SURF: 30 Years of Student Achievement

Annual Report 2008
Summer Undergraduate Research Fellowships
California Institute of Technology
Every summer for the past 30 years something spectacular has happened at Caltech: hundreds of energetic, bright, and curious young scholars have given up their summer of sleeping late and beach parties in favor of scientific discovery. Through SURF, students join a community of scholars who come together to explore some of the most pressing questions in today’s world. Investigating everything from environmental sustainability to the engineering of HIV immunity, this year’s SURF students were no different. More than 385 students worked with nearly 204 mentors in all six academic divisions and the Jet Propulsion Laboratory, and a few adventurous SURFers worked at other schools across the nation and the world. U.S. News & World Report recently described Caltech as “a school with outstanding academic undergraduate research programs”—an assessment that surely owes much to the long success of the SURF program.

SURF is able to maintain its world-class status because of the support and dedication of many individuals. Faculty mentors collaborate with students as senior partners, helping them move from developing a research proposal to assuming full intellectual responsibility for their work. Graduate student, postdoctoral scholar, and staff scientist co-mentors provide day-to-day guidance and support for SURFers as they learn new techniques and encounter obstacles. Staff from various campus offices come together to ensure that the students’ many needs are met, helping to create a welcoming and safe environment. Alumni participate in networking events and professional development workshops, and serve as Seminar Day session chairs and judges. The SURF extended family embraces well over 1,000 people, and I’d like to thank each of them for their invaluable support.

On this special occasion, SURF’s 30th summer, it is especially important to recognize all those who so generously fund the program. This summer, the SURF endowment has reached $15 million. Many long-time donors consistently give to the program because they recognize the significant role it plays in the academic experience of our students. Many new donors start giving because as alumni, alumni parents, and community members they’ve seen the remarkable impact that undergraduate research has had on our students. Through such generosity you have ensured that the SURF story will continue for generations to come.

Happy Anniversary, SURF!

Jean-Lou Chameau
President, California Institute of Technology

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What’s in a number?

XXX (Roman numerals) and 11110 (base 2).

$30 = 2 \cdot 3 \cdot 5$ (the product of the first three primes) and

$30 = 1+4+9+16$ (the sum of the first four squares).

30 is the approximate number of centimeters in a foot.

30 is the number of edges in both a dodecahedron and an icosahedron, two of the five regular polyhedra.

30 is the approximate number of days in a lunar month, and the mean orbital velocity of Earth in kilometers per second.

30 is the melting point of gallium (in degrees Celsius), and the atomic number of zinc. It is also the molecular weight of nitric oxide, and the number of inches of mercury in a barometer (inHg) at the pressure of 1 standard atmosphere.

30 is the number of days in the gestation period of rabbits and the incubation period of whooping cranes.

— Thanks to Po-Ling Loh, SURF ’05, ’06, ’07, ’08
Kirk Dawson, Chair, SURF Board

Reflecting on the past year, I realize what an exciting time it has been to be a part of SURF and the SURF Board. This year has served not only as a time to honor the thirty-year history of SURF but also as a time to focus on making sure the program is solidly positioned for its future. The SURF campaign has been instrumental in this endeavor and as we draw closer to reaching our goal it seems constructive to review our progress and what made the campaign work so well.

In 2002, we established a goal to increase the SURF endowment by $10M. These funds support SURF students’ summer awards. Six years later, donors have generously given over $8.6 million in new endowment and an additional $2.7 million in annual gifts.

Why did the campaign progress so well? What were the “ingredients” that motivated donors to support SURF when there are so many other philanthropic options for giving these days? The answers seem to reside in several factors.

As is true for any successful campaign, it did have a great organization behind it. Carl Larson, as campaign chair, provided exceptional leadership. He and his wife Shirley provided an example for all to follow. John Gee, as SURF Board Chair for most of the campaign period, provided a very effective interface with the Board members and alumni—many of whom contributed significant financial support. The Caltech Development Office assigned Mark Reinecke to spearhead the SURF effort from that office. Mark provided unending energy and the great ability to accurately tell the SURF story to potential donors. His success in bringing donors into the program was exceptional. Finally, Carolyn Ash and Candace Rypisi, the two directors of the Student-Faculty Programs Office during this period, managed SURF in a manner that ensured the program was meeting its objectives—a key requirement in assuring prospective donors that SURF was worthy of their support.

However, beyond the campaign organization and its talented and dedicated staff is a factor that for many prospective donors was the deciding factor. A number of donors with significant resources have told me they are searching for ways to support SURF in a personal and enduring way, activities that have a high potential for major long-term improvements in society and our economy. When the SURF concept is described to them—including their ability to meet the individual students and hear about their research—the prospective donors almost always respond favorably.

These donors realize that great improvements in living standards have resulted from applying the results of research in medicine, transportation, labor saving products, and the like. These advances have made life longer and easier for tens of millions and have created productive jobs in our country and the world economy.

For research to move ahead and produce continuing advances, we must entice the best and brightest minds to pursue careers in research and to teach in research-oriented schools. SURF does exactly that. By providing an opportunity for undergraduates to do research with Caltech’s world-class faculty on challenging summer projects, many have chosen research careers—some are now on the Caltech faculty.

This highly attractive program with its potential for major payoffs from Caltech students entering research careers was a significant factor for many donors and for the success of the capital campaign.

The SURF program is truly remarkable for what it is achieving and its potential for the future. Thanks to all those who support it!

Additional highlights from the 2008 SURF Board:

- The Board would like to thank Bob Roney and Sean Upchurch (SURF ’92, ’93) for their two terms of dedicated service to the SURF Board. Many folks know Sean through his role as Chair of the SURF Seminar Day Committee. He has been instrumental in developing a strong SURF alumni network!
- This year we welcome two new members, Varoujan Gorjian (SURF ’89, ’90, ’91), Spitzer Research Scientist at JPL, and David Tirrell, the Ross McCollum-William H. Corcoran Professor and Professor of Chemistry and Chemical Engineering; and Division Chair of Chemistry and Chemical Engineering.
- The Alumni Committee led by Leslie Maxfield (SURF ’92, ’93, ’94) has developed a new SURF Alumni webpage, www.surf.caltech.edu/alumni, and a Facebook page to help keep in touch with our over 6,000 SURF alums.
Looking Toward the Sun

Fred Shair, Immediate Past-Chair, SURF Administrative Committee (AdComm)

Thirty years ago, Ernest Swift suggested that (1) the “modern SURF” program involve the entire Institute, and allow—even encourage—students in one discipline to conduct research elsewhere and for top students from other universities to experience Caltech. Such an exchange would undoubtedly have an impact on our students’ future academic and career plans, as well as serve as a great opportunity to recruit talented graduate students to campus.

Finally, I hope that Caltech will continue to increase the interaction between the campus and JPL via SURF. Although the cultures of each organization are quite different, both have benefited greatly from such interactions.

During the past three decades it has been profoundly satisfying, and an honor, to have sailed with so many wonderful people in the SURF sloop. May the wind continue to be at your back and the sun in your face.

My hope is that Caltech and the program will continue to expand the worldwide SURF community in order to develop more opportunities for Caltech students to conduct research elsewhere and for top students from other universities to experience Caltech. Such an exchange would undoubtedly have an impact on our students’ future academic and career plans, as well as serve as a great opportunity to recruit talented graduate students to campus.

In their recent book entitled Revolutionary Wealth, Alvin and Heidi Toffler emphasize that “wealth” should be measured in terms of the opportunity to select good options. Through SURF a plethora of opportunities is opened to students.

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Additional highlights from the 2008 SURF Administrative Committee:

> The SURF Class of 2008 was comprised of 293 students from Caltech and another 93 students from throughout the world. An astonishing 204 mentors, 215 co-mentors, and 16 associate mentors worked diligently to provide an extraordinary research experience. Another 61 faculty, alumni, staff, and friends served as Seminar Day session chairs and judges. As noted by Quondam Director Carolyn Ash, SURF is “truly embedded within the Caltech community.”

> Because of the increase in graduate student, postdoc, and research staff co-mentors in some research fields, a pre and post survey was conducted to better understand the impact of this trend. The surveys indicate that overall, co-mentoring is a positive and useful experience for the co-mentors as well as for the SURF students. As a result of the findings, the SURF program will continue to provide co-mentor workshops in the beginning of each summer; continue to urge faculty mentors to involve co-mentors early in the SURF selection process; and focus on providing increased student/mentor/co-mentor interaction throughout the summer.

> In June 2008, an AdComm ad hoc committee was established with the charge to see what, if any, processes need to be changed in order to ensure that the efforts of the SURF AdComm and the SURF Board continue to meet the needs of Caltech, including the Office of the Vice Provost. Members of the ad hoc committee are Paul Bellan (Chair), Kirk Dawson, Steve Frautsch, Anna Hiszpanski (SURF ‘06, ‘07, ‘08), Joe Kirschvink, David Rutledge, David Tirrell, Candace Rypisi (ex officio) and Melany Hunt (ex officio).

Dedication

We proudly dedicate SURF 2008 to Dr. David L. Goodstein, the Frank J. Gilloon Distinguished Teaching and Service Professor and Professor of Physics and Applied Physics. This dedication recognizes his extraordinary contributions to and support of undergraduate research at Caltech, as Vice Provost from 1988–2007, he oversaw the growth and development of the SURF program and the Student-Faculty Programs Office. He has provided outstanding leadership, mentorship, and vision, and for that we will always be grateful!

SURF Dedicatees

1985 Dr. Ernest Swift
1986 Dr. Lee A. DuBridge
1987 Dr. Robert P. Sharp
1988 Dr. Ray D. Owen
1989 Dr. Hans W. Liepmann
1990 Dr. Fredrick H. Shair
1991 Dr. Lew Allen, Jr.
1992 Dr. John D. Roberts
1993 Dr. Robert E. Bacher
1994 Dr. Edward C. Posner
1995 Mr. Samuel P. Krown
1996 Dr. Edward B. Lewis
1997 Dr. Harold Brown
1998 Dr. Thomas E. Everhart
1999 Dr. Ward Whaling
2000 Dr. Terry Cole
2001 Dr. William M. Whitney
2002 Dr. Edward C. Stone
2003 Dr. Thomas A. Tombrello, Jr.
2004 Dr. Harry B. Gray
2005 Paul K. Richter and Evalyn E. Richter Memorial Funds
2006 Lew and Edie Wasserman
2007 Carolyn A. Ash
2008 David L. Goodstein
In Homer’s famous epic, *The Odyssey*, Athena, the goddess of wisdom, took the male form of Mentor. Mentor provided Odysseus and his son, Telemachus, with advice and support to help them through their heroic journey. Thus, the concept of mentoring was born. Many, many years later, in 1978 the *Harvard Business Review* published the seminal article entitled, “Everyone Who Makes It Has a Mentor”—highlighting the importance of mentoring in all our journeys.

When it comes to mentoring SURF students, there is no greater model than Dr. John (Jack) D. Roberts. Since taking on his first SURF student in 1986, Dr. Roberts has mentored 89 individuals on 110 different projects. Carol Casey and Candace Rypisi, of the Student-Faculty Programs Office, sat down with Dr. Roberts for an interview.

**Q: How did you first get involved with SURF?**

JDR: I was Provost when SURF was just getting started. SURF founder, Fred Shair, came to me to discuss starting an endowment for the program. I said no. I told him: “Do it well and the funding will come.” And that’s what happened.

**Q: Had you worked with undergraduate researchers prior to SURF?**

JDR: While I was at MIT, I worked with several students who did exceptional research for their senior thesis projects. One student later discovered Nutrasweet. Another went on to be a Vice President at Dupont. So, I knew undergraduate students who do well at research can expect to have a leg up in going on to outstanding careers.

**Q: What is your perspective on mentoring?**

JDR: Our goal is to provide each SURFer with an individual project with the objective of attaining publishable results. Because these projects have the common theme of using NMR to study conformational analysis, there are many opportunities to share mutual interests and laboratory experiences. Research and education are tightly integrated, with each participant having responsibility for an individual research problem, so in a sense, all participants (including postdoctoral fellows) are treated as equals among equals. It is hard to conceive of a better approach for training beginners to do research, because we bring in all of the elements that are usually involved from beginning to end of a project, except for raising the necessary funds to start and sustain it.

**Q: What do you look for in an undergraduate researcher?**

JDR: I have an email conversation with each of the students who contact me. I tell them about a problem we are studying and, if they are interested, ask them to write up a one to two page explanation of what they might do. It’s great if they have NMR and/or synthesis experience, but I’m really looking for tenacity.

“... I told him: ‘Do it well and the funding will come.’ And that’s what happened.”

— Jack Roberts
Q: Are there other traits, along with tenacity, that an undergraduate researcher needs to be successful?
JDR: They need to understand what they are doing. That begins with the mentor choosing a problem that a student can understand. Then they need to work hard. Students should have an excitement about chemistry. There should be an instinctive desire to solve problems and they should be interested in all sorts of problems, not just the one they are working on.

Q: What advice would you give to a new faculty mentor?
JDR: Get the undergraduates into your groups. You will find it a rewarding experience.

Q: What direction would you like to see the SURF program take in the next five years?
JDR: There should be more emphasis on taking non-Caltech students. They do good work and it is a great way to recruit talented students to come here for graduate work.

Q: What are some of your most memorable SURF stories?
JDR: There have been many memorable SURFers; some have come with extraordinary talent from colleges not usually discussed in the same sentence with Caltech.

One example is A. A. Smith (SURF ’06), who was a junior majoring in chemistry and mathematics from Mount Union College in Ohio. Andy took on a quite difficult problem of great significance for our overall program in validating assumptions made on the basis of molecular models, simple NMR spectra, and estimations from combining sophisticated theory and NMR data. Andy was able to get structural information about a certain molecular arrangement from NMR data taken in a liquid-crystal medium. He wrote the paper himself and it will be published in the Journal of Physical Chemistry in 2009. He is now a graduate student at MIT.

Judy Chen (SURF ’02, ’03) represents a very different example, one of extraordinary persistence. Her parents wanted her to go into medicine, but that was not her wish. So she started off at Cal Poly Pomona in 1994, left school the next year, went into business, and then back to school at Cerritos College, 1999-2003. She was a SURFer in 2002 and showed talent in producing a dazzling final report. After that, she worked with us as a technician, while completing requirements at Cal State LA for admission to Berkeley. She then went off to Berkeley, made excellent grades and did some research. In fall of 2005, still avoiding medical school, she went to New York to work as a chemist in a perfume factory and, in 2006, started at Columbia University as a graduate student. Year 2008, 14 years after high school, she published her first high-level paper on her Columbia research. She is clearly now on the gold road to a fine PhD.

Q: How would students describe you as a mentor?
JDR: Well, you would need to ask the students that question.

Author’s Note: So we did just that. Here is what a few former JDR students had to say.

Alexander Wei (SURF ’86, ’87, ’88) I had the privilege of spending three summers with John D. Roberts. Each summer was a priceless experience. In addition to learning the nuts and bolts of NMR instrumentation and the concepts of relaxation (molecular and mental), the SURF roundtables and lunchtime lectures brought in the broader perspective of putting research to practice. My relationship with JDR was similar to that of a hiker and a park ranger. There was much wilderness to explore, but only a few ground rules were laid—so you had better come up with your own plans! This resulted in the most valuable experience of all: JDR instilled within me a sense of self-reliance, and replaced fear of the unknown with scientific objectivity and critical thinking (he was critical of my thinking, at any rate). Our exchanges have continued long after leaving Caltech, at both the scientific level (eventually resulting in a publication on the role of viscosity in T1 relaxation and the nuclear Overhauser effect in nitrogen-15 NMR spectroscopy) and the personal level—in the form of those unforgettable family photos every holiday season. My experience with Dr. Roberts has had the most direct impact imaginable: I am currently a professor at Purdue University in West Lafayette, Indiana, pursuing research in organic and materials chemistry, and teaching a course on NMR spectroscopy.

Marni (Bozer) Anbar (SURF ’90, University of Notre Dame) What makes Dr. Roberts so special is his willingness to share his considerable talents as a chemist with undergraduates, some of whom (myself included) are not destined for scientific careers. By my junior year of college, I was, much to my great surprise, a mathematics major and I had no intention of studying chemistry seriously. Yet Dr. Roberts was willing to invest time and energy in a student who was not only not from Caltech but was also not destined for any kind of career related to chemistry and was, frankly, quite challenged by the subject matter. It was just the type of disconcerting intellectual experience a young woman needs! I had the privilege of working with a group of very bright people my age and had a wonderful, genuine, collegial, scientific experience. Currently, I am a mostly-at-home mom and I teach music classes for very young children and their caregivers part-time. My SURF experience has had an impact on how I learn, teach, and parent. I thank everyone, past and present at SURF, and Dr. Roberts for investing a little bit of his talent and enthusiasm in me.
Karl Haushalter  
(SURF ‘93, ’94, ’95, Rice University)  
Completing my SURF with Jack Roberts was hugely influential in the formative stages of my career. When I was a first-year student, Jack took a bet on me and offered me this amazing opportunity to do research with him. After a few weeks in lab, I was hooked. I returned the following two summers to do two more SURFs and I benefited greatly from his mentorship. I am very grateful for his guidance and the rigorous approach to science that he taught us. After undergrad, I completed my Ph.D. at Harvard and I am currently the Iris and Howard Critchell Assistant Professor of Chemistry and Biology at Harvey Mudd College.

Matt Goff  
(SURF ‘93, ’95)  
Dr. Roberts was both my freshman advisor as well as my SURF mentor. He provided a great perspective in both capacities and was always very supportive. Looking back, I am impressed that he was able to craft a meaningful project in NMR spectroscopy that a freshman could execute. I learned a great deal about physics and research over the course of my SURF with Dr. Roberts. I am currently an iShares portfolio manager for Barclays Global Investors in San Francisco.

Neelendu Dey  
(SURF ’97, Harvard University)  
My most memorable and formative experience during SURF was having a discussion with Dr. Roberts about the nature of a true scientist, which he described as almost obsessive. He told me that I should be day-dreaming and dreaming about that which I study. I finally knew what he meant. I am a second-year gastroenterology fellow at University of California, San Francisco (UCSF) studying the gut microbiome in inflammatory bowel disease, and I love my work. Thanks, Dr. Roberts!

Tony Guerrero  
(SURF ’99)  
Working for Dr. Roberts took me beyond the books and helped turn me into a real-world problem solver. Though I’m not currently engaged in the world of chemistry, it’s an experience that translates to pretty much anything. I took a leave from Caltech to recover from the sleep deprivation that accompanied an attempted double major in physics and chemistry. I never finished my degree, and at this point, I highly doubt that I will. But my education at Caltech was a valuable experience. I have trouble finding the exact way to describe the experience, but one essential part of it is the ease with which undergraduates can become involved in the lab. I’ve since become a poker strategist, authoring books, hosting a weekly radio show, developing software for online gaming, and serving as an independent consultant.

Richard Rymer  
(SURF ’02, University of Colorado)  
I remember Dr. Roberts most for the marathon lab meetings we had on Fridays. Those 6-hour long meetings engendered a tightly knit community that allowed the superconductor-like free-flow of ideas that was characteristic of his lab. Honestly, I wish more people ran their labs the way he runs his. I am a third-year PhD candidate in Biochemistry at the University of California, Berkeley.

Katherine Rutledge  
(SURF ’03, Williams College)  
Working with Dr. Roberts was an eye-opening experience. He was an excellent preceptor because he asked thought-provoking questions but was also very focused and deliberate in monitoring the research we worked on with him. I’m currently in my third year of medical school at Albany Medical College in New York.

Donnele Daley  
(SURF ’05, Vassar College)  
I have greatly benefited from having Dr. Roberts as a mentor. In addition to learning more than I could have ever imagined about physical organic chemistry and the use of NMR in chemical analysis, Dr. Roberts helped to develop my skills in writing scientific literature and presenting my work to the wider scientific community. He encouraged us to think independently and challenge ourselves intellectually, as this forced us to meticulously analyze the information that we were presented with, and to discover innovative ways to interpret our results. More importantly he emphasized the need for us to work effectively as a team of scientists. I am very grateful to have worked with Dr. Roberts and I am forever indebted to him for the many things he has taught me. I am currently completing an M.D./Ph.D. program at Penn State University.

Olivia Alley  
(SURF ’06, ’07)  
I’m very grateful to Dr. Roberts for taking me on, somewhat at the last minute, for the summer of 2006, and for all the help he gave me that summer and the year after. Despite all his outside obligations, he would always find time to respond to an emailed question, or a question in person in the weekly meetings of his SURFers, or if I knocked on his door—and his answers always seemed to consider every relevant angle and arrive at the best answer to my question, even if it took me a while to understand what he meant. The Caltech chemistry department is full of brilliant professors, but only a handful will sit down with an undergrad and explain what must be to them a mind-numbingly simple theory/fact/procedure. He put a great deal of time into his SURF students, selecting a project for each based on their background and experience, answering questions, as I said before, and even editing SURF proposals, status reports, and final papers himself. Although an Emeritus faculty member, he is still actively dedicated to chemistry and to his students. I’m starting my first year as a graduate student in Chemistry at the University of California, Riverside.

Dmitry Kondratuk  
(SURF ’08, Lomonosov Moscow State University)  
Although I was a part of his group for only three months, I have been acquainted to Prof. Roberts for six years through the Russian edition of his famous “Modern Organic Chemistry” textbook. It was this book that pulled me into marvelous world of organic chemistry as a high school student and conceivably affected me the most in my commitment to science. I was lucky to try on these high teaching standards personally and my thinking of Dr. Roberts as a great teacher has been strengthened significantly. What amazed me most during the summer was how this “Big Name” was able to spend his cherished time teaching us the very rudiments… answering at times, not the cleverest questions…and being so accessible. Dear Prof. Roberts, Thank you for that! I am finishing up my last year at Lomonosov Moscow State University and also am in the middle of applying for graduate school.
Two hallmarks of a Caltech education are teamwork and collaboration. Undergraduate students learn quickly that working together is necessary to solve problem sets, understand complex theories, and even to adequately prepare for Interhouse parties. Through SURF undergraduates bring this commitment of teamwork and collaboration to the research endeavor. SURF is designed so that students become full members of research groups and work in full collaboration with graduate students, postdoctoral scholars, and faculty mentors. This summer the Titan SURF project built on this tradition by bringing together a team of Caltech faculty, JPL scientists and engineers, graduate student and postdoctoral co-mentors, and eight SURF students to design a balloon mission to Titan.

Since the Cassini-Huygens mission to Saturn’s moon, Titan, NASA has been interested in going back to explore its unique character. Titan’s atmosphere is believed to contain methane, ethane, and other complex hydrocarbons. This atmosphere may be similar to the Earth’s before life began. If NASA decides to go back to Titan, the mode of exploration just may be a Montgolfiere, or hot air balloon. Such a lighter-than-air vehicle would allow for it to not only traverse such a dense and challenging atmosphere but also allow it to get close enough for observing and sampling the moon’s surface, which is believed to harbor “lakes” of liquid methane.

The Titan SURF project got its start two years ago with SURF student Sarah Sherman, a Mechanical and Aerospace Engineering major from Princeton University. Sarah worked on a joint Caltech-JPL project with Dr. Jerry Marsden and graduate student Philip Du Toit on designing a navigation system for a balloon mission to Titan. After two summers of research Sarah graduated and has just started working at JPL. Sarah’s work sparked further interest in the topic in Virendra Saroha, Assistant to the Chief Technologist at JPL. Much of Dr. Saroha’s work is focused on increasing the collaboration between Caltech’s Division of Engineering and Applied Science and the Jet Propulsion Laboratory. In the Titan SURF project he saw a great way to further this goal! Together with Craig Peterson, a Senior Engineer at JPL, he lined up the mentors and helped secure the necessary funding to move forward.

According to Dr. Marsden this team approach has had many benefits. “There is a lot of enthusiasm and team spirit with this effort. It is wonderful to have students exploring different aspects of the same project. They inform one another’s work and keep the excitement going.” The team began meeting monthly in May, providing an opportunity for students and researchers to present and discuss their work within the framework of the entire mission. Student Han Bin Man sums it up:

“This experience was very unique to Caltech. Who knew that I would be working alongside the world’s best scientists at Caltech and JPL trying to fly a hot air balloon around Titan?”
The Titan SURF team focused on several aspects involved in the planning and design of a possible balloon flight to Titan. Students worked in the areas of balloon design, path prediction and trajectory, navigation, flight simulations, atmospheric analysis, and surface sampling models.

The Titan SURF starting line-up:

Anuj Arora, a freshman in Electrical Engineering, and Daniel Beylkin, a sophomore in Applied and Computational Math, worked with mentors Jerry Marsden, Carl F Braun Professor of Engineering and Control and Dynamical Systems, and Claire Newman, an Associate Research Scientist, on path prediction for an Earth-based demonstration flight. Anuj employed Lagrangian Coherent Structures, typically applied to ocean currents, as a way of understanding how a balloon could autonomously navigate the atmosphere. In order to do this, he has used data from the Weather Research and Forecasting Model to understand wind fields and predict a path for a passive Montgolfiere balloon.

Daniel, one of five Kiyo and Eiko Tomiyasu SURF Scholars, also worked with the Weather Research and Forecasting Model in order to apply Discrete Mechanics and Optimal Controls (DMOC) systems to computer balloon flight trajectories in a wind field. The main goal of his work is to use DMOC to compute trajectories in a three-dimensional, time-dependent wind field. Both students would like to understand how best to exploit the wind fields in order to optimize the control system of the balloon.

Tony Wu, a freshman in Electrical Engineering, and Kyle Dyroff, a junior from the University of Toronto, both worked on creating and simulating an aerobot model. Tony worked with mentors Mark Powell and Alberto Elfes, members of the technical staff at JPL, to create a graphical interface for existing aerodynamic modeling software used to simulate aerobot missions to Titan. Kyle, mentored by JPL engineer Jonathan Cameron, focused on validating the underlying physics associated with the aerodynamics of the aerobot model and to further develop the existing computer simulation program.

While other members of the team worked on flight paths and aerobot modeling, junior Kevin Chen, an Aeronautics major at Caltech, worked with Tim Colonius, Professor of Mechanical Engineering, and JPL Senior Engineer Jeffery Hall, to determine the best balloon design to maximize the buoyant forces of the Titan atmosphere. Kevin, the Kirk and Marjory Dawson Family SURF Fellow, explored various balloon designs, such as using interior baffling to redirect flow in order to uniformly heat the balloon interior. Using the immersed-boundary method, Kevin examined the impact of design on the temperature and velocity fields of the balloon.

Lagrangian Coherent Structures provided both Evan Gawlik and Han Bin Man a way to better understand trajectories and drift patterns associated with the mission. Working with Dr. Marsden and graduate student Philip Du Toit, Evan, an Aerospace Corporation SURF Fellow, designed fuel-efficient trajectories by using the dynamics of the three-body problem, a classic problem from celestial mechanics. Han, the Fred and Jean Felberg SURF Fellow, focused on predicting drift patterns of the balloon while within Titan's atmosphere.

On Titan, scientists hope to sample both the atmosphere and the surface of the moon. Kevin Noertker, a junior majoring in Mechanical Engineering and History, worked with Dr. Joel Burdick, Professor of Mechanical Engineering and Bioengineering, to analyze which sampling mechanism would offer the best access considering the balloon height and drift speed. Kevin, the John and Barbara Gee SURF Fellow, suggests that a dropped and tethered sampling device might be best for use from the balloon's aerial platform.

It is unclear at this time whether or not NASA will move forward with the Titan mission. If they do, it is estimated that a launch could happen in 2018, with an arrival at Titan scheduled for 2026. Next summer, scientists and engineers will present a demonstration project of the hot-air balloon in the Mojave Desert. With any luck SURFers will be a part of it all!
Spotlight on Alumni

Excerpts from the Caltech Public Relations
June 2008 press release, “SURFing the Waves of Success for 30 Years”

Ari Kaplan, SURF ’89

“I’ve had an incredible couple of decades living my dream of working with Major League Baseball. It’s all a direct result of my work with SURF, and I’m still going strong with it.”—Ari Kaplan (BS ’92)

Ari Kaplan has worked with Major League Baseball teams since 1989. During that year, under the direction of Rod Kiewiet, professor of political science at Caltech, Kaplan conducted a SURF project entitled “How Do You Spell Relief? An Analysis of Baseball Pitching, 1876-Present.” His research led directly to working with MLB. While he was giving his SURF presentation as a sophomore, sitting in the audience was the owner of the Baltimore Orioles. He hired Kaplan on the spot. Kaplan later landed on NBC’s Today Show, which put him in touch with former Dodgers general manager Fred Claire. His early work with MLB focused on individual players, analyzing reliever effectiveness and other common statistics. Now he works on game-based strategies, like determining the best batting order.

In addition to continuing his work with teams, for the past three years Kaplan was president of the Independent Oracle Users Group, a 22,000-member professional technical association for the Oracle Corporation, one of the world’s largest software companies—second only to Microsoft. He was awarded Caltech’s prestigious Alumni of the Decade distinction for the ’90s. In 2001, he was included in Crain Communications’ “40 Under 40” profile of business leaders.

Sabeer Bhatia, SURF ’89

Another successful SURF alumnus is Sabeer Bhatia (BS ’91), cofounder of Hotmail and now the chairman of Nanocity. During the summer of 1989, Bhatia was the Hugh F. and Audi Cohn International SURF Fellow under the tutelage of Roddam Narasimha, director of the National Institute of Advanced Studies in India. Bhatia studied high-speed phase detection at the National Aeronautical Laboratory in Bangalore, India. He says his SURF project provided his first experiences working outside academia.

“The skill set that I acquired, most important of which is to ask the right questions, has led me on an exciting path of creating companies that solve problems through the use of technology,” Bhatia says.

Bhatia’s quest following SURF started with creating Hotmail, which solved the problem of universal e-mail access, and continued guiding him in all of his technology ventures. Bhatia says, “I think the SURF program is one of the most meaningful aspects of the education at Caltech.”

Christopher Hirata, SURF ’99, ’00

An equally impressive alumnus came to Caltech in 1997, at the mere age of 14. Chris Hirata spent his undergraduate years studying physics while maintaining an active social life, spending all four years on the varsity swim team, for instance. During the summer of 1999, Hirata conducted his first SURF project with research advisor Fiona Harrison, professor of physics and astronomy. It involved designing an X-ray imaging system for a satellite. This was Hirata’s first research project. And, he says, being so young then, the most important part of his experience with SURF was the research group itself.

“Seeing the processes and sociology of how a research group operates helped convince me that I wanted to continue doing research,” says Hirata. “I wouldn’t have found that in the classroom.”

Hirata’s research experience was just beginning. The following summer he conducted a second SURF project with Peter Goldreich, Lee A. DuBridge Professor of Astrophysics and Planetary Physics, Emeritus. It involved studying turbulence in a conducting magnetized fluid—research to be used in interstellar space.

After graduating from Caltech at 18 with his bachelor’s degree in 2001, Hirata flew to the East Coast to earn his PhD in physics at Princeton University. In the fall of 2007, Hirata returned to Caltech as an assistant professor of astrophysics.

His current projects at the Institute include cosmology—the study of the origin, structure, and evolution of the universe. He is involved in large research collaborations, making observations that help test cosmological models. Other work involves determining how to analyze current and future cosmological data sets.

To read the entire press release visit the Caltech Media Relations website at: http://mr.caltech.edu/media/Press_Releases/PR13166.html

New ways for SURF alumni to connect

Led by Leslie Maxfield (SURF ’92, ’93, ’94), the Alumni Relations Committee of the SURF Board has created two new ways for SURF alumni to keep in touch. The first is a SURF Alumni Webpage, which can be found at http://www.surf.caltech.edu/alumni/index.html. Here alums can learn about what is going on and find ideas for how to get involved.

Highlights of Summer 2008

Allied Programs

This summer the undergraduate research community at Caltech consisted of 570 students from schools and universities across the nation and world. While many of these were SURF students, others were participants in one of the allied programs administered by the Student-Faculty Programs Office.

MURF
Laser Interferometer Gravitational-Wave Observatory (LIGO) SURF
Caltech Amgen Scholars Program
NASA Undergraduate Student Research Program
NASA Space Grant
NASA Planetary Geology and Geophysics Undergraduate Research Program
Caltech-IFT Kanpur Exchange
Caltech-National University of Singapore Exchange
Caltech-Hong Kong Universities Exchange
Caltech-Cambridge Exchange
Caltech-University of Iceland Exchange
Howard Hughes Medical Institute EXROP

SURFers 2008

<table>
<thead>
<tr>
<th>Class Level</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Freshman</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Freshman</td>
<td>27%</td>
</tr>
<tr>
<td>Sophomore</td>
<td>34%</td>
</tr>
<tr>
<td>Junior</td>
<td>34%</td>
</tr>
<tr>
<td>Senior</td>
<td>4%</td>
</tr>
<tr>
<td>Women</td>
<td>32%</td>
</tr>
<tr>
<td>Minorities</td>
<td>8%</td>
</tr>
<tr>
<td>Average GPA*</td>
<td>3.43</td>
</tr>
</tbody>
</table>

* Caltech students only, excluding pre-freshmen and freshmen

SURF Summer Program

Caltech Seminar Series

Nathan S. Lewis
George L. Argyros Professor and Professor of Chemistry
"Powering the Planet With Fuel From the Sun"

Ashley Stroupe
JPL, Mars Rover Driver; Staff Engineer, Advanced Robotic Controls Group
"The Present and Future of Robotic Planetary Exploration"

Erik Winfree
Associate Professor of Computer Science, Computation and Neural Systems, and Bioengineering
"Programming a DNA World"

Dennis Dougherty
George Grant Hoag Professor of Chemistry
"The Chemistry of Nicotine Addiction"

John Preskill
John D. MacArthur Professor of Theoretical Physics
"Putting Weirdness to Work: Quantum Information Science"

Joann Stock
Professor of Geology and Geophysics
"What Happens to the San Andreas Fault at Its Southern End, and Should We Be Worried About It?"

David Chan
Associate Professor of Biology
"The Dynamic Properties of Mitochondria"

Diana Kormos-Buchwald
Professor of History
"Working With Einstein"

Jet Propulsion Lab Seminar Series

Cecilia N. Guiar
Formulation Projects Systems Engineer, Astronomy and Physics Directorate
"System Engineering at JPL"

Robert F. Shotwell
Project Systems Engineer for Phoenix and Program Systems Engineer Phoenix

Yoseph Bar-Cohen
Senior Research Scientist and Supervisor, Advanced Technologies Group
"Human-Like Robots"

Diane L. Evans
Director for the Earth Science & Technology Directorate
"Global Climate Change"

Charles D. Norton
Strategic Initiative Leader: Advanced Simulation and Modeling; Supervisor: Model-Based Systems Engineering and Architectures Group
"High-Performance Computing and Applications"

Janet B. Matthews
ATHLETE Task Manager & Lead Systems Engineer, Principal Investigator for the Lunar Tweel; Robotic Hardware Systems Group
"The ATHLETE Rover"

Candice J. Hansen
Ultraviolet Imaging Spectrograph (UVIS) Investigation Scientist and UVIS Co-Investigator on Cassini, Deputy Principal Investigator on Mars Reconnaissance Orbiter's (MRO)'s High Resolution Imaging Science Experiment (HiRISE)
"The Discovery of Enceladus' Water Vapor Plume"

Kendra Short
Manager, Mechanical Systems Division
"Mars Science Laboratory (MSL)"

The William Whitney Workshops on Professional Development

Inventing Your Future: What Are Your Options?
Dr. William Whitney, Deputy Manager, Education Office, JPL; Carolyn Ash, Quondam Director, Student-Faculty Programs Office

Building a Professional Reputation
Julia McCallin, Associate Vice President for Human Resources; Debra Dixon Hall, Partner, Allen Matkins; Kirk Dawson, SURF Board Chair; Heather Pinkett, Postdoctoral Scholar in Biochemistry; Helen McBride, Senior Scientist, Amgen; Todd Gingrich (SURF '06, Amgen Scholar '07).

Informational Interviewing and Networking: How to Make It Work for You
Candace Rypisi, Director, Student-Faculty Programs Office; Alumni and Friends

Understanding Your Leadership Style
Dr. Jerry Houser, Director, Career Development Center

Embrace Your Fear Like a Pro: Standing Up and Giving Effective Presentations
Robert Hanna (SURF '90), JPL, Project Manager for the Next Generation Navigation Software Project

Scientist as Speaker
Evan Gawlik, Junior, 2007 Perpall Speaking Competition, First Place; 2006 Perpall Speaking Competition, Third Place

Graduate School:
The Nuts and Bolts of the Application Process
Jonie Watanabe Tsuji, Career Counselor, Career Development Center; David Wales, Professor of Mathematics; Natalie Gilmore, Assistant Dean of Graduate Studies; Nneka Williams, Graduate Student in Geological and Planetary Sciences; Madeline Miller, Graduate Student in Mechanical Engineering; Peter Hung (SURF '05, '06, '07), Graduate Student in Applied Physics
This year, thanks to the hard work and dedication of the SURF Student Advisory Council, summer students enjoyed a full calendar of social, cultural, and athletic activities. Led by Andrew Freddo, Chao Liu, and Yiwen Peng, students coordinated events such as:

- Beach Trip to Santa Monica
- Tour of the Huntington Gardens
- Explore LA on the Metro
- July 4th BBQ
- Pool Party
- Broomball and Ice Skating
- Weekly sports night

And much more! Thank you to Student Affairs for their support of these events.

Wednesday nights were reserved for the always popular SURFSAC Suppers. Each week a group of faculty mentors and students enjoyed dinner and conversation together at a local restaurant. A special thanks to Dr. Catherine Jurca, Master of Student Houses, for her continued generous subsidy of these dinners.

**Awards and Prizes**

Each year the students who prepare and deliver excellent SURF presentations receive the Doris S. Perpall Speaking Award. This competition was endowed by Robert C. Perpall (B.S ’52, M.S ’56) in memory of his late wife, Doris Perpall, and encourages and supports effective oral communication. The 2007 Perpall winners were: Evan Gawlik, Kate Craig, and Andrew Freddo.

**Conferences**

**SFP Seminar Days**

The highlight of each summer is the seminar days where students present their research projects and findings. On August 20 and 21 students working at JPL presented their work to colleagues and peers on lab. Students working on campus gave oral or poster presentations at Summer Seminar Day on August 21 or Fall Seminar Day on October 18. To view the abstracts of these presentations, please visit: www.surf.caltech.edu

**Southern California Conference on Undergraduate Research (SCCUR)**

Congratulations to the following summer students who presented at the 2007 Annual Southern California Conference on Undergraduate Research (SCCUR).

- Aileen Ariosa
- Brandt Belson
- Natasha Cayco Gajic
- ZeNan Chang
- Emma Crow-Willard
- Teresa Dominguez
- Evan Gawlik
- Brandon Hensley
- Aaron Hoffer
- Vibha Laljani
- Moran Levi
- Benji Lin
- Xueliang Liu
- Micah Manary
- Anthony Mendez
- Lev Pisarski
- David (Zeb) Rocklin
- Kathryn Schafer
- Dan Song
- Christina Theodros
- Harsh Vasudevan
- Joshua Weiner
- Andy Yen
- Zhong-Yin Zhang

SCCUR is a one-day conference held each November on a college or university campus in the Los Angeles area. Over 500 student participants attend for a day of presentations and discussions on undergraduate research and scholarship.

**National Conference on Undergraduate Research (NCUR)**

The mission of NCUR is to promote undergraduate research and scholarship done in partnership with a faculty mentor. Each year the Doris S. Perpall Speaking Competition finalists have the opportunity to attend NCUR and present their research. NCUR 2008 was held at Salisbury University and attended by Kate Craig, Evan Gawlik, Andrew Kositsky, Matthew Lew, Deepak Mishra, and Joy Sheng.

**SURFers 2008**

<table>
<thead>
<tr>
<th>Division</th>
<th>Total # of Students</th>
<th>GT Students</th>
<th>Non-GT Students</th>
<th>Mentors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>59</td>
<td>39</td>
<td>20</td>
<td>26</td>
</tr>
<tr>
<td>Chemistry and Chemical Engineering</td>
<td>71</td>
<td>60</td>
<td>11</td>
<td>27</td>
</tr>
<tr>
<td>Engineering and Applied Science</td>
<td>100</td>
<td>80</td>
<td>20</td>
<td>41</td>
</tr>
<tr>
<td>Geological and Planetary Sciences</td>
<td>19</td>
<td>10</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Humanities and Social Sciences</td>
<td>17</td>
<td>13</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Physics, Mathematics, and Astronomy</td>
<td>52</td>
<td>43</td>
<td>9</td>
<td>34</td>
</tr>
<tr>
<td>Jet Propulsion Laboratory</td>
<td>46</td>
<td>27</td>
<td>19</td>
<td>33</td>
</tr>
<tr>
<td>Off Campus</td>
<td>10</td>
<td>9</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>International</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>386</td>
<td>293</td>
<td>93</td>
<td>204</td>
</tr>
</tbody>
</table>

**Statistics From the 2008 Graduating Class**

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Total number of B.S. graduates</th>
<th>Of these, the number graduating with honors %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of B.S. graduates who have done a SURF</td>
<td>206</td>
<td>53%</td>
</tr>
<tr>
<td>Of these, the number graduating with honors</td>
<td>109</td>
<td>61%</td>
</tr>
<tr>
<td>Percentage of B.S. graduates who have done a SURF</td>
<td>93</td>
<td>61%</td>
</tr>
<tr>
<td>Number of prizes awarded to B.S. graduates</td>
<td>141</td>
<td>83%</td>
</tr>
<tr>
<td>Of these, the number of prizes awarded to SURFers</td>
<td>117</td>
<td>83%</td>
</tr>
</tbody>
</table>
Funding SURF

SURF students receive an award of $8,000 for the ten-week summer period, a total program budget of over $2 million. Funds are raised from a variety of sources including gifts from individuals, foundations and corporations; faculty grants and other Institute sources; and NASA funds (for students working at JPL). SURF relies on the generosity of our many friends and we thank the many donors who supported SURF 2008. Below we highlight just some of those friends.

Reed and Ruth Brantley SURF Endowment

This new endowment was established by Mrs. Ruth Brantley in honor of her late husband, Dr. L. Reed Brantley. Dr. Brantley earned a doctorate degree at Caltech in 1930. Linus Pauling was chair of his thesis committee. Dr. Brantley went on to serve on the faculty of both Chemistry and Physics at nearby Occidental College, where he was instrumental in raising funds to support student research. In 1967, Dr. Brantley moved to Honolulu where he helped build a science curriculum at the University of Hawaii. He retired in 1972. Dr. Brantley and Ruth met and married in 1984, traveled the world, wrote and published several books, and enjoyed the "best times of our lives." Mrs. Brantley writes: "Reed is missed all of the time I know he would approve of supporting this great educational program."

The first Reed and Ruth Brantley SURF Fellow is Ali Abrahim. Ali worked with Dr. Jacqueline Bar-

The first Reed and Ruth Brantley SURF Fellow was Arthur H. Chang. Arthur is Professor of Electrical Engineering and Control and Dynamical Systems at Caltech. Arthur received his Ph.D. from Stanford University in 1982. After postdoctoral research at Caltech, he joined the faculty in 1985.

The Aerospace Corporation SURF Fellows

Since 2001, the Aerospace Corporation has been providing support and mentoring to SURF students. Initiated by Caltech alumnus Gary Stupian, this collaboration now provides support to five students annually. Students are selected on the basis of research interests and, in addition to their Caltech faculty mentor, are paired with an Aerospace advisor. These advisors meet with students regularly and help guide them in their academic and professional paths. In most cases, these relationships continue well beyond the SURF period!

The 2008 Aerospace Corporation SURF Fellows were:

Arthur H. Chang
Mentor: Dr. Ali Hajimiri, Professor of Electrical Engineering
Project: Near-Field Modulation Technique Using Antenna Reflector Switching at 2.4GHz

Daryl B. Coleman
Mentor: Dr. James R. Heath, Elizabeth W. Gilcom Professor and Professor of Chemistry
Project: "Click" Chemistry Attachment of Alkyne Terminated Organic Molecules to Silicon (1 1 1) Surfaces

Matthew J. Czubakowski
Mentor: Dr. Harry Atwater, Howard Hughes Professor and Professor of Applied Physics and Materials Science
Project: Metal-Insulator-Metal Plasmon Waveguides for Color Filtering Applications

Evan S. Gawlik
Mentor: Dr. Jerrold E. Marsden, Carl F Braun Professor of Applied Math and Electrical Engineering
Project: Quantum Analysis of Directed Cell Migration on Novel Surfaces With Micropatterned Lignands

Jan A. Petykiewicz
Mentor: Dr. Harry Atwater, Howard Hughes Professor and Professor of Applied Physics and Materials Science
Project: Optical Absorption in Silicon Nanowire Arrays

The Rose Hills Foundation SURF Fellows

The Rose Hills Foundation is a legacy created by the founders of the Rose Hills Memorial Park, which is the largest cemetery in North America and is located in the city of Whittier. The Foundation supports organizations in Southern California, with an emphasis on programs that benefit the residents of this area.

In 2007, the Rose Hills Foundation generously committed to support fifteen SURF students each year, for five years. These students must demonstrate a strong academic record and be from Southern California.

Congratulations to the 2008 Rose Hills Foundation SURF Fellows:

Pradeep Bugga
Mentor: Dr. Brian M. Stoltz, Ethel Wilson Bowles and Robert Bowles Professor of Chemistry
Project: Progress Toward the Syntheses of HIV Integrase Inhibitors Integrastastics A and B

Stephanie S. Chang
Mentor: Dr. Anand R. Asthagiri, Assistant Professor of Chemical Engineering
Project: Structural Characterization of the Enzyme PglA of Bacteroides fragilis Colonization That Selects for Multiple Polysaccharides

Edward H. Chen
Mentor: Dr. Gil Refael, Associate Professor of Theoretical Physics
Project: Vortex Interactions in a Rotating, Multi-Flavored Bose-Einstein Condensate

Sunny Chun
Mentor: Dr. William M. Clemons, Jr., Assistant Professor of Chemical Engineering
Project: Structural Characterization of the Enzyme PglA of the N-Linked Glycosylation Pathway

Sherwin Doroudi
Mentor: Dr. Adam C. Wierman, Assistant Professor of Computer Science
Project: A Game Theoretic Approach to the Sensor Coverage Problem

Matthew J. Glassman
Mentor: Dr. David Baltimore, Robert Andrews Millikan Professor of Biology; Nobel Laureate; President Emeritus
Project: Creation of Influenza Reporter Cell Lines and Developing a Poll-Based Expression System

Julie Y. Huang
Mentor: Dr. Sarkis K. Mazmanian, Assistant Professor of Biology
Project: Mucus Binding: A Possible Mechanism of Colonization That Selects for Multiple Polysaccharides Expressing Bacteroides fragilis

Hui-Hsing Liu
Mentor: Dr. Mark E. Davis, Warren and Katharine Schlinger Professor of Chemical Engineering
Project: Correlation Between siRNA Inhibition of Ribonucleotide Reductase Subunit M2 and Cell Proliferation in vivo

Justin K. Ng
Mentor: Dr. Julian M. Tyszka, Member of the Professional Staff in Biology
Project: Magnetic Stage Resonance Microscope

Nam P. Nguyen
Mentor: Dr. Joel W. Burdick, Professor of Mechanical Engineering and Bioengineering
Project: Designing a Surface Environmental Data Sampling Method for a Dirigible on Titan

Diane J. Plummer
Mentor: Dr. Jesse L. Beauchamp, Mary and Charles Ferkel Professor of Chemistry
Project: Selective Ionization Using Photocleavable Linkers

Rebecca L. Russell
Mentor: Dr. Harvey B. Newman, Professor of Physics
Project: Improving the Identification of Electron Neutrinos in the MINOS Detector

Daniel R. Talancon
Mentor: Dr. Beverley J. McKeon, Assistant Professor of Aeronautics
Project: Airfoil Pressure Drag Into Pressure Thrust: A Computational Study

Yang Yang
Mentor: Dr. Anand R. Asthagiri, Assistant Professor of Chemical Engineering
Project: Osmotic Pressure of Water and EGF-Mediated Beta-Catenin Signaling

Andy L. Yen
Mentor: Dr. Harvey B. Newman, Professor of Physics
Project: Analysis of Ophiophtin Production at the LHC and Its Impact on Higgs Searches in the H → yy Channel
A Timeline of SURF Funding

1977
Law and Edie Wasser- established using the the Tomiyasu SURF Endowment. An anonymous donor creates a matching fund. The matching funds provide $50,000, of $125,000 needed to establish a scholarship.

1999
George and Mary Lou Booms create a new endowment. Eight new endowments are established. Endowments Through Planned Gifts

2005
An anonymous donor creates a matching fund. The matching funds provide $50,000, of $125,000 needed to establish a scholarship. Seven new endowments are established using the matching funds. CARL AND SHIRLEY LARSON give a $1 million gift to establish the Larson SURF Scholar Endowment.

2002
Caltech launches the capital campaign, The Only One. The campaign includes increasing the SURF endowment by $10 million. The SURF Board SURF Endowment is established by John Glavine, Nancy Glavine, and the Glavine Family Foundation to encourage Board members to support the campaign.

1994
Robert C. Perpall creates a new endowment. The Campaign creates a matching fund with a $2 million gift. These matching funds provide $10 million in annual gifts have been raised, solidifying SURF for generations to come.

2008
Nine new endowments are established. These include several creation of new endowment in the Larson SURF Scholar Endowment, which supports five students annually. Another seven new endowments are established, including one in honor of the Class of ’72.

1998
Marcella Bonsall establishes the Marcella and Joel Bonsall SURF Prize for Technical Writing.

2007
Alumnus Kiyo Tomiyasu and his wife Eiko establish the Tomiyasu SURF Scholar Endowment, which supports five students annually. Another seven new endowments are established, including one in honor of the Class of ’72.

1983
Samuel and Frances Krown establish the first SURF endowment, which now supports seven students each year. The Paul K. and Evalyn E. Cook Richter Memorial Funds supported 33 students.

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SURF Administrative Committee
Dr. Fredrick H. Shair, Chair
Dr. Paul M. Bellan
Dr. Geoffrey A. Blake
Dr. S. George Djokovski
Dr. Steven C. Fusiachi
Dr. Joseph L. Kirschvink
Dr. Nathan S. Lewis
Dr. Carl S. Parker
Dr. David B. Rudolph
Dr. Thomas A. Tomblin, Jr.
Dr. William M. Whitney
Dr. Richard M. Wilson
Ex-Officio Members
Dr. Gerald Houser
Ms. Candace Rypisi

SURF Student Advisory Council (SURFASC)
Andrew Freddo, Chair
Ioana Aanei
Zhihan Chang
Tina Ding
Gongnie Li
Beng Lin
Yixin Liu
Chau Liu
Helen Luo
Calbo Ng
Yifen Peng
Andrew Price
Ayar Sajzew
John Schuman
Leslie Tong
Jack Wang
Fei Yang
Andy Yan
Lisa Zang

SURF Co-Mentor Advisory Council
Holly Carlisle
Ashish Mahabal
Brad Olsen
Mara Salvato
James Van Deventer

In Memoriam

Donors
Donald M. Altstadt
Robert E. Anderson
George N. Boone
Patricia J. Cassat
LeVal Lund, Jr.
Neville S. Long
William H. Halpenny
Clyde C. Chivens
Robert E. Anderson
Donald M. Alstadt

Mentors
Giuseppe Attardi
Seymour Benzer
Giuseppe Attardi

SURF Student Fellowships

SURF Board
Mr. Kirk M. Dawson, Chair
Ms. Gabrielle A. Adelman, SURF ’85, ’86
Ms. Karen Carlson
Dr. Carol Carmichael
Dr. James A. Culits
Dr. Phoebe Dias
Mr. H. Kent Frewing
Mrs. Heather S. Haaga
Dr. Catherine James
Ms. Leslie M. Marfield, SURF ’92, ’93, ’94
Mr. Don M. Prinkleton
Dr. Robert R. Roney
Dr. Gary W. Stupian
Mr. Sean A. Upchurch
Mr. Kirk M. Dawson
Ms. Candace Rypisi

SURF Co-Mentor Advisory Council
Holly Carlisle
Ashish Mahabal
Brad Olsen
Mara Salvato
James Van Deventer

30 PearlS oF SurF WISdom
1. Watching the growth and development of SURF, I have learned about the special qualities of Caltech students and faculty and the work they do together. — Morton L. Goldberger, President Emeritus, 1986 SURF Annual Report
2. Students at the starting line have every reason to hope for an improved future. There can be no greater challenge to a student than the desire and will to make things better. — Robert L. Shaffer, Former Member of the SURF Board, on the opportunity SURF provides to students, 1986 SURF Annual Report
3. In some quarters teaching and research are regarded as incompatible, but at Caltech we feel that a program of undergraduate research can be a highly pedagogical procedure. — Robert K. Shapely, Professor Emeritus, 1987 SURF Annual Report
4. Youth’s confidence that all is fresh is partly due to the exhilaration of research. In that sense it is good that I am convinced that some things need to be experienced anew after they have been forgotten as science pursued new popular lines; they can’t just be dug out of the aging literature to much effect. — Ray Olson, Professor Emeritus, Excerpt from speech at the 1989 SURF Kickoff Dinner
5. When an old-timer tries to tell you that his science is on the brink of ‘complete solution,’ that you won’t have much to do for long, and that in any case help is needed, don’t be discouraged. Maybe the old-timer is just a little tired. — Ray Olson, Professor Emeritus, Excerpt from speech at the 1989 SURF Kickoff Dinner. 6. The passing on of ideas and style to the next generation is the most lauding and gratifying raison d’etre of a university. — Hans Lampepp, Professor Emeritus, Excerpt from speech at the 1989 SURF Kickoff Dinner
7. SURF always reflects well on its parent institution, which also endeavors to excel at everything it sets out to do. — Thomas E. Everhart, President Emeritus, 1989 SURF Annual Report
8. While background materials, related results, and other attempts at solving a problem may be found in books and journals, insight into a problem, and its possible resolution, come about only through a student’s systematic attack on the problem. — 1989 SURF Annual Report
9. We are neither able to shape the future with much certainty, nor are we able to stay around very long to see what happens. The best thing we can do is to help you people develop: 1) a yearning for discovery, 2) a spirit of openness, and 3) a deep sense of compassion for all of life. There is no better handshake with the future. — Fredrick H. Shair, SURF Founder, Excerpt from speech at the 1990 SURF Kickoff Dinner
10. SURF is providing me with more than a summer job. I have the invakable opportunity to test and, I hope, prove myself in a laboratory setting before attempting to go on to graduate school. — Matthew Mow, 1994, Kohler SURF Scholar, 1994 SURF Annual Report
11. Four weeks of fighting against instrumentation failures is enough to make anyone wonder if research is the right choice for them. The SURF program gave me a supportive environment to find out that for me the answer is Yes! — Kimberly L. Kosmacek, 1993, Class of ’36 SURF Fellow, 1993 SURF Annual Report
12. I’ve learned that professors don’t publish papers every week, experiments do fail and that getting results was thrilling! — Paula Ng, 1993, Howard Hughes Medical Institute SURF Fellow, 1993 SURF Annual Report
13. As I complete my tenure as President of Caltech, I have reflected upon the outstanding individuals, projects, and programs that make the Institute a world leader in research and education. SURF is one of those programs. — Thomas E. Everhart, President Emeritus, 1999 SURF Annual Report
14. An important aspect of SURF is encouraging students to believe that they or the research they can accomplish may be important to society. — Fredrick H. Shair, SURF Founder, 1998 SURF Annual Report
15. There is room for energetic young people working at the edge of human knowledge. — Robert P. Sharp, Professor Emeritus, 1998 SURF Annual Report
16. First, make SURF 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! — Comments from Ernest Schenow when asked his thoughts on the future of SURF, 1998 SURF Annual Report
17. 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 collect it. — Christopher E. Kurtz, 1998 and 1999 SURF Fellow, 1998 SURF Annual Report
18. Working in the lab was about more than discovery; it was about developing an independent philosophy for thinking. — Sophia Xiang, 1997 and 1999 SURF Fellow, 1999 SURF Annual Report
19. SURF is widely recognized as the premier undergraduate research program in the country, and it is one of the enterprises that keeps Caltech at the forefront of higher education. — David Baltimore, President Emeritus, 2000 SURF Annual Report
20. They are a breath of fresh air in the lab. They bring enthusiasm to science, and they offer a new perspective. — Marianne Bronner-Fraser, Albert Billings Ruddock Professor of Biology
21. Students need confidence. They might need to work on something simple so they succeed and gain confidence. Other students are like grad students or cheerleaders. — Harry Gray, Professor and Mentor, 2004 SURF Annual Report
22. I believe that money I put into education—my own, my children’s, or of the society I live in—is really an investment, perhaps the best investment I can make. — William Whaling, Professor of Physics, Emeritus
23. I came to Caltech knowing I could receive a great education many
24. My former SURF students frequently write to thank me for the introduction to research and note the important influence of their SURF experience. To me, participating as a SURF mentor is one of the most rewarding parts of my job! — Marianne Bronner-Fraser, Albert Billings Ruddock Professor of Biology
25. As someone has said, “If you know what you are doing, it’s not research.” — Jack Roberts, Institute Professor of Chemistry, Emeritus
26. SURF is a great experience and a wonderful preparation for a lifetime of inquiry and learning. — Richard Murray, Thomas E. and Doris Everhart Professor of Control and Dynamical Systems
27. Caltech is known for its world-class faculty and its highly motivated underclassmen. The SURF program forms the most intimate connection between these two valuable resources. — Jonathan Bird, SURF ’91, ’92
28. Your donations not only fund stipends, they feed minds and fuel the futures of many aspiring students, and it is the research of these very students that will someday, somehow revolutionize the world. — Josep F. de Jesus, SURF ’91
29. To have a research project like this is worth everything to me and I really want to thank you for contributing to it. I thought I had high expectations on the research I would be allowed to do. They were far exceeded. — Karen Ohye, SURF ’93, ’94
30. I came to Caltech knowing I could receive a great education many places, expecting unequaled research opportunities, and that’s what I found. — Brian Cleary, SURF ’03

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