

The Hertz Foundation builds America's capacity for innovation by nurturing remarkable applied scientists and engineers who show the most promise to change the world.

From the President's Desk

By Jay Davis



It's a pleasure to introduce Norm Augustine's lead article for this newsletter. Mr. Augustine had a distinguished career in the

aerospace industry and at DoD, retiring as CEO of Lockheed-Martin. He led the National Academy's 2005 study of S&T education, *Rising Above the Gathering Storm*. He has now updated that study as *Rising above the Gathering Storm, Revisited: Rapidly Approaching Category Five*. This short document makes the case for technical education of the brightest that we make when explaining the goals of the Hertz Foundation.

Norm spoke at a DOE workshop on national security applications of accelerators in October 2009. He convulsed the audience with a story about his own career. He said that his proudest accomplishment was in being on the team that put twelve men on the moon and returned them safely, a straightforward but daunting and demanding task of engineering. He was thus dismayed to hear it described as "Rocket Science." He was further dismayed that whenever code writing physics theorists produce a debacle on Wall Street, it's inevitably called "Financial Engineering!" He is justly famous for his small book titled *Augustine's Laws* that explains the interrelationship of government, finance, hardware design, project management—and failure. In retirement, he teaches at Princeton.

The Land of the Unemployed

By Norman R. Augustine

Americans are currently experiencing what it means to have ten percent unemployment—and another seven percent underemployed or having simply dropped out of the workforce. Worse yet, there is a substantial likelihood that the nation will fall victim to sustained unemployment at these rates—or worse.

Why? Because a firm seeking to hire Americans to work in American plants is faced with wages (not to mention benefits) that range from three to twenty times those representative of developing countries; with a mature domestic market; with a workforce that is among the poorest educated in the world; with a corporate tax structure that is the second most punitive in the industrial world; and the prospect of spending nearly three times as much on litigation as on research—as is the case today.

How then can Americans hope to find quality jobs over the longer term? The answer appears to be that they can't—unless we do some things differently. Numerous studies of the predicament towards which the nation is heading agree that the only answer is through innovation...that is, being first to gain new knowledge through research, being first to apply that knowledge through world-class engineering, and being first to market with new products and services that result from extraordinary entrepreneurship.

The common denominator of these steps is a talented workforce, particularly in science and engineering. During the last half century over half the seven-fold growth in the nation's output per capita has been attributed to advances in science and engineering. So how are we doing in preparing to compete in such a world?

A few statistics are illuminating. In recent international tests in 30 nations, U.S. 17-year-olds finished in 21st place in science and 25th place in mathematics. (Remember the outcry and response when our Olympic basketball team finished in fourth place?) In spite of an increase over the past 35 years in public school employment by 75% and inflation-adjusted spending by 150%, our high school graduates (excluding the one-third of students who drop out before graduating) have improved by 1 point in reading and 2 points in math on a 500 point scale. McKinsey & Co., the management consultant, concludes that if U.S. youth could match the performance of students in Finland, America's economy would be between 1.3 and 2.3 trillion dollars larger each year.

So what can be done? There are many things that can be done: double investment in research, revise the immigration laws to permit more individuals to work in the U.S.

Changes for the New Year

by Susan Overman



As we close this calendar year, I am happy to report that we have had our best fundraising year to date with over four million

from our Hertz Fellows and Friends. Since beginning this initiative, we have supported the Fellowship Program with over fifteen million, in large part, thanks to your generosity and assistance.

Our symposia, national workshops, and local gatherings provide great opportunities for connecting with other Fellows and building a strong community. I am proud to have been integrally involved in these programs and have enjoyed meeting and working with many of you.

I will be leaving the Hertz Foundation at the end of the year and would like to take this opportunity to express my deep appreciation to all of you who have helped us continue the Fellowship Program. During the past six years, I have been inspired by your creativity, energy, dedication, and good humor. It has been my very great pleasure to be part of the Hertz Foundation.

If you wish to reach me after the New Year, please contact Linda Souza who can provide contact information. I look forward to following your careers and appreciate what you have brought to my life.

My warm wishes for the holiday season, and I wish you the very best for the New Year. May it bring you joy, good health, and much success.

Upcoming Events

2011 Summer Workshop

Join us for part or all of the 2011 Summer Workshop to be held August 5-7, 2011 at the University of California, Santa Cruz, Oakes College. More information will be sent out in early Spring.

who possess skills that are needed here, and, most importantly, provide every young person with a math and science teacher qualified to teach those subjects—something that most students do not enjoy today.

Not surprisingly, relatively few high school graduates have qualified themselves to pursue courses in science or engineering in college. In the past, many foreign students have been attracted to America's research universities and remained after completing their education (about 2/3 of the PhD's in engineering awarded by U.S. universities go to foreign students). Today, however, more and more of those students indicate their intent eventually to return to their home country. Further, America's great research universities, long considered to be the international gold standard, are finding themselves inundated by budget reductions and competition from abroad for faculty.

Many public and private organizations are now devoting substantial resources toward meeting these overall challenges—the Hertz Foundation being among the foremost of these. Nonetheless, this is a national problem that has evolved over several decades and will take decades to overcome. It is a marathon, not a sprint.



From left to right: Dan Roberts, Michael Li, Vince Holmberg, Jeff Weber, Robert Bao, Michael Baym, Elizaveta Freinkman, Jane Wang, Paul Tillberg at Monticello

Alumni Fellows Participation at Retreats and Workshops

by Jay Davis

At each retreat or workshop, we encourage Alumni and Board Members to attend and interact with the Fellows and speakers, adding to the mix of experiences and ideas that the Fellows are exposed to. It also helps, of course, if these alumni attendees are strong and interesting personalities, thus compelling attention to their yarns and stories.

Two successful exemplars of this type are Doug Birdwell and Jim Chambers, who joined us at the Summer Workshop this summer at the University of Virginia, Charlottesville. Doug and Jim contributed greatly to the discussions, and enjoyed the students and the experience. Their words tell the story. We expect to see them back. Please consider joining them next summer.

Perspectives of 2010 Summer Workshop

By Doug Birdwell and Jim Chambers

Jim: I wasn't sure what to expect at the Summer Workshop since I had not met many Hertz Fellows before. The level of enthusiasm among the current students and the level of camaraderie were more than welcoming. It felt as if I was coming home to a family I never knew I had. I came away reinvigorated while making many new research contacts that should prove mutually beneficial. The workshop was, in a word, "cool!"

Doug: My first Summer Workshop was in Steamboat Springs. “Invigorating” is a good word; another way to describe the experience is “And Now for Something Completely Different!” (apologies to Monty Python). That Workshop and the Charlottesville Workshop were organized around speakers who gave presentations on “big ticket” themes: climate, energy, systems biology, space systems, entrepreneurship, etc. What do you get when you have 70 or so Hertz Fellows in one place? A lot of very serious discussion! Presenters should not expect to make it through their prepared remarks without fielding numerous questions, and the discussions continued over evening dinners, day hikes, and informal encounters.

Jim: I did not overlap with any Hertz Fellows while in school. (I think there were <10 at Georgia Tech in all the years leading up to my Fellowship.) I had little contact with the Foundation while in school or after. I sent them my thesis and occasionally saw some newsletters or information on the upcoming application process to be posted on bulletin boards on campus.

Doug: I was at MIT in the 70’s, and I knew a few Fellows (past and current) there, but there was only one organized Hertz event: a dinner at the Museum of Science in Boston. I remember two things: Edward Teller came up to me and asked what I was doing to deserve Hertz’ investment (after I had finished most of a very tall Scotch and water!), and I enjoyed some very good food and wine. My next one-on-one contact with Hertz was a dinner in Boston a few years ago. While it was good to see some people I had met years back, there was not much opportunity for interaction among the Fellows. What a difference in the Summer Workshops!

Jim: The East and West Coast Retreats came much later, and the Summer Workshops are apparently a very new item as I had missed them in the newsletters.

Doug: My advice to the roughly 1K older Fellows: Get involved and plan to attend one of these events. I now view them as vacations: I am able to meet a lot of very bright people who are involved in cutting-edge research and businesses across numerous disciplines, and the discussions range from physics and engineering to global issues to biology—and anything else that comes to mind. You may come away with a new outlook, and—as I did—you will find new friends and can choose to mentor a current Fellow.

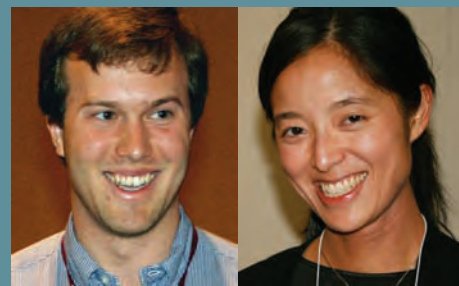
Jim: I think the workshops provide a unique opportunity to interact with a unique group of people not found in many other settings. At typical conferences you will be around many smart people who are nominally in your same line of work. On campus (or in your company) you may be around many smart people but the realities of the structures in place (employee-employer, professor-student) may skew potential interactions. The Workshop may have some of these same restrictions, but they seemed lessened as attendees are from different backgrounds and are pursuing nominally different lines of work. You have an opportunity to discuss cross-disciplinary topics and see the “big picture,” and just see where it goes.



James (Jim) Chambers, Fellowship Award 1990, Mechanical Engineering, Georgia Institute of Technology. Currently Jim is Interim Executive Director of the National Center for Physical Acoustics and Research Associate Professor of Mechanical Engineering at the National Center for Physical Acoustics, University of Mississippi.



J. Douglas (Doug) Birdwell, Fellowship Award 1975, Electrical Engineering, Massachusetts Institute of Technology. Currently Doug is the Director of the Laboratory for Information Technologies and a Professor of Electrical and Computer Science at the University of Tennessee, Knoxville.



Board Actions – October 2010

The Hertz Board took several important actions at its October Meeting. First, the Board elected Phillip Eckhoff (Hertz Fellow 2004) and Jessica Seeliger (Hertz Fellow 2000) as Board Members. Secondly, we decided to move the Hertz assets to Towneley Capital Management to provide professional management of the present and future funds against investment guidance adopted by the Board. Finally, the Board voted to establish a Program Committee to oversee the nature of the Fellowship itself, our selection process, the growing number of special programs that we operate for Fellows, and the coming 50th Anniversary of the PhD Program. Additionally, Chairman Galas pledged to fund a Fellowship for the coming five years, challenging the Board to exceed him at this level.



Ray Sidney, Shannon Yee



Summer Workshop Engineering Challenge

2009-10 Theses

Luis Alvarez, MIT

Modulating Cell Behavior with Engineered HER-Receptor Ligands

Dmitriy Aronov, MIT

Neural Mechanisms of Early Motor Control in the Vocal Behavior of Juvenile Songbirds

Michael Baym, MIT

Large, Noisy, and Incomplete: Mathematics for Modern Biology

Brett Bethke, MIT

Kernel-Based Approximate Dynamic Programming Using Bellman Residual Elimination

Michael Busch, Caltech

Shapes and Spins of Near-Earth Asteroids

Kyle Gustafson, U. Maryland

Dispersion of Ion Gyrocenters in Models of Anisotropic Plasma Turbulence

M. David Henry, Caltech

ICP Etching of Silicon for Micro and Nanoscale Devices

Erez Lieberman, Harvard

Evolution and the Emergence of Structure

Chang Liu, Scripps

Directed Evolution of and with Expanded Genetic Codes

Po-Shen Loh, Princeton

Results in Extremal and Probabilistic Combinatorics

Elizabeth Stephens, Rice

Composition, Turnover, and Mechanics of Extracellular Matrix in Developing, Aging, and Pathological Valves for Application in the Design of Age-specific Tissue Engineered Heart Valves

Kathryn Todd, Stanford

Transport through Graphene Nanoconstrictions

E. Courtenay Wilson, MIT

Interactions Between the Auditory and Vibrotactile Senses: A Study of Perceptual Effects

David Yu Zhang, Caltech

Dynamic DNA Strand Displacement Circuits

Technologies on the Final Frontier

Article by Michael Busch



David Thompson is the co-founder and CEO of Orbital Sciences, a company that builds a wide variety of launch vehicles and satellites. These include the Dawn spacecraft currently on the way to the asteroid belt and the Pegasus launch vehicle, which puts satellites into orbit using a combination of aircraft and conventional rockets.

Dave gave an in-depth description of Orbital's current projects and of the future of space business more generally. I can't describe everything here, but one thing struck me as particularly important: the most profitable product from spaceflight has been information, and the markets for different types of data have been much larger than originally estimated.

There are now roughly 500 million active GPS receivers; and the market for commercial satellite imaging is also growing rapidly. Dave described several possibilities for newly developed technologies that could change those markets: improved satellite-to-satellite and satellite-to-ground communications using optical lasers, multiple element adaptive optics both for looking at the Earth and for looking at astronomical targets, and electrical propulsion to allow larger satellites at lower cost.

Energy Talk

Article by Shannon Yee

Early morning on Saturday July 31, 2010, current In-school Hertz Fellows and Alumni Fellows gathered in the central auditorium of Minor Hall on the grounds of the University of Virginia to listen to a provocative lecture by former UC Berkeley Professor and current Director of the Advanced Research Projects Agency for Energy (ARPA-E), Dr. Arun Majumdar. The dialogue was simple; the message was clear—scientists and engineers have a new challenge: they must find ways of providing energy to the world while reducing green house gas emissions, improving energy efficiency, and maintaining the U.S. technological lead. Majumdar motivated the discussion by graphically overlaying the world population density and energy consumption maps depicting a large mismatch. "Imagine what will happen when the rest of the world turns on the lights," Majumdar commented. To address this concern, ARPA-E was recently formed within the U.S. Department of Energy to fund high risk, high reward, transformational energy research and has funded over one hundred new technologies in its inaugural year. In Majumdar's talk, he highlighted specific funded projects including a company that engineers plants that will digest themselves after they are harvested. "This is putting the cow in the plant rather than the plant in the cow," Majumdar mentioned. This technology and others captivated the audience and motivated them to dream of new approaches, invent new energy technologies, and rise to the challenge of energy.



Enjoying the beauty of the Blue Ridge Mountains



West Coast Retreat

by Jane Wang, Vince Holmberg and Daniel Rosenfeld

This fall, the 2010 West Coast Hertz Fellows Retreat was held from September 30 to October 3 in Livermore, California. The event was attended by 34 in-school and recently graduated Hertz Fellows, Hertz Foundation Board Members and staff, as well as several friends and associates of the Foundation. During the weekend, the Fellows participated in the "Toxic Waste" engineering challenge, which required them to devise a way to transport 1 liter of "contaminated" water 50 feet without coming within an 8-foot radius of the liquid at any time, and then construct a device to lift the water as high as possible. The Fellows were scored on the amount transported and the height to which they were able to lift the water. The winning contraption was an elegantly constructed pulley device, jutting off the front of the hotel from one of the fourth story balconies. The device was successfully able to lift 1 liter of water to a height of over 30 feet.

Another highlight of the Retreat was an all-day tour of Sandia and Lawrence Livermore National Laboratories (SNL and LLNL) on October 1st. Participants were able to tour the combustion facilities at Sandia as well as visit the National Ignition Facility, the Center for Accelerator Mass Spectrometry (CAMS), and the Terascale Computing Facility at LLNL. In conjunction with the lab tours, Dr. Jay Davis, President of the Hertz Foundation, spoke about his career building accelerators at LLNL, where he founded the CAMS in the late 80s. Later during the Retreat, Dr. Davis gave a captivating talk about his experiences in nuclear forensics, nuclear security, and counter-terrorism, discussing his time as a weapons inspector for the United Nations Special Commission in Iraq after the First Gulf War, and his experiences in the Department of Defense as the founding Director of the Defense Threat Reduction Agency.

Once again, the Retreat proved to be an exceptional forum for Fellows to learn about each others' ongoing research. Throughout the Retreat, current Fellows were given the opportunity to give short talks to groups of their peers during several "chalk talk poster sessions", and several senior Fellows also gave excellent extended talks discussing their PhD research. This discussion helped forge connections between Hertz Fellows and already has led to several collaborations.

The last night of the Retreat, Mary and Jay Davis graciously invited the attendees over to their home for a barbecue, and after a splendid night of food, wine, and conversation, many Fellows returned the next day to help the Davis household in the annual harvest of petit syrah grapes from their vineyard.

A big thank you goes out to all who made the retreat a success: Louis Lerman for his generous financial support, Jay Davis for the fascinating and insightful discussions, the Hertz Foundation staff for administrative support, and Fellows Jane Wang, Vince Holmberg and Daniel Rosenfeld for their work in planning the retreat.

East Coast Retreat

By Jeff Thompson



The 2010 East Coast Retreat took place from October 15-17. Around 30 current and alumni Fellows met for dinner on Friday

in Cambridge, including Jay Davis, Louis Lerman, Tom Weaver and some alumni Fellows in the Boston area. After dinner, we heard a talk from MIT Neuroscience Professor Sebastian Seung about mapping connections in the brain. The talk was received with enthusiasm by the attendees, and we had to cut off the audience after half an hour of questions.

After dinner, around 20 Fellows drove out to Harvard Forest in Petersham, MA, where we spent the rest of the weekend under clear skies and beautiful fall foliage. We got acquainted on Saturday morning by playing charades with excerpts from scientific abstracts. Though it sounds difficult, the Fellows are surprisingly good: it took one team only 30 seconds to act out *Plasmodium chabaudi* (a malaria parasite). The remainder of the day consisted of chart talks from the Fellows, two talks from guest speakers, and a short hike. Our first guest was MIT Professor M. Fatih Yanik, who told us about the dizzying array of techniques under development in his lab for high-speed processing of *C. elegans* in microfluidic channels for drug development. In the evening, Jay Davis gave a very interesting talk about his recent national security work in Washington.

The Retreat was sponsored by Louis Lerman and organized with help from Fellows Jeff Thompson, Brent Dorr, and the Hertz Foundation staff.



Annual harvest of petit syrah grapes from the Davis vineyard.

Events

Boston, MA Gathering

Alumn Fellows Lily Kim, Amir Nashat, Mikhail Shapiro and Stephen Fantone hosted a gathering of approximately 30 attendees (a mix of alums and current Fellows in academia and industry) September 28, 2010 at Flat Top Johnny's in Kendall Square in Cambridge for food, pool and lots of energetic conversations.

Seattle, WA Gathering

David Galas, Hertz Fellow and Board Chairman, hosted a dinner at the Wild Ginger with alum Fellows on October 12, 2010. With over 30 Fellows currently in the Seattle area, the Fellows are hoping to gather more often to forge collaborations and build their network.

Santa Fe, NM Gathering

Board Member Sid Singer and his wife Elizabeth Allred hosted a reception and dinner at their home on October 23, 2010 for alum Fellows and friends in the Santa Fe, Albuquerque and Los Alamos area. The gathering followed the Council on International Relations Special Program at The Forum at Santa Fe University of Art & Design earlier that afternoon.

Los Altos, CA Gathering

John Wakerly, Hertz Fellow 1973, and his wife Joanne Jacobs hosted their annual fall dinner on October 24, 2010 with a mix of alum, in-school Fellows and friends enjoying an evening of lively conversation and a talk by Brian Von Herzen on the BioChar Project.



Mountain View, CA Gathering

Mike Montemerlo and Justin Solomon, the first Hertz Google Fellowship recipient, participated at a Hertz Fellow luncheon hosted by Astro Teller at Google, Mountain View, on November 8, 2010.

Foundation Capital Entrepreneurial Fellows Program

By Steve Vassallo, General Partner, Foundation Capital



For more than 15 years, Foundation Capital has been helping entrepreneurs turn their great ideas into great companies. Many of these great ideas—from Peribit's WAN optimization algorithms to Atheros' WiFi on CMOS chipsets to EnerNOC's demand response services for the electricity grid to SunRun's residential 'solar as a service' business model—were born in university labs or dormitories. In all cases, these great ideas were conceived by a small team with a big dream and nothing else.

Foundation Capital is a different kind of venture capital firm in that its philosophy has always been to put entrepreneurs first—an approach that flows from the fact all of Foundation's general partners were technologists and entrepreneurs first. It is this deep admiration for remarkable individuals with a sense of vision and purpose that brought Foundation Capital in contact with the Hertz Foundation almost two years ago, and it is this same force that inspired us to co-create the Entrepreneurial Fellows Program.

The Hertz Foundation Capital Entrepreneurial Fellows Program will offer two or three entrepreneurially inclined Hertz Fellows an opportunity to complement their technical passion with applied business and leadership experience through a paid summer internship with a Foundation Capital-backed startup. HFC Entrepreneurial Fellows will be exposed to a broad array of issues related to starting an early stage venture, and will also receive direct mentorship from a Foundation Capital partner during a one-month stint at our office in Menlo Park, California.

The Entrepreneurial Fellows program will kick off with a competitive application process in the spring of 2011. Individuals interested in learning more in the meantime can contact Steve Vassallo at svassallo@foundationcapital.com

Hertz BioChar Team: Winner of the 2009 Lerman Challenge

by John Frank

For longer than recorded history, humans have been making charcoal by subjecting plant matter to high temperatures in low-oxygen. This breaks down organic molecules without oxidation. As the charring process progresses, more carbon atoms rearrange to form graphene sheets. In this state, the carbon is sequestered and cannot re-enter the atmosphere. The porous structure of charcoal also provides a rich environment for living microbes and other processes that can greatly enhance soil fertility.

Archaeological evidence indicates that biochar enabled large populations to flourish in the Amazonian jungle before knowledge of biochar was lost during conquests by European explorers. Today, biochar has emerged as a potential tool for reducing green house gas emissions and as an enabler for the second green revolution.

A group of Hertz Fellows and colleagues have self-organized to explore biochar and its applications. In order to produce biochar at large scale, the Hertz Biochar Team has been building quasi-continuous feed pyrolyzers and has initiated collaborations with a range of potential partners in government, academia, and industry.

The Team began at the Hertz Summer Workshop in Steamboat Springs 2009, where the Lerman Challenge was announced. At the gathering, Brian Von Herzen presented a seminar on a diverse collection of ideas and projects on climate change, including biochar. A brainstorm ensued and the dialog has expanded to include Shannon Yee, Tony Miller, John Frank, several other Hertz Fellows (David Henry, Eric Hoke, and Dario Amodei) and a group of committed mechanical engineers at UC Berkeley.

The team combines entrepreneurial passion with expertise in heat transfer, combustion, and machine design. In addition to winning the 2009 Lerman Challenge, the team has been self-funded. The team meets on the phone weekly and hosts periodic "biochar parties" near Berkeley. To join in, contact Shannon Yee, shannon.yee@berkeley.edu.

Our Board, Fellows, and Staff Thank the Annual Fund Contributors

Despite the continued economic insecurity, fiscal year 2010 was our best so far with a total of \$4,236,222 from 134 donors, 20 who were new to our family of contributors. We welcome your participation on whatever level is appropriate for you.

The following list includes Donors to the Annual Fund, those who made their gifts between July 1, 2009 and June 30, 2010. Several individuals have named Fellowships that are supported with their annual gifts. Thank you for being a part of this distinguished group.

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2010 Hertz Thesis Prize



The 2010 Hertz Thesis Prize, including \$5,000 and a framed certificate, was awarded to **Erez Lieberman-Aiden**,

Harvard University, for his thesis, *Evolution and the Emergence of Structure*. Erez' thesis also won the American Physical Society's Prize for Outstanding Dissertation in Biological Physics. Erez' thesis advisors and his undergraduate mentor will each receive a \$1,000 award.

Honorable Mention Awards for their theses were awarded to **Elizabeth Stephens**, Rice University, *Composition, Turnover, and Mechanics of Extracellular Matrix in Developing, Aging, and Pathological Valves for application in the design of age-specific tissue engineered heart valves*, and to **David Zhang**, California Institute of Technology, *Dynamic DNA Strand Displacement Circuits*.

In Memory



Peter Strauss, Board Member Emeritus, Scarsdale, New York, passed away November 9, 2010. Without resources for medical school, he pursued a career in finance, becoming a partner at Neuberger Berman, where he labeled himself a financial "doctor" promoting the financial health for his family, friends and clients. Many owe their way of life and opportunities to his exceptional judgment. His investment acumen first became apparent during the depression when at the age of eight he insisted on removing his entire savings from the bank just days

before the crash. He went on to graduate early from Yale so he could join the Marines where he was one of three officers who accepted the Japanese surrender in China and received the bronze star. He was an avid reader with a keen mind who loved to share and discuss the latest history books. A strong believer in the value of education, in addition to his years on the Hertz Board, he established several scholarship programs to enable needy students to pursue their dreams. The Board, Staff and Fellows appreciate the decades of time, concern and involvement he provided to the Foundation.

Peter was a beloved husband for 61 years to Barbara Strauss, cherished father to John, Eileen and Sally, and "Papa" to Jennifer, David, Jill, Amy, Alexandra, Ariel and Drew.

News and Announcements

Visit our website www.hertzfoundation.org/dx/newsevents/pressreleases.aspx for some of the latest news on Hertz Fellows. Do you have News to share? Contact Linda Souza at lsouza@hertzfoundation.org or at 925-373-1642.

Cover Images (left to right): Flipchart Drawings from West Coast Retreat; Dmitry Aronov, Spectrogram of a song produced by a male zebra finch.
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