

# SURF: 30 Years of Student Achievement

Proof 1 Caltech SURF 2008



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

# 30

## What's in a number?

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

**30 = 2\*3\*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

# Capital Campaign: A Great Success!

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. First the campaign was extremely well organized, thanks to the skills, dedication, and energy of the people involved. The second factor lies in the very nature of SURF, its goals, and its demonstrated success over thirty years of providing an undergraduate research experience.



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, 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](http://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 with faculty in other disciplines, (2) the program should be endowed, and above all, (3) SURF should always try to do what is best for the student. Since that time, SURF has become the premier program that it is today because so many Caltech faculty, students, administrators, and friends have taken an interest in realizing Swift’s vision.

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.

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.

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.

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 Frautschi, 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 Dedictees

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



# An interview with the legendary Jack Roberts



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**

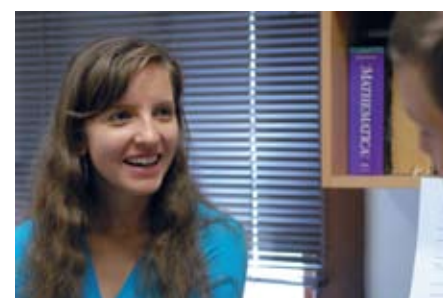
(SURF '93, '95)

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 know 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.



# Team Titan

Proof 3 Team Titan



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wo 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 Sarohia, Assistant to the Chief Technologist at JPL. Much of Dr. Sarohia'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 the passive Montgolfiere balloon. Daniel, one of five Kiyu 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.



**Dipping my hands into space mission research while learning from Caltech professors, JPL scientists, and fellow student researchers was both enlightening and fun.**

— Evan Gawlik

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"

### 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.

The second is a new SURF Alumni Facebook page. Become a "fan" at <http://www.facebook.com/pages/Caltech-SURF-Alumni/19099488491>.

### 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 Audy Colvin 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.

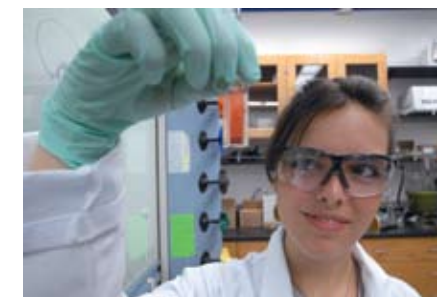
"Seeing the processes and sociology of how a research group operates helped convince me that I wanted to continue doing research," says Hirata. "I wouldn't have found that in the classroom."

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](http://mr.caltech.edu/media/Press_Releases/PR13166.html)





# 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-IIT 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

Class Level	Percent
Pre-Freshman	< 1%
Freshman	27%
Sophomore	34%
Junior	34%
Senior	4%
Women	32%
Minorities	8%
Average GPA*	3.43

\* 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*

#### Jaret 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 (HRISE)  
*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 Dison 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

## SURFSAC Events

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 Iceskating
- 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 (BS '52, MS '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](http://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	Xueliang Liu
Brandt Belson	Micah Manary
Natasha Cayco Gajic	Anthony Mendez
ZeNan Chang	Lev Pisarsky
Emma Crow-Willard	David (Zeb) Rocklin
Teresa Dominguez	Kathryn Schaefer
Evan Gawlik	Dan Song
Brandon Hensley	Christina Theodoris
Aaron Hoffer	Harish Vasudevan
Vibha Laljani	Joshua Weiner
Moran Levi	Andy Yen
Benji Lin	Zhong-lin 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

Division	Total # of Students	CIT Students	Non-CIT Students	Mentors
Biology	59	39	20	25
Chemistry and Chemical Engineering	71	60	11	27
Engineering and Applied Science	100	80	20	41
Geological and Planetary Sciences	19	10	9	12
Humanities and Social Sciences	17	13	4	10
Physics, Mathematics, and Astronomy	52	43	9	34
Jet Propulsion Laboratory	46	27	19	33
Off Campus	10	9	1	10
International	12	12	0	12
<b>Total</b>	<b>386</b>	<b>293</b>	<b>93</b>	<b>204</b>

## Statistics From the 2008 Graduating Class

Total number of B.S. graduates	206	
Of these, the number graduating with honors	109	53%
Total number of B.S. graduates who have done a SURF	152	
Of these, the number graduating with honors	93	61%
Percentage of B.S. graduates who have done a SURF		74%
Number of prizes awarded to B.S. graduates	141	
Of these, the number of prizes awarded to SURFers	117	83%





## Funding SURF

SURF students receive an award of \$6,000 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 Abraham. Ali worked with Dr. Jacqueline Barton, Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry, on a project entitled "Sequence Specific Detection of Proteins With a Multiplexed DNA Array."

### 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. Gilloon 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 Engineering and Control and Dynamical Systems  
*Project:* Titan Mission Trajectory Design

#### 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

### Rose Hills Foundation SURF Fellowships

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 Integristatins A and B

#### Stephanie S. Chang

*Mentor:* Dr. Anand R. Asthagiri, Assistant Professor of Chemical Engineering  
*Project:* Quantitative Analysis of Directed Cell Migration on Novel Surfaces With Micropatterned Ligands

#### 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 Chemistry  
*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 PollI-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*

#### Hongdau P. 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:* Crosstalk of Wnt- and EGF-Mediated Beta-Catenin Signaling

#### Andy L. Yen

*Mentor:* Dr. Harvey B. Newman, Professor of Physics  
*Project:* Analysis of Diphoton Production at the LHC and Its Impact on Higgs Searches in the  $H \rightarrow \gamma\gamma$  Channel

## Established Endowments

Thanks to the generosity of many committed donors, gifts to the SURF endowment will ensure students the opportunity to conduct research for generations to come. Scholar endowments provide support for five students annually in perpetuity. Fellow endowments provide support for one student annually in perpetuity.

### SURF Scholar Endowments

Larson Scholars  
Kiyoo and Eiko Tomiyasu Scholars

### SURF Fellow Endowments

Arthur R. Adams SURF Endowment  
Stephen Adelman Memorial SURF Endowment  
Brenda and Louis J. Alpinieri SURF Endowment  
Carolyn Ash SURF Endowment  
The Associates SURF Endowment  
Robert L. Blinkenberg SURF Endowment  
Marcella Bonsall SURF Endowment  
Hannah Bradley SURF Endowment  
Reed and Ruth Brantley SURF Endowment  
Bristol-Myers SURF Endowment  
Carol Carmichael SURF Endowment  
Bob and Carole Chapman Minority SURF Endowment  
Donald S. Clark SURF Endowment  
J. Kent Clark SURF Endowment  
Class of '36 SURF Endowment  
Class of '52 SURF Endowment  
Dr. Terry Cole SURF Endowment  
Hugh F. and Audy Lou Colvin International SURF Endowment  
Hugh F. and Audy Lou Colvin SURF Endowment  
Robert F. Connelly SURF Endowment  
Karen and James Cutts SURF Endowment  
Mary P. and Dean C. Daily SURF Endowment  
Kirk and Marjory Dawson Family SURF Endowment  
Frederick W. Drury, Jr., SURF Endowment  
Charles and Valerie Elachi SURF Endowment  
David C. Elliot SURF Endowment  
Doris Everhart SURF Endowment  
Fred and Jean Felberg SURF Endowment  
Flintridge Foundation SURF Endowment

Robert I. and Winifred E. Gardner SURF Endowment  
John and Barbara Gee SURF Endowment  
David L. Goodstein SURF Endowment  
Harry B. Gray SURF Endowment  
J. Weldon Green SURF Endowment  
Heather and Paul Haaga SURF Endowment  
W.H. Halpenny SURF Endowment  
William Hassenzahl Family SURF Endowment  
Thomas C. Hays SURF Endowment  
Robert T. Herzog SURF Endowment  
Edward W. Hughes SURF Endowment (1992)  
Edward W. Hughes SURF Endowment (2005)  
Richard T. Jones SURF Endowment  
David S. Koons SURF Endowment  
Samuel P. and Frances Krown SURF Endowment  
Toshi Kubota Aeronautics SURF Endowment  
William N. Lacey SURF Endowment  
Arthur E. Lamel Memorial SURF Endowment  
William H. and Helen Lang SURF Endowment  
Shirley and Carl Larson SURF Endowment  
Thomas Lauritsen SURF Endowment  
Lester Lees Aeronautics SURF Endowment  
Peter A. Lindstrom, Jr., SURF Endowment  
Robert J. McEliece and David Rutledge SURF Endowment  
James J. Morgan SURF Endowment  
Thomas Hunt Morgan SURF Endowment  
Joanna Wall Muir SURF Endowment  
Victor Neher SURF Endowment  
Franz and Anne Nierlich SURF Endowment  
Northern California Associates SURF Endowment  
Arthur A. Noyes SURF Endowment  
Ray Owen SURF Endowment  
Toni and Bob Perpall SURF Endowment  
Sidney R. and Nancy M. Petersen SURF Endowment  
Alain Porter Memorial SURF Endowment  
Ernest R. Roberts SURF Endowment  
Jack and Edith Roberts SURF Endowment

Arthur Rock SURF Endowment  
Robert K. and Alice L. Roney SURF Endowment  
Dr. Chandler C. Ross SURF Endowment  
Rossum Family SURF Endowment  
Warren and Katharine Schlinger SURF Endowment  
Professor Fredrick H. Shair SURF Endowment  
Sung-Hsien Chen Shih SURF Endowment  
Øistein and Rita A. Skjellum SURF Endowment  
Rita A. and Øistein Skjellum SURF Endowment  
Soli Deo Gloria SURF Endowment  
Samuel and Berta Spalter SURF Endowment  
Edward C. and Alice Stone SURF Endowment  
Laurence J. Stuppy SURF Endowment  
Captain Pradeep B. Suklikar Memorial SURF Endowment  
SURF Board SURF Endowment  
Ernest H. Swift SURF Endowment  
Nellie Bergen and Adrian Foster Tillotson SURF Endowment  
Howell N. Tyson, Sr., SURF Endowment  
Mary Vodopia SURF Endowment  
Erika C. Vote SURF Endowment  
Chung Ip Wing-Wah Memorial SURF Endowment  
Frank W. Wood SURF Endowment  
Harold and Mary F. Zirin SURF Endowment

### SURF Prize Endowments

Marcella and Joel Bonsall SURF Prize for Technical Writing  
Doris S. Perpall SURF Speaking Award

### Endowments Through Planned Gifts

Dr. and Mrs. George Boone  
Dr. Paraskeva N. Danailov Endowed SURF Fellowship in Biology

### A Timeline of SURF Funding

#### 1977

Lew and Edie Wasserman give gift to Caltech that stimulated the founding of SURF

#### 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 make their first gift to SURF. This annual support continues today and in 2008 the Richter Memorial Funds supported 33 students

#### 1994

Robert C. Perpall creates the Doris S. Perpall SURF Speaking Awards to encourage and recognize excellence in oral presentations

#### 1998

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

#### 1999

George and MaryLou Boone make arrangements through their estate plan to provide a gift of \$1 million to the SURF endowment

#### 2002

Caltech launches the capital campaign, There's Only One. Caltech. The campaign includes increasing the SURF endowment by \$10 million

The SURF Board SURF Endowment is established by John Glanville, Nancy Glanville, and the Glanville Family Foundation to encourage Board members to support the campaign

#### 2005

An anonymous donor creates a matching fund pool with a \$2 million gift. These matching funds provide \$50,000 of the \$125,000 needed to establish a SURF endowment

Seventeen new endowments are established using the matching funds! Carl and Shirley Larson give a \$1 million gift to establish the Larson SURF Scholar Endowment

#### 2006

The matching funds continue to create excitement. Eight new endowments are established

#### 2007

Alumnus Kiyoo 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 '52

#### 2008

Nine new endowments are established. These include several created by parents of SURF alumni; several more named in honor of Caltech faculty; and one given as a holiday gift from President Chameau in honor of his wife, Carol Carmichael. Since the start of the campaign, \$8.6 million in new endowment and \$2.7 million in annual gifts have been raised, solidifying SURF for generations to come



## Honor Roll of 2008 SURF Donors

### Annual Gifts

Mr. and Mrs. Stuart Adler  
 Mr. Viktor Y. Alekseyev, SURF '97, '98  
 Dr. and Mrs. Lew Allen  
 Mr. Robert C. Anderson III, SURF '93  
 Mr. Michael V. Anshelevich, SURF '93  
 Ms. Tara L. Arvedson, SURF '91, '92, '93  
 Ms. Carolyn A. Ash  
 Mr. and Mrs. Hugh A. Baird  
 Dr. Joshua A. Bardin  
 Mrs. Ellen F. Barrett  
 Mr. and Mrs. John N. Barrett  
 Dr. Elizabeth J. Barton, SURF '91, '92, '93  
 Mr. and Mrs. Ray Baumer  
 Mr. and Mrs. Arlen W. Bell  
 Mr. and Mrs. Mikhail Belyi  
 Mr. Richard C. Berryman, Jr.  
 Dr. and Mrs. Donald Blumenthal  
 Mr. Joseph R. Boeke  
 Mrs. Jane F. Bondi  
 Mr. Ned B. Bowden, SURF '92, '93  
 Mrs. Hannah Bradley  
 Mrs. Anna J. Brosnahan, SURF '90  
 Mr. Christopher W. Bryant, SURF '92, '93,  
 and Dr. Jasmine R. Bryant,  
 SURF '93, '94  
 Dr. Patricia V. Burke  
 Mr. and Mrs. Roderick P. Calkins  
 Ms. Sascha B. Calkins, SURF '99, '00 '01  
 Mr. George L. Cassat  
 Mr. and Mrs. Joseph Y. Chang,  
 SURF '98, '99  
 Mr. and Mrs. Fon-Chiu Mia Chen  
 Mr. Hailong Chen  
 Ms. Jane C. Chen  
 Mr. Carl W. Chin, SURF '02, '04  
 Mr. Daniel H. Chou, SURF '97  
 Ms. Chun-Young Chu  
 Dr. and Mrs. Won I. Chun  
 Mr. Peter K. Clark  
 Mr. and Mrs. Evan G. Colgan, SURF '81  
 Mr. and Mrs. LeRoy F. Coulter  
 Mr. David A. Cuthbert, SURF '95  
 Mr. and Mrs. Jan W. Dash  
 Mr. Thomas A. Daula, SURF '00  
 Dr. and Mrs. John F. Davis, SURF '91  
 Dr. Peter L. Davis  
 Mr. and Mrs. Kirk M. Dawson  
 Dr. Heather L. Dean, SURF '98, '99  
 Mr. and Mrs. David P. Denny-Frank  
 Mr. and Mrs. Paul M. DiCato  
 Mr. James Donald, SURF '00  
 Mr. James H. Dooley and  
 Mrs. Laura E. Dooley (SURF '94)

Mr. and Mrs. Robert Douglas  
 Dr. Duane R. Edgington  
 Dr. and Mrs. Thomas E. Everhart  
 Mr. and Mrs. Jay Farr  
 Ms. Iljie J. Fitzgerald, SURF '98, '99, '00  
 Mr. and Mrs. H. Kent Frewing  
 Mr. Jeffrey T. Freymueller, SURF '83  
 Mr. Ilya Fushman, SURF '00, '02  
 Dr. David C. Gakenheimer  
 Dr. Delwyn L. Gilmore, SURF '89  
 Mr. David L. Glackin  
 Ms. Nancy H. Glanville  
 Dr. Edray H. Goins, SURF '92, '93  
 Ms. Rachel F. Gray, SURF '99  
 Dr. Jane R. Greco, SURF '94, '95  
 Dr. and Mrs. Robert H. Grubbs  
 Dr. Philip M. Gschwend  
 Mr. and Mrs. Paul Haaga  
 Ms. Debra Dison Hall  
 Mr. and Mrs. Franklin Hardesty  
 Mr. Sean S. Hardesty, SURF '01, '03  
 Dr. and Mrs. Daniel C. Harris  
 Dr. Robert H. Harris  
 Mr. and Mrs. Wallis G. Hines  
 Mrs. Iwona M. Hiszpanski  
 Mr. and Mrs. Feng Chu Ho  
 Ms. Sally D. Holbrook  
 Mr. Everett W. Howe, SURF '85  
 Mr. Carter Hunt  
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**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. — *Marvin L. Goldberger, President Emeritus, 1986 SURF Annual Report*

**2.** Students at the 'starting line' have every reason to have 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. Shafer, 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 effective pedagogical procedure. — *Robert P. Sharp, Professor Emeritus, 1987 SURF Annual Report*

**4.** Youth's confidence that all is fresh is doubtlessly part of 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 Owen, Professor Emeritus, Excerpt from speech at the 1988 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 it can't help but be dull, don't be discouraged. Maybe the old-timer is just a little tired. — *Ray Owen, Professor Emeritus, Excerpt from speech at the 1988 SURF Kickoff Dinner*

**6.** The passing on of ideas and style to the next generation is the most lasting and gratifying raison d'etre of a university. — *Hans Liepmann, 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 we can do is to help our young 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 invaluable opportunity to test and, I hope, prove myself in a laboratory setting before attempting to go on to graduate school. — *Matthew Metz, 1994, Richter 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. Komisarek, 1995, Class of '36 SURF Fellow, 1995 SURF Annual Report*

**12.** I've learned that professors don't publish papers every week, experiments do fail, and that getting results was thrilling! — *Pauline Ng, 1995, Howard Hughes Medical Institute SURF Fellow, 1995 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, 1997 SURF Annual Report*

**14.** An important aspect of SURF is the encouragement of each student to believe that she or he can accomplish tasks that others have not. — *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 Swift 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. — *Frances Arnold, Professor and Mentor, thoughts on SURF students, 2001 SURF Annual Report*

**21.** Some students need confidence. They might need to work on something simple so they succeed and gain confidence. Other students are like grad students or postdocs and are able to take on a problem independently. I think mentoring is really understanding that and being able to adjust to the situation. — *Harry Gray, Professor and Mentor, 2004 SURF Annual Report*

**22.** Through the struggles of research, I learned that I am my own worst critic and also my biggest cheerleader. — *Adele Shakal, SURF '93, '94*

**23.** 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. — *Ward Whaling, Professor of Physics, Emeritus*

**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 '01, '02*

**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. — *Joseph F. de Jesus, SURF '01*

**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. — *Karin Öberg, SURF '02, '03, '04*

**30.** I came to Caltech knowing I could receive a great education many places, expecting unequalled research opportunities, and that's what I've found. — *Brian Cleary, SURF '03*



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