Undergraduate Science & Engineering Symposium (USES)

8 – 9 May 2009
Santa Clara University
Kennedy Commons

2009 Undergraduate Science & Engineering Symposium (USES)

The goal of this symposium is to promote research science at Santa Clara University through three strategies:

1) **Encourage and recognize student research by providing a venue for formal presentation**
   Walking advanced students through the professional meeting process, from abstract submission through presentation, provides them with a sense of accomplishment and conveys an important aspect of the research experience: explaining results with concision & general appeal.

2) **Actively engage new majors in research opportunities & ongoing projects by their peers**
   By engaging sophomore, and even freshmen students, to studies conducted by their peers, 1-2 years ahead of them, research becomes an attractive and feasible endeavor. Students will be exposed to faculty research programs (many may have no clue what their instructors study…), while, at the same time, learning how to become involved in research.

3) **Increase interaction between students and research scientists, in a casual setting**
   The symposium will be formal enough to demonstrate the atmosphere of a meeting, but casual enough to make newly declared science & engineering majors comfortable enough to ask student and faculty researchers about the culture of science: what types of careers one can expect? What are pros and cons of the lifestyle? What the challenges and rewards of research? How do you choose a research focus?

We hope that all attendees will join us for the Keynote Address on Friday evening and at least one full session. Longer sessions will include a ten-minute break and close with a Research Panel where all of the presenters will answer questions and discuss the research experience. For this reason, please be ready to jot down questions during the course of the talks.

Thank you to everyone who helped and participated in this event!

Sincerely,
Sean M. Watts

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The Santa Clara University Provost's office and Undergraduate Research Initiative
The Environmental Studies Institute
The Anthropology Club
John Wiley & Sons Inc.
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USES Agenda: 8 May 2009

(Presenting authors are underlined, advisors in parentheses)

Introduction **12:00 – 12:15pm**

Session I: Biology & Biochemistry **12:15 – 1:00pm**

Jason Buenrostro and Michelle Mattson (C. Stephens & J. Whittall)
"Program for data acquisition: Measuring gene expression in real time"

Debbie Caswell, Justen Jarrell, Brenda Alvarez, Rachel Badua, Tim Butler, Margaux Chan, Stephanie Chin, Christina Eavis, Alyssa Erickson-Wagner, Kendra Garcia, Rachel Munsen, Whitney Porter, Matt Weiss & Kekaui Zukeran-Kerr (C. Stephens & A. Lieu)
"Evolution of the Lac repressor family as a control system for digesting plant polymers in the aquatic bacterium *Caulobacter crescentus*"

Dana Honzel (G. Jensen)
"Antioxidants: fighting crime to keep you healthy "

Break **1:00 – 1:10pm**

Session I (cont'd): Biology & Biochemistry **1:10 – 1:40pm**

Alexandra M. Lewis, Christelle Sabatier & John T. Birmingham (J.T. Birmingham & C. Sabatier)
"Excitatory actions of GABA on a stomatogastric muscle in the crab *Cancer borealis"*

Christopher M. Rose, Mary E. Lucas, John T. Birmingham & Steven W. Suljak (J.T. Birmingham & S. Suljak)
"Determination of GABA Concentration in the hemolymph of *Cancer borealis* through LC-MS analysis"

Research Panel **1:40 – 2:10pm**

Session II: Physics & Engineering **2:10 – 3:25pm**

Raymond Wu, Ke Li, Xuhui Sun, Wen Wu, Shoba Krishnan & Cary Y. Yang (S. Krishnan)
"Contact resistance in carbon nanotube interconnect vias"

Navid Akhavan Tafti , Toshishige Yamada & Cary Y. Yang (T. Yamada)
"A study on quantum capacitance and kinetic inductance in nanostructures"

Zefram Marks, John Jameson**,** Xuhui Sun & Cary Y. Yang (J. Jameson)
"Electrical breakdown of carbon nanofibers due to direct and Joule heating "

Hope Sheffield (C. Weber)
"A fast-laser experiment to measure microscopic motion of electrons"

Craig Benko (C. Weber)
"Using lasers to understand magnetic semiconductors"

Research Panel **3:25 – 3:55pm**

Session III: Environmental Science **3:55 – 4:55pm**

Laura Huston, Erin Justice, David Krauth, Jimmy Mack and Siddhartha Oza (A. Strawa, J.W. Skiles, M. Legg & C. Schmidt)
"Using NASA satellites to improve air quality monitoring in the San Joaquin Valley"

Daniel Bates (I. Stewart-Frey & E. Maurer)
"Development of a GIS database to evaluate climate-induced streamflow timing changes in California"

Miranda Melen & Marta Langland (I. Stewart-Frey & P. Dicochea)
"Improving the quality of life for everyone? Ethnic neighborhoods in San José bear the brunt of pollution and redevelopment"

Patty Guzmán, Betsy Purner, Miranda Melen, Marta Langland, & Kimee Goeggel (I. Stewart-Frey & P. Archie)
"The garden as an experiential classroom: The dirt on educational gardens for Santa Clara County elementary schools"

Research Panel **4:55 – 5:25pm**

Keynote Address: Dr. Heather Tallis **5:30 – 6:30pm**

Thinking Back Inside the Box: Merging Science & Society

Dr. Heather Tallis is Research Associate in the Department of Biology at Stanford University. She is also Lead Scientist of the Natural Capital Project, a new partnership among Stanford, The Nature Conservancy and the World Wildlife Fund designed to align economic forces with conservation. Dr. Tallis's work addresses the ecological and social relationships between people and nature. She is advancing practical tools and approaches to development that integrate human and environmental well-being.

USES Agenda: 9 May 2009

(Presenting authors are underlined, advisors in parentheses)

Introduction **12:00 – 12:15pm**

Session IV: Costa Rica Field School & Ecology **12:15 – 1:15pm**

Michelle Bezanson
Research Opportunity: "Bringing the classroom to the field"

Christinah Barnett (M. Bezanson)
"The ecological role of the prehensile tail in black-handed spider monkeys (*Ateles geoffroyi*)"

Kelly Ferron (M. Bezanson & S. Watts)
"Focal fecal follow of fascinating feces: The fundamental function of primate frugivores in the rainforest"

Christina Hagerty (S. Watts & M. Bezanson)
"Leafcutter ants (*Atta* sp): A systematic and observational study of pheromone usage"

Break **1:15 – 1:25pm**

Session IV (cont'd): Costa Rica Field School & Ecology **1:25 – 2:25pm**

Christopher Melisi (S. Watts & M. Bezanson)
"The effects of microhabitat type on poison dart frog populations (*Dendrobates auratus*, *Dendrobates pumilio*, and *Phyllobates lugubris*)"

Kristin Sterling (M. Bezanson & S. Watts)
"Canopy density and animal interactions with the river"

Khaaliq Dejan (J. Edgerly-Rooks)
"Vibrational communication: A language of its own"

Thomas Lloyd-Davies (D. Wahl)
"Analysis of macroscopic charcoal amounts in Guatemalan lake sediment cores"

Research Panel **2:25 – 2:55pm**

Session V: Sociology & Environmental Studies **2:55 – 3:40pm**

Dr. Regina Davis-Sowers
Research Opportunity: "The need for interdisciplinary research at the undergraduate level in the search for social justice"

Meghan Mooney, (L. Calero)
"Working at the margins: Access to recycling cooperatives as a means of social inclusion for *catadores* (waste pickers) in Salvador, Brazil"

Nick Obradovich (S.A. Starbird & C.L. Evans)
"Do anti-smoking programs make us fatter? Empirical evidence from New York City"

Break **3:40 – 3:50pm**

Session V (cont'd): Sociology & Environmental Studies 3:50 – 4:35pm

Elizabeth Tellman (L. Gray)
"Can poverty be solved by exporting cash crops? A case study of two coffee farms in El Salvador"

Alexandra Dunne (L. Gray)
"Quality of life: The impacts of gender, emigration, health, and education in coffee-producing communities."

M. Klipa & Alexandra Burkhuch (J. Farnsworth)
"How much energy could the university save by simply implementing an energy plan in the Library?"

Research Panel 4:35 – 5:05pm

Awards Ceremony 5:10 – 6:30pm

USES Abstracts: 8 May 2009

Session I: BIOLOGY & BIOCHEMISTY 12:15 – 1:00pm

Program for Data Acquisition: Measuring Gene Expression in Real Time

Jason Buenrostro[1] & Michelle Mattson[2]

[1]Senior, Biology and Bioengineering
[2]Senior, Bioengineering

Mentors: Dr. Craig Stephens, Assoc Prof, Biology & Dr. Justen Whittall, Asst Prof, Biology

All living things are governed by the central dogma of molecular biology: DNA to RNA to protein. Understanding and quantifying this pathway can give researchers insight into the living world around us. Establishing assays for quantitative-real-time polymerase chain reaction (qRT-PCR) will offer Santa Clara University (SCU) students and faculty an invaluable research and teaching tool. An affordable and accurate gene expression assay is being developed for *Caulobacter crescentus,* an oligotrophic freshwater bacterium. Accurate assay development for *C. crescentus* has required the extraction of highly pure RNA and the development of three endogenous controls for normalizing gene expression measurements. Endogenous controls were designed by selecting highly expressed genes of known function, whose expression had been previously shown by microarray data to be constant in *C. crescentus* cultures grown under different conditions. These genes serve as standards by which to measure the relative expression of the gene XylX (CC0823) in *C. crescentus.* XylX is an inducible gene on the *xyl* operon, which is regulated by the XylR repressor (CC3065), a D-xylose-responsive LacI-type repressor. This assay will determine the repressive ability of XylR in mutant and wild type *C. crescentus* strains and serve as a model for the development of future qRT-PCR assays for Arctic Mustards and *C. elegans.*

Evolution of the Lac repressor family as a control system for digesting plant polymers in the aquatic bacterium *Caulobacter crescentus*

BIOL176 Recombinant DNA Technology: Debbie Caswell[1], **Justin Jarrell**[2], Brenda Alvarez, Rachel Badua, Tim Butler, Margaux Chan, Stephanie Chin, Christina Eavis, Alyssa Erickson-Wagner, Kendra Garcia, Rachel Munsen, Whitney Porter, Matt Weiss & Kekaui Zukeran-Kerr

[1]Senior, Biology
[2]Senior, Biology

Mentors: Dr. Craig Stephens, Assoc Prof, Biology & Amanda Lieu, Research Technician, Biology

The aquatic bacterium *Caulobacter crescentus* is highly adapted for life on surfaces in environments with very low nutrient levels. The *C. crescentus* genome contains multiple genes for secreted enzymes used to break down plant cell wall polysaccharides, including cellulose, xylans, and arabinogalactans. Several of the genes encoding these enzymes are located on the genome in close proximity to suspected transport systems, which would presumably be used to take in the products of extracellular polysaccharide digestion. These same genomic loci also include several members of a family of putative repressor proteins that are homologous to the well-studied Lactose repressor of *E. coli.* We hypothesized that these repressor proteins control expression of the secreted hydrolytic enzymes and sugar uptake systems, so that they are only produced when appropriate plant polysaccharides are available to the bacteria (for example, when they colonize decaying vegetation). To test this, we used recombinant DNA techniques to produce targeted mutations in seven of the repressor genes. We are using the mutant bacteria to analyze the roles of this family of repressor proteins on gene expression.

Antioxidants: fighting crime to keep you healthy

Dana Honzel, Junior, Biochemistry

Mentor: Dr. Gitte Jensen, Research Director, Natural Immune System (NIS) Labs

Antioxidants found in fruits, vegetables, spices and many other foods we ingest help to fight the free radicals that arise during metabolism and numerous other biological processes. We established the cell-based antioxidant protection in erythrocytes (CAP-e) to evaluate the antioxidant potential found in natural supplements and foods. The CAP-e assay addresses the question of whether antioxidants in complex natural products enter the cytosol and contribute to the reduction of oxidative damage within the cell. The CAP-e utilizes the structural elements of erythrocytes (red blood cells) including plasma membrane and lack of organelles to create a simple cell model for testing antioxidants. A free radical generator is used to create free radicals within the cells and a fluorescent indicator is used to calculate the relative fluorescence of the free radical concentration. CAP-e addresses some questions about antioxidant bioavailability at the cellular level. We have shown that the CAP-e assay can also be used to test serum and cells from blood samples before and after people consume antioxidant rich foods. In that situation the test addresses antioxidant bioavailability *in vivo*.

Break **1:00 – 1:10pm**

Session I (cont'd): BIOLOGY & BIOCHEMISTRY **1:10 – 1:40pm**

Excitatory Actions of GABA on a stomatogastric muscle in the crab *Cancer borealis*

Alexandra Lewis[1], Christelle Sabatier[2] & John T. Birmingham[3]

[1]Senior, Physics
[2]Mentor: Lecturer, Biology
[3]Mentor: Assoc Prof, Physics

Gamma-aminobutyric acid (GABA) is best known as an inhibitory neurotransmitter in the mammalian central nervous system. Here we show, however, that GABA has an excitatory effect on nerve-evoked contractions and on excitatory junction potentials (EJPs) of a stomach muscle from the crab *Cancer borealis*. The threshold concentration for these effects was between 1 and 10 μM. Using immunohistochemical techniques, we further demonstrate that GABA is colocalized with the vesicle-associated protein synapsin in nearby nerves and hence presumably released there. However, since these nerves do not innervate the muscle directly, we conclude that these release sites likely are not the source of the GABA responsible for muscle modulation.

Determination of GABA concentration in the hemolymph of *Cancer borealis* through LC-MS Analysis

Christopher M. Rose[1], Mary E. Lucas[2], John T. Birmingham[3] and Steven W. Suljak[4]

[1]Junior, Biochemistry/Biology
[2]Senior, Biochemistry
[3]Mentor: Assoc. Prof., Physics
[4]Mentor: Asst. Prof., Chemistry

The neurotransmitter gamma-aminobutyric acid (GABA) has a novel excitatory action on contractions of a muscle in the stomatogastric nervous system of the crab *Cancer borealis*. No local source of GABA has been

identified, suggesting that GABAergic modulation of the muscles might be due to release from a distal site. We extracted hemolymph from the pericardial chamber from ten crabs. The pericardial chamber contains the pericardial organs, a major neurosecretory structure. Through LC-MS analysis we show that the concentration of the GABA in crab hemolymph averaged 3.30 (± 0.7) μM, high enough to modulate this muscle. These findings support the theory that this muscle could be modulated by GABA produced by and released from a distant neurohemal organ.

Research Panel 1:40 – 2:10pm

Session II: PHYSICS & ENGINEERING 2:10 – 3:25pm

Contact resistance in carbon nanotube interconnect vias

Raymond Wu [1], Ke Li[2], Xuhui Sun[3], Wen Wu[4], Shoba Krishnan[5] & Cary Y. Yang[6]

[1]Senior, Electrical Engineering
[2]Senior, Electrical Engineering
[3]Senior Research Asst Prof, SCU Center for Nanostructures
[4]Research Associate, SCU Center for Nanostructures
[5]Mentor: Shoba Krishnan Assoc Prof Electrical Engineering, SCU Center for Nanostructures
[6]Prof, Electrical Engineering, Director, Center for Nanostructures

Copper interconnect technology is rapidly approaching its scaling limit because of increasing resistivity, reliability concerns due to electromigration, and excessive power dissipation related to ever-increasing clock frequencies. One viable alternative to copper is carbon nanotube (CNT). Before CNT can be used in next-generation integrated circuits, its electrical and thermal properties of CNTs must first be studied. One of the most important information that is needed in this area is the contact resistance between the CNTs and the metal layers in a vertical interconnect via. Minimizing contact resistance is the key issue in the interconnect fabrication process, especially when the dimension is in the nanoscale. The purpose is to study the contact resistance between vertically grown CNTs and the base metal in the vias. Since the contact resistance is not a function of length, by measuring the resistances of CNT vias with different lengths, the contact resistance can be extracted from the resistance vs. length plot. In addition, the contact resistance between a single CNT and the base metal can also be obtained by using the atomic force microscopy (AFM) current-sensing technique.

A study on quantum capacitance and kinetic inductance in nanostructures

Navid Akhavan Tafti[1], Toshishige Yamada[2] & Cary Y. Yang[3]

[1]Senior, Electrical Engineering
[2]Mentor: Research Prof, Engineering SCU Center for Nanostructures
[3]Prof, Electrical Engineering, Director, SCU Center for Nanostructures

We study quantum capacitance and kinetic inductance in nanostructures, especially carbon nanotubes (CNTs). Their physical origin is examined and their expected values for a CNT with given specifications are predicted. We show that these elements have appreciable influences only under some special circumstances, and such conditions are clarified.

Electrical breakdown of carbon nanofibers due to direct and Joule heating

Zefram Marks[1], John Jameson[2], Xuhui Sun[3] & Cary Y. Yang[4]

[1]Senior, Electrical Engineering

[2]Mentor: Prof, Engineering, SCU Center for Nanostructures
[3]Prof, Engineering, SCU Center for Nanostructures
[4]Prof, Electrical Engineering, Director, SCU Center for Nanostructures

Carbon nanotubes (CNTs) and carbon nanofibers (CNFs) are candidates to replace copper as interconnects in integrated circuits (IC) due to their potentially superior electrical characteristics. In order to advance the use of CNTs and CNFs for these applications, their electrical properties must be thoroughly characterized and techniques for their fabrication and integration into next-generation process technology must be developed. One important performance and reliability concern is how and why CNTs and CNFs fail under high current stressing. In order to elucidate this, CNFs are tested against a previously proposed model[1] for current-induced breakdown. The model predicted that Joule heating generated by the current through the CNF is principally responsible for breakdown. To further verify this model, the breakdown or critical current density Jmax is measured for each CNF at various temperatures to determine the effect of direct heating on Jmax. New test structures are designed and fabrication processes are developed to implement these measurements, including a testing rig for high-temperature studies.

[1]H. Kitsuki, T. Yamada, D. Fabris, J.R. Jameson, P. Wilhite, M. Suzuki, and C.Y. Yang. 2008. Length dependence of current-induced breakdown in carbon nanofiber interconnects. *Applied Physics Letters*, **92:** 173110 (1–3).

A fast-laser experiment to measure microscopic motion of electrons

Hope Sheffield Junior, Engineering & Physics

Mentor: Dr. Chris P. Weber, Asst Prof, Physics

A material's electronic properties are often controlled by processes that happen at microscopic length scales and in times faster than 1/1,000 of a nanosecond. Experimental observation of such processes is difficult, but vital to the understanding and design of novel electronic materials. In this talk we present "transient spin grating spectroscopy," a laser-based method for studying the microscopic motion of electrons and their spins. We discuss the principles of operation of the experiment and the short-pulsed laser on which it relies, and we describe the results of building and commissioning a transient spin grating apparatus at SCU.

Using lasers to understand magnetic semiconductors

Craig Benko Junior, Physics

Mentor: Dr. Chris P. Weber, Asst Prof, Physics

Some semiconductors become magnetic when they are "doped" with small quantities of impurities. The combination of semiconducting and magnetic behavior offers unique possibilities for new, "spintronic" electronic devices, but these applications will require the design of new semiconducting materials that are magnetic at room temperature, rather than the chilly 100K or so of current materials. The search for such materials has largely been held back by a lack of theoretical understanding of how the materials become magnetic--that is, of the microscopic electronic processes involved.

Research Panel 3:25 – 3:55pm

Session III: ENVIRONMENTAL SCIENCE 3:55 – 4:55pm

Using NASA satellites to improve air quality monitoring in the San Joaquin Valley

Laura Huston[1], Erin Justice[2], David Krauth[3], Jimmy Mack[4] & Siddhartha Oza[5]

[1]Senior Math/Env Sci
[2]California State University, Monterey Bay
[3]University of California, Berkeley
[4]University of Arizona
[5]Stanford University

Mentors: Dr. Anthony W. Strawa, NASA Ames Research Center, Dr. J. W. Skiles, NASA Ames Research Center, Marion Legg, Bay Area Environmental Institute & Cindy Schmidt, San Jose State University

Air quality in the San Joaquin Valley has failed to meet state and federal particulate matter (PM) attainment standards for the past several years. Air quality agencies currently use ground sensors to monitor the region's air quality. While this method provides accurate information at specific locations, it does not provide a clear indication of conditions over large regions. Measurements from satellite imagery have the potential to provide timely air quality data for large swaths of land. While previous studies show strong correlations between MODIS-derived Aerosol Optical Depth (AOD) and surface PM measurements on the East Coast of the United States, only weak correlations have been found in the West. Specific causes of this discrepancy have not been identified, nor has a solution been found. This study compares hourly and daily surface PM measurements using both traditional and Deep Blue-derived Aqua MODIS AOD data. Deep Blue is a newly developed algorithm that was recently applied to all Aqua MODIS data. Additionally, we analyze the effects of relative humidity and surface reflectance on PM and AOD measurements. Results show using hourly $PM_{2.5}$ data improves correlations with satellite AOD values. Also $PM_{2.5}$ data seems to correlate better with Deep Blue-derived AOD values than with traditional MODIS AOD. Further investigation into the effects of seasonal variation, surface reflectance and speciation is needed.

Development of a GIS database to evaluate climate-induced streamflow timing changes in California

Daniel Bates Senior, Environmental Science & Civil Engineering

Mentors: Dr. Iris Stewart-Frey, Asst Prof, Environmental Studies & Dr. Edwin Maurer, Assoc. Prof., Civil Engineering

Recent studies have indicated that generally warmer temperatures have led to reduced snowpack and earlier timing of peak snowmelt throughout California and the West potentially resulting in serious consequences for ecosystems and human water supplies. While the link between increased temperatures and shifts in streamflow timing appears well established, there is very little information that helps to explain the varying responses to increased temperatures in different watersheds. In order to understand the observed changes in streamflow timing, this study analyzed the physical characteristics the watersheds for approximately 60 stream gauges in California that have at least 30 years of continuous data, are snowmelt dominated, and relatively free from human influences. Geographic Information Systems (GIS) software was used to delineate the watersheds above the gauges from Digital Elevation Models (DEMs), and a database of the characteristics such as the distribution of elevation, slope, aspect, soil, and vegetation in the watersheds above the gauges was established. Thus several classes of snowmelt-dominated watersheds could be established from the physical characteristics of a watershed, and these classes could be linked to varying degrees of streamflow

timing change. Defining the physical properties of each basin will lead to a better understanding and predictability of California's hydrology in response to climate change.

Improving the quality of life for everyone? Ethnic neighborhoods in San José bear the brunt of pollution and redevelopment

Miranda Melen[1] & Marta Langland[2]

[1]Senior, Environmental Science
[2]Senior, Spanish/Environmental Studies

Mentors: Dr. Iris Stewart-Frey, Asst Prof, Environmental Studies & Dr. Perlita Dicochea, Asst Prof, Ethnic Studies

The growth of industry (especially high-tech industry) in San José and the related restoration and redevelopment efforts along the Guadalupe River are generally perceived as improving the quality of life for the citizens of San José. However, their impact on low income and marginalized ethnic neighborhoods over the past decades has gone largely unrecognized. For example, in Santa Clara County, the computer-related industries have heavily contributed to groundwater contamination, and are responsible for almost 20 EPA Superfund sites. In addition, redevelopment projects adjacent to San José's Guadalupe River downtown region involved the removal of several established low-income Latino neighborhoods as well as the dispersal of downtown homeless persons. Using GIS and statistical analysis, this study establishes the location and distribution of race and class along the expanse of the Guadalupe River over the past several decades. Census and city data highlight the relationship between the location of groundwater sites, their contaminants, Guadalupe River water pollution monitoring points, and redevelopment and restoration efforts. Our preliminary results suggest that likely groundwater and surface water contamination sites along the Guadalupe River have been and are now disproportionately affecting lower-income and mixed, non-white neighborhoods. In addition, it appears that predominantly lower-income and non-white neighborhoods have faced displacement and obliteration as a direct result of the City of San José's massive redevelopment and river restoration projects. This must be seen as an environmental justice issue warranting further systematic documentation, analysis, and direct action.

The garden as an experiential classroom: The dirt on educational gardens for Santa Clara County elementary schools

Patty Guzmán[1], Betsy Purner[2], Miranda Melen[3], Marta Langland [4] & Kimee Goeggel[5]

[1]Senior, Env Sci/ Environmental Studies
[2]Junior Env Sci/ Religious Studies
[3]Senior, Env Sci
[4]Senior, Spanish/ Environmental Studies
[5]Senior, Environmental Science

Mentors: Dr. Iris Stewart-Frey, Asst Prof, Environmental Studies & Patrick Archie, Lecturer, Environmental Studies, Director of Campus and Community Programs

The use of gardens in elementary school education has been shown to promote healthy and well-balanced child development while facilitating effective teaching in multiple academic disciplines. This study identifies major determinants and effects of successful educational gardens in elementary schools throughout Santa Clara County (CA). To investigate how a school's access to resources affects the ability to have and maintain an educational garden, we assessed garden presence in relation to economic scarcity based on parents' income, students ethnic and racial background, academic aptitude, and effective garden management and

coordination using GIS and statistical analysis. In addition, the benefits of educational gardens were examined through an assessment of children's access to natural play areas as well as student's fitness. Preliminary results indicate a significant positive relationship between academic aptitude, based on API scores, and garden presence as well as a significant inverse relationship between economic scarcity, based on percentage of students receiving free or reduced-cost meal plans (FRMP), and garden presence. To examine how the presence of educational gardens benefit students, further analyses will assess both student fitness measured by the school's averaged Body Mass Index (BMI) as well as access to natural play areas. The prime goal is to address resource inequity for elementary schools throughout Santa Clara County and provide a scientific basis for the establishment of county-wide elementary school garden education programs.

Research Panel **4:55 – 5:25pm**

Keynote Address: Dr. Heather Tallis **5:30 – 6:30pm**

Thinking Back Inside the Box: Merging Science and Society

In an age where there are no natural systems untouched by humanity, and society struggles more than ever with poverty, disease and global change, can we afford to limit our work to pure science? I will argue that, while continuing science at the fringe, it is time for students, institutions, governments and society to explicitly address the need for science for the masses.

Dr. Heather Tallis is Research Associate in the Department of Biology at Stanford University. She is also Lead Scientist of the Natural Capital Project, a new partnership among Stanford, The Nature Conservancy and the World Wildlife Fund designed to align economic forces with conservation. Dr. Tallis's work addresses the ecological and social relationships between people and nature. She is advancing practical tools and approaches to development that integrate human and environmental well-being.

USES Abstracts: 9 May 2009

Session IV: COSTA RICA FIELD SCHOOL & ECOLOGY **12:15 – 1:15pm**

Research Opportunity: Bringing the classroom to the field

Michelle Bezanson, Asst Prof, Anthropology

"Ever since I was 6-years old, I've known that I have wanted to study monkeys, just like Jane Goodall". This is a sentiment expressed by many undergraduates whether it is about monkeys, other mammals, insects, birds, plants, or conservation. If one is going to attend graduate school, potentially go into debt, and define their professional goals-- then one should be certain they have passion for fieldwork. The primary goal of a Santa Clara field course is to provide undergraduate students with a field opportunity/experience. Currently, education of college students, conservation goals and scientific research often are not integrated at academic institutions. This pattern must change if we are to protect ecosystems around the world. Santa Clara students are fortunate to participate in a university community that engages them to think about globalization, ethical issues, sustainability, and communities other than their own while gaining an education that involves hands-on experience. As mentors, we can facilitate these important experiences by teaching field courses that involve independent projects or guiding students working in the field with other instructors. Since the

inception of the La Suerte Primate Behavior and Plant Ecology field course at Santa Clara University, 18 students have completed independent projects and over half of these students have presented their projects at this and other professional symposia. In this presentation, we highlight student achievement, the role of the field school in the local community, and conservation priorities related to these research endeavors.

The ecological role of the prehensile tail in black-handed spider monkeys (*Ateles geoffroyi*)

Christinah Barnett Senior, Anthropology

Mentor: Dr. Michelle Bezanson, Asst Prof, Anthropology

The purpose of this study is to examine positional behavior (posture and locomotion) and tail prehensility in *Ateles geoffroyi* (black-handed spider monkey). Five genera of New World primates possess prehensile tails. Anatomical features suggest that *Ateles* tails are stronger in terms of mass-bearing capacity and gripping ability. For example, compared with other primates, *Ateles* tails are longer, exhibit greater flexion capabilities (muscles cross fewer joints), and have a specialized gripping pad at the distal end. Therefore, I explored different environmental, behavioral, and sex/age-based contexts of tail use. Research was conducted in a tropical premontane wet forest in northeastern Costa Rica. Data were collected using instantaneous focal-animal sampling. In both locomotion and posture, the tail was used in conjunction with 96.24% of all behaviors, while the primate's body mass was supported greatly, if not entirely by the tail at a proportion of 74.73%. Tail-use patterns did not differ according to branch size, angle, and crown location. The prehensile tail serves a biological role related to mass distribution during feed/forage in all age and sex categories of *Ateles*. In addition, juveniles employ it often during play and explore activities. These activities may serve as practice for refinement of suspensory postures during feed/forage or just merely owning a prehensile tail facilitates diverse actions during play.

Focal fecal follow of fascinating feces: The fundamental function of primate frugivores in the rainforest

Kelly Ferron Junior, Environmental Studies

Mentors: Dr. Michelle Bezanson, Asst Prof Anthropology & Dr. Sean M. Watts, Lecturer, Environmental Studies

Primate seed dispersal is fundamental to understanding the diversity and composition of neotropical rainforests. In this study, I examine germination success in white-faced capuchins (*Cebus capucinus*) seed dispersal due to digestion and placement in sleeping sites at La Suerte Biological Research Station in NE Costa Rica. *C. capucinus* activity logs were taken, fecal samples collected, seeds identified, and then planted at various sleeping and defecation sites. *C. capucinus* were recorded spending 39.4% of their time feeding or foraging and 24.9% of time spent traveling. Nine different fruits were identified in their diet during a 3-week period (four of which were planted) and 204 seeds were collected in total. Digested seeds had higher germination success than non-digested (eight digested seeds. Germinated, zero undigested). Seeds planted in sleeping site locations showed no difference in germination rate. These results suggest that primates function as effective seed dispersers due to their effect of digestion, scarification, and travel patterns associated with gut passage times. Further studies in successful germination sites and limiting factors on germination are required to better understand the role of primates in neotropical forest ecology and evolution.

Leafcutter ants (*Atta* sp): A systematic and observational study of pheromone usage

Christina Heber Hagerty Junior, Environmental Science/Biology

Mentors: Dr. Sean M. Watts, Lecturer, Environmental Studies & Dr. Michelle Bezanson, Asst Prof, Anthropology

This research explores pheromone usage and its relationship with foraging efficiency in leafcutter ants (*Atta* sp) in Northeastern Costa Rica. Leafcutter ants are imperative to the health and productivity of neotropical rainforests. Leafcutters are responsible for consuming 15-20% of the net productivity within neotropical forests and this 15-20% returned as nutrient rich soil after utilization. Therefore, understanding leafcutter foraging behavior is crucial to the health of neotropical forests. I evaluated distance of optimal pheromone communication, correlation with species richness, inter-colony and inter-species communication, and leaf fragment pick up. Results indicated pheromone communication is most effective at short range, is not strongly related to species richness, shows an inter-colony pattern, and is weakly correlated to leaf fragment pick up. Additionally, results showed that pheromone communication is most effective at zero range, still effective at 10 cm from active trail, and ineffective at 5 meters from an active trail. Pheromone "baited" boards had an average of 2.08 more species of insects than control boards when placed in areas of activity. Human cut leaf fragments were utilized five times more often than cut leaf fragments taken from another colony. Although this research is primarily focused on subtle nuances of leafcutter behavior, it contributes to a greater understanding of their impact on the community ecology of neotropical rainforests.

Break 1:15 – 1:25pm

Session IV (cont'd): COSTA RICA FIELD SCHOOL & ECOLOGY 1:25 – 2:25pm

The effects of microhabitat type on poison dart frog populations (*Dendrobates auratus*, *Dendrobates pumilio*, and *Phyllobates lugubris*)

Christopher James Melisi, Sophomore, Environmental Science

Mentors: Dr. Sean M. Watts, Lecturer, Environmental Studies & Dr. Michelle Bezanson, Asst Prof, Anthropology

Microhabitats have an often under-appreciated influence on the ecology of forests and other ecosystems. These microhabitats are especially important to amphibians due to their sensitivity to humidity and litter composition; anurans in the family Dendrobatidae are no exception. Hand-capture surveys of Dendrobatid frogs were conducted in three 10x2m plots within three distinct microhabitat types of a lowland tropical forest in eastern Costa Rica. The three microhabitat types were less than a kilometer apart and included: non-native bamboo forest, a riparian zone in secondary forest, and a much older forest site, between two large, old-growth buttress trees. Surveys revealed site specific differences in the abundance and size distributions of three species of Dendrobatids: *Dendrobates auratus*, *D. pumilio* and *Phyllobates lugubris*. The old-growth site had five times more Dendrobatid frogs than the non-native bamboo forest. The old-growth site also had the most juveniles (14); an important indicator of a healthy population. In contrast, the riparian site had 6 juveniles and the bamboo forest had none. The rarest species, *Phyllobates lugubris*, was only found within the riparian microhabitat. These results emphasize the impact of exotic dominated forest patches and the importance of primary forest for reproduction. The results also suggest that broader surveys focused on adult captures might overestimate the suitability of an otherwise seemingly healthy forest.

Canopy density and animal interactions with the river

Kristin Sterling Junior, Accounting and Environmental Studies

Mentors: Dr. Sean M. Watts, Lecturer, Environmental Studies & Dr. Michelle Bezanson, Asst Prof, Anthropology

With ecotourism on the rise, Costa Rican forests have become subject to a number of policies and regulations regarding land use and management, one of the most recent and influential being the 1996 Forest Law and the 1997 regulations. This study examines the relationship between canopy density, or lack thereof due to land management by farmers, and the frequency and types of animal interactions in the riverine ecosystems of La Suerte neotropical, premontane wet forest. Data were collected in observations sessions at three different sites along the La Suerte River in periods of one to two hours, at different times of day. I used an all-occurrence and *ad libitum* sampling method. I predicted that interactions would occur more frequently in canopy dense areas, where flora had not been disturbed by human interferences and that mammalian interactions would occur in greater frequency in canopy dense areas. My results suggest that canopy density and animal interactions were both positively and strongly correlated with one another. I observed no mammals where canopy was scarce and observed mammals, avifauna, and herpetofauna where canopy was most dense (78%). This relationship demonstrates the ill effects of destructive land management on Costa Rica's sensitive riverine ecosystems.

Vibrational communication: A language of its own

Khaaliq Dejan Senior, Bioengineering

Mentor: Dr. Janice Edgerly-Rooks, Prof, Biology

Embiids (silk spinning insects) lunge and shake their bodies within their silk domiciles apparently in response to natural enemies. Field evidence suggests that propensity to signal is greater for egg-guarding females than for others, and as such the signals appear defensive. The purpose of this study was to develop methods to record vibrations and to determine the context in which they are elicited. Vibrations in the lab were recorded using piezoelectric film (a detector) connected to a computer, The detector was placed inside an arena where an adult female was allowed to spin a domicile, within which she would lay eggs. To understand the context of signaling, two factors were varied: intruder threat level and reproductive state of the resident. Intruder threat level ranged from high (adult female and nymphs who can devour eggs) to low (adult males who would not be a threat to eggs because they do not feed). Reproductive state of the resident was either pre-reproductive or egg guarding. Our predictions were that egg-guarding females would be aggressive and that nymphs and adult females would elicit signals because they represent a threat. As individual intruders entered the arena, a continual record was made of all vibrations and behaviors. Preliminary results show that pre-reproductive residents do not exhibit defensive behavior; they did not produce vibratory signals in response to intruders. In contrast, egg-guarding females reacted defensively to both immature and mature females, signaling most vigorously to adults who were more reluctant to retreat than were the nymphs. The embiids did not attack each other suggesting that vibrations serve to communicate while eliminating the need for a real fight. Adult males elicited scant signals even though males were likely to enter the resident's domicile to court the female. In this presentation, signals will be characterized using Audacity software and compared to those of other insects that use substrate vibration as communication.

Analysis of macroscopic charcoal amounts in Guatemalan lake sediment cores

Thomas Lloyd-Davies Senior, Environmental Science

Mentor: Dr. David Wahl, US Geological Survey, Menlo Park

Understanding the history of fire occurrences in a region can provide important information about the links among climatic, vegetative, and human interactions during the late Holocene. Charcoal preserved in lake sediments and other media presents a chronicle of this fire occurrence. Macroscopic analyses of charcoal in sediment cores from Laguna Yaloch in Guatemala were used to recreate the regional fire history for the past

3000 years. Fire intervals range from approximately 100 to 600 years apart, with peak periods occurring around 900 B.C., 700 B.C., 250 B.C., 600 A.D. and 1000 A.D. These events are significant as they signal a time when climate shifted to a point where rainforest dried enough to sustain major fires, undoubtedly affecting the established local civilizations.

Research Panel 2:25 – 2:55pm

Session V: SOCIOLOGY & ENVIRONMENTAL STUDIES 2:55 – 3:40pm

Research Opportunity: The need for interdisciplinary research at the undergraduate level in the search for social justice

Dr. Regina Davis-Sowers, Postdoctoral Fellow, Sociology

In order to ensure social justice for all, it is imperative that researchers utilize a holistic approach to studying the social world. Too often, knowledge from one discipline is not shared across disciplines, leading to repetitive research as well as findings that do not include very pertinent information. I believe that the time to start interdisciplinary research is at the undergraduate level, with undergraduates from two or three disciplines sharing information that enhances research capabilities. Understanding social problems such as health disparities across race and ethnicity, age, and social class, requires knowing the results of health disparities on individuals and communities, information available from our science colleagues. As graduate programs become more focused on research and publishing, it is important for undergraduates from Santa Clara University to be able to demonstrate not just that they understand the concepts and theories of their own disciplines, but that they are well-rounded in other disciplines. Interdisciplinary research allows for greater understanding and prepares our students for the rigors of graduate school, as they enter graduate school already versed in research that crosses disciplinary boundaries. It is important for professors to create opportunities for interdisciplinary research for our undergraduate students. It allows us to help our students comprehend the ideas of social justice for all.

Working at the margins: Access to recycling cooperatives as a means of social inclusion for *catadores* (waste pickers) in Salvador, Brazil

Meghan Mooney Senior, Anthropology

Mentor: Fr. Luis Calero, Assoc Prof, Anthropology

Brazil, like many other emerging nations, is home to a large and diverse population of *catadores*, waste pickers who survive by sorting through trash for recyclable materials they can resell for money. In recent decades, cooperatives performing a similar type of recycling have sprung up throughout Brazil, and have been acknowledged for their potential to organize informal waste-picking work, offer higher wages, safer working conditions and greater social inclusion to informal waste pickers. This interview-based, anthropological research, located in the urban center of Salvador, evaluates the success of the cooperative system by examining its relationship with and effect on the larger population of informal waste workers operating in the city. Through in-depth participant observation and an examination of knowledge and opinions, reasons and realities—both explicit and implicit—for why the informant population continues to work outside the cooperatives, this research discovered that cooperatives generally fail to include informal waste pickers or offer reasonable wages better than those found on the street. In fact, the most significant relationship between informal waste pickers and cooperatives has nothing to do with access to cooperatives as a means of social inclusion, but rather indirect competition for the same resource, recyclable materials in trash.

Do anti-smoking programs make us fatter? Empirical evidence from New York City

Nick Obradovich Senior, Economics/Environmental Studies

Mentors: Dr. S. Andrew Starbird, Prof, Operations & Management Information Systems, Faculty Director, Business & Dr. Carolyn L. Evans, Assoc Prof, Economics

Smoking and obesity are two of the leading causes of preventable illness and death in the United States. Both conventional wisdom and previous scientific research indicate that smoking (via the effects of nicotine) has a downward effect on body weight, reducing body mass index (BMI). Thus far, the economic literature examining the subject has provided conflicting results. Utilizing the 'natural experiment' provided by New York City's 2002-2003 comprehensive tobacco control program, this paper employs an alternative empirical strategy, difference-in-differences, to analyze the question. Effects of the comprehensive tobacco control program on overweight and obesity in New York City are examined.

Short Panel & Break **3:40 – 3:50pm**

Session V (cont'd): SOCIOLOGY & ENVIRONMENTAL STUDIES 3:50 – 4:35pm

Can poverty be solved by exporting cash crops? A case study of two coffee farms in El Salvador

Elizabeth Marie Tellman Senior, Individual Studies (Sustainable Globalization)/Environmental Studies

Mentor: Dr. Leslie Gray, Assoc Prof, Environmental Studies

Coffee is the world's 2nd most internationally traded commodity after oil. Thus, when the coffee market crashed in 2001, 25 million families were thrown into poverty, and began to search for solutions. Though Fair Trade, a certified alternative trading system that guarantees a higher price for farmers, has been marketed as the panacea for this coffee crisis, the certification process is too expensive for most small Salvadoran coffee farmers. Two alternative solutions practiced by farmers in El Salvador are to market organic coffee nationally, or to export organic coffee directly to the United States. We researched two types of organic coffee cooperatives, one that exports and one that does not, to determine which system generates greater economic benefits to farmers and protects families from going hungry, or becoming food insecure. Through interviews, surveys, and observation, our case studies show that better coffee prices farmers receive from alternative markets do not guarantee economic stability. The weakness of the national market, and the violent history of land reform are two mitigating factors. Although exporting coffee directly under a "fair price" with out paying for a Fair Trade certification provides farmers with more income, in our case study, all extra profits went to paying cooperative debt leftover from the 2001 coffee crisis instead of going into farmers pockets. Solutions to rural poverty for Salvadoran coffee farmers will require more than trading organic coffee "fairly."

Quality of life: The impacts of gender, emigration, health, and education in coffee-producing communities

Alexandra Nicole Dunne Senior, Individual Studies (Global Cultural Studies)

Mentor: Dr. Leslie Gray, Assoc Prof, Environmental Studies

When examining export markets for organic coffee it is essential to go beyond economics. Our research indicates that in El Salvador better coffee prices and markets do not translate into bettering the social conditions in two coffee producing communities. We specifically focused on inadequate health care, substandard education systems, unstable community infrastructures, deep-rooted and often violent gender inequality, and the culturally devastating rise in emigration that seemingly fractures every family. The first coffee cooperative, that decided to forego the expenses of global trade, and to sell its product locally and at lower prices, fared better in all measured factors. The second coffee cooperative, whose direct coffee exports did not attribute to their social gains. The only short-term improvement in the communities' livelihood was its infrastructure cognizance. Trickle down effects of benefits may not be experienced in this community for at least five years. Poverty in El Salvador cannot be reduced to matters of economics, nor the lack of social mobility or responsibility, it is a combination of these interconnected factors that contribute to the improvement of coffee communities' livelihoods.

How much energy could the university save by simply implementing an energy plan in the library?

Mitchell Klipa[1] and Alexandra Burkhuch[2]

[1]Sophomore, Marketing
[2]Sophomore, English

Mentors: John S. Farnsworth, MFA. MLA. Lecturer, Environmental Studies

There are more than a dozen major computer labs on the campus of Santa Clara University; many of these labs run more than 30 computers. A high percentage of these labs run at full capacity 24 hours a day, seven days a week. Although the university has a goal of reducing carbon dioxide emissions to a level of 20% below 1990 emissions by the end of 2010, nothing is currently being done to monitor energy use in computer labs. I hypothesize that the university could easily cut energy use within the computer labs consonant with that goal by adjusting the power settings on these computers. Methodologically, we are proceeding by measuring energy use on per computer basis as well as determining what power settings are being used on lab computers. Preliminary results suggest that there has been absolutely no coordination of effort between SCU Facilities, lab managers, and IT services to reduce energy consumption of campus computer labs. We anticipate being able to make specific recommendations for power settings that should lead to significant energy reductions throughout the university.

Research Panel **4:35 – 5:05pm**

Awards Ceremony **5:10 – 6:30pm**

USES Participants: 8/9 May 2009

Name	Title/Year	Dept/Major	Email (@scu.edu)
Akhavan Tafti, Navid	Senior	Electrical Engineering	NAkhavantafti
Archie, Patrick	Lecturer	Env'tal Studies	JArchie
Barnett, Christinah	Senior	Anthropology/Studio Art	CBarnett
Bates, Daniel	Senior	Env'tal Science/Civil Engineering	DBates
Benko, Craig	Junior	Physics	CBenko
Bezanson, Michelle	Asst Prof	Anthropology	MBezanson
Birmingham, John	Assoc Prof	Physics	JBirmingham
Buenrostro, Jason	Senior	Biology/Bioengineering	JBuenrostro
Burkhuch, Alexandra	Sophomore	English	ABurkhuch
Calero, Luis	Assoc Prof	Anthropology	LCalero
Davis-Sowers, Regina	Postdoctoral Fellow	Sociology	RDavisSowers
Dejan, Khaaliq	Senior	Bioengineering	KDejan
Dicochea, Perlita	Asst Prof	Ethnic Studies	PDichochea
Dunne, Alexandra	Senior	Indiv Studies: Global Cultural Studies	ANDunne
Edgerly-Rooks, Janice	Prof	Biology	JEdgerlyRooks
Evans, Carolyn L.	Assoc Prof	Economics	CLEvans
Farnsworth, John	Lecturer	Env'tal Studies/English	JFarnsworth
Ferron, Kelly	Junior	Env'tal Science	KFerron
Gray, Leslie	Assoc Prof	Env'tal Studies	LGray
Guzman, Patty	Senior	Env'tal Science/Studies	PGuzman
Hagerty, Christina	Junior	Env'tal Science/Biology	CHagerty
Honzel, Dana	Junior	Biochemistry	DHonzel
Huston, Laura	Senior	Math/Env'tal Science	LHuston
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Li, Ke	Senior	Electrical Eng	KLi1
Lieu, Amanda	Senior	Biology	ALieu
Lewis, Alexandra	Junior	Physics	ALewis
Lloyd-Davies, Thomas	Senior	Env'tal Science	TLloydDavies
Marks, Zefram	Senior	Electrical Engin.	ZMarks
Maurer, Edwin	Assoc Prof.	Civil Engineering	EMaurer
Melisi, Chris	Sophomore	Env'tal Science	CMelisi

Name	Title/Year	Dept/Major	Email (@scu.edu)
Mooney, Meghan	Senior	Anthropology	MMooney
Obradovich, Nick	Senior	Economics	NObradovich
Rose, Christopher	Junior	Biochemistry/Biology	CMRose
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Sheffield, Hope	Junior	Engineering/Physics	HSheffield
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Starbird, S. Andrew	Prof	Business, OMIS	SStarbird
Stephens, Craig	Associate Prof	Biology	CStephens
Sterling, Kristin	Senior	Accounting/Env'tal Studies	KSterling
Stewart-Frey, Iris	Asst. Prof	Env'tal Studies Inst.	IStewartFrey
Strawa, Anthony		NASA Ames Research Center	Anthony.W.Strawa@nasa.gov
Students of BIOL 176		Biology	
Suljak, Steven	Asst Prof	Chemistry	SSuljak
Sun, Xuhui	Prof	Engineering	XHSun
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Tellman, Elizabeth	Senior	Indiv Studies: Sustainable Globalization/Env'tal Studies	ETellman
Weber, Chris P.	Asst Prof	Physics	CWeber
Whittall, Justen	Asst Prof	Biology	JWhittall
Wu, Wen	Sen Res Asst Prof	SCU Center for Nanostructures	W1Wu
Yamada, Toshishige	Research Prof	Engineering	TYamada
Yang, Cary Y.	Prof	Electrical Engin.	CYang

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