

SAN DIEGO STATE UNIVERSITY
2012 - 2013
RESEARCH
HIGHLIGHTS



ALPHA
LIGHTHOUSE
HAWAII



SAN DIEGO STATE
UNIVERSITY

Leadership Starts Here



SAN DIEGO STATE UNIVERSITY

Leadership Starts Here

In spite of last year's automatic, across-the-board, federal spending cuts known as sequestration, SDSU research continued to flourish. More than 300 faculty and staff received \$115 million in external funding. The pages that follow highlight some of their diverse and interesting work. A complete listing of 2012-13 awards can be found at www.foundation.sdsu.edu.

Also last year, SDSU made a commitment to four "areas of excellence"—collaborative research programs which are addressing some of the most critical challenges for society today. Investments were made in these programs:

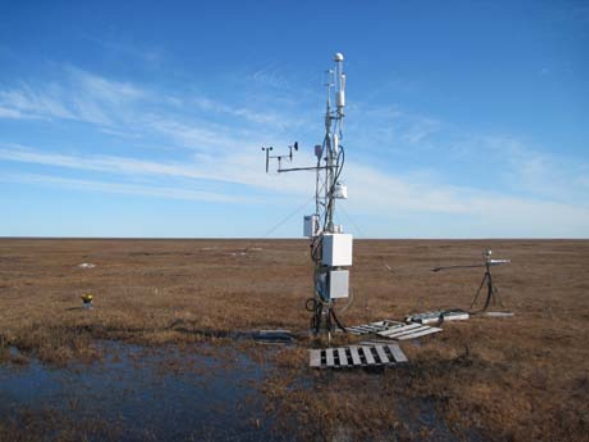
- **Human Dynamics in the Mobile Age** involves faculty from 14 different disciplines in a collaboration that mines and analyzes large digital datasets from mobile technology or social networks to understand spatial and temporal patterns in areas as diverse as human health and infectious disease, crime prevention or urban planning.
- **The Viral Information Institute** integrates researchers from biology, mathematics, computer science, engineering and public health to study viruses and their interactions with living systems so as to manipulate these interactions for the benefit of human and environmental health.
- **Clinical and Cognitive Neuroscience**, aligned with the White House BRAIN initiative, advances SDSU's contributions to the understanding and treatment of brain-based disorders such as autism, aphasia, fetal alcohol spectrum disorders and Alzheimer's disease.
- **The Center for Climate and Sustainability Studies** is on course to become a global resource for predicting impacts of climate change—with implications for regional planners and national and international policy—and to serve as a local hub for education and policy development to help guide San Diego's sustainability decisions.

For further information about these areas of excellence, please visit:
http://newscenter.sdsu.edu/sdsu_newscenter/news.aspx?s=74430.

Thanks to all of the SDSU researchers who are making discoveries, improving lives, training future scientists and educators, and serving society.

Stephen C. Welter
Vice President for Research and Dean of Graduate Affairs
San Diego State University

Cover: *The Accra Lighthouse, in Accra, Ghana is an important historical landmark, as well as a signpost for locating urban features from satellite imagery. It stands at the boundary of two of the city's oldest neighborhoods - Jamestown and Ushertown - among Accra's most vibrant commercial and residential areas. These neighborhoods are populated primarily by people from the Ga tribes, who are dealing with extreme population and economic pressures. Photo by Marta Jankowska. See page 2.*



Arctic Ecosystems

WALTER C. OECHEL

Biology

Since the 1880's, atmospheric CO_2 has risen by more than 25% resulting in an increase in the global mean temperature. Ecologist Walter Oechel directs SDSU's Global Change Research Group which conducts research on the response of plants and ecosystems to elevated CO_2 . Their work aids the understanding of potential changes so politicians can make informed decisions that affect the world's biological future.

Dr. Oechel is a world-renowned expert on global change. His research examines the interconnections of terrestrial, atmospheric, and marine systems on global change, primarily in the Arctic. His team in Alaska is collecting data that identifies important differences in carbon flux (carbon dioxide and methane exchange with the atmosphere). Their research will make a fundamental contribution toward reducing uncertainties in predicting climate change.

Dr. Oechel's work also takes him to the Pacific Basin and the semi-arid ecosystems of Italy, France, and San Diego. He incorporates a small research aircraft, a marine flux platform, eddy covariance towers, soil measurements, remote sensing, and modeling in his research programs.

Top: Dr. Oechel (rear middle) with members of the Global Change Research Group on the sea ice off the coast of Barrow, AK. Photo by Francis Bozzolo

Middle: The GCRG's first eddy covariance tower in Barrow, AK has been measuring carbon fluxes at the NOAA Global Monitoring Division's baseline observatory for more than 15 years. Along with many others in Alaska, it has recently been upgraded to measure year-round methane fluxes as part of a new National Science Foundation grant to Dr. Donatella Zona, Dr. Oechel, and Dr. David Lipson. Photo by Patrick Murphy

Middle: Salvatore Losacco, GCRG technician, wires a new infrared radiometer into a data logger to measure surface temperature within the footprint of the eddy covariance tower. Measurements like these are critical to understanding the fluxes, considering that increased uptake or release of carbon can be contributed to by many different ecological processes. Photo by Patrick Murphy

Bottom: Whaling boats on the sea ice around midnight. Local traditions of hunting are impacted by climate change; because of this, the science community in Barrow is welcomed and supported. Photo by Patrick Murphy

Urban Health Inequalities: Accra, Ghana

DOUGLAS STOW AND JOHN WEEKS

Geography

The world's population is expected to increase by two billion in the next four decades; the majority will live in the crowded cities of developing countries.

By examining poverty, disease and physical place in urban Africa, Drs. Douglas Stow and John Weeks are providing a model for urban health inequalities. Their research is funded by the National Aeronautics and Space Administration (NASA) as part of the Interdisciplinary Earth Science Program. The satellite, demographic and health data they are gathering and knowledge gained from it will be shared with policy makers who can help these communities grow out of the poverty cycle. Satellite imagery is used to provide a detailed analysis of land cover and land use and their change over time in the study area that includes four regions (states) and four major cities of Ghana. Census data are examined and the team conducts health-related surveys and interviews to verify the satellite data and to generate statistical models of existing and predicted patterns.

Health is a critical element of an economically productive population. Poorer health and poverty tend to be associated in cities of the developing world. Poverty and socio-economic status in general may be inferred from biophysical environmental indicators associated with neighborhoods. For example, in Accra, the amount of green vegetation cover within neighborhoods is directly correlated with census-based measures of housing quality. By mapping the distribution of poverty and assessing its spatial association with health and mortality outcomes, this research will help people in developing countries achieve a higher level of health and thus productivity.

An international team is working with Drs. Stow and Weeks, which includes remote-sensing, human environment, landscape, ecological and social scientists. SDSU graduate and undergraduate students are involved in the research, as well as Dr. Li An (Geography professor) and Pete Coulter (Research Foundation staff)

Top left: Map of regional study area (in gray) and study cities (in red).

Top right: Dr. Marta Jankowska, recent graduate from SDSU-UCSB joint doctoral program in Geography, interacts with children during health-related interviews of families in Accra, the capital city of Ghana. This picture depicts an important component of spatial data-driven research approaches, where interviews and surveys support spatial analysis of census data and satellite image analyses, to better tie these geographic information sources to health consequences on the ground. Photo by MadelineTuller

Bottom left: View of the beach from the Cape Coast Castle in Cape Coast. This castle is infamous for being one of the holding and departure points for slaves being traded to the Americas and Caribbean. Intensive residential settlement and fishing activity is observed along this stretch of the Indian Ocean coast, which is also readily observable from high spatial resolution satellite imagery. Photo by Marta Jankowska

Bottom right: A ground-level view of Kumasi, the second largest and rapidly growing city in Ghana. This provides just one view of the great diversity of urban structures and organizations that are being analyzed to tie the physical urban environments to health outcomes. Photo by David Rain





Making Sports Safer

DANIEL GOBLE

Exercise and Nutritional Sciences

Dr. Daniel Goble specializes in proprioception – how the brain knows where the body is in space - and postural control.

The work he and his UCSD colleagues have done with older adults has shown that regular use of the Nintendo Wii balance games can increase balance in nursing home residents, resulting in fewer falls – a major source of injury among the elderly.

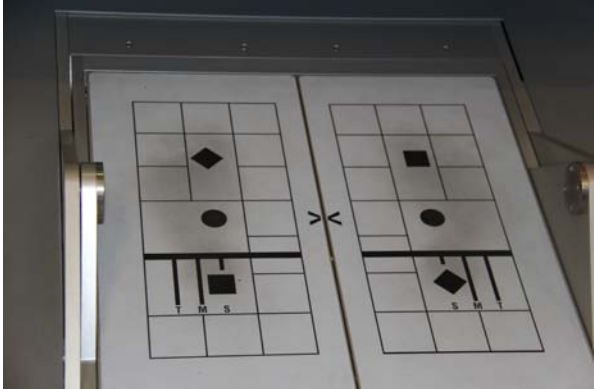
Dr. Goble has expanded his balance studies to the problem of concussion, a topic of great concern to athletes, parents and coaches. Dr. Goble has developed a low-cost and portable tool for the diagnosis of concussion by measuring an athlete's balance, a standard tool for diagnosing concussion. This research will help to make sports safer for all participants by providing the necessary tools, at a reasonable cost, to make proper decisions regarding the health of athletes.

This technology could also be applied to other conditions characterized by balance deficits including Parkinson's disease, multiple sclerosis, and stroke.

Top: Dr Goble working on video-game based balance training protocol with graduate student Jacob Schwartz.

Middle: Force plate technology for the assessment of body sway.

Bottom: Clinical balance testing setup.
Photos by Debbie Brighton



CARES

CULTURALLY AFFIRMING RESPONSIVE EDUCATION SPECIALIST



Improving Outcomes for Foster Youth

TONIKA DUREN GREEN *Counseling and School Psychology*

Dr. Tonika Duren Green's research explores educational issues of children from ethno-linguistically diverse backgrounds. She is preparing school psychologists who are multicultural thinkers who understand how racial, ethnic and sociocultural factors influence student performance. Her specific focus is on closing the achievement gap for foster youth.

More than 400,000 children in the U.S. are in foster care. California's foster youth population is the largest in the nation and has tripled in the last 20 years. While some youth in foster care blossom, the majority struggle. In California, 83% of students in foster care repeat a grade, 75% are working below grade level, and only 30% of students in foster care graduate. These weak K-12 educational outcomes lead to poor post-secondary results for youth in foster care, with high percentages of unemployment, incarceration, homelessness, and low percentages of college completion.

These outcomes are compounded for children in foster care from culturally and linguistically diverse (CLD) backgrounds, as they are often overrepresented in foster care and in special education. CLD foster youth with disabilities need educational advocates who are culturally affirming, accountable, collaborative and skilled in prevention and intervention services. Dr. Green's Project CARES program fills this need by preparing highly qualified pre-service school psychologists, counselors, and social workers through seminars, CASA (Court Appointed Special Advocate) training, coursework and educational institutes.

Her work is funded by the U.S. Department of Education Office of Special Education Programs and is reducing achievement gaps, improving school stability, and improving the quality of special education services.

Middle: Dr. Green holds a starfish, which has become a symbol for children in foster care.

Bottom: Dr. Green and school counseling, school psychology and social work graduate students participating in a training session. Photos by Debbie Brighton



Decoding the Microbial Kingdom

ROBERT EDWARDS *Computer Science*

Dr. Robert Edwards and his team at SDSU's Bioinformatics Lab apply computational science to important biological questions.

They use all kinds of computers, from clusters to cell phones, to solve the most unsolvable computational problems that help us better understand biology.

Computational metagenomics (the study of genetic material directly recovered from nature) is used to analyze microbial genomes and how they interact with the environment. This work uses high performance computing to examine the smallest biological organisms: viruses – and is leading to breakthroughs in our understanding of how viruses interact with their hosts, and how virus samples carry critical genetic information. Dr. Edwards' National Science Foundation-funded research analyzes microbes in diverse environments including human samples, oceans, coral reefs, and mines.



Right: Dr Edwards scuba diving in the highly diverse coral reefs of North Sulawesi, Indonesia, asking the question: "Are the microbes as diverse as the macro-organisms in this environment?"

Above: In addition to investigating the microbes, Dr Edwards uses 3D images to bring back the environment to the classroom.
Photos by Elizabeth Dinsdale



“Microbes are the most important living organisms, responsible for both the bad things that we live with such as infection and disease, as well as the good things like bread and wine.” – R. Edwards



The Science of Collaboration

ROBERT BRIGGS *Management Information Systems*

Professor of Information Systems Robert O. Briggs is a co-founder of the emerging research field of “Collaboration Engineering,” an approach to designing collaborative work practices and systems for high-value tasks.

Dr. Briggs has developed special software called Computer Assisted Collaboration Engineering (CACE) that collaboration experts can use to package collaboration expertise with collaboration technology in a form that non-experts can reuse without training. It is useful for many purposes, from optimizing the core processes of commercial firms to speeding military decision cycles, while improving decision quality.

He is currently working on a pilot study to reduce the dropout rate among K-12 learners-at-risk with the use of collaborative learning techniques.

The CACE concept emerged as Dr. Briggs and his colleagues derived a layered model of collaboration that integrates hundreds of previously disconnected concepts into a coherent, interrelated structure. Collaboration engineers can use the model design collaboration processes and systems that yield predictable group dynamics. One layer, for example, identifies six patterns of collaboration that characterize how groups move through their activities: generate, reduce, clarify, organize, evaluate, build commitment. The next layer includes collaboration techniques for invoking predictable variations on those six patterns. Dr. Briggs is co-inventor of the ThinkLets design pattern language - a collection of named, scripted, optimized techniques pertaining to this layer.

Results have shown that cognitive tools like ThinkLets can be used to enable a collaborative team culture and to maximize group creativity and performance.

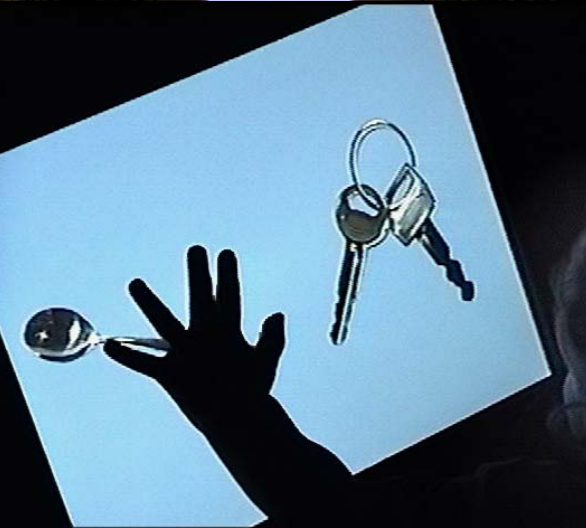
Top: Dr. Robert Briggs

Middle: The Electronic Boardroom, a collaborative decision laboratory that Dr. Briggs administers, where faculty conduct a wide range of research with groups.

Bottom: Dr. Briggs demonstrates ThinkTank™, a commercial collaboration system informed by his research. He is currently working on the next generation of this technology under a grant from GroupSystems Corporation.



“In the long history of humankind (and animal kind, too) those who learned to collaborate and improvise most effectively have prevailed.” – Charles Darwin



Measuring Language Comprehension in Babies

MARGARET FRIEND *Psychology*

Developmental psychologist Margaret Friend directs SDSU's Infant and Child Development Lab where they are determining how early language comprehension prepares children for literacy and school-readiness.

Results of her National Institutes of Health-funded study have shown that a direct measure of the words that children know in their second year of life can tell researchers about the kinds of concepts that are well-established in the child's repertoire. Children with larger early vocabulary are better at learning words in general, compared to children with smaller vocabulary comprehension. This finding held across children from English, French, and bilingual French-English homes.

Dr. Friend is also assessing the relationship between early comprehension and school-readiness in children from Spanish and bilingual Spanish-English homes. Findings from monolingual Spanish children reveal lower overall variability in vocabulary comprehension at 16 to 18 months of age relative to monolingual English children. Although it is too early to say with certainty, this may indicate slightly different paths to literacy across languages.

Exploring what concepts and words children know even before they can speak will help identify language delays earlier to predict risk and allow intervention before they create problems in school.

Top: English toddler points to the screen in response to the prompt, "Where's the cup? Touch cup!"

Middle: Spanish toddler touches the screen in response to the prompt, "¿Dónde está la cuchara? Toca cuchara!" (Where's the spoon? Touch spoon!).

Bottom: Check trial in a word learning game. The check trial allows researchers to determine that the toddler understands the rules of the game.

Preventing Deadly Brain Infection

KELLY DORAN
Biology

Bacterial meningitis is the most common serious infection of the central nervous system and a major cause of death and disability worldwide. While antibiotic therapy has improved fatality rates, outcomes remain unfavorable with 5-10% mortality rate and permanent neurologic complications occurring in 5-40% of survivors.

The blood-brain barrier serves to keep dangerous viruses and bacteria from entering the brain. Biologist Kelly Doran examines the mechanisms by which bacteria penetrate this barrier and is helping to explain why this neuroprotective barrier fails during bacterial meningitis. Her National Institutes of Health-funded studies focus on major human pathogens including *Streptococcus*, *Staphylococcus aureus* and *Bacillus anthracis*.

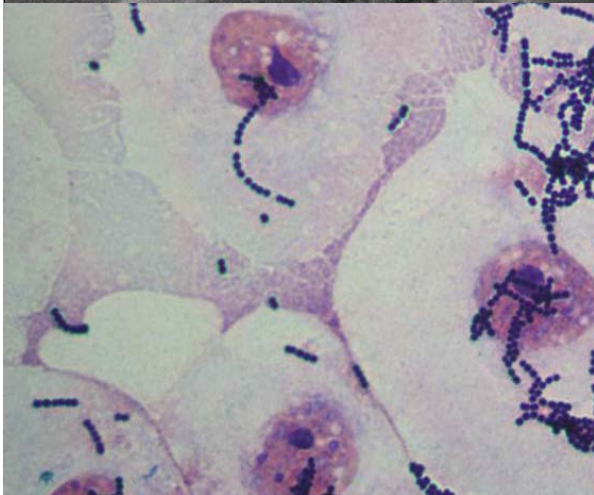
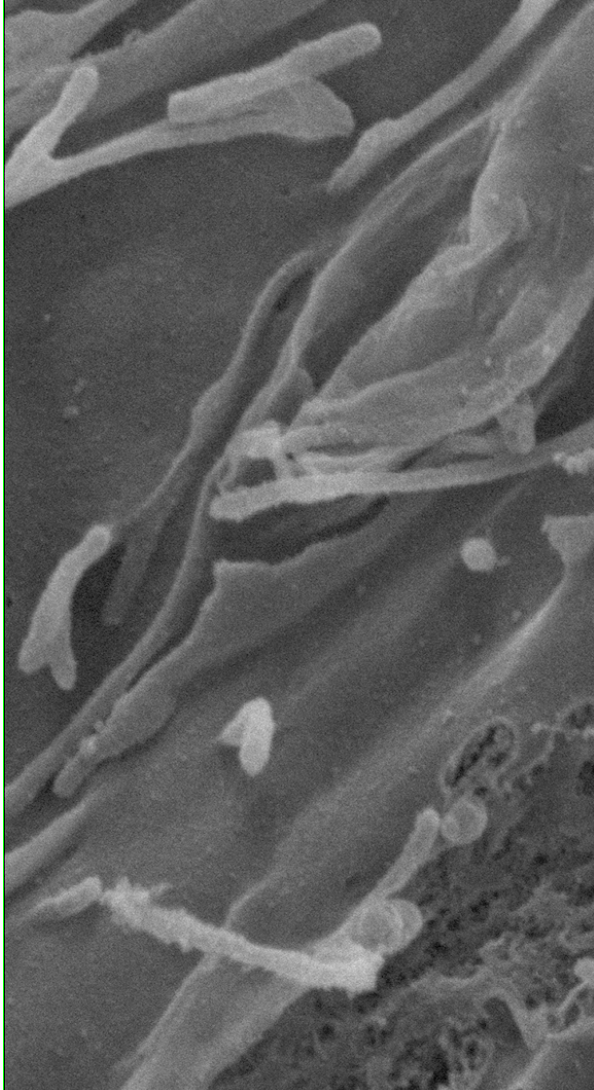
Dr. Doran and her colleagues were the first to show that anthrax bacteria has the ability to directly penetrate the blood-brain barrier. Anthrax exposure is so deadly because it tricks the brain into thinking it's a safe invader - making it possible to escape the immune system and enter the brain to cause meningitis. Anthrax meningitis has a fatality rate of almost 100%.

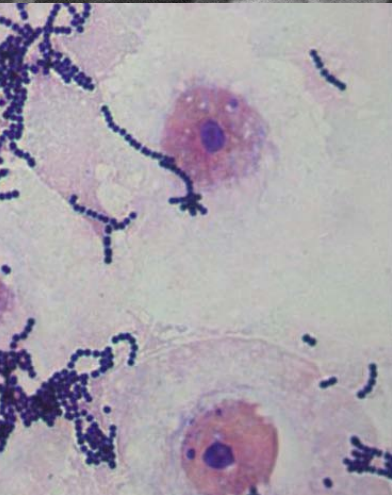
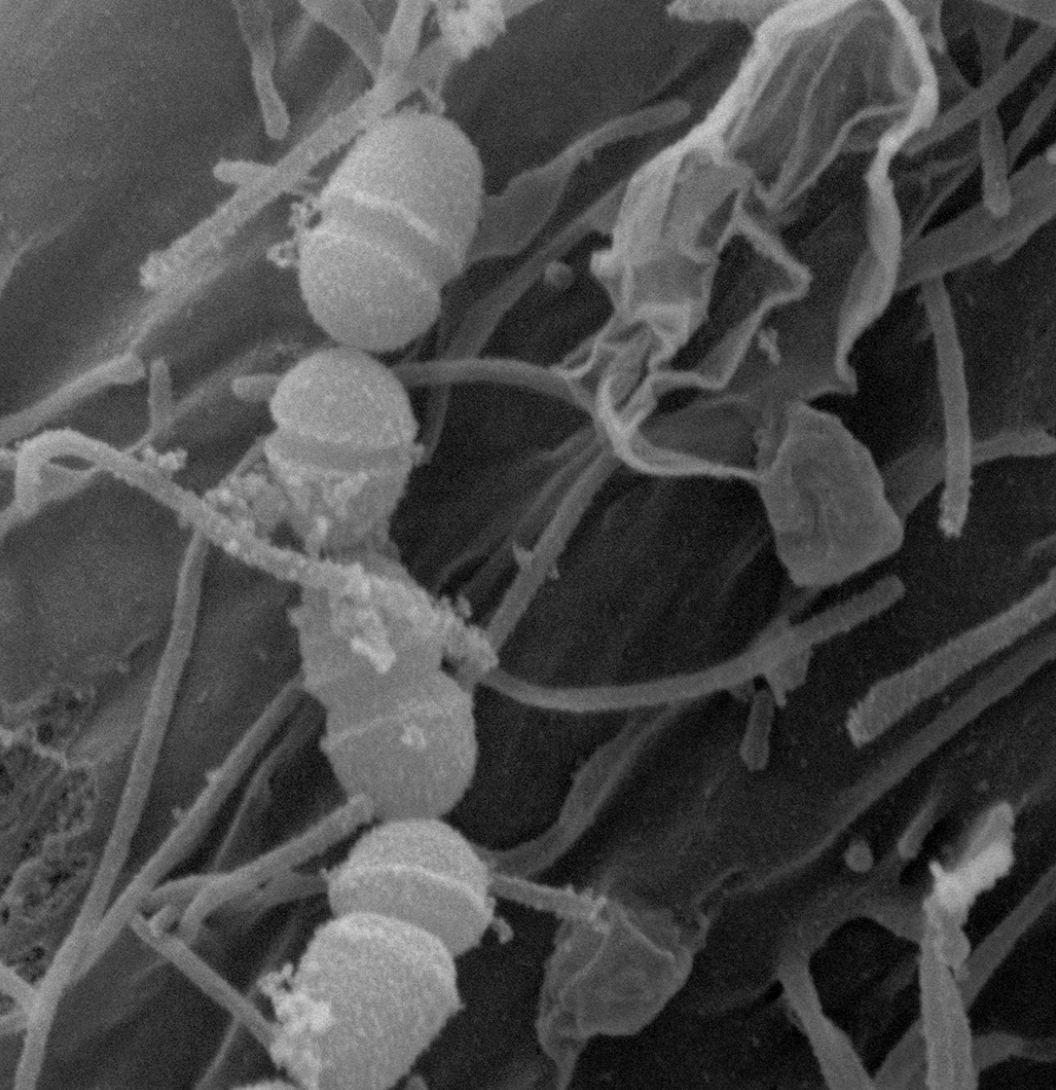
Dr. Doran is also developing therapies to disrupt the pathogens and prevent these deadly and debilitating invasions.

Top: Scanning electron microscopic image of Group B streptococcus binding to human cells.

Right: Gram stained bacteria (Group B streptococcus) (the cocci in chains) shown binding to human cells.

Far Right: Dr. Kelly Doran and Ph.D. student Katy Patras in the Host Pathogen Interactions Laboratory.





Communicating About Cancer

WAYNE BEACH *Communication*

The National Cancer Institute emphasizes the importance of communication when delivering quality of care from medical professionals, and for minimizing cancer burdens for patients and family members. In partnership with Klein Buendel and the National Cancer Institute, Communication professor Wayne Beach addresses these priorities through close examinations of recordings and transcriptions of naturally occurring human interactions. In clinics and homes, his research documents distinct and previously undiscovered patterns of everyday communication involving cancer – e.g., how conversations about cancer affirm life rather than death, and hope over despair.

By analyzing video recorded clinical interviews between cancer patients and oncologists, Dr. Beach has revealed how raising and responding to cancer fears, uncertainties, and hopes are routine and often delicate social actions.

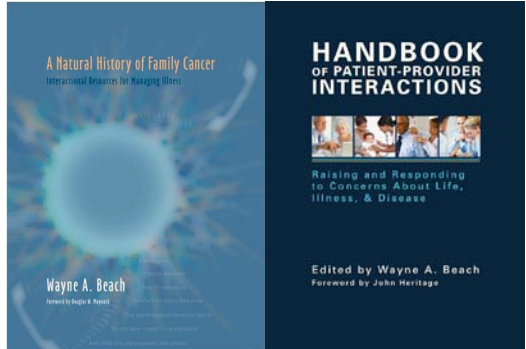
His award-winning book, *A Natural History of Family Cancer*, has been adapted into a unique stage production entitled *When Cancer Calls...* — a new genre of “reality” theatre, where all dialogue is drawn from verbatim transcriptions of ordinary phone conversations. *When Cancer Calls...* is currently being disseminated across the United States, and has positively impacted thousands of audience members by exposing and encouraging meaningful dialogue about the trials, tribulations, hopes, and triumphs of real cancer journeys.

Top: Doctor explaining test results to patient.

Middle: Books on family cancer communication and interactions in the clinic.

Bottom: Dr. Beach (third from right) with *When Cancer Calls...* director Delicia Turner Sonnenberg (third from left) and cast members (from left) Stephon Elton, Maggie Carney, Deanna Driscoll, William Damkoehler, and Brian Bielawski.

Photos courtesy of Wayne Beach





Hispanic Health

GREGORY TALAVERA *Public Health*

Dr. Gregory Talavera is a bilingual, bicultural physician trained in public health and preventive medicine. He is co-director of SDSU's Institute for Behavioral and Community Health and principal investigator for the landmark Hispanic Community Health Study/Study of Latinos (HCHS/SOL) San Diego Field Site – the largest and longest study on the health of Latinos in the nation – assessing cardiopulmonary risk and protective factors for chronic illness in Latinos living in San Diego's South Bay. HCHS/SOL is an NIH-funded multi-site longitudinal study following 16,000 individuals for decades into the future, examining everything from their diet and exercise patterns to sociocultural factors and even genetics.

According to the Centers for Disease Control, Latinos live longer than any other minority group in the U.S. They also have been shown to have disproportionately high rates of diabetes, obesity, asthma and tuberculosis. Dr. Talavera's study is helping to explain these seemingly contradictory findings and helping to maintain the health of this population in the future.

Left: Dr. Talavera supervising a fitness test in the SOL-Youth Ancillary Study. Photo by Jeffrey Lamont Brown/Tallgrass Pictures

Below: Dr. Talavera with a Project SOL participant.



Protecting Children from Secondhand Smoke Exposure

MELBOURNE HOVELL
Public Health

Secondhand smoke (SHS) comes from a lighted cigarette, pipe, or cigar or the smoke exhaled by a smoker. SHS exposure poses a significant health risk, especially to children. The majority of exposure occurs at home and in low-income households. SHSe also leads to thirdhand smoke exposure (THSe), which ages to new toxic agents that also harms health. The U.S. Environmental Protection Agency classifies SHSe as a human carcinogen. The Food and Drug Administration is now funding studies of THSe that will enable regulations to reduce disease. According to the American Cancer Society, there is no safe level of SHS exposure and probably not for THSe.

Epidemiologist Mel Hovell uses the Behavioral Ecological Model to study health-related behavior that emphasizes consequences of behavior and environmental influences, over topography. Dr. Hovell completed the first clinical trial demonstrating coaching as an effective means of lowering SHSe. Now, with support from NIH, he and colleagues have designed a home-based cutting-edge technological intervention to protect children from SHS exposure. The system combines innovative SHS particle monitors that provide real-time feedback (lights and sounds) to families and relays data to third parties. In the future, third parties may be the child's pediatrician. Combined with advice and recognition of smoking outdoors exclusively, the use of the monitors' prompts reinforces reduction in children's exposure to smoke in the home. This technology offers prospects for prevention of child SHSe and THSe and the prevention of a wide range of diseases.

Top: SHS particle monitors provide real-time graphic feedback on indoor particle levels.

Bottom: Evaluation of biological samples for SHS exposure.

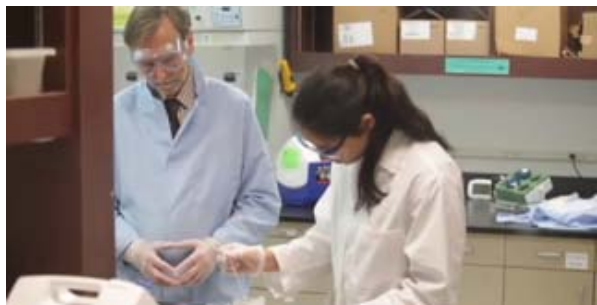
Photos by Scott Brigante, Reel to Real Foundation

Tobacco smoke can move through air ducts, wall spaces to contaminate apartments on other floors, not be controlled with ventilation, air cleaning, or by — American Cancer Society

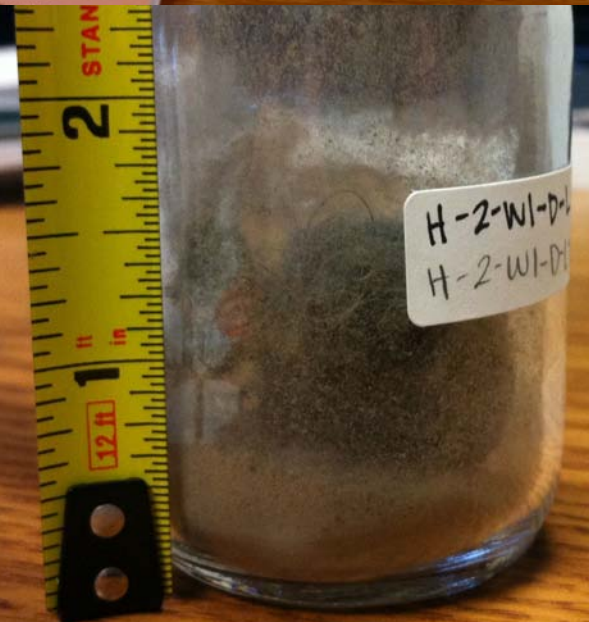


“The adoption of real-time measurement and real-time treatment will radically change the nature of behavioral health science, and it offers the prospect of supporting preventive lifestyle practices, achieving more profound and lasting disease prevention, and reducing premature mortality.”

— M. Hovell



and floor cracks, elevator shafts, and along crawl even those that are far from the smoke. SHS can separate smokers from non-smokers.



Thirdhand Smoke Exposure Presents New Hazards - in Homes, Cars and Hotels

GEORG MATT and PENELOPE QUINTANA *Psychology/Public Health*

Secondhand smoke that creeps into hair, clothing, dust and is trapped on surfaces like walls, ceilings and carpets is called “thirdhand” smoke (THS). Particles and gases remain after smoke is no longer visible and are re-emitted into the air. Research conducted by psychology professor Georg Matt, environmental health professor Penelope Quintana, Eunha Hoh, Mel Hovell and others, indicates a need for protection from the harmful long-term consequences of tobacco smoke pollutants that persist after cigarettes have been extinguished. Their work is supported by the California Tobacco Related Disease Research Program and the Roswell Park Cancer Institute.

By measuring toxic tobacco smoke residue and analyzing urine samples for tobacco exposure, Dr. Matt et al found higher contamination levels in former smokers’ homes than non-smoker homes; new residents were also exposed to THS even after a smoker’s home was vacant for two months and was cleaned/repainted.

Used cars sold by smokers are also polluted and are offered at sale prices below comparable cars of non-smokers. Even when smokers impose smoking bans inside their vehicles, dust and surface contamination levels are still elevated.

Non-smoking guest rooms in hotels that allow smoking elsewhere are as polluted with THS as some smoking rooms. Surface nicotine levels were more than twice as high in non-smoking rooms of hotels with partial smoking bans as those of hotels with total smoking bans; air levels of THS were seven times as high.

These findings support the need to educate non-smokers about the risks of THS and to implement 100% smoke-free policies in hotels and multi-unit apartment buildings.

Top: A research assistant collects wipe samples from a rental car.

Middle: Testing solvents to collect surface wipe samples with the goal of removing THS pollutants from their deposits on surfaces without damaging the surfaces.

Bottom: House dust, a reservoir of thirdhand smoke is collected with a High Volume Small Surface Sampler and stored for analysis. Photos by Measurement and Evaluation Research Group

Teaching Teachers

LISA LAMB AND RANDOLPH PHILIPP *Teacher Education*

Mathematics educators Lisa Lamb and Randolph Philipp are investigating children's mathematical thinking and the strategies students use to solve problems. Making sense of integers $\{\dots -3, -2, -1, 0, 1, 2, 3, \dots\}$ is a challenging mathematical topic but critical to a child's later success with algebra. Along with Dr. Jessica Bishop, Drs. Lamb and Philipp have mapped a trajectory of students' integer understandings and conducted professional development to support the teaching of integers. Their work has resulted in revised integers sections in textbooks for prospective teachers, and in research and teaching publications in top-tier journals.

Drs. Lamb and Philipp (along with Drs. Susan Nickerson, Donna Ross, Meredith Houle Vaughn, and Kathy Williams) also co-direct SDSU's Noyce Mathematics and Science Master Teaching Fellowship Program. This partnership includes SDSU educators, the San Diego Science Alliance, and six school districts; and is funded by the National Science Foundation with a gift from the Qualcomm Foundation. This project has identified excellent mathematics and science teachers and is providing them with professional development experiences so that they can develop into expert teachers, mentors and teacher leaders.

Top: Some children use counting strategies to solve problems with negative numbers.

Middle: Young students surprised the team with their initial ideas about negative numbers.

Bottom: SDSU's specially-selected Noyce Master Teaching Fellows will be working together for five years.



"Teachers learn from teaching, but the extent of growth solely from teaching is subject to ceiling effects. Professional development is not a pedagogical luxury that enables teachers to teach in better style; instead, well-designed, content-related, student-focused, sustained professional development provides entirely new and effective pedagogical possibilities." – R. Philipp



Using Lasers to Detect Cancer, Alzheimer's, Parkinson's and Improvised Explosive Devices

WILLIAM TONG *Chemistry*

Bill Tong is a nationally recognized expert in ultrasensitive laser-based detection methods for biomedical, environmental and security applications. He has developed, patented and licensed nonlinear multi-photon laser methods that offer significant advantages over currently available methods including parts-per-quadrillion-level detection sensitivity, excellent chemical selectivity for label-free samples in their native form, and compact portable detector designs that are suitable for field use in identifying biological and chemical agents in trace amounts.

Dr. Tong's novel laser wave-mixing methods allow earlier detection of diseases including Alzheimer's, Parkinson's, cancer, HIV; standoff remote detection of improvised explosive devices on the battlefield; better design of cleaner drugs; and even authentication of paintings and objects of art.

His work has been supported by major grants from the National Science Foundation, National Institutes of Health, Department of Defense, Department of Homeland Security, Army Research Office and industry funding sources including Lockheed Martin, Beckman, Johnson and Johnson.

***Left:** Bill Tong optimizing a multi-photon laser wave-mixing detector that is interfaced to a microfluidics system for zepto-mole-level detection and separation of label-free biomarkers. Photo by Joel Zwick*

Ultra Sensitive Sensors

ANTONIO PALACIOS *Mathematics and Statistics*

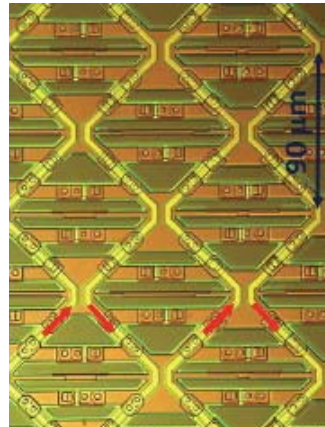
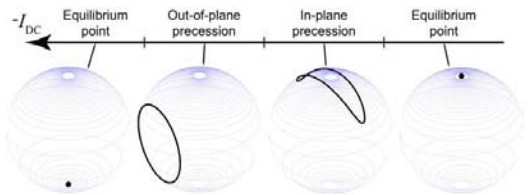
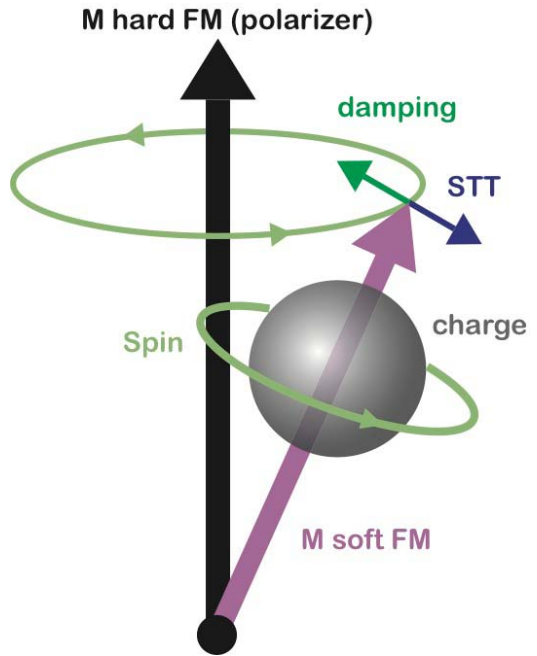
The non-linear dynamics work of professor Antonio Palacios spans the fields of engineering, mathematics and physics. A common theme of his work is to turn mathematical ideas and theorems into reality by exploiting the symmetry of interconnected objects to enhance performance while minimizing power needs and costs.

His research focus on non-linear dynamics – more easily understood as processing information where the output of a system is not a multiple of the input, and taking advantage of symmetry and chaotic behavior to reduce the negative effects of noise. Examples include: magnetic and electric field sensors, arrays of superconductive loops, networks of nano-oscillators, and coupled gyroscope systems for navigation.

This work impacts many different applications such as the development of ultra sensitive; non-contact sensors for biomedical applications; computing and satellite communications; design and fabrication of microwave signal generators at the nano-scale; and radar and antenna systems.

Top: Spin Torque Nano-oscillator; Funded by a grant from the National Science Foundation, Dr. Palacios is studying and classifying the various coherent states that a network of STNOs can produce. Image by James Turtle

Bottom: This small and powerful network of thousands of superconducting loops fits inside a finger tip. Image by Dr. Oleg Mukhanov, HYPRES Inc.





Powder Power

EUGENE OLEVSKY *Mechanical Engineering*

sin-ter: verb to make (a powdered material) coalesce into a solid or porous mass by heating it (and usually also compressing it) without liquefaction.

Mechanical engineer Eugene Olevsky is an expert in powder sintering. The research from his Powder Technology Lab is applied to fuel and solar cells, hydrogen storage and nanotechnology.

The process of sintering causes a powdered material to become a coherent mass by heating without melting and creates materials with very uniform contents. Dr. Olevsky uses the powder consolidation technique of spark-plasma sintering (SPS) to produce highly dense materials with a significant potential for grain size retention. The heat generation is internal, which facilitates a very high heating or cooling rate, and results in a very fast sintering process.

Spark-plasma sintering gains particular prominence in connection with its unique capabilities of processing very hard-to-deform materials. This approach significantly shortens processing and improves the performance in terms of both time and quality. It is especially promising with regard to maintaining the nano and sub-micron structure in nano-powder-based materials after consolidation.

SPS has many significant advantages over conventional heating methods, resulting in dramatically improved properties of sintered products, low manufacturing costs, and environmental friendliness. It has already been successfully implemented for processing of many structural (wear-resistant tools, refractory materials, etc.) and functional (thermoelectrics, semi-conductors, etc.) components.

Dr. Olevsky's work is supported by the National Science Foundation, Department of Defense, NASA, and Department of Energy.

Top: Professor Olevsky explains principles of microwave sintering. Photo by Dennis Ma

Middle: Olevsky's lab research team discusses results of spark-plasma sintering. Photo by Debbie Brighton

Bottom: Loading spark-plasma sintering device – starting a new experiment is always exciting. Photo by Dennis Ma

Conservation Strategist

LI AN Geography

Payments for ecosystem services (PES) have been in practice for more than two decades. These incentives are offered to farmers or landowners in exchange for managing their land to provide ecological or environmental services and seek to promote the conservation of natural resources. Ecosystem services include providing food, water, clean air, soil, and other life-supporting resources such as forests.

Geographer Li An is investigating the impacts of PES to determine what measurable environmental and demographic changes have occurred due to PES programs. Dr. An is using data gathered from the Fanjingshan National Nature Reserve (habitat of the endangered Guizhou golden monkey) in southwestern China to answer these questions. With support from the National Science Foundation, he and his colleagues are analyzing the coupled natural and human (CNH) system to assess the long-term effects of PES programs on human and environment interaction, focusing on China's "Grain-to-Green Program," a program that pays cash or grain to local farmers in order to return their sloped farmland to forest. Research will examine how human activity, livelihood and demography, and the golden monkey and its habitat may interact over space and time with the goal of recommending effective conservation strategies that can be applied to other places or endangered species.

Top: The Guizhou golden monkey in natural habitat. Photo by Mr. Xiaoping Lei

Right: Li An and his colleagues doing fieldwork in the monkey reserve (reserve staff, Li An, Sarah Wandersee, and reserve staff). Photo courtesy of Li An

Far Right: A Guizhou golden monkey captured by one of Li An's infrared cameras). Photo by Li An





Language and the Brain

**TRACY LOVE AND
LEWIS SHAPIRO**

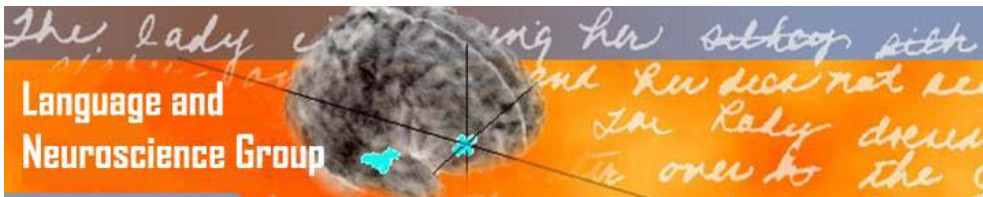
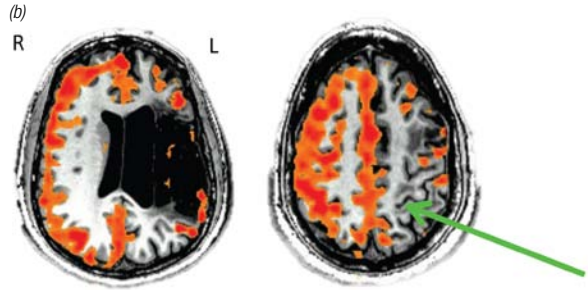
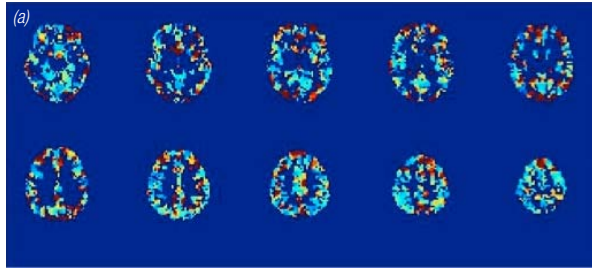
*Speech, Language and
Hearing Sciences*

Research at SDSU's Language and Neuroscience Group (LANG) laboratory centers on the study of human cognitive processes and how these processes are mapped on the brain, with an emphasis on language processing throughout the lifespan. Co-Directors Tracy Love and Lewis Shapiro study, for example, the language deficit in aphasia, a language disorder caused by stroke that has enormous physical, emotional, and financial consequences for the individuals and families affected.

Drs. Love and Shapiro use several different cutting-edge techniques in their work, including eye tracking while listening, pupillometry, and brain mapping; the overarching goal is to discover how different types of information (e.g., syntax, semantics) and cognitive processes (e.g., memory, attention) work together in the brain when a listener/reader is trying to understand sentences. This NIH-funded work has important implications for assessment and rehabilitation of people who have language and cognitive disorders.

Top and middle: (a) Example of Perfusion maps, demonstrating the rate of blood flow to areas of the brain (blue= faster, red= slower). (b) Overlaying these maps onto individual images has revealed that structurally intact brain regions are getting less blood flow resulting in functional lesions.

Right: Child participant in a Cross Modal behavioral study investigating how auditory sentences are processed in real time. Photos courtesy of the LANG laboratory



Contaminated Surfaces: A Metagenomic Approach

SCOTT KELLEY *Biology*

Humans in developed countries spend the majority of their time indoors - but we know very little about the microbes that inhabit these environments. Biologist Scott Kelley is using metagenomic methods and bioinformatics analyses to survey microbial diversity in office and hospital settings. These analyses will provide information about indoor microbial communities and the sources of these organisms.

Dr. Kelley's studies of hospitals, daycare centers, shower curtains and airplanes have shown human environments to contain a rich mixture of environmental and human-associated microbes. He has also developed special software to track sources of contaminations. Findings include:

- Bathrooms on commercial jetliners are especially contaminated, mostly with human associated bacteria
- Men's offices are more contaminated than women's offices
- Frequently touched surfaces in Newborn Intensive Care Units harbor many bacteria with disease-causing potential.

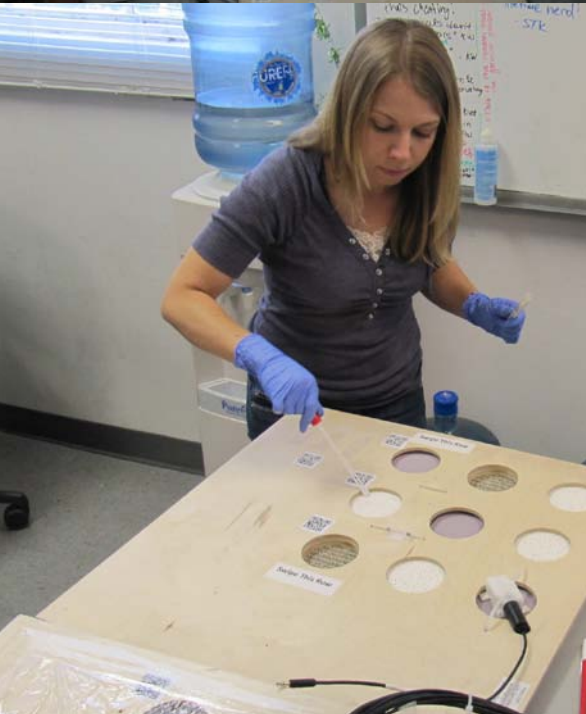
Research was conducted in New York, Tucson and San Francisco. Future work will take place in other regions to determine seasonal and climactic differences.

Dr. Kelley has also developed sampling methods to collect and examine microbial diversity of geothermal spring water and his team was the first to develop efficient methods for sampling high temperature steam vents. In another project, Dr. Kelley is exploring the microbial diversity of gum disease, and testing the efficacy of a low-cost antimicrobial treatment approach which can be implemented world-wide.

His work is supported by the Alfred P. Sloan Foundation and the Clorox Company.

Top: Indoor bacterial sampling devices. Photo by Jennifer Fouquier

Bottom: Graduate student Jennifer Fouquier conducts sampling for a microbial succession project on three office surfaces across different climates. Photo by Scott Kelley



New Energy Solutions

FLETCHER MILLER *Mechanical Engineering*

Mechanical engineer Fletcher Miller and his students are designing a revolutionary high temperature solar receiver that can be used to drive a gas turbine to generate low-cost electricity.

He and his team started with a lab-scale model and are developing a full-scale model to test at the National Solar Thermal Testing Facility in New Mexico. Rather than relying on steam to generate power, Dr. Miller is exploring a way to use air as a power generator – reducing the need for water and making the production of solar power more efficient. San Diego-based Solar Turbines is a partner in this project.

Heating air inside tubes can be compared to cooking a potato. In a regular oven the outer layer cooks quickly and the inside takes longer to warm; in a microwave the whole potato heats at the same time. Miller's design heats the air throughout the volume – like a microwave – rather than just at the surface of a pipe. This is accomplished by seeding the air with carbon nano particles that act as microscopic solar absorbers.

Dr. Miller's research, in conjunction with Thermaphase Energy, also elucidates how to operate the receiver on a cloudy day when sunlight alone is not enough to power the turbine. By using thermal storage, solar plants can operate in the evening until they can be recharged.

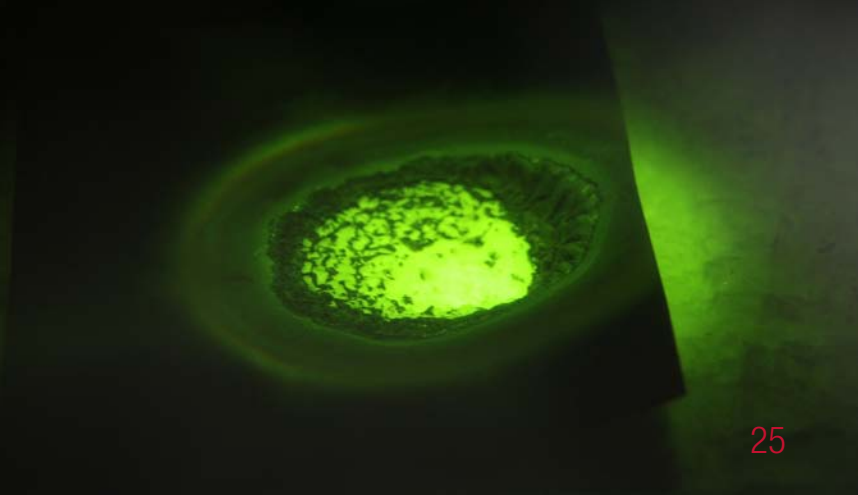
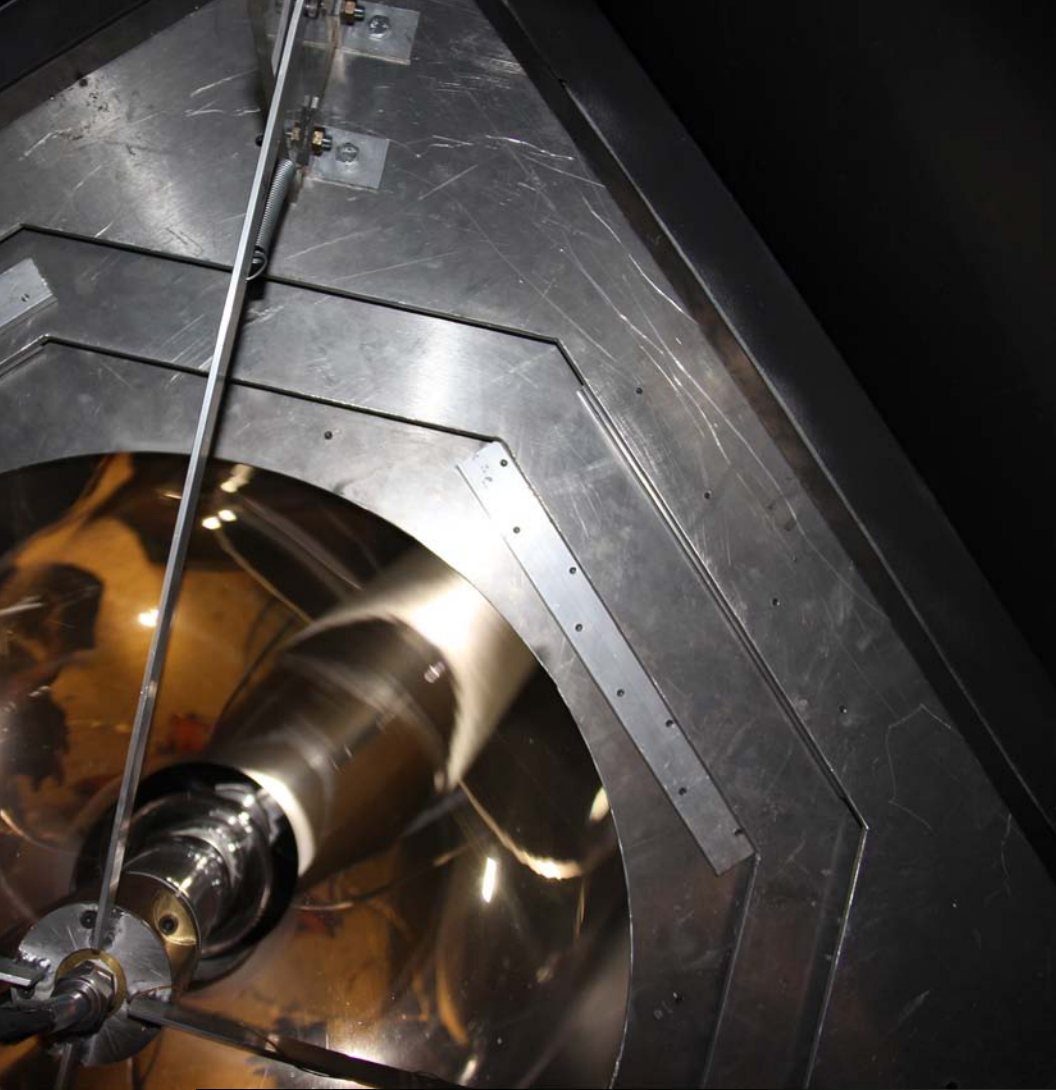
This work has been supported by Google, the California Energy Commission and the U.S. Department of Energy.

Top: View looking up at the 15000 Watt xenon arc lamp inside the solar simulator built by students in Dr. Miller's laboratory.

Bottom left: Graduate student Lee Frederickson tending to the carbon nano particle generator

Bottom right: View through welding glass of stainless steel being melted and burned by the intensely focused solar energy.





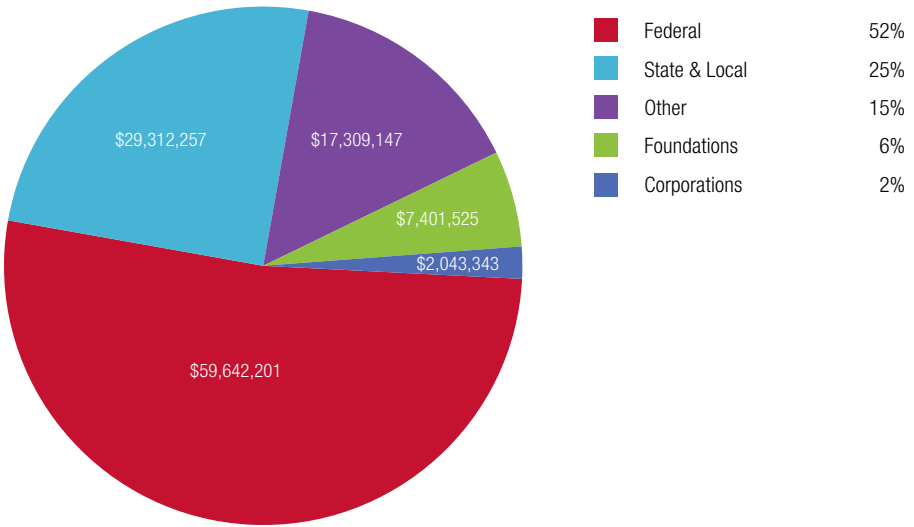
FY 2012-13 “Millionaires”*

Principal Investigator	Department	Total
Melbourne Hovell	Graduate School of Public Health	\$9,072,779
Anita Harbert	Social Work	\$4,725,522
Forest Rohwer	Biology	\$4,435,343
Caren Sax	Administration, Rehabilitation & Postsecondary Education	\$3,195,000
Susan Woodruff	Social Work	\$3,192,592
Guadalupe X. Ayala	Graduate School of Public Health	\$2,866,235
Gregory Talavera	Graduate School of Public Health	\$2,724,262
Ethan Singer	Academic Affairs	\$2,702,446
Roberta Gottlieb	BioScience Center	\$2,672,310
Cynthia Park	Teacher Education	\$2,619,058
Thomas Karlo	KPBS	\$2,604,783
Mary Ann Lyman-Hager	Language Acquisition Resource Center	\$2,556,355
Thomas Reilly	Social Work	\$2,523,411
Alex DeNoble	Management	\$2,369,783
Mark Sussman	Biology	\$1,867,625
Alan Sweedler	Physics	\$1,790,000
Sarah Mattson	Psychology	\$1,551,818
John Elder	Graduate School of Public Health	\$1,505,019
Sanford Bernstein	Biology	\$1,448,411
Joseph Shapiro	College of Extended Studies	\$1,367,916
Edward Riley	Psychology	\$1,338,228
Barry Janov	Research Advancement	\$1,327,525
Thomas Zink	Biology	\$1,297,960
Karen Emmorey	Speech Language and Hearing Sciences	\$1,280,234
Ralph Feuer	Biology	\$1,243,351
Joseph Johnson	Educational Leadership	\$1,223,841
Elizabeth Klonoff	Psychology	\$1,168,009
Joseph Price	Psychology	\$1,059,636
Elva Arredondo	Graduate School of Public Health	\$1,013,525
Ian Pumpian	Educational Leadership	\$1,004,062

* Recipients of one award or multiple awards totaling \$1 million or more.

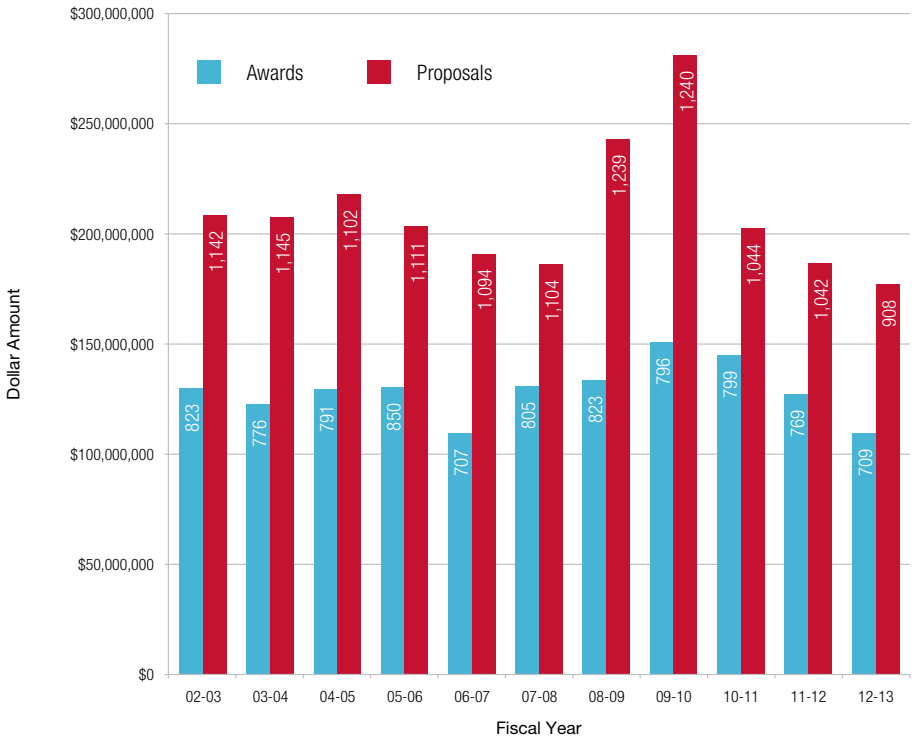
Awards by Sponsor Type Fiscal Year 2012-2013

Total Awards = \$115,708,473



Ten Year Proposal/Award Data

(Numbers and Dollars)



SDSU is proud to offer these joint doctoral programs:

SDSU Joint Doctoral Programs

MAJOR/CONCENTRATION	PARTNER UNIVERSITY
Audiology (Au.D.)	UC San Diego
Biology	UC San Diego
Chemistry	UC San Diego
Clinical Psychology	UC San Diego
Computational Science	Claremont Graduate University
Computational Science: Statistics	Claremont Graduate University
Ecology	UC Davis
Education	Claremont Graduate University
Education Leadership: Pre K-12 School Leadership	Independent
Education Leadership: Community College/Post-Secondary Leadership	Independent
Engineering Sciences: Bioengineering	UC San Diego
Engineering Sciences: Electrical & Computer Engineering	UC San Diego
Engineering Sciences: Mechanical & Aerospace Engineering	UC San Diego
Engineering Sciences: Structural Engineering	UC San Diego
Evolutionary Biology	UC Riverside
Geography	UC Santa Barbara
Geophysics	Scripps Institution of Oceanography/UCSD
Language & Communicative Disorders	UC San Diego
Math & Science Education	UC San Diego
Physical Therapy (DPT)	Independent
Public Health: Epidemiology	UC San Diego
Public Health: Global Health	UC San Diego
Public Health: Health Behavioral Sciences	UC San Diego

Other Distinctions

- SDSU faculty and staff garnered \$115.7 million in support of their research programs.
- SDSU faculty and staff received 98 awards and \$26 million from the National Institutes of Health.
- The National Science Foundation provided \$9 million in awards to SDSU research programs.
- SDSU is classified as a research university with “high” research activity by The Carnegie Foundation.
- Last year’s Student Research Symposium showcased the work of more than 450 students from 80 majors in posters and oral presentations.
- SDSU is one of the top “Up-and-Coming Schools” in the nation, according to *U.S. News & World Report’s* annual ranking of America’s Best Colleges, having risen higher in the rankings than any other university in the nation over the last three years.
- SDSU is a top producer of Fulbright awardees.
- SDSU is ranked among the top graduate programs in the nation by *U.S. News and World Report* in business, engineering, public health, psychology, education, fine arts, biological sciences, public affairs and speech, language and hearing sciences.
- SDSU ranks #19 nationwide in advancing women in science, technology, engineering and mathematics (STEM) disciplines.
- SDSU’s joint interdisciplinary Ph.D. program in global health instructs and provides research opportunities for students in response to global health problems both in California and abroad.
- SDSU has joined the Sustainable Cities Network of institutions and will launch a Community Engagement for Sustainable Cities program.
- SDSU art professor and artist Neil Shigley’s portrait, “Michael 59,” was displayed in the Smithsonian’s National Portrait Gallery.
- SDSU’s new Integrated Regenerative Research Institute aims to harness the power and healing potential of stem cells.
- San Diego State University’s new Doctor of Physical Therapy Program is educating students working to advance the fields of orthopedics, neurology, and other physical therapy areas of practice.
- The Mathematics, Engineering and Science Achievement (MESA) Engineering Program celebrated 30 years of graduating underserved students in the fields of engineering and physical sciences, and increasing diversity in the technical workforce.
- In early August, the Mars Rover “Curiosity” successfully landed in an effort to discover more about earth’s next door neighbor. Eight SDSU alumni who work with the Mars Science Laboratory played a variety of roles in the mission.
- San Diego State University’s Risa Levitt Kohn is one of five international scholars responsible for the innovatively interactive exhibits at Russia’s Jewish Museum and Tolerance.
- Dr. Peter Torre is an expert on HIV and hearing science; last year he led a pilot study in South Africa to analyze whether HIV in children is associated with hearing loss.
- A research team led by SDSU postdoctoral fellow Jeremy Barr identified a new immune system that protects humans and animals from infection.
- SDSU’s Mount Laguna Observatory (MLO) is one of the best overall observatory sites in the continental United States. MLO has grown to include four well-equipped research telescopes, ranging in size from 21- to 50-inches (0.5- to 1.25-meters). The 50-inch Phillips Claud Telescope is now under construction.
- The Zahn Innovation Center is a commercial and social incubator that supports San Diego State University innovators and aspiring entrepreneurs—students, faculty and staff from any major or department on campus—as they transform their ideas into enterprises.



SAN DIEGO STATE UNIVERSITY

5500 Campanile Drive
San Diego, CA 92182-8220
619 594-5213
gra@mail.sdsu.edu
gra.sdsu.edu

