Foundation
MURF Fellow

Photomultiplier Tube Readout Optimization
Using a Custom Built Very Large Scale Integration
(VLSI) Chip

Fiona A. Harrison
Assistant Professor of Physics

Cynthia-May S. Gong

Senior, Ch
Arthur A. Noyes SURF Endowment

Synthesis of Novel Carbohydrate Molecules for
Inhibition Studies of the *Rhizobium*-Derived
Sulfotransferase NodH

Carolyn Bertozzi
Assistant Professor of Chemistry, University
of California at Berkeley
Douglas C. Rees
Professor of Chemistry; Full Investigator,
Howard Hughes Medical Institute

Daniel W. Green

Delaware State University
Junior, Ph
General Motors MURF Fellow

Plume Sensing and Tracking With Adaptive Robots

Rodney M.F. Goodman
Professor of Electrical Engineering
Sanza T. Kazadi
Graduate Student in Computation
and Neural Systems

David K. Hammond

Senior, Ch/Ma

Computational Study of Charged and Neutral Sulfur
Trioxide-Water Complexes

Mitchio Okumura
Associate Professor of Chemical Physics

Si-ping Han

Sophomore, Ph/CS
Richter Scholar

Higgs Searches at the LHC Using Networked Object
Databases

Harvey B. Newman
Professor of Physics

Andrea R. Hasenstaub

Senior, Ma/EAS
Mrs. Vernon L. Barrett SURF Fellow

Size and Distance Cues in Macaque Monkeys

John M. Allman
Hixon Professor of Psychobiology
and Professor of Biology

Garrett C. Heffner

Freshman
Caltech Merit Scholar

Evidence for Endothelin Autocrine Growth
Regulation in Melanoma Cell Lines

Paul H. Patterson
Professor of Biology

William E. Hiestand

Junior, ME
Donald S. Clark SURF Endowment

Design, Construction, and Testing of a Sample Probe
for Use in Neutron Diffraction Experiments With
Calcium Doped Lanthanum Chromite

Sossina M. Haile
Assistant Professor of Materials Science

Andrew W. Hinman

Harvard University
Senior, Ch
Howard Hughes Medical Institute
SURF Fellow

A Highly Convergent Reductive Coupling
of Alkylolithium Reagents Across a Fully Saturated
2 Carbon Bridge

Andrew G. Myers
Professor of Chemistry

Elizabeth J. Hong

Freshman
Caltech Merit Scholar

Magnetotaxis in Model Genetic Organisms: Sensory
Perception of the Geomagnetic Field in *C. elegans*
and *D. melanogaster*

Stephen R. Quake
Assistant Professor of Applied Physics
Bruce A. Hay
Assistant Professor of Biology

STUDENT	TOPIC	MENTOR
Russel Howe Junior, AMA Paracel, Inc. SURF Fellow	A Graphical Method for Motif Identification	Richard J. Diephuis Vice President of Engineering, Paracel, Inc. Glen A. George Lecturer in Computer Science and Electrical Engineering
Vit Hradecky Sophomore, Ay/Ph Richter Scholar	A Search for Dwarf Spheroidal Galaxies and Globular Clusters Using the Digitized Palomar Observatory Sky Survey	S. George Djorgovski Professor of Astronomy
Grace K. Hsu State University of New York at Stony Brook Senior, CS Howard Hughes Medical Institute SURF Fellow	The Transitional Evolution of Parallel Digital Organisms	Christoph Adami Senior Research Fellow and Lecturer in Computation and Neural Systems
Zhao Huang Junior, Ph Howard Hughes Medical Institute SURF Fellow	Unmanned Observation of Nematode Behavior	Paul W. Sternberg Professor of Biology; Investigator, Howard Hughes Medical Institute
Wook J. Hwang Sophomore, APh Richter Scholar	Calculation of the Effective Diffusion Coefficient as a Function of the Parameters of a Residual Electric Field	Michael Schatz Assistant Professor, Georgia Institute of Technology Melany L. Hunt Associate Professor of Mechanical Engineering
Adrianne M. Hyldahl Junior, Env Howell N. Tyson SURF Fellow	A Study of Below Ground Treatment of Arsenic Tainted Water	Janet G. Hering Associate Professor of Environmental Engineering Science
Tanim Islam Sophomore, Ph/CS	Performance Evaluation of the LIGO Observatory Technical Slab Foundations	Kenneth G. Libbrecht Professor of Physics Richard Savage Member of the Professional Staff in Physics
Aleksandar M. Ivanovic University of Belgrade Senior, Electronics	Modeling the A.C. Electrical Response of Ionically Conducting Materials	Sossina M. Haile Assistant Professor of Materials Science
Rozalie V. Jackson Xavier University Junior, Ch Howard Hughes Medical Institute MURF Fellow	Trans-Splicing Using Mutant 3' Splice Site	John N. Abelson George Beadle Professor of Biology
Scott I. Jackson Brown University Senior, Eng	Reduction of Visible and Near-Infrared Data on Jupiter and the Saturn System	Glenn S. Orton Senior Research Scientist, JPL
Stona R. Jackson Sophomore, Ch	Synthesis of Substrates for a Photochemical Reaction	Erick M. Carreira Professor of Chemistry
Joanne W. Jang Senior, Bi/Ch Richter Scholar	The Anaphase Exit Pathway	Raymond Deshaies Assistant Professor of Biology
Diana Jong Pomona College Senior, Ph/Ay	Mars Pathfinder Landing Site Rock Analysis	Albert Haldemann Member of the Engineering Staff, JPL
Kanwarpal S. Kahlon Junior, Bi Bristol-Myers Endowment Fellowship	Role of p135Syn-GAP in LTP	Mary B. Kennedy Professor of Biology

STUDENT	TOPIC	MENTOR
R. Scott Kemp Moorpark College Junior, Ph JPLUS SURF Fellow	Thin Client Graphical User Interfaces for Accessing Scientific Data Archives and High Performance Computing	Roy D. Williams Senior Scientist, CACR
Amit P. Kenjale Sophomore, EE	Miniaturizing Ion Pumps	Thomas George Member of the Technical Staff, JPL
David R. Kent IV Texas A&M University Senior, Ch	C ₄ H ₇ Cation and Radical	John D. Roberts Institute Professor of Chemistry, Emeritus Ahmed H. Zewail Linus Pauling Professor of Chemical Physics and Professor of Physics
Iljie J. Kim Sophomore, Bi/Lit Richter Scholar	Angular Distribution of Solar Limb Spicules	Harold Zirin Professor of Astrophysics, Emeritus
Paul Y. Kim Senior, Bi Howard Hughes Medical Institute SURF Fellow	In vivo Analysis of Apoptosis Induced by Mitochondrial Respiratory Chain Inhibitors	Giuseppe Attardi Grace C. Steele Professor of Molecular Biology
Alexander J. King University of Leicester Junior, Ph	Modeling the Spectra of the Outer Planets: Analysis of Spacecraft and Earth-Based Observations and Supporting Laboratory Data	Glenn S. Orton Senior Research Scientist, JPL
Brent M. Kiouss Junior, Bi Beckman Scholar	Isolation of Novel Transcripts Expressed in the Epibranchial Placodes of the Developing Chick	Marianne Bronner-Fraser Professor of Biology
Nicholas A. Knouf Freshman Caltech Merit Scholar	Localization of FMRP and PSD Proteins in Dissociated Hippocampal Neurons From Fragile X Syndrome Knockout Mice	Mary B. Kennedy Professor of Biology
Minoree Kohwi Senior, Bi Northern California Associates SURF Fellow	Auditory Gating in the Nucleus HVc of Young Zebra Finches	Masakazu Konishi Bing Professor of Behavioral Biology Marc F. Schmidt Research Fellow in Biology
Sila Konur Bilkent University Senior, Molecular Biology and Genetics Howard Hughes Medical Institute SURF Fellow	Identification of the Effects of Acetylcholine on Gabaergic Synaptic Transmission in Cultured Rat Hippocampal Neurons and Characterization of the Cholinergic Receptors Responsible for These Effects	Henry A. Lester Professor of Biology
Milan P. Kovacevic University of Belgrade Senior, EE	Planck Space Mission	Charles D. Lawrence Research Scientist, JPL
Jordan A. Krall Amherst College Sophomore, Ch	The Search for the Quaternary Structure of the Particulate Methane Monooxygenase From <i>Methylococcus capsulatus</i> (Bath) Using Amine Seeking Cross-Linkers	Sunney I. Chan George Grant Hoag Professor of Biophysical Chemistry
Predrag M. Krstajic University of Belgrade Senior, Optoelectronics	Interactive Data Analysis and Archival Tool Applied to 1995 Earth-Saturn Ring Plane Crossings	Glenn S. Orton Senior Research Scientist, JPL
Amit G. Kshatriya Junior, Ph	A Chaotic Rotation for Nereid?	Bonnie J. Buratti Research Scientist, JPL
Max P. Kullberg Junior, Ph Hugh F. and Audy Lou Colvin International Fellowship Endowment	Yb:YAG Microchip Lasers	Ursula Keller Professor in Experimental Physics, Swiss Federal Institute of Technology Zurich Donald W. Skelton Member of the Professional Staff in Physics

STUDENT	TOPIC	MENTOR
Mohana R. Kumar Sophomore, GPS Richter Scholar	True Polar Wander and Martian Plate Tectonics: A Study on the Feasibility of a Fractured One-Plate or Multi-Plate System on Mars	David J. Stevenson <i>George Van Osdel Professor of Planetary Science</i>
William Y. Kung Senior, Ph Richter Scholar	Calculation of Graviton Scattering Amplitudes in Eleven-Dimensional M-Theory	Melanie Becker <i>Senior Research Fellow in Physics</i> Katrin Becker <i>Senior Research Fellow in Physics</i>
Kenneth H. Kuo Sophomore, EE Richter Scholar	"Rotating Wall" Electric Field Asymmetry in a Pure Electron Plasma	Roy W. Gould <i>Simon Ramo Professor of Engineering, Emeritus</i>
Christopher E. Kurtz Junior, Ch Sidney R. and Nancy M. Petersen SURF Endowment	Conformational Analysis of Some Organic Acids via Proton NMR Spectroscopy	John D. Roberts <i>Institute Professor of Chemistry, Emeritus</i>
Christina O. Lee City College of San Francisco Senior, Astrophysics	Observations of Distant Comets	Paul Weissman <i>Senior Research Scientist, JPL</i>
Jui-Ting Lee Junior, Ph Richter Scholar	Measuring the Weak Magnetism of the Proton	Robert D. McKeown <i>Professor of Physics</i>
Troy J. Lee Junior, Ph Richter Scholar	Collective Forage Selection by Social Insect Societies	Robert S. MacKay <i>Professor, University of Cambridge</i> Jerome Pine <i>Professor of Physics</i>
François P. Lekien Free University of Brussels Senior, Eng	Transport Theory in Multidimensional Mappings: Application to Van Der Waals Dissociation	Stephen R. Wiggins <i>Professor of Applied Mechanics</i>
Melvin B. Leok Junior, Ma	A Mathematical Model of True Polar Wander	Jerrold E. Marsden <i>Professor of Control and Dynamical Systems</i>
Daniel L. Levy Junior, Bi/Ch Beckman Scholar	Role of <i>Saccharomyces cerevisiae</i> DNA Polymerase ϵ in DNA Replication and Cell Cycle Regulation	Judith L. Campbell <i>Professor of Chemistry and Biology</i>
Huimou Li Junior, EE Allied Signal SURF Fellow	Driver Amplifier for 14-MHz and 21-MHz Class-E Amplifiers	David B. Rutledge <i>Professor of Electrical Engineering</i>
Calvin K. Liang Occidental College Sophomore, Ph	Neural Imaging	Gregory Bearman <i>Group Supervisor, JPL</i>
Jie De Liang Sophomore, EE/EC	Towards High Quality Factors of Superconducting Niobium Cavities	Nai-Chang Yeh <i>Professor of Physics</i>
Angela Y. Lin Senior, Env	Kinetics of Halogenated Organic Compounds Degradation by Sonolysis and Ozone	Michael R. Hoffmann <i>James Irvine Professor of Environmental Science</i>
Charles C. Lin Harvard University Sophomore, Bioch	Characterization and Kinetics of Product Formation of the Photolytic Reaction of "Caged" Ubiquinol With 2-Mercaptoethanol and Tributyltin Hydride	Sunney I. Chan <i>George Grant Hoag Professor of Biophysical Chemistry</i> Brian E. Schultz <i>Senior Postdoctoral Scholar in Chemistry</i>
John C. Lin Senior, Ec First Quadrant SURF Fellow	Combinatorial Markets—None Brute Force Approach Under AUSM	David P. Porter <i>Visiting Associate in Economics</i> John O. Ledyard <i>Professor of Economics and Social Sciences</i>

STUDENT	TOPIC	MENTOR
Edward K. Little Sophomore, Ph Richter Scholar	The Caltech Deep Redshift Survey	Judith G. Cohen <i>Professor of Astronomy</i>
Christianto C. Liu Senior, EE Dr. Edward C. Posner SURF Fellow	Adaptive Modulation Using Turbo Codes	Andrea J. Goldsmith <i>Assistant Professor of Electrical Engineering</i>
Nita Losoponkul Sophomore, Ch Samuel P. and Frances Krown SURF Endowment Fund	The Photolysis of HNO ₄	Paul O. Wennberg <i>Associate Professor of Atmospheric Chemistry and Environmental Engineering Science</i>
Natalia A. Luera Seattle University Senior, Honors General Science Howard Hughes Medical Institute MURF Fellow	Localization of the <i>Arabidopsis thaliana</i> CLAVATA1 Protein	Elliot M. Meyerowitz <i>Professor of Biology</i> Bobby Williams <i>Graduate Student in Biology</i>
Derek E. Lyons Reed College Junior, Ch	Extreme Exploring With JPL: Antarctica and Jupiter's Moons	Joan C. Horvath <i>Europa/Vostok Task Manager, JPL</i>
Katherine M. Mackenzie Stanford University Junior, Psychology Howard Hughes Medical Institute SURF Fellow	Conformational Preferences of 3-Hydroxyglutaric Acid in Various Solvents and at Variable Temperatures as Studied by NMR Spectroscopy	John D. Roberts <i>Institute Professor of Chemistry, Emeritus</i>
Elitza N. Maneva Sophomore, CS	A Measurement of the Contribution of the Strange Quark to the Magnetic Moment of the Nucleon: Feedback Control of the Laser Motion	Robert D. McKeown <i>Professor of Physics</i>
Daniel P. Marrone Sophomore, Ph Dr. and Mrs. Lew Allen, Jr. SURF Fellow	Building the Waveplate Rotator for the Polatron	Andrew E. Lange <i>Professor of Physics</i>
Mario L. Mata University of Texas at San Antonio Senior, Neurobi/Bioph Howard Hughes Medical Institute MURF Fellow	The Expression and Functional Analysis of Mammalian Olfactory Receptors <i>in vitro</i>	Kai Zinn <i>Associate Professor of Biology</i>
Vivian F. McNeill Senior, ChE Professor Fredrick H. Shair SURF Endowment	A New Particle Size Magnifier	Richard C. Flagan <i>Professor of Chemical Engineering</i>
Jason T. Meltzer Sophomore, ME Richter Scholar	Search for High Redshift Quasars	S. George Djorgovski <i>Professor of Astronomy</i>
Aron J. Meltzner Junior, Ge Dr. and Mrs. George N. Boone SURF Fellow	A Stigraphic Study of the 610 A.D. Eruption of the Mono Craters	Kerry E. Sieh <i>Professor of Geology</i>
Jeffrey M. Mendez Senior, Ch Peter A. Lindstrom SURF Endowment	Novel Platinum Catalyst Approach to Hydrocarbon Oxidation	John E. Bercaw <i>Centennial Professor of Chemistry</i>
Arjun Mendiratta Junior, Ch Richter Scholar	Theoretical Studies on the Second-Order NLO Properties of Diimine Metal Complexes and an Explanation of NLO Switching	William A. Goddard III <i>Charles and Mary Ferkel Professor of Chemistry and Applied Physics</i>

STUDENT	TOPIC	MENTOR
Sarah M. Merkel University of California, Irvine Junior, English Carolyn Merkel SURF Fellow	Hawthorne's Problems With and Solution to Gendered Spheres of Society in His Nineteenth-Century American Fiction	Cindy Weinstein Associate Professor of Literature
Florian T. Merkle Freshman Caltech Merit Scholar	Enhancing Survival and Visibility of Hippocampal Neurons in the Neurochip	Jerome Pine Professor of Physics
Sarah M. Milkovich Junior, PlSc Samuel P. and Frances Krown SURF Endowment Fund	Location and Depth of Lightning Strikes on Jupiter	Andrew P. Ingersoll Professor of Planetary Science
Alishia T. Miller Tennessee State University Senior, EnvEng The James Irvine Foundation MURF Fellow	Factors Influencing Arsenic (V) Sorption and Desorption of Anionic Gel Beads	Janet G. Hering Associate Professor of Environmental Engineering Science
Vladimir Mitsner Senior, Bi	Building of Chimeras of Fc and Fluorescent Protein as Tools for Biochemical Studies of FcRn	Pamela J. Bjorkman Associate Professor of Biology; Associate Investigator, Howard Hughes Medical Institute
Ivan A. Mokhnal Junior, Ma Richter Scholar	Some Conjectures in Extremal Graph Theory	Richard M. Wilson Professor of Mathematics
James J. Monaghan University of Leicester Junior, Ph	Climatological Applications of the Scanning Multichannel Microwave Radiometer	Eni G. Njoku Research Scientist, JPL
Wren Montgomery Junior, Ph Mrs. Hannah Bradley SURF Fellow	Ultrafast Energy Transfer in High Explosives	William A. Goddard III Charles and Mary Ferkel Professor of Chemistry and Applied Physics
Shayan Mookherjee Senior, EE Richter Scholar	Analysis of Noise in Photonic Switching	Amnon Yariv Martin and Eileen Summerfield Professor of Applied Physics
Frank K. Mote Swarthmore College Junior, Eng/Ec First Quadrant SURF Fellow	The New Millenium Project: Estimation of Consumer Surplus Derived From Innovation in Inputs to Space Science Research	David P. Porter Visiting Associate in Economics John O. Ledyard Professor of Economics and Social Sciences
Kudah C. Mushambi Junior, EAS General Motors SURF Fellow	Understanding the Horn Effect: Road Generated Exterior Noise From Tyres	Ann P. Dowling Professor of Mechanical Engineering, University of Cambridge Richard M. Murray Associate Professor of Mechanical Engineering
Jasvinder S. Nangiana University of California at Berkeley Sophomore, Bi	Preparation of HFE Constructs for Localization Studies in Polarized Cells	Pamela J. Bjorkman Associate Professor of Biology; Associate Investigator, Howard Hughes Medical Institute
Puneet P. Newaskar Sophomore, ChE	Effect of Oxygen-Related Defects on Pyramid Formation in the Anisotropic Etching of Silicon	Wee Kiong Choi National University of Singapore Axel Scherer Professor of Electrical Engineering, Applied Physics, and Physics
Elinor C. Newman University of Edinburgh Senior, Ph	Analysis of Near-Infrared Imaging of Jupiter's Great Red Spot	Glenn S. Orton Senior Research Scientist, JPL

STUDENT

Brenda M. Ng
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Senior, EE/CS

Martin A. Nguyen
Junior, CS

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Sophomore, Bi
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Peter T. Nguyen
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John P. Niccolai
Senior, Ma
Shirley and Carl Larson SURF Fellow

Kristine E. Nielson
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Ivana D. Nikolic
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William N. Lacey SURF
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University of Puerto Rico
at Mayagüez
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Stavroula Otis
Senior, Bi
The Associates SURF Endowment

Kevin L. Parkin
University of Leicester
Senior, Ph

TOPIC

Enhancements to the Spacecraft Design Tool

Progressive Mesh Construction of Smooth
Parameterizations for Texture Mapping

Disruption of Endogenous N-Cadherin in the
Synaptic Junction by the Exogenous Expression
of Dominant Negative N-Cadherin

Imaging Polarimetry in Screening Combinatorial
Libraries of Chiral Compounds

Computing Galois Groups Over Local Fields

Localization of Muscle Regulator Factors
Using GFPs

Tissue Adsorbing Polymers

Long Range Oxidative Damage in Restriction
Fragments

Development of GFP-ABP Fusion Proteins for
Imaging Structural Changes at the Synapse

Pathogenesis of Borna Disease Virus
in Neonatally Infected Rats

Dissection of CLAVATA Binding Protein (CBP)

Social Criticism in Victorian Literature

Low Thrust Optimal Trajectory Tool

MENTOR

Joel C. Sercel
Visiting Associate in Mechanical Engineering

Peter Schröder
Associate Professor of Computer Science

Erin M. Schuman
*Assistant Professor of Biology; Assistant
Investigator, Howard Hughes Medical Institute*

Richard C. Willson
*Associate Professor of Chemical Engineering and
Biochemistry, University of Houston*
Frances H. Arnold
Professor of Chemical Engineering

Matthias Flach
Associate Professor of Mathematics

Barbara J. Wold
Professor of Biology

Jeffrey A. Hubbell
*Professor of Biomedical Engineering,
Swiss Federal Institute of Technology and
University of Zurich Institute for Biomedical
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Jacqueline K. Barton
*Arthur and Marian Hanisch Memorial
Professor and Professor of Chemistry*

Erin M. Schuman
*Assistant Professor of Biology; Assistant
Investigator, Howard Hughes Medical Institute*

W. Ian Lipkin
*Professor of Neurology, Anatomy and
Neurobiology, and Microbiology and Molecular
Genetics, University of California, Irvine*
Marianne Bronner-Fraser
Professor of Biology

Elliot M. Meyerowitz
Professor of Biology
Kevin Roberg
Postdoctoral Scholar in Biology

Kevin M. Gilmartin
Associate Professor of Literature

Joel C. Sercel
Visiting Associate in Mechanical Engineering

STUDENT	TOPIC	MENTOR
Matthew R. Paul Junior, EAS Howard Hughes Medical Institute SURF Fellow	Development of Multimodal Integration in Human Infants	Shinsuke Shimojo Associate Professor of Biology Christian Scheier Postdoctoral Fellow in Biology
Curtis W. Pehl Freshman Caltech Merit Scholar	Electrochemical Characterization of Lithium Cobalt Oxide Thin Films	Brent T. Fultz Professor of Materials Science
Nemanja D. Petrovic University of Belgrade Senior, Telecommunications Howard Hughes Medical Institute SURF Fellow	Numerical Methods for Mapping Blood Pressure With MRI	David H. Laidlaw Member of the Professional Staff in Biology
Jennifer N. Phend University of Richmond Senior, Ph/Ch	Polyaniline Sensors for the Electronic Nose	Nathan S. Lewis Professor of Chemistry
Aimee L. Pierce Senior, Bi Arthur R. Adams SURF Fellowship	Analysis of CLAVATA1 Kinase Activity and Binding Properties	Elliot M. Meyerowitz Professor of Biology
Tze-Lei Poo University of Cambridge Junior, EE	Quantum Information Dynamics in Cavity Quantum Electrodynamics	Hideo Mabuchi Assistant Professor of Physics
Gabriel A. Post Occidental College Junior, Ph/Eng	Mars Pathfinder Rock Data Analysis Project	Albert Haldemann Member of the Engineering Staff, JPL
Madeleine E. Price Sophomore, Bi Howard Hughes Medical Institute SURF Fellow	When Should One Wake Up?	James M. Bower Professor of Biology Alejandro Bäcker Graduate Student in Biology
Sinead E. Quin University of Leicester Junior, Ph	Laser Frequency Noise in LIGO's Thermal Noise Interferometer	Kenneth G. Libbrecht Professor of Physics Eric Black Postdoctoral Scholar in Physics
Loban A. Rahman Sophomore, CS/EE Richter Scholar	Tactile Visualization of Multi-Dimensional Scientific Imaging Data	David H. Laidlaw Member of the Professional Staff in Biology
David A. Rahmlow Freshman Caltech Merit Scholar	Snowflake Growth in an Electric Field	Kenneth G. Libbrecht Professor of Physics
Patricia Ramirez University of California, Riverside Junior, Biomedical Sciences Howard Hughes Medical Institute MURF Fellow	Introduction of an RRE1 Adaptive Mutation Into the Parental Chimera	James H. Strauss Ethel Wilson Bowles and Robert Bowles Professor of Biology
Timothy D. Raub Freshman Caltech Merit Scholar	Baja-British Columbia: Long Distance Tectonic Transport of the Insular Superterrane -or- Give Vancouver Back to Mexico!	Joseph L. Kirschvink Professor of Geobiology
Sean N. Raymond Bowdoin College Senior, Ph/Ma	Frequency Doubling a Diode Laser	H. Jeff Kimble William L. Valentine Professor and Professor of Physics
Timothy S. Reed Junior, CS Paracel, Inc. SURF Fellow	Machine Learning and the Human Genome	Richard J. Diephuis Vice President of Engineering, Paracel, Inc. Glen A. George Lecturer in Computer Science and Electrical Engineering

STUDENT	TOPIC	MENTOR
Christian L. Reichardt <i>Sophomore, Ph</i> <i>Northern California Associates</i> <i>SURF Fellow</i>	Testing and Refining a Prototype Cherenkov Detector Using Waveshifter Bars	Richard A. Mewaldt <i>Senior Research Associate in Physics</i>
Joseph M. Renes <i>Senior, Ph</i> <i>Richter Scholar</i>	Investigating Hamiltonians in Quantum Mechanics	John P. Preskill <i>Professor of Theoretical Physics</i>
Aspen D. Richter <i>Sophomore, Ch</i> <i>Richter Scholar</i>	A pH-Switch for a DNA-Binding Small Molecule	Peter B. Dervan <i>Bren Professor of Chemistry</i>
Juan C. Rodriguez Domenech <i>Polytechnic University</i> <i>of Puerto Rico</i> <i>Senior, ME</i>	Validation of the End-to-End Simulation Model for LIGO	Kenneth G. Libbrecht <i>Professor of Physics</i> Biplab Bhawal <i>Senior Postdoctoral Fellow in Physics</i>
Elizabeth H. Roemer <i>Emory University</i> <i>Senior, Psychology</i> <i>Howard Hughes Medical Institute</i> <i>SURF Fellow</i>	Is There a Stroop Effect in Face Recognition?	Fiona Cowie <i>Associate Professor of Philosophy</i> Beena Khurana <i>Visiting Assistant Professor of Psychology</i>
Jameson G. Rollins <i>University of Michigan</i> <i>Senior</i>	The LIGO 40 Meter Interferometer	Kenneth G. Libbrecht <i>Professor of Physics</i> Richard Gustafson <i>Research Scientist, University of Michigan</i>
Alan M. Rosenwinkel <i>Junior, ME</i>	Energetics of Subsurface Exploration	Brian H. Wilcox <i>Group Supervisor, JPL</i>
Robb B. Rutledge <i>Freshman</i> <i>Caltech Merit Scholar</i>	The Search for High Red-Shift Quasars	S. George Djorgovski <i>Professor of Astronomy</i>
Roxanna A. Sadri <i>Citrus College</i> <i>Junior, Micro and Molecular Genetics</i> <i>Howard Hughes Medical Institute</i> <i>SURF Fellow</i>	Site-Directed Mutagenesis of Taq Polymerase	John H. Richards <i>Professor of Organic Chemistry</i>
Ashwani P. Sastry <i>Sophomore, Ma</i> <i>Samuel P. and Frances Krown</i> <i>SURF Endowment Fund</i>	An Exploration of Latin Squares	Richard M. Wilson <i>Professor of Mathematics</i>
Veronica A. Savu <i>Junior, Ph</i>	Sample Experiment	Robert D. McKeown <i>Professor of Physics</i>
Rory A. Sayres <i>Junior, Bi</i> <i>Howard Hughes Medical Institute</i> <i>SURF Fellow</i>	Effects of Sleep on Recall of Unattended Stimuli	James M. Bower <i>Professor of Biology</i> Alejandro Bäcker <i>Graduate Student in Biology</i>
Joseph M. Schaeffer <i>Sophomore, CS/Ph</i> <i>Soft Tech SURF Fellow</i>	Proof Editor Interface	James R. Arvo <i>Associate Professor of Computer Science</i>
Kevin M. Schulz <i>Junior, Ph</i> <i>Richter Scholar</i>	Construction of a Fingerprint Recognition System Using a Holographic Optical Correlator	Demetri Psaltis <i>Thomas G. Myers Professor</i> <i>of Electrical Engineering</i>
Marla L. Scott <i>Dillard University</i> <i>Senior, Ch</i> <i>Amgen MURF Fellow</i>	Detection of Mutations in Mitochondrial DNA of Variouslly Aged Human Fibroblast Cells	Giuseppe Attardi <i>Grace C. Steele Professor of Molecular Biology</i> Yuichi Michikawa <i>Research Fellow in Biology</i>

STUDENT	TOPIC	MENTOR
Frank P. Seelos IV Wofford College Senior, Ph/Ma	Welcome to HAVANA	Eleanor F. Helin Research Scientist, JPL
Derek M. Shannon Freshman Caltech Merit Scholar	Beyond Byrd — Mars Global Surveyor in the Southern Polar Region	Bruce C. Murray Professor of Planetary Science and Geology
Joshua W. Shao Senior, EE Allied Signal SURF Fellow	Performance of Digital Communications Over Land-Mobile Satellite Channels	Andrea J. Goldsmith Assistant Professor of Electrical Engineering
Denis A. Shcherbakov Sophomore, ChE Warren and Katharine Schlinger SURF Endowment	Emulsions at the Critical Capillary Number in Simple Shear Flow	John F. Brady Professor of Chemical Engineering
Jonathon D. Shlens Swarthmore College Senior, CS/Ph	Predicting the Future With Artificial Neural Networks	Rodney M.F. Goodman Professor of Electrical Engineering
Vanessa A. Sih Sophomore, APh Lester Lees Aeronautics SURF Fellowship	Improving the MEMS Gyroscope	William A. Goddard III Charles and Mary Ferkel Professor of Chemistry and Applied Physics
Claudiu Simion Senior, Bi Howard Hughes Medical Institute SURF Fellow	Developmental Choices of T Cell Thymic Precursors	Ellen V. Rothenberg Professor of Biology
Aaron W. Simons Freshman Caltech Merit Scholar	Design and Fabrication of Large Volume Dielectric Waveguides Possessing High Modal Selectivity	Axel Scherer Professor of Electrical Engineering, Applied Physics, and Physics
Jaideep Singh Junior, Ph Richter Scholar	Nuclear Spin Polarization of Noble Gases	Emlyn W. Hughes Associate Professor of Physics
Aleksandrs L. Slivkins Junior, Ma	Multiplicity in Length Spectra of Hyperbolic Surfaces	Igor Rivin Olga Taussky-John Todd Instructor in Mathematics
Anna Smirnova Senior, Ec	Analysis of the Russian Banking System	D. Roderick Kiewiet Professor of Political Science
Jeremiah J. Smith Junior, EE Arthur Rock SURF Endowment	21 MHz Class-E Power Amplifiers	David B. Rutledge Professor of Electrical Engineering
Thomas M. Snyder Freshman Caltech Merit Scholar	Statistical Thermodynamic Theory of Gelation of Rod-Coil-Rod Copolymers Using Graph Theory	Zhen-Gang Wang Associate Professor of Chemical Engineering
Joseph B. Soriaga Senior, EE Richter Scholar	Synthesis of Magnetic Semiconductor Films by Electrochemical Atomic Layer Epitaxy	Gyula Vigh Professor of Chemistry, Texas A&M University Jehoshua Bruck Professor of Computation and Neural Systems and Electrical Engineering
Helmut Spitzl Ecole Centrale Paris Sophomore, Technical Physics	Calibration of Mars Meteorological Network Stations	Glenn S. Orton Senior Research Scientist, JPL
Kartik A. Srinivasan Junior, APh AstroTerra SURF Fellow	Study and Fabrication of Fiber Bragg Gratings	Kerry J. Vahala Professor of Applied Physics

STUDENT	TOPIC	MENTOR
Lakshminarayan Srinivasan Freshman Caltech Merit Scholar	Speed and Direction Processing in the Medial Superior Temporal (MSTd) Region of the Brain	Richard A. Andersen <i>James G. Boswell Professor of Neuroscience</i>
Regina R. Stallworth Alabama State University Junior, Bi Amgen MURF Fellow	Use of CHIP Assays and PCR for the Detection of DNA-Protein Interactions in the Initiation of DNA Replication of <i>E. coli</i>	Judith L. Campbell <i>Professor of Chemistry and Biology</i>
Rachel E. Steinberger Senior, Bi Mr. and Mrs. Victor V. Veysey SURF Fellow	Characterization of the Proteins of the Magnetosomal Membrane	L. Elizabeth Bertani <i>Visiting Associate and Lecturer in Biology</i>
Michael B. Stone Senior, Ph Sidney R. and Nancy M. Petersen SURF Endowment	Turbulence in the Interstellar Medium	Peter M. Goldreich <i>Lee A. DuBridge Professor of Astrophysics and Planetary Physics</i>
Erik W. Streed Senior, Ph J. Weldon Green SURF Fellow	Revenge of the Silica Microspheres	H. Jeff Kimble <i>William L. Valentine Professor and Professor of Physics</i>
Michael J. Suh Occidental College Senior, Ch	Electrochemically Triggered Protein Unfolding in Cytochrome b_{562}	Harry B. Gray <i>Arnold O. Beckman Professor of Chemistry</i> Pernilla Wittung-Stafshede <i>Postdoctoral Scholar in Chemistry</i>
Kara M. Swedlow Senior, EAS Erika C. Voté SURF Endowment	Micromachining an Accelerometer	Linda M. Miller <i>Senior Research Engineer, JPL</i>
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Johan Noel G. Tabora Florida Institute of Technology Senior, AeEng	The Design of the Jovian Satellite Tour, Endgame Design, and Europa Orbit Insertion of the Europa Orbiter Mission	Robert Maddock <i>Deputy Lead, Solar Probe Project, JPL</i>
Yuhki J. Tajima Swarthmore College Senior, Ph	Fault Detection Using Neural Networks and Hidden Markov Models	Rodney M.F. Goodman <i>Professor of Electrical Engineering</i> John Lindal <i>Graduate Student in Electrical Engineering</i>
Yuki D. Takahashi Sophomore, Ph Samuel P. and Frances Krown SURF Endowment Fund	Search for New Millisecond Pulsars	Shrinivas R. Kulkarni <i>Professor of Astronomy and Planetary Science</i>
Jenny M. Tam Washington University Senior, Ch/CS	Something Rotten in the Air: Use of Amine-Capped Colloidal Gold Particles to Detect Sulfur Containing Analytes	Nathan S. Lewis <i>Professor of Chemistry</i>
Efrem A. Tekle Long Beach City College Junior, Ph	LIGO Data Analysis in the Root Environment	Kenneth G. Libbrecht <i>Professor of Physics</i> Walid A. Majid <i>Postdoctoral Scholar in Physics</i>
Mukund Thattai Cornell University Senior, Ph	Simulation of Thermal Noise in Non-Uniform Fused-Silica Fibers and Experimental Measurement of Suspended Mass Oscillation Modes	Kenneth G. Libbrecht <i>Professor of Physics</i>

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SURF Fellow***Gabriela Valverde***University of Texas at El Paso
Junior, Electrical and Computer Eng
The James Irvine Foundation
MURF Fellow***TOPIC**

Search for High Redshift Quasars

Carbonyl Sulfide and the Hydroperoxonium Ion:
Investigation of an Oxidation PathwaySearching for Regions of Transcriptional Regulation
in Vulval Cells of *C. elegans*

Optical Imaging of Intracellular Calcium Stores

Documentation of CAD and CAE Software
for Standardization of JPL InterfaceJoint Design of Fixed-Rate Source Codes
and Multiresolution Channel Codes for
Fading Channels

Characterizations Studies of Double Quantum Wells

In vitro Investigation of the Interaction Between
Schwann Cells and Macrophages. Lessons
From the Neuropoietic CytokinesThreshold Levels and Competition of Visual Stimuli
for Preattentive Saliency

Computer Modeling of Near Earth Asteroids (NEA's)

Understanding the Atmospheres of Galilean Moons:
A Spectroscopic Study Using the Hubble and
Keck TelescopesThe Joy of Calibrating the Highest Resolution
Observation of Mars With the HST/WFPC2Spin-Injection-Induced Magnetic Pair-Breaking
Studies in Ferromagnet-Insulator-Superconductor
(FIS) Heterostructures

Automated Design of Quantum Circuits

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*James Irvine Professor of Environmental Science*Paul W. Sternberg
*Professor of Biology; Investigator,
Howard Hughes Medical Institute*David Weitz
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Ultra-Computer Technical Research Group, JPL*

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Ernesto F. Vera University of California at Los Angeles Junior, EE The James Irvine Foundation MURF Fellow	Magnetic Resonance Force Microscopy	Michael L. Roukes Professor of Physics
Koen J.C. Verbrugghe Senior, Bi	The Search for the Anchor Cell Response Element in Lin-3	Paul W. Sternberg Professor of Biology; Investigator, Howard Hughes Medical Institute
Elizabeth R. Verschell Sophomore, Ph Richter Scholar	Inclusive Electro-Production of e^+/e^- Pairs	Bradley W. Filippone Professor of Physics
Matthieu J. Verstraete Swiss Federal Technical Institute Senior, Ph/Eng	Assembling the AirMISR Aerosol and Surface Retrieval Data Chain	David J. Diner Member of the Technical Staff, JPL
Phuong K. Vu Junior, Bi Richter Scholar	Characterization of Human CUL1 Interaction With PP2A	Raymond Deshaies Assistant Professor of Biology
Vicki L. Walsh University of Leicester Junior, Ph	Climatological Applications of Surface-Sensing Microwave Satellite Data: A Study of Radio Frequency Interference	Eni G. Njoku Research Scientist, JPL
Kimberly M. Walter University of Virginia Senior, Bi Howard Hughes Medical Institute SURF Fellow	P Element Insertion-Dependent Gene Activation Functions as a Screen for Modifiers of Apoptosis Inducers in the <i>Drosophila</i> Eye	Bruce A. Hay Assistant Professor of Biology
Emily Wang Freshman Caltech Merit Scholar	Identification and Characterization of DNC and TNT, Two Genes Expressed During Early Neural Development	Marianne Bronner-Fraser Professor of Biology
Rebecca A. Washenfelder Pomona College Senior, Ch Howard Hughes Medical Institute SURF Fellow	Studies in the Kinetics of Cross Metathesis	Daniel J. O'Leary Visiting Associate in Chemistry
Betsy Weaver Washington State University Senior, Ph	RGA Analysis and Hydrocarbon Contamination	Kenneth G. Libbrecht Professor of Physics Frederick J. Raab Member of the Professional Staff in Physics
Sean M. Welch Wofford College Senior, Ph/Ma	Evaluating Object-Oriented to Formal Specification Language Translation	John C. Kelly Principal Engineer, JPL
Michael J. Westover Senior, Ay Flintridge Foundation SURF Fellow	Weak Gravitational Lensing Analysis of MS 0839+29	Mark R. Metzger Assistant Professor of Astronomy
Stephen M. Wexler Sophomore, CS Allied Signal SURF Fellow	Lossless Data Compression	Glen A. George Lecturer in Computer Science and Electrical Engineering
Paula B. Whitten Sophomore, Bi Howard Hughes Medical Institute SURF Fellow	REM Sleep: A Mechanism for Removal of Obsolete Memories	James M. Bower Professor of Biology Gabriel Kreiman Graduate Student in Biology

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Matthew F. Wilhelm Junior, CS Northrop Grumman SURF Fellow	Interactive Volume Warping for 3D Model Morphing	David E. Breen Assistant Director, Computer Graphics Laboratory
Agnieszka E. Wójciewowska Junior, Bi Howard Hughes Medical Institute SURF Fellow	Absolute Mobilities of Biologically Relevant Ions	Petr Viscor Associate Professor, Roskilde University Scott E. Fraser Anna L. Rosen Professor of Biology
Jim Y. Wong Junior, Bi Samuel P. and Frances Krown SURF Endowment Fund	Characterization of the Expression and Function of the CLAVATA3 Gene in <i>Arabidopsis thaliana</i> Through Immunolocalization and the Yeast Two-Hybrid Assay	Elliot M. Meyerowitz Professor of Biology Jennifer C. Fletcher Research Fellow in Biology
Thomas E. Woods II Wofford College Junior, CS/Ma	Evaluating Object-Oriented to Formal Specification Language Translation	John C. Kelly Principal Engineer, JPL
Phillip E.M. Wortley University of Leicester Junior, Ph	Obscuration of the South Polar Cap of Mars and Its Implications on the Landing Site of the Mars 98 and DS 2 Probes	Bruce C. Murray Professor of Planetary Science and Geology
Kaiwen Xu Junior, Ph	Laser Intensity Stabilization	Kenneth G. Libbrecht Professor of Physics Eric Black Postdoctoral Scholar in Physics
Celeste E. Yang Sophomore, Ph/EE Arthur R. Adams SURF Fellowship	Observations of Spheromaks Using an Optical Multichannel Analyzer	Paul M. Bellan Professor of Applied Physics
Yifan Yang Junior, EAS Ford Motor Company SURF Fellow	Design and Construction of a Shape Memory Crawler	Kaushik Bhattacharya Assistant Professor of Applied Mechanics and Mechanical Engineering
Helen S. Yeh Senior, EE Applied Materials SURF Fellow	Synthesis of Properties of Copper Microelectronic Interconnects	Harry A. Atwater, Jr. Associate Professor of Applied Physics
Saujin Yi Massachusetts Institute of Technology Sophomore	Construction of a High-Temperature Mechanical Testing Setup	Ersan Üstündag Assistant Professor of Materials Science
Anthony S. Young Yale University Senior, CS/Film	The Implementation of Texture-Mapping in SOAP	Robert C. Carnright Member of the Engineering Staff, JPL
Haitao Yu Junior, Ph	Climate Change in the Last Century	Yuk L. Yung Professor of Planetary Science
Rumina A. Zaman Massachusetts Institute of Technology Junior, Brain and Cognitive Sciences Howard Hughes Medical Institute SURF Fellow	Determining the Role of Inflammatory Events in the Progression of Alzheimer's Disease	Paul H. Patterson Professor of Biology
Jacob J. Zasada Freshman Caltech Merit Scholar	Polynomials With Roots and Critical Points at Lattice Coordinates	Dinakar Ramakrishnan Professor of Mathematics Matthias Flach Associate Professor of Mathematics
Hao Zhang Junior, CS	Low Thrust Optimal Trajectory Tool	Joel C. Sercel Visiting Associate in Mechanical Engineering

STUDENT

Jianhui Zhang
 Junior, EAS
 Richter Scholar

Naishen Zhou
 Senior, EE

Martin R. Zwikel
 Grinnell College
 Junior, Ph

TOPIC

A Molecular Graphics Tool for Quantum Chemistry

Design and Characterization of an 8-bit Embedded
 Micro Controller

Simulation of the Alignment Sensitivity in LIGO
 Lock Acquisition

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William A. Goddard III
*Charles and Mary Ferkel Professor
 of Chemistry and Applied Physics*

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Ae	Aeronautics
AMa	Applied Mathematics
APh	Applied Physics
Ay	Astronomy
Bi	Biology
Bioch	Biochemistry
BioPh	Biophysics
CE	Civil Engineering
Ch	Chemistry
ChE	Chemical Engineering
CNS	Computation & Neural Systems
CS	Computer Science
EAS	Engineering & Applied Science
Ec	Economics
EE	Electrical Engineering
Eng	Engineering
Env	Environmental Engineering
Ge	Geology
GeoCh	Geochemistry
Lit	Literature
Ma	Mathematics
ME	Mechanical Engineering
Ph	Physics
Psy	Psychology
PlSc	Planetary Science
SES	Science, Ethics, and Society
SS	Social Science

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**On the cover: SURFer Heather Dean in the laboratory of Gilles J. Laurent.
Photo by Bob Paz**

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