

# Presentation Days 2009



## A Celebration of Student Projects

May 4, 5 & 6

**HARVEY MUDD**  
C O L L E G E

Claremont, CA

---

## Presentation Days 2009

### A Celebration of Student Projects

Research is an integral part of the education of all students at Harvey Mudd College. The ability to conduct original investigations, to plan an approach to a problem, and to see it through are essential to success in any scholarly endeavor. We set time aside during the spring semester to celebrate the work of Harvey Mudd College students as they present their original projects in design or research. Whether this work is done in the context of the Clinic Program, as an individual research project with a faculty adviser, or as part of a class project, the emphasis is on the students' own achievements. Some of this work has already been published; much more of it will be published in the future.

This year, over 300 students are participating in Presentation Days, including more than 100 research talks from students in each of the majors. Students in the Department of Humanities, Social Sciences and the Arts are displaying their photographs, while students in the club Mudd Software Designs are discussing software as community service. Experimental Ecology students are presenting studies on coastal sage scrub and potential effects of development near the Bernard Field Station. The results of the Introduction to Engineering Design projects, involving teams of first-year and sophomore students, will also be presented. The Jazz Improvisation class will perform the music of Tom Harrell, modern jazz trumpet player and composer.

The keynote speaker for Presentation Days 2009 is Kerry Karukstis, professor of chemistry at HMC. Professor Karukstis serves as a *Journal of Chemical Education* feature editor on the role of undergraduate research in chemical education and is immediate past president of the Council on Undergraduate Research, which named her Volunteer of the Year in 2004. Her talk, "Taking Undergraduate Research from Good to GREAT: Pivotal Junctures in the Undergraduate Research Enterprise," will be delivered Monday, May 4, at 4:00 P.M. in Galileo Hall.

For more information about Presentation Days events, contact the Office of the Dean of Faculty at Harvey Mudd College, 909.621.8122. To find out more about research at HMC, visit [www.hmc.edu/academicsclinicresearch/research1.html](http://www.hmc.edu/academicsclinicresearch/research1.html).

The Presentation Days Committee consists of Robert Drewell, Gerald Van Hecke '61, Donald Remer, Paul Steinberg, Nicholas Pippenger, Patricia Sparks, Stephanie Graham and Esther Hughes, and is chaired by Robert Keller.

## Schedule Monday, May 4

All-Day Exhibits Humanities, Social Sciences and the Arts– Art 50, Art 100, Art 150 Photography, Art 60; Biology 110; Chemistry posters; and poster by Mark Cyffka

	<b>BIOLOGY</b> Galileo-Edwards	<b>CHEMISTRY</b> Galileo-Edwards	<b>ENGINEERING</b> Jacobs B132	<b>ENGINEERING</b> Jacobs B134	<b>HUMANITIES, SOC. SCI., ARTS</b> Galileo-Pryne	<b>MATHEMATICS</b> Beckman B126	<b>PHYSICS</b> Galileo-McAlister
8:30 A.M.	Reception–Galileo Foyer						
9:00 A.M.	Alexandria Taylor		E80: Matthew Keeter, Kyle Klipfel, Timothy Nguyen, Hannah Troisi	E80: Scott Almond, Leo Altmann, Benjamin Hsieh, Cullen McMahon	Alex Randall	Ben Preskill	C.P.E. Gaebler
9:15 A.M.	Andrew Nevarez				Elizabeth Ellis		David Stachnik
9:30 A.M.	Christina Snyder		E80: Daniel Ihlenfeldt, Cassie Nguyen, Erin Powers, Max Wishman	E80: Julia Karl, Lauren Nishioku, Erin Parltan, Allison Russell	Martijn Van Schaardenburg	Ben Fogelson	Brandon Horn
9:45 A.M.	Diana Tran				Ian Jimenez		Andrew Higginbotham
10:00 A.M.	Reception–Galileo Foyer						
10:15 A.M.	Reception–Galileo Foyer						
10:30 A.M.	Donna Phu		E80: Aaron Guillen, Yael Mayer, Allison Wynn	E80: Dillon Ayers, Joel Brown, Rachid Grimes, Maryellen Moore-Simmons	Jinsun Yoo	Natalie Durgin	
10:45 A.M.	GINNA KIM				Julian Freed-Brown		
11:00 A.M.	John M. Allen		E80: Becky Glick, Christian Jolivet, Susanna Lin, Roque Muña	E80: Kyle Baran, Madeleine Ong, Kevin Renfrow, Kevin Yeung	Rachel-Mikel Arce Jaegar	Hendrik Orem	Nathan Jones
11:15 A.M.	Kerri Thomas				Maxwell Lee		Tahir Yusufaly
11:30 A.M.	Leslie Mallinger		E80: Marie Godla, Caitlin Jacques, Jason Kang, Andrew Macrae	E80: Ariel Berman, Julia Diaz, Tae Lee, Yoichi Sagawa, Kramer Straube	Martin Field	Sarah Fletcher	Akash Rakholia
11:45 A.M.					Arthur Eigenbrot		Eric Peterson
NOON	Lunch						
1:00 P.M.		Taylor Neiman	E80: Chris Ferguson, Winfong Lee, Alexander McAuley, Matthew Phillips, Thomas Strizic	E80: Timothy Challener, Christopher Nield, Wei Wei, Zhao Andrew Xue	Steven Huntzicker	Nadia Abuelezam	
1:15 P.M.		Rachel Nishimura			Shannon McKenna		
1:30 P.M.		Jonathan Litz	E80: Doo Chung, Visar Jahiu, Paige Pruitt, David Rolfe	E80: Austin Anderson, Kirsten McAfee, Claire Robinson, Benjamin Ryan	Maryellen Moore- Simmons	Andrew Hunter	
1:45 P.M.		Ken Loh					
2:00 P.M.		Nancy Eisenmenger	E80: Zachary Flom, Narayan Propato, Matthew Streshinsky, Daniel Taller	E80: Brandyn Carlson, Katherine Maddalena, Brendan Smith, Harry Wornick	STS 190: Community Outreach in STEM Education: History and Critical Analysis– Catherine Bradshaw, Kelley Hodges, Kathryn Schmiedicke, Laura Willson	Julian Freed-Brown	
2:15 P.M.		Aurora Pribram- Jones					
2:30 P.M.		Joanne Redford	E80: Matthew Cummins, Ian Jimenez, Ashley Nelson, Eric Nieters	E80: Steven Gordon, Rachael Martin, Chris Ramos, Kristina Runas, Elliot Smith			
2:45 P.M.							
3:00 P.M.			E80: Nicholas Card, Esther Hwang, Jennifer Rinker, Yen-Kuei Peter Tu	E80: Steven Berry, Kevin Chan, David Turner, Sarah Yi			
3:15 P.M.							
3:30 P.M.	Reception–Galileo Foyer						
3:45 P.M.	Reception–Galileo Foyer						

4:00 P.M. **Presentation Days Address–Galileo-McAlister**

SPEAKER: Professor of Chemistry Kerry Karukstis, Harvey Mudd College

“Taking Undergraduate Research from Good to GREAT: Pivotal Junctures in the Undergraduate Research Enterprise”

## Tuesday, May 5

10:30 A.M.– Projects Day, Clinic Presentations

6:00 P.M. Please see page 14 for general information. The Projects Day program, available from the Department of Engineering, contains times and locations, or visit [www.hmc.edu/academicsclinicresearch/clinicprogram1/projectsday.html](http://www.hmc.edu/academicsclinicresearch/clinicprogram1/projectsday.html).

## Schedule Wednesday, May 6

All-Day Exhibits    Humanities, Social Sciences and the Arts– Art 50, Art 100, Art 150 Photography, Art 60; Engineering posters

	<b>BIOLOGY</b> Galileo-Edwards	<b>CHEMISTRY</b> Galileo-Pryne	<b>COMPUTER</b> <b>SCIENCE</b> Beckman B126	<b>ENGINEERING</b> Galileo-McAlister	<b>ENGINEERING</b> Galileo-Edwards	<b>HUMANITIES,</b> <b>SOC. SCI., ARTS</b> Jacobs B132	<b>MATHEMATICS</b> Beckman B126	<b>PHYSICS</b> Galileo-McAlister & Galileo-Pryne*	
8:30 A.M.	Reception–Galileo Foyer								
9:00 A.M.	Hallie Kuhn					Phil 125 20-minute talks	MCM: Designing a Traffic Circle	Ian Wright	
9:15 A.M.	Jordan Eboreime								Albert Tsao
9:30 A.M.	Elizabeth Corpuz						MCM: Cut the Cord: Evaluating Cell Phone Recharger	Ethan Rubin	
9:45 A.M.	Oksana Sergeeva								Benjamin Roig
10:00 A.M.	Reception–Galileo Foyer								
10:15 A.M.	Reception–Galileo Foyer								
10:30 A.M.	Matthew Borok					Phil 125 20-minute talks	Theodore Spaide	Rudy Resch	
10:45 A.M.	Robert Egan								Matthew Lawson
11:00 A.M.	Stacy Sun							Rachel Cranfill	Physics 170*: Robocode Competition (in Galileo-Pryne)
11:15 A.M.	Terence Wong								
11:30 A.M.	Marissa Quitt							Jennifer Iglesias	
11:45 A.M.									
NOON	Lunch								
1:00 P.M.		Steven Pankratz	CS121: Ehrlich, Vonnegut		E4: Device to implement photo- biomodulation in the ear (5 presentations)	Phil 125 20-minute talks			
1:15 P.M.		Lauren Hughs	CS121: Ma, Watanabe, Wodrich	E4: Low-cost remote water height reporting post (3 presentations)					
1:30 P.M.		Alison Lee	CS121: Bickerman, Fielder, Yust						
1:45 P.M.		Joshua Cobb	CS121: Just, Wang, Yakovlev						
2:00 P.M.		Judy Hines	CS121: Green, Ingram, King	E4: Design of a robo-fluke (3 presentations)					
2:15 P.M.		Trevor McQueen	Adrian Sampson				E4: Assistive device for lifting objects into a car trunk (2 present.)		
2:30 P.M.		Glennis Rayermann							
2:45 P.M.	Reception–Galileo Foyer								
3:00 P.M.	Reception–Galileo Foyer								
3:15 P.M.		Ryan Pakula	James Brown, Martin Field	E4: Automatic gate-opening device for a chicken coop (5 presentations)	E4: Stove design for communities in Malawi (6 presentations)				
3:30 P.M.		Seanna Vine	Mudd Software Designs						
3:45 P.M.		Maggie Weber							
4:00 P.M.			James Brown						
4:15 P.M.									
4:30 P.M.									
4:45 P.M.									

7:45 P.M.– Reception– Green Room, Platt Campus Center

8:00 P.M.– Humanities, Social Sciences and the Arts Concert, Music 84– Green Room, Platt Campus Center

## **All-Day Exhibits, Monday, May 4**

### PARSONS GALLERY

**Art 50: Beginning Black & White Photography.** Course Instructor: *Steve Schenck, Humanities, Social Sciences and the Arts*  
**Nadia Abuelezam, Daniel Bobrowsky, Alicyn Henkhaus, Greg Herschler, Judy Hines, Calvin Loncaric, Jennifer Osgood, Maureen Ruiz, Stacy Sun, Natalie Suzuki (Pitzer)**

On display will be students' best work from the Introductory Black and White Photography class.

### SPRAGUE LIBRARY

**Art 60: Workshop in Hand-Press Printing.** Course Instructor: *Jeffrey D. Groves, Humanities, Social Sciences and the Arts*  
**Seth Anderson (CGU), Christiana Bedard, Mark P. Cyffka, Chelsea Drenick, Benjamin Goldenberg, Karen Isaac (Pitzer), Benjamin Jencks, Glennis Rayermann, Hannah Troisi**

Students learn traditional letterpress typesetting and how to print on nineteenth-century iron hand presses. The exhibit will display student work from the founding of the First-Floor Press in 2007 to the present.

### GALILEO FOYER

**Art 100: Introduction to Digital Photography.** Course Instructor: *Steve Schenck, Humanities, Social Sciences and the Arts*  
**Denis Aleshin, David Berryrieser, Simon Lee (Pitzer), Jade McGill (Pomona), Megan Pham, Ryan Quarfoth, Joanne Redford, Scott Smith, Moira Tagle, Kanny Wan, Simon Yang, Kevin Yeung, Caro de Freitas**

**Art 150: Intermediate/Advanced Photography.** Course Instructor: *Tad Beckman, Humanities, Social Sciences and the Arts*  
**Anton Bakalov, Daniel Bobrowski, Sam Gordon, Mark Hubenschmidt, Geoff Kuenning (faculty), Lorraine Laprade (CGU), Jennifer Lee, Kyle Marsh, Brett McLarnon, Rachel Nishimura, Benjamin Preskill, Benjamin Taborsky**

The Art 100 and Art 150 presentations will be "streaming slide shows" of selected works. Members of the classes will be on hand to comment and answer questions throughout.

**Mark P. Cyffka: *From Textura to Italic: Examples from the First Century of Typographical Design.*** Course Instructor: *Jeffrey D. Groves, Humanities, Social Sciences and the Arts*

The project is a brief history of early typography, tracing the development of printing fonts from the earliest German texturas of the 1450s, through the romans of the 1460s, and to the Aldine italics of the 1500s. By working through three primary sources from the Honnold Library archive—sheets from a Gutenberg Bible, a 1471 printing of Thucydides, and a 1505 edition of Dante—the rapid typographical progress that took place in the earliest years of the printed book will be described. Mark will be on hand **9:00–10:00 a.m.**

**Biology 110: Experimental Ecology Laboratory: The Price of a Parking Lot: Ecological Impacts on the Coastal Sage Scrub Community at the Bernard Field Station.** Faculty Adviser: *Catherine S. McFadden, Biology*

**Harry Dudley, Eric Gunther, Chris Gurney, Clint Leach, Andrew Nevarez, Marissa Quitt, Andreas Schmid, Juliet Shih, Brian Stock, Karla Whitfield**

HMC purchased 11 acres of coastal sage scrub habitat north of Foothill Blvd. for possible future construction of a parking lot and other facilities. Students in Biology 110 conducted studies to predict the impact of this planned development on populations of plants, invertebrates, small vertebrates and predatory birds and mammals in adjacent areas of the Bernard Field Station. Potential ecological consequences include loss of biodiversity, edge effects leading to increased invasion by non-native species, and trophic cascades resulting from loss of top predators. Students will be on hand from **3:00–4:00 p.m.**

### **Chemistry Posters**

**Alison Lee, Aurora Pribram-Jones, Taylor Neiman, Trevor McQueen, Jonathan Litz, Joshua Cobb, Glennis Rayermann, Mark P. Cyffka, Andrew Chung, Chiara Giammanco, Eric Nacs, Joanne Redford, Lauren Hughs, Rachel Nishimura, Ken Loh**

Students will be on hand from **3:00–3:30 p.m.**

**Presentations, Monday, May 4****8:45 A.M.**

Galileo Foyer RECEPTION

**9:00 A.M.**

Galileo- BIOLOGY

Edwards **Alexandria Janine Nalei Taylor: *Intraspecific Trade-offs between Maximal Sprint Speed and Endurance of Sceloporus occidentalis in Claremont, California***

A trade-off is a relationship that demonstrates a negative correlation between at least two sets of data. For example, if we compared an Olympic sprinter with an Olympic long distance runner we would probably find that the fastest sprinters are not as successful when running long distances, thereby demonstrating the presence of a trade-off between sprint speed and endurance capability. The same principle can be applied to *Sceloporus occidentalis* (Western Fence lizards); it is expected that lizards with a higher maximum sprint speed will also have a lower endurance capacity and vice versa.

Faculty Adviser: *Stephen Adolph, Biology*

## ENGINEERING

**E80: Experimental Engineering– *Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions***Faculty Advisers: *Tony Bright, Mary Cardenas, Sarah Harris, Erik Spjut, Engineering*Jacobs B132 **Matthew Keeter, Kyle Klipfel, Timothy Nguyen, Hannah Troisi**Jacobs B134 **Scott Almond, Leo Altmann, Benjamin Hsieh, Cullen McMahon**

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**Integrative Experience (IE) 150: Public Speaking for Science and Citizenship**

The goal of this course is to build student speaking skills in three areas: communicating science to non-specialists; speaking out on questions of politics and values; and engaging the intersection of the two through oral presentations on technically intensive social controversies.

Faculty Adviser: *Paul Steinberg, Humanities, Social Sciences and the Arts***Alex Randall: *Will u b my gf?: The Effects of Computer-Mediated Communication on Interpersonal Relationships***

Beckman B126 MATHEMATICS

**Ben Preskill: *Existence and Nonexistence of Continuous Solutions to a Semilinear Wave Equation***

We prove two results; first, we show that a boundary value problem for the semilinear wave equation with smooth, asymptotically linear nonlinearity and sinusoidal smooth forcing along a characteristic cannot have a continuous solution. Thereafter, we show that if the sinusoidal forcing is not isolated to a characteristic of the wave equation, then the problem has a continuous solution.

Faculty Adviser: *Alfonso Castro, Mathematics*

Galileo- PHYSICS

McAlister **C.P.E. Gaebler: *Distinguishability of Hyperentangled Bell States***

In quantum theory, the Bell states of two entangled particles are a set of four very important states. Certain important processes in quantum communication require distinguishing between all four states. However, under common experimental conditions, only three cases can be reliably distinguished. I find theoretical limits for the distinguishability of analogous states of particles that are entangled in multiple modes.

Faculty Adviser: *Theresa Lynn, Physics*

**9:15 A.M.**

Galileo-  
Edwards      BIOLOGY

**Andrew Nevarez: *Rapidly evolving gene regulatory regions in Drosophila***

The fruit fly *Drosophila melanogaster* occupies an extraordinarily wide ecological niche, living in close proximity to humans with the ability to eat a wide variety of rotting fruits. Differential gene expression between species has emerged as a primary hypothesis to explain differences between organisms, and it is possible that *D. melanogaster's* ability to live everywhere is the result of adaptive evolution in gene regulatory regions. In this project, I identify potentially functional genomic regions that are evolving rapidly in *D. melanogaster*. I then test some of these elements in *Drosophila* S2 cells for evidence of gene regulatory function.

Faculty Advisers: *Eliot Bush and Robert A. Drewell, Biology*

HUMANITIES, SOCIAL SCIENCES AND THE ARTS

Galileo-Pryne      **IE150: Public Speaking for Science and Citizenship** (See description, page 5.)  
**Elizabeth Ellis: *The Life of the Flesh: Meat-eating in the Industrial World***

Galileo-  
McAlister      PHYSICS

**David Stachnik: *Resistance of spin valves with varying Tantalum seed layer thicknesses***

Spin valves are widely used in magnetic storage media and spintronics devices, yet they are not fully understood. In studies of the antiferromagnetic layer thickness, anomalous temperature-dependent resistivity features were observed. Similar features were also observed in tantalum thin films. Since tantalum is commonly used as a seed layer and capping layer in spin valves, these resistivity effects might indicate that the seed layer affects the spin valve characteristics, contrary to expectations. The effect of tantalum seed layers on spin valve properties is investigated here.

Faculty Advisers: *C-Y Chen, J.C. Eckert and P.D. Sparks, Physics*

**9:30 A.M.**

Galileo-  
Edwards      BIOLOGY

**Christina Snyder: *Exploring the DNA-Protein Interactions of the Catalytic Domain of Human APOBEC3G***

Human APOBEC3G is an antiretroviral enzyme known to restrict the replication of HIV-1 and other retroviruses by catalyzing the hydrolytic cytidine deamination of nascent single stranded viral DNA in the host cell's cytoplasm. Previously proposed models for the structure of this enzyme suggest two distinct possible modes by which it might bind target DNA. Site directed mutagenesis was utilized in order to explore this interaction and determine which model more accurately portrays APOBEC3G-DNA binding. The results provide a basis for better understanding the underlying mechanisms of this protein's deamination of single stranded DNA.

Faculty Adviser: *Karl Haushalter, Biology*

ENGINEERING

**E80: *Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions***

Jacobs B132      **Daniel Ihlenfeldt, Cassie Nguyen, Erin Powers, Max Wishman**

Jacobs B134      **Julia Karl, Lauren Nishioku, Erin Partlan, Allison Russell**

Galileo-Pryne      HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**IE150: Public Speaking for Science and Citizenship** (See description, page 5.)

**Martijn Van Schaardenburg: *Why We're Doomed: The Threat Nanobots Pose and Why We Will Fail to Address It***

Beckman B126      MATHEMATICS

**Ben Fogelson: *Survival and Proliferation of Chronic Lymphocytic Leukemia in Lymphoid Tissue***

Chronic lymphocytic leukemia is a cancer characterized by complex interactions with healthy immune cells that may influence disease outcome. In this work, a partial differential equation model of some of these interactions is developed. In particular, the model accounts for cancer survival and growth, and for the chemotactic movement of cancer and immune cells.

Faculty Adviser: *Lisette de Pillis, Mathematics*

Galileo-  
McAlister      PHYSICS  
**Brandon Horn: *Laying the Groundwork for an Adaptive Optics System for Table Mountain Observatory***

In this work, I describe the basics of an adaptive optics system, and how one can be effectively implemented on Pomona College's 1-meter Table Mountain Observatory (TMO). I describe the reasoning behind my design of the computer model of the AO system and modifications that may be made to this model for ease of engineering or to make the system more affordable. Finally, the current setup of the adaptive optics components in an AO testbed is discussed, and I describe its capabilities, as well as how it will be improved by implementing the computer model.

Faculty Adviser: *Phil Choi, Pomona College*

**9:45 A.M.**

Galileo-  
Edwards      BIOLOGY  
**Diana Tran: *Functional characterization of an ultra-conserved module at the Telomerase gene promoter***

Telomerase (TERT) is an enzyme that is essential in the maintenance of telomeres. Its misregulation in over 90% of cancers prompted the study of its regulation at the transcriptional level. Bioinformatic analysis of the promoter region of TERT revealed a region of high conservation between mouse and human, which we named Telomerase Ultra-Conserved (TUC). Conservation of DNA sequence is frequently an indicator of important functional activity. Using cell-based luciferase reporter gene assays, we investigated the TUC as a cis-regulatory module capable of influencing expression of the adjacent TERT gene.

Faculty Adviser: *Robert A. Drewell, Biology*

HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
Galileo-Pryne      **IE150: Public Speaking for Science and Citizenship** (See description, page 5.)  
**Ian Jimenez: *The Rise of the Anti-Commons in Intellectual Property***

Galileo-  
McAlister      PHYSICS  
**Andrew Higginbotham: *Harmonic Faraday excitation with applications in laser driven fusion***

Micron scale fluid aerosols have a wide range of applications in industry and science. Of particular interest, the aerosols may be used as targets for laser-driven, thermonuclear fusion. However, nonlinear fluid effects make it difficult to generate aerosols with the desired properties. To side step this constraint, we have studied a new phenomena in fluid mechanics: harmonic Faraday waves in an inviscid fluid. Using this effect, we can create aerosols composed of smaller particles, which may ultimately improve fusion yield.

Faculty Adviser: *Tom Donnelly, Physics*

**10:00–10:30 A.M.**

Galileo Foyer      RECEPTION

**10:30 A.M.**

Galileo-  
Edwards      BIOLOGY  
**Donna Phu: *Investigating the Interactions between the Corneal ECM and Rabbit Corneal Fibroblasts***

Human donor tissue transplantation is associated with problems such as immunorejection and recurring graft failures. A viable tissue-engineered cornea offers a promising alternative to using human donor tissues in treating corneal diseases. A TE cornea must be optically transparent. This transparency can be achieved by controlling the protein expression of cells and the microarchitecture of the surrounding extracellular matrix (ECM). The aim of this project is to combine the effects of the ECM and the cellular components to build a stable three-dimensional construct that will maintain a transparent phenotype.

Faculty Adviser: *Elizabeth Orwin '95, Biology*

ENGINEERING  
**E80: *Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions***

Jacobs B132      **Aaron Guillen, Yael Mayer, Allison Wynn**  
Jacobs B134      **Dillon Ayers, Joel Brown, Rachid Grimes, Maryellen Moore-Simmons**

**10:30 a.m., continued**

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**IE150: Public Speaking for Science and Citizenship** (See description, page 5.)  
**Jinsun Yoo: *Not the Best One, but the Only One: The Importance of Intellectual Property***

Beckman B126 MATHEMATICS  
**Natalie Durgin: *Abelian Sandpile Model: Symmetric Sandpiles***

The abelian sandpile model, or chip-firing game, is a cellular automaton model on finite directed graphs often used to describe the phenomenon of self-organized criticality. Here we present a thorough introduction to the theory of sandpiles. We define the notion of a symmetric sandpile configuration, and show that such configurations form a subgroup of the sandpile group. Using these constructions, we explore various properties of this symmetric sandpile subgroup.

Faculty Adviser: *Francis Su, Mathematics*

**10:45 A.M.**

Galileo-Edwards BIOLOGY  
**GINNA KIM: *The Construction of a Ddx4-Cre-dsRed Transgenic Mouse***

Our goal was to develop a genetic tool, a transgenic mouse line for Cre-mediated recombination of floxed regions of interest specifically in the germ cells of mouse embryos. The project involved recombining steps to generate a transgenic construct where the Cre-dsRed fusion gene is inserted next to the promoter of the Ddx4 gene, which is germ cell specific. We hope that the fusion protein will be expressed only in mouse fetal germ cells and will allow germ cell-specific Cre-mediated recombination as well as cell sorting of germ cells based on red fluorescence of the dsRed protein.

Faculty Advisers: *Piroska Szabo and Robert A. Drewell, Biology*

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**IE150: Public Speaking for Science and Citizenship** (See description, page 5.)  
**Julian Freed-Brown: *Soggy Waffles: Schools, Spending and Statistics***

**11:00 A.M.**

Galileo-Edwards BIOLOGY  
**John M. Allen: *Molecular Dissection of the IAB5 Enhancer***

Whole-genome sequencing revealed that most DNA is non-coding, but further investigations revealed a complex regulatory network in this non-coding DNA that acts to properly direct gene expression and cell differentiation. My investigation of one such region, IAB5, contained within the homeotic bithorax gene complex of *Drosophila melanogaster* hope to elucidate the molecular landscape and possible functionality of non-coding RNA transcripts.

Faculty Adviser: *Robert A. Drewell, Biology*

ENGINEERING

**E80: *Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions***

Jacobs B132 **Becky Glick, Christian Jolivet, Susanna Lin, Roque Muña**  
 Jacobs B134 **Kyle Baran, Madeleine Ong, Kevin Renfrow, Kevin Yeung**

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**IE150: Public Speaking for Science and Citizenship** (See description, page 5.)  
**Rachel-Mikel Arce Jaeger: *Feeding the World: The Science Behind Flood-Tolerant Rice***

Beckman B126 MATHEMATICS  
**Hendrik Orem: *Fast Matrix Multiplication via Group Actions***

Recent work has shown that fast matrix multiplication algorithms can be constructed by embedding the two input matrices into a group algebra, applying generalized discrete Fourier transform, and performing the multiplication in the Fourier basis. Developing an embedding that yields a matrix multiplication algorithm with running time faster than naive matrix multiplication leads to interesting combinatorial problems in group theory. I show how the process of finding embeddings can in some cases be greatly simplified by considering a natural action of the group.

Faculty Adviser: *Michael Orrison, Mathematics*

Galileo-  
McAlister      PHYSICS  
**Nathan Jones: *Second Harmonic Generation from Mie Spheres***

When an intense beam of monochromatic photons is incident upon a dielectric medium, photons with twice the frequency of those in the incident beam may be produced. Using Maxwell's equations, we can find the power carried by this second-harmonic signal through any solid angle for a given geometry. The research focused on a spherical dielectric medium, specifically, water droplets. After briefly outlining the mechanism responsible for second-harmonic generation, I present previous experimental results, highlight changes our group made to improve the accuracy of the data we collected, and give the experimental results collected after the changes. I hope to demonstrate that we are moving toward a better understanding of how water droplets generate second-harmonic light.

Faculty Adviser: *Tom Donnelly, Physics*

### 11:15 A.M.

Galileo-  
Edwards      BIOLOGY  
**Kerri Thomas: *Resolution of species boundaries within the tropical soft coral genera *Sarcophyton* and *Lobophytum* (Anthozoa; Octocorallia) using the ribosomal internal transcribed spacer (ITS) region***

Several species in two soft coral genera, *Sarcophyton* and *Lobophytum*, exhibit intermediate morphology and are not easily classified using classical morphology-based taxonomy. Genetic differences may help to identify these cryptic species. Previous molecular work with the mitochondrial gene *msh1* distinguished three distinct clades: *Sarcophyton*, *Lobophytum*, and a mixed clade. Still, species boundaries within these clades were unclear. My project examined a more variable region of the nuclear genome (the ribosomal ITS region) to determine whether it was sufficiently variable to define species boundaries within the mixed clade.

Faculty Adviser: *Catherine S. McFadden, Biology*

### HUMANITIES, SOCIAL SCIENCES AND THE ARTS

Galileo-Pryne      **IE150: Public Speaking for Science and Citizenship** (See description, page 5.)  
**Maxwell Lee: *The Historical and Modern Uses of Insurance***

Galileo-  
McAlister      PHYSICS  
**Tahir I. Yusufaly: *Improving Polarization Entanglement in Type-I Spontaneous Parametric Downconversion***

Type-I spontaneous parametric down conversion (SPDC) creates two quantum entangled photons, a signal and an idler, from a single pump photon incident on a beta-barium-borate (BBO) crystal. However, experimental implementation of SPDC is rife with imperfections, including dispersion in the laser beam, non-degenerate signal and idler photons, and a finite, limited-precision collection angle for detecting photons. These nonidealities hinder the purity of the entanglement, which is important in quantum information. I present a theoretical analysis of the imperfections in polarization entanglement, and discuss ways to improve them in our experimental apparatus.

Faculty Adviser: *Theresa Lynn, Physics*

### 11:30 A.M.

Galileo-  
Edwards      BIOLOGY  
**Leslie Mallinger: *Exploring the Possibility of Speech Impairment Due to Mutations in FOXP2, a Gene Implicated in Language Development***

The FOXP2 gene is associated with human language development. Mutations in FOXP2 have been found in several individuals with language disorders. This study focused on a nine-year-old child who is unable to communicate using language. I investigated the possibility of a mutation in her FOXP2 gene by sequencing the FOXP2 coding exons belonging to her and to her parents and then comparing the resultant sequences to each other and to those published in public databases.

Faculty Adviser: *Catherine S. McFadden, Biology*

### ENGINEERING

**E80: *Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions***

Jacobs B132      **Marie Godla, Caitlin Jacques, Jason Kang, Andrew Macrae**  
Jacobs B134      **Ariel Berman, Julia Diaz, Tae Lee, Yoichi Sagawa, Kramer Straube**

**11:30 a.m., continued**

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**IE150: Public Speaking for Science and Citizenship** (See description, page 5.)  
**Martin Field: *Powering the Internet: The Environmental Cost of Data Centers and Network Infrastructure***

Beckman B126 MATHEMATICS  
**Sarah Fletcher: *Exploring Agreeability in Tree Societies***

A forthcoming paper views questions about the intersection properties of a collection of subsets of a line in the context of voting in a society. I have been working on extending these ideas to societies where the underlying set is a tree and have developed a reduction method that makes these tree societies much easier to work with. In particular, I have used this method to show that in several cases the agreement proportion of tree societies is at least as large as the agreement proportion of linear societies with the same intersection properties.

Faculty Adviser: *Francis Su, Mathematics*

Galileo- PHYSICS  
 McAlister **Akash Rakholia: *Investigating Hyperentanglement in Type I Spontaneous Parametric Down Conversion***

Hyperentanglement refers to states entangled in more than one degree of freedom. These states have applications in dense coding and quantum communication protocols. A nonlinear process known as spontaneous parametric down conversion is used to generate photons entangled in polarization, linear momentum, orbital angular momentum, and energy. Using a 405 nm diode laser incident on a BBO crystal, observations of polarization entanglement and linear momentum correlations are made. In addition to experimental results, the possibility of observing orbital angular momentum entanglement will be discussed.

Faculty Adviser: *Theresa Lynn, Physics*

**11:45 A.M.**

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**IE150: Public Speaking for Science and Citizenship** (See description, page 5.)  
**Arthur D. Eigenbrot: *Dwindling Dark: The Effects Of Light Pollution And What You Can Do About It***

Galileo- PHYSICS  
 McAlister **Eric Peterson: *A Teaching Internship at Claremont High School***

During fall 2008, I interned in a general chemistry class at Claremont High School in order to evaluate critically observed practices and to attempt to address those criticisms in my own teaching. In that time, I observed class sessions, assisted my mentor teacher, and ultimately taught a class for two weeks. Throughout the experience, I sought to focus on fundamentals and holistic learning while struggling to overcome obstacles to such a delicate pedagogy.

Faculty Adviser: *Theresa Lynn, Physics*

**NOON-1:00 P.M. LUNCH BREAK**

**1:00 P.M.**

Galileo- CHEMISTRY  
 Edwards **Taylor C. Neiman: *Spontaneous 2-D Nanostructures Formed from Binary Mixtures of Diblock and Triblock Copolymers***

Diblock copolymers such as polyethylene oxide-polystyrene (PEO-PS) have both a hydrophilic (PEO) and hydrophobic (PS) block that allows the polymer to spontaneously self-assemble into various structures when spread at the air-water interface. These structures include dots, strands, or large aggregates depending on the %PEO. Previous studies of pure diblock blends demonstrate that the nanostructures formed can be controlled by judicious choice of PS:PEO ratio. A new study of diblock-triblock blends found bimodal structures that formed at unexpected PEO ratios. Thus, the observed structures reflected their constrained geometries at the air-water interface.

Faculty Adviser: *Shenda Baker, Chemistry*

## ENGINEERING

**E80: Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions**

Jacobs B132 **Christopher Ferguson, Winfong Lee, Alexander McAuley, Matthew Phillips, Thomas Strizic**  
 Jacobs B134 **Timothy Challener, Christopher Nield, Wei Wei, Zhao Andrew Xue**

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**IE150: Public Speaking for Science and Citizenship** (See description, page 5.)

**Steven Huntzicker: Dam it! The Consequences of Dams in the Western United States**

Beckman B126 MATHEMATICS

**Nadia Abuelezam: Treating HIV/AIDS: Preferential ART Distribution in Rural and Urban Uganda**

HIV/AIDS is one of the largest health problems the world is currently facing. Even with the growing popularity of anti-retroviral therapy (ART), resource constrained countries are unable to meet the treatment needs of their infected populations. To this extent ART distribution methods need to be created that prevent the largest number of future HIV infections. We have developed a mathematical compartment model that tracks the spread of HIV in multiple two-sex populations over time in the presence of limited treatment. We draw conclusions about how various preferential treatment strategies will affect the spread of HIV in rural and urban Uganda.

Faculty Advisers: *Lisette de Pillis, Mathematics; Karl Haushalter, Chemistry*

**1:15 P.M.**

Galileo-  
Edwards CHEMISTRY

**Rachel Nishimura: Towards a biomimetic synthesis of the endiandric acids using protected boronates**

Medicinal compounds are often found in nature and inspire the chemical synthesis of new and readily available drugs. The endiandric acids come from a rare Australian walnut tree and have applications in the treatment of asthma. Through an efficient and divergent strategy, my work has built precursors that can be used to synthesize all of endiandric acids and explore unnatural compounds that may have new or heightened medicinal properties.

Faculty Adviser: *David Vosburg, Chemistry*

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**IE150: Public Speaking for Science and Citizenship** (See description, page 5.)

**Shannon McKenna: The Problems and Policies of Nuclear Waste**

**1:30 P.M.**

Galileo-  
Edwards CHEMISTRY

**Jonathan Litz: A concise, biomimetic total synthesis of (+)-davanone**

Davanone is an antifungal, antispasmodic natural product of the Indian sagebrush *Artemisia pallens*. We have synthesized this molecule enantioselectively from geranyl acetate in seven steps with 9% overall yield. A Sharpless asymmetric epoxidation, a thiazolium-catalyzed esterification, and a biomimetic palladium-mediated cyclization were used to selectively generate all three stereocenters. This is the first natural product synthesis to use this style of thiazolium-catalyzed esterification. The synthesis is free of protecting groups and is atom- and redox-economical.

Faculty Adviser: *David Vosburg, Chemistry*

## ENGINEERING

**E80: Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions**

Jacobs B132 **Doo Chung, Visar Jahiu, Paige Pruitt, David Rolfe**  
 Jacobs B134 **Austin Anderson, Kirsten McAfee, Claire Robinson, Benjamin Ryan**

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**IE150: Public Speaking for Science and Citizenship** (See description, page 5.)

**Maryellen Moore-Simmons: How Desalination Can Solve Worldwide Water Shortages**

**1:30 p.m., continued**

Beckman B126 MATHEMATICS

**Andrew Hunter:** *Locality & Complexity in Path Search*

The path search problem models networks as channel graphs: directed acyclic graphs with a single source and sink. Each vertex represents a switching point, and each edge a communication line, possibly unavailable to us (with some probability.) We seek to efficiently search the graph: examine as few edges as possible before determining if a path of free edges exists from source to sink. We consider the difficulty of searching various graphs under different search models, and examine the computational complexity of calculating the search cost of arbitrary graphs.

Faculty Adviser: *Nicholas Pippenger, Mathematics*

**1:45 P.M.**

Galileo- CHEMISTRY

Edwards

**Ken Loh:** *Towards a biomimetic synthesis of the endiandric acids using organotrifluoroborates*

The endiandric acids cascade are a class of natural products found in *Endiandra introrsa*, an endangered plant native to Australia. Endiandric acid H has anti-inflammatory properties and has yet to be synthesized. These polycyclic compounds arise from linear precursors in a cyclization cascade. Efforts have been made towards a biomimetic synthesis of acyclic polyene precursors that would generate these natural products through non-enzymatic electrocyclizations. In particular, the employment of palladium-catalyzed cross-coupling reactions such as the Suzuki-Miyaura reaction using organotrifluoroborates has been a focus of our efforts towards these precursors.

Faculty Adviser: *David Vosburg, Chemistry*

**2:00 P.M.**

Galileo- CHEMISTRY

Edwards

**Nancy Eisenmenger:** *Optimizing Porphyrin Sensitizers on ZnO Nanotubes for Dye Sensitized Solar Cells*

Dye sensitized solar cells have the potential to be an inexpensive replacement for silicon solar cells, but further research is needed to improve their efficiency. One possible construction, which we study, involves the use of porphyrin dyes on zinc oxide nanostructures. The novel zinc oxide nanostructures, which are nanotubes (200 nm diameter) embedded in a disk, form the photonanode of the cell. Our research on these solar cells involves determining the effect of the dye acidity on the efficiency of the cell.

Faculty Adviser: *Hal Van Ryswyk, Chemistry*

ENGINEERING

**E80:** *Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions*

Jacobs B132 **Zachary Flom, Narayan Propato, Matthew Streshinsky, Daniel Taller**

Jacobs B134 **Brandyn Carlson, Katherine Maddalena, Brendan Smith, Harry Wornick**

Galileo-Pryne HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**STS190:** *Community Outreach in Science, Technology, Engineering and Mathematics Education: History and Critical Analysis*

**Catherine Bradshaw, Kelley Hodges, Kathryn Schmiedick, Laura Willson**

Students of STS 190 will present the results of their service learning projects. Projects involve a critical look at a local community outreach program that seeks to redress inequities in access to high quality science education via personal involvement and service with the program.

Instructors: *Richard Olson, Humanities, Social Sciences and the Arts, and Catherine Bradshaw '09*

Beckman B126 MATHEMATICS

**Julian Freed-Brown:** *A Generalization of Euler's Totient Function*

Jordan's totient function,  $J_k(n)$ , is a generalization of Euler's totient function,  $\phi(n)$ , that counts the number of ordered  $k$ -tuples that generate the group  $Z/nZ$ . Placing constraints on these  $k$ -tuples allows us to make a new generalization of Euler's totient,  $M_k(n)$ . I will discuss how we used recursion, the subgroup lattice and symmetric polynomials to explore the structure of this new function.

Faculty Adviser: *Michael Orrison, Mathematics*

**2:15 P.M.**Galileo-  
Edwards

## CHEMISTRY

**Aurora Pribram-Jones: *Binary Liquid Mixtures and Bulk Chirality: Two New Explorations of the 2,7-Diacyl Fluorenes***

Our library of 2,7-diacyl fluorenes has illustrated how molecular asymmetry affects the phase behavior and transition energetics of liquid crystalline materials. A thermodynamic model of binary liquid mixtures is presented and used to interpret calorimetric data about binary systems of these fluorenes. Additionally, it is shown that these achiral molecules can exhibit bulk chirality, with their degree of asymmetry influencing the ease with which they align in simultaneous chiral and achiral arrangements.

Faculty Adviser: *Gerald Van Hecke '61, Chemistry***2:30 P.M.**Galileo-  
Edwards

## CHEMISTRY

**Joanne Redford: *Synthesis of a Tethered ligand for hydroamination of aminoallenes***

We have previously demonstrated that titanium complexes with chiral amino alcohol ligands can be used as pre-catalysts for the enantioselective intramolecular hydroamination of aminoallenes. We hypothesize that a tethered ligand consisting of a cyclopentadienyl group attached to the amino alcohol backbone will increase the stereoselectivity of this reaction. This ligand should increase steric constraints on the metal complex. A four-step modular synthesis of the ligand has been developed and coordination to the metal has been explored. The metal complex will be used in asymmetric hydroamination with amino allenes.

Faculty Adviser: *Adam Johnson, Chemistry*

## ENGINEERING

**E80: *Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions***

Jacobs B132

**Matthew Cummins, Ian Jimenez, Ashley Nelson, Eric Nieters**

Jacobs B134

**Steven Gordon, Rachael Martin, Chris Ramos, Kristina Runas, Elliot Smith****3:00 P.M.**

## ENGINEERING

**E80: *Analysis of Video and Telemetry Data from Small Rocket Flights and Comparison with Model Predictions***

Jacobs B132

**Nicholas Card, Esther Hwang, Jennifer Rinker, Yen-Kuei Peter Tu**

Jacobs B134

**Steven Berry, Kevin Chan, David Turner, Sarah Yi****3:30–4:00 P.M.**

Galileo Foyer

## RECEPTION

**4:00 P.M.**Galileo-  
McAlister

## PRESENTATION DAYS ADDRESS

**Kerry Karukstis: *Taking Undergraduate Research from Good to GREAT: Pivotal Junctures in the Undergraduate Research Enterprise***

The involvement of undergraduate students in collaborative research with faculty members is a proven and powerful practice as a consequence of the many educational benefits gained by students, the professional rewards accorded to faculty mentors, and the contributions provided to institutions and the wider research community. But successful research programs and thriving institutional research cultures are not overnight occurrences. Propitious external environments and compelling internal conditions are key elements to transformational change. What decisions and actions in a faculty member's career are pivotal in shaping a research program? What were some of the defining moments in the history of HMC that have propelled our undergraduate research enterprise on its journey from good to great? What next steps should the college take to retain its pre-eminence in undergraduate research and remain at the forefront of the undergraduate research landscape?

*Kerry K. Karukstis, professor of chemistry and Joseph B. Platt Professor of Effective Teaching at Harvey Mudd College, received her B.S. degree in chemistry and her Ph.D. degree in physical chemistry from Duke University. After postdoctoral work in the Laboratory of Chemical Biodynamics at the UC Berkeley supported by a National Institutes of Health Postdoctoral Fellowship, she joined the faculty at HMC in 1984 and regularly teaches courses in general chemistry, physical chemistry and biophysical chemistry. Her research interests focus on using spectroscopic and light scattering techniques to characterize the structure and physical properties of surfactant aggregates and macromolecular host guest systems. She has conducted research in collaboration with 95 undergraduates at HMC, and her research has been supported by the National Science Foundation, National Institutes of Health, American Chemical Society Petroleum Research Fund, Research Corporation, and the Camille and Henry Dreyfus Foundation. She is co-author of "A Guide to Lasers in Chemistry" and "Chemistry Connections: The Chemical Basis of Everyday Phenomena" and co-editor of "Developing and Sustaining a Research-Supportive Curriculum: A Compendium of Successful Practices" (Council on Undergraduate Research, 2007). She serves as a Journal of Chemical Education feature editor on the role of undergraduate research in chemical education. Karukstis served as the 2007–2008 President of the Council on Undergraduate Research (CUR). She received the 2003 Henry T. Mudd Prize for outstanding service to HMC and the 2004 CUR Volunteer of the Year Award.*

**Projects Day, Tuesday, May 5**

**10:30 A.M.**

Registration and Poster Viewing (Linde Activities Center)

**1:00 P.M.**

General Session (Galileo-McAlister)

Welcome: **President Maria Klawe**

Remarks: **Richard Haskell**, director, Physics Clinic

Milestone Awards: **Robert J. Cave**, vice president for academic affairs and dean of faculty

Milestone Award Recipients: QUALCOMM Corporation and Southwest Research Institute

**1:30-5 P.M.**

Clinic Presentations (in classrooms, Galileo halls and labs)

**5:15 P.M.**

Poster Reception for guests, faculty and students (Linde Activities Center)

COMPUTER SCIENCE CLINIC

FICO (Fair Isaac Corporation)– *Automatic Collaboration Enhancement*

Fox Interactive Media-MySpace– *MySpace Music Recommendation System*

Genius.com Inc.– *Auto-Detecting Third-Party Generated Events for Real-Time Personal Website Analytics*

LinkedIn Corporation– *Building A Replicated Transaction Log Library*

magnify360– *Maximizing Yield in the Shopping Cart by Predictive Modeling of Individual User Behavior*

The Platform for Media– *Building a Domain-Specific Language for Media Publishing*

QUALCOMM– *Management Data Repository for Open Source Network Management*

COMPUTER SCIENCE/MATHEMATICS CLINIC

Community of Ordinary Differential Equations Educators– *ODE Toolkit: Deployment of Software to Aid the Teaching and Learning of Ordinary Differential Equations*

ENGINEERING CLINIC

9:Fish Surfboards– *Manufacturing Process for a Recyclable Surfboard*

The Aerospace Corporation– *Picosatellite Wireless Communication*

AeroVironment, Inc.– *Increased Covertness of Small Unmanned Aerial Vehicles*

Cardinal Health– *Respiration Sensing*

Center for Integration of Medicine and Innovative Technology (CIMIT)– *Design and Development of an Integrated Clinical Environment Supervisor (ICES) for Trauma Care*

Cobham; Sargent Fletcher Inc.– *Design of Test Firing Apparatus for Pneumatic Ejection Racks*

DirecTV Inc.– *Aiding the Satellite Dish Installation Process*

Honeywell Aerospace– *Aerospace-Grade Induction Motor Tester*

Intel Corporation– *CMOS Public-Key Cryptography Accelerators*

Los Alamos National Laboratory– *Development of a Diagnostic Wire Scanner for a Linear Particle Accelerator*

National Optical Astronomy Observatory (NOAO)– *Ultra-Low Noise Digital Readout System for a CCD Telescope*

Nike, Inc.– *In-Store Assembly and Customization of Footwear*

Nike, Inc.– *Design of Cleatless Soccer Shoes*

Northrop Grumman Corporation– *Point to Point Wireless Communication Interface to Test Navigation Systems*

Oregon Biomedical Engineering Institute (OBEI)– *Advanced Hemostatic Agent Delivery Device (AHADD)*

Oregon Biomedical Engineering Institute (OBEI)– *Automated Nanofiber Vascular Fabrication Device*

Orthodyne Electronics– *Modeling the Viscoelastic Behavior of Vibration Isolation Mounts for an Ultrasonic Wire Bonder*

Southwest Research Institute (SwRI)– *Time-of-Flight Measurements Using FPGAs*

Space Systems/Loral– *Modeling Shock Attenuation in Spacecraft Panels*

SRI International– *Development of Barometric Altimetry System for Personnel Tracking*

Three Valleys Municipal Water District– *Use of Alternative Energy Sources at Three Valleys Municipal Water District*

TREX Enterprises Corporation– *In-Building Tracking of Emergency Rescue Personnel*

#### GLOBAL CLINIC

Applied Biosystems– *Low Cost Real-Time Polymerase Chain Reaction Instrument for Educational Market*

Lien Institute for the Environment– *Design of a Household Level Arsenic Treatment System for Rural Cambodia*

#### KGI/ENGINEERING CLINIC

Syngenta– *Automated Design for Single Seed Handling*

#### MATHEMATICS CLINIC

Chicago Trading Company– *Building a Multi-Agent Artificial Stock Market*

Citadel Investment Group– *Optimizing Pairs Trading Portfolios*

Laserfiche– *Deblurring: Removing Image Distortion Induced by Camera Motion*

#### PHYSICS/ENGINEERING CLINIC

Lawrence Livermore National Laboratory– *Calibration Source for a Prototype Car-Wash Detector of Fissile Material*

#### PHYSICS/MATHEMATICS CLINIC

Cardinal Health– *Modeling Fluid Transport in Subcutaneous Tissue*

For times and locations, please see Projects Day program, or visit [www.hmc.edu/academicsclinicresearch/clinicprogram1/projectsday.html](http://www.hmc.edu/academicsclinicresearch/clinicprogram1/projectsday.html)

## All-Day Exhibits, Wednesday, May 6

### PARSONS GALLERY

**Art 50: Beginning Black & White Photography.** Course Instructor: *Steve Schenck, Humanities, Social Sciences and the Arts*  
**Nadia Abuelezam, Daniel Bobrowsky, Alicyn Henkhaus, Greg Herschler, Judy Hines, Calvin Loncaric, Jennifer Osgood, Maureen Ruiz, Stacy Sun, Natalie Suzuki (Pitzer)**  
 On display will be students' best work from the Introductory Black and White Photography class.

### SPRAGUE LIBRARY

**Art 60: Workshop in Hand-Press Printing.** Course Instructor: *Jeffrey D. Groves, Humanities, Social Sciences and the Arts*  
**Seth Anderson (CGU), Christiana Bedard, Mark P. Cyffka, Chelsea Drenick, Benjamin Goldenberg, Karen Isaac (Pitzer), Benjamin Jencks, Glennis Rayermann, Hannah Troisi**  
 Students learn traditional letterpress typesetting and how to print on nineteenth-century iron hand presses. The exhibit will display student work from the founding of the First-Floor Press in 2007 to the present.

### GALILEO FOYER

**Art 100: Introduction to Digital Photography.** Course Instructor: *Steve Schenck, Humanities, Social Sciences and the Arts*  
**Denis Aleshin, David Berryrieser, Simon Lee (Pitzer), Jade McGill (Pomona), Megan Pham, Ryan Quarfoth, Joanne Redford, Scott Smith, Moira Tagle, Kanny Wan, Simon Yang, Kevin Yeung, Caro de Freitas**

**Art 150: Intermediate/Advanced Photography.** Course Instructor: *Tad Beckman, Humanities, Social Sciences and the Arts*  
**Anton Bakalov, Daniel Bobrowski, Sam Gordon, Mark Hubenschmidt, Geoff Kuenning (faculty), Lorraine Laprade (CGU), Jennifer Lee, Kyle Marsh, Brett McLarnon, Rachel Nishimura, Benjamin Preskill, Benjamin Taborsky**  
 The Art 100 and Art 150 presentations will be "streaming slide shows" of selected works. Members of the classes will be on hand to comment and answer questions throughout.

**Engineering Posters.** Students will be on hand from 2:30–3:30 p.m.

- **Annika Eberle and Kenny Quinn:** *Free Coiling in Tendril-Bearing Plants* (Lori Bassman)
- **Kevin King and Benyue Liu:** *Novel Method for Identifying Low-Angle Subgrain Boundaries* (Lori Bassman)
- **Ryan Quarfoth:** *Finite Element Model of Compression of Polycrystalline Layers Showing Banding Behavior* (Lori Bassman)
- **Masanori Honda, Susanna Lin, Kristina Runas, Emily Snyder, Jessica Wen:** *Effects of Uniaxial Extension of Skin on Transdermal Drug Delivery* (Nancy Lape)
- **Susanna Lin, Kristina Runas, Emily Snyder, Jessica Wen:** *Finite Element Modeling of Transport in Human Stratum Corneum: Effects of Hydration and Model Geometry* (Nancy Lape)
- **Lupita Bermudez, Scott Butters, Georgi Dinolov, Jonathan Hubbard, Sean Kim, Thomas Oh, Daniel O'Neil, Seanna Vine:** *Gas Transport in Poly(dimethylsiloxane)-SiO<sub>x</sub> Composite Films: Effects of Filler Size Variation from Micro to Nanoscale* (Nancy Lape)
- **Brian Bosak:** *An Efficient Approach to Determine the Approximate Deflection of an Arbitrarily Supported Beam Subjected to External Loads* (Phil Cha)
- **Masanori Honda:** *Using a Characteristic Force Approach to Determine the Modes of Vibration of a Beam Carrying Miscellaneous Attachments* (Phil Cha)
- **Leah Anderson, Dan Goodwin, Betsy Ellis, Florian Scheulen, Vatche Attarian:** *Dissipation Characteristics of Suspension Cable Systems* (Ziyad Durón '81)
- **Benjamin Keller:** *Impact of Process Variation on Domino Keeper Sizing* (David Money Harris)
- **Trevor Ashley, Andrew Macrae:** *A Balancing Robot* (David Money Harris)
- **Steve Huntzicker, Austin Lee, William Koven:** *SCMOS Shifters in 130 nm CMOS* (David Money Harris)
- **Arjun Kalyanpur, Clark Zhang, Christina Kneen, Kacy McKibben, Michael Trejo:** *Development and Characterization of a Novel Chitosan-Collagen Composite Matrix for Treating Traumatic Brain Injury* (Elizabeth Orwin '95)
- **Marie Godla, Scott Smith, Janet Komatsu:** *The Effect of Strain on Rabbit Corneal Fibroblasts: Cell Phenotype and Bioreactor Characterization* (Elizabeth Orwin '95)
- **Robert Warren, Jessica Wen, Donna Phu:** *Correlating  $\alpha$ -sma Expression to Levels of Transparency in a Tissue-Engineered Cornea* (Elizabeth Orwin '95)
- **Graham Orr:** *Systematic Design and Analysis of a High Performance Solid Fuel Rocket Motor* (Erik Spjut)

Ammonium Perchlorate Composite Propellant (APCP) is widely used as a solid rocket fuel in many applications—most notably the Space Shuttle Solid Rocket Boosters. This project aims simply to be an engineering practice in the field of propulsion and implement many of the aerospace industry's design techniques in a high efficiency and lightweight APCP rocket motor with a total impulse of 10000 Ns. The motor was then analyzed for adherence to thrust, pressure, temperature, time and resonance predictions.

**Presentations, Wednesday, May 6****8:30 A.M.**

Galileo Foyer RECEPTION

**9:00 A.M.**

Galileo- BIOLOGY

Edwards

**Hallie Kuhn: Role of Dynein LC4 in Calcium-Mediated Ciliary Reversal in *Tetrahymena thermophila***

Ciliary beating must be precisely controlled in order to produce the coordinated movements required for cellular motility. Dynein light chain 4 (LC4) may regulate the calcium-dependent pathway involved in the regulation of ciliary beating. This study aims to characterize the functions and locations of two LC4 isoforms, LC4A and LC4B, in *Tetrahymena thermophila*. Immunolocalization experiments indicate that only the LC4A isoform is located in the cilia, while reactivation experiments provide insight on the specific function of LC4A in the calcium-mediated regulation of ciliary reversal.

Faculty Adviser: *David J. Asai, Biology*

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**Philosophy 125: Ethical Issues in Science and Engineering**

Each 20-minute presentation touches on an ethical issue arising in the practice of engineering, the natural and formal sciences, and science-related professions such as medicine. Presentation will explore current work in these areas by philosophers and other scholars. Times and topics posted at presentation room.

**Trevor Ashley, Steven Berry, Roger Billingsley, Bob Chen, Nancy Eisenmenger, Christopher R. Ferguson, Benjamin Fogelson, Nathan Jones, Zeke Koziol, Erik Kuefler, Michael Lee, Rachael Maltiel, Eric A. Nieters, Alexandra Simoni**

Faculty Adviser: *Darryl Wright, Humanities, Social Sciences and the Arts*

Beckman B126 MATHEMATICS

**Mathematical Contest in Modeling (MCM) 2009****Aaron Abromowitz, Andrea Levy, Russell Melick: Designing a Traffic Circle**

Many cities and communities have traffic circles—from large ones with many lanes in the circle (such as at the Arc de Triomphe in Paris and the Victory Monument in Bangkok) to small ones with one or two lanes in the circle. The goal of this problem was to use a model to determine how best to control traffic flow in, around and out of a circle.

Faculty Adviser: *Rachel Levy, Mathematics*

Galileo- PHYSICS

McAlister

**Ian Wright: Production of Monodisperse Chitosan Nanoparticles via Piezoelectric-Driven Atomization**

Chitosan nanoparticles have recently emerged as possible vectors for gene therapy and drug delivery. Their rate of cellular uptake is predominantly determined by their diameter, and consequently, methods of generating nanoparticles of specific sizes have become increasingly important. We describe a device capable of producing monodisperse nanoparticles in a tunable size range. A piezoelectric oscillator is used to atomize a solution containing dissolved chitosan. Using a drying tube, chitosan nanoparticles are then produced from the ejected droplets.

Faculty Adviser: *Tom Donnelly, Physics***9:15 A.M.**

Galileo- BIOLOGY

Edwards

**Jordan Eboime: Characterization of Retrograde Intraflagellar Transport in *Tetrahymena thermophila***

Cilia are hair-like projections which act as sensory organelles, aid in the movement of particles across a cell surface, or power the movement of an organism. Cilia are built using the intraflagellar transport (IFT) mechanism, which is responsible for bringing building proteins to the ciliary tip. IFT140 is thought to be part of the protein complex associated with retrograde IFT. However, studies show that *Tetrahymena* may undergo atypical retrograde IFT. Thus, to better characterize retrograde IFT in *Tetrahymena*, an IFT140 knockdown cell line will be created and the phenotype will be analyzed by observing ciliary length and density, swimming speed and growing patterns.

Faculty Advisers: *David J. Asai, David Wilkes, Vidya Rajagopalan, Biology*

**9:15 a.m., continued**

Galileo-                      PHYSICS  
 McAlister                    **Albert Tsao: Immunogold Labeling of Cells in Engineered Corneal Tissue: Investigations of Antibody Binding**

In our quest to engineer an artificial cornea, we have found it essential to monitor both cell growth and cell phenotype during the developmental process. We have devised a technique to label corneal cells (keratocytes) with 90 nm diameter gold particles, which allows us to visualize the cells in culture as well as identify their phenotype. The most recent labeling procedure appears successful, as gold labeling particles are successfully attached to target sites. However, extensive non-specific binding of those labeling particles has limited the effectiveness of the labeling. In order to reduce non-specific binding, we have closely investigated the nature of antibody binding to gold particles.

Faculty Adviser: *Richard Haskell, Physics*

**9:30 A.M.**

Galileo-                      BIOLOGY  
 Edwards                      **Elizabeth O. Corpuz: Comparison of the light intermediate chains of cytoplasmic dyneins 1 and 2 in Tetrahymena thermophila**

Cytoplasmic dynein is a molecular motor that is capable of carrying a variety of molecular cargoes in the cell. The ciliated, unicellular organism *Tetrahymena thermophila* has two cytoplasmic dyneins, dynein 1 and dynein 2. Our aim is to determine the functions of dyneins 1 and 2 in *Tetrahymena* by using the light intermediate chain (LIC) subunits, D1LIC and D2LIC, as “tags” for each dynein. We will measure the relative expression levels of D1LIC and D2LIC and disrupt the expression in of each gene.

Faculty Adviser: *David J. Asai, Biology*

Jacobs B132    HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room)

Beckman B126    MATHEMATICS

**Mathematical Contest in Modeling (MCM) 2009**  
**Denis Aleshin, Natalie Durgin, Bryce Lampe: Cut the Cord: Evaluating the Energy Concern for the Cell Phone Recharger Circle**

With cell phones soaring in popularity, we sought to create a mathematical model for the energy required to use and produce cellular and landline (e.g. cordless) phones in order to weigh the advantages and disadvantages of the two options. Given the results of our model, we recommend a complete transition to cellular phones. To give our results context, we addressed the energy waste of cell phones left in their rechargers, and compared this waste to that of other “idle” appliances. We conclude by offering suggestions for more pressing energy concerns.

Faculty Adviser: *Rachel Levy, Mathematics*

Galileo-                      PHYSICS  
 McAlister                    **Ethan Rubin: Analyzing Crustal Heterogeneity with Cross-Correlation Methods**

The HMC seismology lab operates a three component broadband seismometer that records ground motion from earthquakes and other sources at distances ranging from a few kilometers up to intercontinental distances. Typically, it is assumed that the path of propagation between the source and receiver is a great circle path, but this is not necessarily the case when lateral variability on crustal refractivity of seismic surface waves is admitted. In this study, cross-correlation analysis applied to the east and north vector components of observed ground motion is used to examine the feasibility of detecting crustal heterogeneity by this means.

Faculty Adviser: *Gregory A. Lyzenga, Physics*

**9:45 A.M.**

Galileo-  
Edwards

BIOLOGY

**Oksana A. Sergeeva: *End Binding Protein 1 in Tetrahymena thermophila***

Microtubules are found in many structural components of eukaryotic cells. One protein that is thought to regulate the assembly dynamics of microtubules is End Binding Protein 1 (EB1). *Tetrahymena thermophila* has two bona-fide EB1 proteins. In this study, the functional specificity/redundancy of the two isoforms will be investigated through the characterization (growth curves, phagocytosis assays, and gene expression profiles) of single- and double-knockdown cell lines, and the localization of the two EB1 proteins using a 6xHis tag via western blots and affinity purification.

Faculty Adviser: *David J. Asai, Biology*

Galileo-  
McAlister

PHYSICS

**Benjamin Roig: *Modeling Size Evolution of Red Elliptical Galaxies through Adiabatic Expansion and Dry Mergers***

Studies of red galaxies at high redshift have recently led to some unexpected observational conclusions. These galaxies are uniformly smaller and denser than would be predicted by comparing to the similar population in today's universe, yet still fit the R1/4 law that defines an elliptical galaxy. We present the results of two models (adiabatic expansion and dry mergers) in attempting to show how the population of red, gas-poor elliptical galaxies at higher redshift ( $z \sim 3$ ) can potentially evolve into the population of red, gas-poor ellipticals in today's universe. Neither seem to show enough growth, so either a deeper understanding or a new model is required.

Faculty Advisers: *Philip Choi, Pat McCarthy, Pomona Physics*

**10:00 A.M.-10:30**

Galileo Foyer RECEPTION

**10:30 A.M.**

Galileo-  
Edwards

BIOLOGY

**Matthew Borok: *Characterization of dCTCF-binding regions in transgenic Drosophila melanogaster***

Insulators are genetic elements that regulate gene transcription by interfering with enhancer-promoter communication. This activity is mediated by specific proteins binding the insulator sequence and creating boundaries between regulatory regions. The Bithorax Complex (BX-C) of *D. melanogaster* contains a number of autonomous regulatory regions directly adjacent to one another. It has been suggested for over a decade that there are insulators between these regions, and a recently discovered protein (dCTCF) has been shown to bind these boundary regions. I have begun to test these regions for insulator activity using the attB-attP transgenesis system.

Faculty Adviser: *Robert Drewell, Biology*

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**Philosophy 125: *Ethical Issues in Science and Engineering*** (Times and topics posted at presentation room)

Beckman B126 MATHEMATICS

**Theodore Spaide: *Fast Fourier Transforms on the Special Linear Group***

The structures of finite groups can be related to the structures of matrix algebras by a certain map called the discrete Fourier transform (DFT). In the case that  $G$  is the cyclic group  $Z/nZ$ , this coincides with the DFT from signal processing, for which there exists special algorithms, called fast Fourier transforms (FFTs) which calculate this isomorphism quickly. I describe the construction of FFTs for a different class of groups, namely,  $SL(2,q)$ , the group of  $2 \times 2$  matrices with determinant 1 whose matrix elements come from a finite field.

Faculty Adviser: *Michael Orrison, Mathematics*

Galileo-  
McAlister

PHYSICS

**Rudy Resch: *A Search for Charm-Strange Baryons***

In a complex field such as particle physics, there is a great deal of interplay between experimental and theoretical results. As information about particles is discovered experimentally, theoretical predictions can be revised to become more accurate. One area in which this is important is in the study of excited states of particles. A particularly rich family of excited states is that of the charm-strange baryon. I will discuss a search for such an excited charm-strange baryon decaying to a lambda baryon and a D meson. The dataset was collected by the BaBar collaboration at the SLAC National Accelerator Laboratory.

Faculty Adviser: *A.J. Edwards, Physics*

**10:45 A.M.**

Galileo- BIOLOGY

Edwards **Robert Egan: *Morphometric Analysis of Sclerite Shape***

Genetically distinct but closely related species of soft corals are often difficult to distinguish from one another using only qualitative morphological variables. Four cryptic species of *Alcyonium* once thought to comprise a single widespread species were clearly differentiated using genetic markers. I used fluorescent microscope images to generate complex outlines of  $\text{CaCO}_3$  sclerites from *Alcyonium* specimens. After preparing quantitative data based on elliptical Fourier analysis of these outlines, I applied discriminant analysis to effective shape components to classify these cryptic species.

Faculty Adviser: *Catherine S. McFadden, Biology*

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room)

Galileo- PHYSICS

McAlister **Matthew Lawson: *How slow can you go? Tracking the Movement of the San Gabriel Mountains***

Precise monitoring of nearby fault systems is of immediate interest in Southern California. The movement of the San Gabriel mountain range was tracked using highly accurate corrected GPS data. The data acquisition methods will be described as well as the basic theoretical models and the computer programs for data analysis. The broad implications of the presented data will be discussed.

Faculty Adviser: *Gregory A. Lyzenga, Physics*

**11:00 A.M.**

Galileo- BIOLOGY

Edwards **Stacy Sun: *Investigating the Plasticity of Isolated Corneal Stromal Cells***

Corneal blindness impairs over 10 million people through corneal cloudiness and disease. One alternative method to transplantation is a tissue-engineered corneal equivalent that mimics in vivo conditions in order to induce normal cell phenotype and corneal transparency. Corneal stromal cells, the main component of the cornea, undergo the wound-healing cascade upon injury and eventually repair to restore the transparent phenotype. The plasticity of these cells is investigated over time in response to various environmental cues in order to better characterize the stromal cell behavior and ultimately optimize a condition for increased corneal transparency.

Faculty Adviser: *Elizabeth Orwin '95, Biology*

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room.)

Beckman B126 MATHEMATICS

**Rachel Cranfill: *Group Frames from Permutation Representations***

A frame is a spanning set of vectors for a Hilbert space  $H$ . For a group  $G$  with representation  $\rho$ , a frame can sometimes be constructed by fixing a vector in the Hilbert space and applying the images of all of the group elements under the representation. Such a frame is called a group frame. My thesis focuses on group frames that arise from restricting the action of  $G$  to different subspaces  $H$ , where the action of  $G$  on  $H$  arises from a permutation representation of  $G$ . This presentation presents some preliminary results.

Faculty Adviser: *Michael Orrison, Mathematics*

Galileo- PHYSICS

Pryne **Physics 170: Computational Methods in Physics, Robocode Competition**

**Marc Badger, James Blau, Arthur Eigenbrot, Julian Freed-Brown, C.P.E. Gaebler, Andrew Higginbotham, Nathan Jones, Trystan Koch, Matthew Lawson, Akash Rakholia, Rudy Resch, Benjamin Roig, Stephen Rosenthal, David Stachnik, Eric Langman, Rachael Martin**

Groups of students program the artificial intelligence code for small software robots that sport radars and weapons. The different robots are then pitted against each other in a virtual arena and fight to death. Through a process of elimination, one robot remains standing at the end—presumably the one with the best artificial intelligence-based strategy. Student groups represent their dorms; and the winning group gets treated to dinner at a local restaurant.

Faculty Adviser: *Vatche Sahakian, Physics*

**11:15 A.M.**

Galileo-  
Edwards

BIOLOGY

**Terence Wong: Characterization of putative CTCF binding sites in the proximal exonic region of the hTERT gene**

In humans, the ends of linear chromosomes are maintained by telomerase, an enzyme consisting of a reverse transcriptase (hTERT) and an RNA template (hTR). The expression of hTERT is the limiting factor for telomerase activity. Recent work has shown that CTCF, an 11 zinc-finger protein binds to the proximal exonic region (PER) of hTERT and inhibits its transcription. In this study, we identified putative CTCF binding sites in the PER and we used a dual-luciferase reporter assay to show that the PER significantly represses the expression of a reporter gene in HeLa-S3 cells when compared to other coding regions.

Faculty Adviser: *Robert Drewell, Biology*

Jacobs B132

HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room.)

**11:30 A.M.**

Galileo-  
Edwards

BIOLOGY

**Marissa A. Quitt: Variability of Walking in Humans**

In this study, we examined the relationship between the variability of gait patterns and neural control patterns with differences in calf muscle morphology during walking in 11 young adults. In half the subjects (MG-biased), medial gastrocnemius (MG) activity levels were three to six times that of the lateral gastrocnemius (LG), whereas the other subjects (unbiased) showed roughly equal activity. The MG-biased group had larger MG muscles and shorter heels, but there was no difference in joint kinematics. The relatively less plastic skeletal system seems to drive the motor recruitment patterns of walking as well as calf muscle size in humans.

Faculty Adviser: *Anna N. Ahn, Biology*

Jacobs B132

HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room.)

Beckman B126

MATHEMATICS

**Jennifer Iglesias: The Linear Complexity of a Partially Ordered Set**

The linear complexity of a partially ordered set  $P$  is a measure of the minimum number of additions, subtractions and multiplications necessary to carry out Möbius inversion on  $P$ . In this talk, I will present bounds for the linear complexity of several partially ordered sets.

Faculty Adviser: *Michael Orrison, Mathematics*

**NOON-1:00 P.M. LUNCH BREAK**

**1:00 P.M.**

Galileo- CHEMISTRY  
Pryne **Steven Pankratz: ZnO Nanorod Morphology and pKa Sensitivity**

The relationship between ZnO nanorod morphology and the resistance of that material to etching by acidic dyes is poorly understood. Functionally, understanding this relationship is essential to designing effective, efficient DSSCs. This project outlines the common ZnO nanorod assemblies used in the DSSC field today and their ability to withstand, as a function of exposure time and pKa, the dye-adsorption process.

Faculty Adviser: *Hal Van Ryswyk, Chemistry*

Beckman B126 COMPUTER SCIENCE  
**CS121: iPhone Applications for Mathematics Education**  
**Joshua Ehrlich, Wynn Vonnegut**

Software design and implementation projects, have been designed to the specification of a client within the college.

Client: *Francis Su*

Instructor: *Robert Keller, Computer Science*

Galileo- ENGINEERING  
Edwards **E4: Device to implement photobiomodulation in the ear**  
**Alena Rau, Alex Ross, Kiley Sobel, Mary Sullivan**

Novel therapies for the treatment of tinnitus, and optical therapies are needed and hold much promise. Photobiomodulation, also known as LLLT, is an emerging medical technique in which exposure to light is used to stimulate or inhibit cellular function leading to beneficial clinical effects. Certain wavelengths of light at specific intensities (delivered by laser, LED or another monochromatic source) have been demonstrated to aid tissue regeneration, resolve inflammation, and relieve pain. It is thought that photochemistry rather than heat-related effects play the dominant role. We believe that LLLT for cochlear-vestibular disease has potential. We see a device that works in concert with an MP3 type player/personal audio system that would provide power to earbud mounted LEDs/diode laser to illuminate the middle ear. The light can be modulated at speech frequencies as well. The MP3 player can provide both functions.

Clients/Liaisons: *Drs. Brian Wong and Dmitry Protsenko, Beckman Laser Institute*

Faculty Advisers: *Lori Bassman, Philip Cha, Patrick Little, Elizabeth Orwin '95, Engineering*

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room.)

**1:15 P.M.**

Galileo- CHEMISTRY  
Pryne **Lauren Dolores Hughs: Titanium and tantalum cyclopentadienyl complexes as precatalysts for the intramolecular asymmetric hydroamination of aminoallenes.**

Titanium and tantalum cyclopentadienyl complexes can be used in concert with chiral amino-alcohol derived ligands as precatalysts for the asymmetric hydroamination of aminoallenes. In previous work, titanium amide alkoxide complexes catalyzed the target reaction with high regioselectivity, but with poor enantioselectivity. The addition of the cyclopentadienyl group conferred constrained geometry to the catalyst, and the tantalum complexes resulted in improved enantiomeric excesses in the reaction to form the desired pyrrolidine product.

Faculty Adviser: *Adam R. Johnson, Chemistry*

Beckman B126 COMPUTER SCIENCE  
**CS121: Faculty Course Scheduling System**  
**Singer Ma, Steven Watanabe, Matthew Wodrich**

Client: *Lisette de Pillis*

Galileo- ENGINEERING  
Edwards **E4: Device to implement photobiomodulation in the ear** (See description above.)  
**Samuel Meyer, Chris Parks, Sara Sholes, Susan Tan**

Galileo- ENGINEERING  
 McAlister **E4: *Low-cost remote water height reporting post***  
**Thomas Aldrich, Will Buik, David Golay, Vincent Pai**

In outback Australia, as well as in other rural areas, heavy rains can cause flooding that prevents vehicles from passing where creeks cross roads. A remote reporting device would save people from having to examine every crossing by eye. The reporting could be every half-hour, or even longer. We had in mind a unit that has a small water-powered turbine down at road-level, with a simple transmitter up the top reporting the depth of water between the turbine and the top of the water. There are similar designs around, but most are powered by solar and are much more sophisticated than we need. We have in mind something that is completely housed inside the vertical post, which will need to be up to 2.5 meters in height and could be any diameter from 25mm to about 75mm. The unit would need to be bug-resistant and able to survive rather muddy water. It would need to be extremely simple, and extremely rugged.

Client/Liaison: *Rod Shannon*

Faculty Advisers: *Philip Cha, Elizabeth Orwin '95, Engineering*

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room.)

**1:30 P.M.**

Galileo- CHEMISTRY  
 Pryne **Alison Lee: *Spectroscopic characterization of prodan encapsulated within the nanocavities of cyclodextrins and cucurbiturils***

The complexes formed by a host-guest system involving a fluorescent guest (prodan) and a host macromolecule (cyclodextrin [CD] or cucurbituril [CB]) were examined. CDs and CBs are composed of 6 to 8 glucose or glycoluril molecules, respectively, forming a non-polar cavity with similar diameters. When prodan is bound to CD or CB, its fluorescence is blue-shifted. All CDs form 1:1 complexes with prodan at some concentration. Substitutions to CD hydroxyl groups increase binding. CBs were studied in salt solutions to improve solubility and were found to be fluorescent. Salt, CBs and prodan exhibit complex interactions in their fluorescence behavior.

Faculty Adviser: *Kerry Karukstis, Chemistry*

Beckman B126 COMPUTER SCIENCE  
**CS121: *Game Construction Kit for Teens***  
**Gregory Bickerman, Daniel Fielder, David Yust**

Client: *Elizabeth Sweedyk*

Galileo- ENGINEERING  
 Edwards **E4: *Device to implement photobiomodulation in the ear*** (See description page 22.)  
**Chelsea Fischbach, Daniel Furlong, Benjamin Liu, Kevin Tham**

Galileo- ENGINEERING  
 McAlister **E4: *Low-cost remote water height reporting post*** (See description above.)  
**Dalar Nazari, Colin O'Byrne, Josh Rowe, David Turner**

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room.)

**1:45 P.M.**

Galileo- CHEMISTRY  
 Pryne **Joshua M. Cobb: *Stereoselectivity in Bimolecular Thermal Reactions Through Liquid Crystalline Control***

Liquid crystals, due to their ordered nature, offer a manner in which to control the stereoselectivity of chemical reactions; reagents of the appropriate shape and chemical properties fit within the liquid crystalline structure and become impaired in their movement and orientation, which results in favoring a particular product when a stereocenter is involved in the reaction. The impact of a liquid crystalline solvent on the stereoselectivity of the Diels-Alder reaction was studied by reacting 2,6-dialkoxyanthracenes with fumarates in a liquid crystalline solvent and comparing the resulting stereoselectivity against the same reaction carried out in an isotropic solvent.

Faculty Adviser: *Gerald Van Hecke '61, Chemistry*

**1:45 p.m., continued**

Beckman B126 COMPUTER SCIENCE  
**CS121: Solar Energy Economic Evaluation Web Application**  
**Samuel Just, Marquis Wang, Dmitriy Yakovlev**

Client: *Sam Tanenbaum*

Galileo- ENGINEERING  
 Edwards **E4: Device to implement photobiomodulation in the ear** (See description page 22.)  
**J. Emery, Philip Geurin, Julie Kraus, Kristen Warren**

Galileo- ENGINEERING  
 McAlister **E4: Low-cost remote water height reporting post** (See description page 23.)  
**Craig Levin, Steve Matsumoto, Scott Ogilvie, Wylie Rosenthal**

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room.)

**2:00 P.M.**

Galileo- CHEMISTRY  
 Pryne **Judy P. Hines: Characterization of Phase for n-octyl-β-D-galactopyranoside in Water using Fluorescence Spectroscopic Techniques**

A lyotropic liquid state of matter occurs when some substance (called the “aggregate”) is dissolved in highly polar or apolar solvent at high concentration and spontaneously arranges into some ordered phase due to solvent-aggregate interactions. Such liquid crystalline systems have applications in drug delivery, protein crystallization, and biological modeling. Fluorescence spectroscopy was used to construct a phase diagram of n-octyl-β-D-galactopyranoside in water, using prodan as a “molecular reporter.” In a previous literature study of this system, the phase diagram was incomplete and incorrect because it violated the horizontal transverse rule.

Faculty Advisers: *Kerry K. Karukstis and Gerald Van Hecke '61, Chemistry*

Beckman B126 COMPUTER SCIENCE  
**CS121: Face Learning Web Application for Instructors**  
**Rebecca Green, Keith Ingram, Kevin King**

Client: *Rachel Levy*

Galileo- ENGINEERING  
 Edwards **E4: Device to implement photobiomodulation in the ear** (See description page 22.)  
**Aaron Guillen, Andrew Ho, William Koven, Brian Soe**

Galileo- **E4: Design of a robo-fluke**  
 McAlister **Mira De Avila-Shin, Kirby Haraguchi, Tynan McAuley, Joseph Min**

When whales swim near the surface of the ocean, the interaction of their flapping flukes with the water leaves a smooth patch of water on the surface called a whale footprint. We have generated footprints in a swimming pool with a large polypropylene fluke. The goal is to design a smaller robotic fluke that could be used in an indoor tank to generate footprints that are controlled, repeatable, and measurable.

Client/Liaison: *Rachel Levy*  
 Faculty Adviser: *Lori Bassman, Elizabeth Orwin '95*

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS  
**Philosophy 125: Ethical Issues in Science and Engineering** (Times and topics posted at presentation room.)

**2:15 P.M.**Galileo-  
Pryne

CHEMISTRY

**Trevor McQueen: *MacGyvering a Solar Simulator: The Quest for an Inexpensive Reliable Solar Simulator***

In an ever more energy hungry world, there is a need to develop new sources of energy to satiate the rising demand. Our group is focused on developing dye-sensitized solar cells (DSSC's) in order to meet the worlds rising energy needs. In order to compare the solar cells that we made against other DSSC's, we needed to be able to simulate the spectrum of light which reaches the Earths surface after traveling through one and a half atmospheres of air, called AM 1.5. To do this, it was necessary to construct an appropriate solar simulator. Once the instrument was built, it was necessary to see if it could be used to calculate a reasonable estimate for solar cell's efficiency.

Faculty Adviser: *Hal Van Ryswyk, Chemistry*

Beckman B126 COMPUTER SCIENCE

**Adrian Sampson: *Algorithms for Controlling Traffic in Optical Networks***

I describe how efficient algorithms can be used to control the next generation of optical computer networks. Techniques such as wavelength-division multiplexing and traffic grooming allow many low-bandwidth computers to efficiently share a high bandwidth optical network. A traffic grooming algorithm for simple networks was designed that is both distributed and on-line. This work was presented at the IEEE 2008 International Conference on Communications.

Adviser: *Ran Libeskind-Hadas, Computer Science*Galileo-  
Edwards

ENGINEERING

**E4: *Assistive device for lifting objects into a car trunk*****Cora Carbajo Melon, Eric Johnson, Alyssa Paulson, Lowell Reade**

Maggie Plunkett, the administrative assistant in the business affairs office, finds lifting difficult. She also likes to use the trunk of her car for transporting things. She would like to have a small, hydraulic lift cart to put items into or remove from her trunk. The device could be separate or attached to a cart or box. The lift would come to the edge of the bumper so the items can be inserted or removed. Weight and size are primary issues.

Client/Liaison: *Maggie Plunkett*Faculty Advisers: *Lori Bassman, Patrick Little, Engineering*Galileo-  
McAlister**E4: *Design of a robo-fluke*** (See description page 24.)**Alix Chan, William Grabill, Richard Truong, Heather Williams**

Jacobs B132 HUMANITIES, SOCIAL SCIENCES AND THE ARTS

**Philosophy 125: *Ethical Issues in Science and Engineering*** (Times and topics posted at presentation room.)**2:30 P.M.**Galileo-  
Pryne

CHEMISTRY

**Glennis Rayermann: *Novel Osmium Porphyrin Cofacial Dimers: Towards an Understanding of Metal-Metal Coupling***

Koopman's Theorem-Generalized Mulliken-Hush has been used to calculate theoretical values for the metal-metal coupling of donor-acceptor pairs, HDA, in a variety of metalloporphyrin oligomers. Of these, cofacial dimers mimic the structure of the special pair in chlorophyll. Previous work has determined the experimental HDA for ruthenium porphyrin cofacial dimers. For comparison, osmium analogues were synthesized, via reductive metallation and photolysis, and characterized. It was found that the photolysis has a low quantum yield, resulting in a mixture of products that cannot be oxidized with iodine to form the mixed-valence species.

Faculty Adviser: *Hal Van Ryswyk, Chemistry*Galileo-  
Edwards

ENGINEERING

**E4: *Assistive device for lifting objects into a car trunk*** (See description above.)**Chris Abella, Rohan Kothari, Harry Lenahan, Byungyoun Park**Galileo-  
McAlister**E4: *Design of a robo-fluke*** (See description page 24.)**Gregory Fong, Aaron Gable, Max Gonzalez, Marc Nurik**

**2:45–3:15 P.M.**

Galileo Foyer RECEPTION

**3:15 P.M.**Galileo-  
Pryne CHEMISTRY**Ryan Pakula: *Creation of a General Scheme for Low pKa Zinc Porphyrin Dye Synthesis***

Toward the goal of creating more efficient dye-sensitized solar cells (DSSCs), general routes for the synthesis of zinc porphyrin dye molecules needed to be demonstrated. Many synthetic schemes were tested, and ultimately palladium-catalyzed cross coupling reactions proved to be the most useful tools. Using organic chemistry, including these cross coupling reactions, zinc porphyrin dye molecules were designed and synthesized with the goal of creating dyes of lower pKa. This goal was established in order to test the hypothesis that there is a correlation between a lower pKa value and more efficient charge injection, and, thus, greater overall efficiency of DSSCs.

Faculty Adviser: *Hal Van Ryswyk, Chemistry*

Beckman B126 COMPUTER SCIENCE

**James Brown, Martin Field: *Recognition of Hand-Drawn Digital Circuit Symbols***

Recognizing symbols in hand-drawn digital circuit diagrams is quite challenging because drawings are messy, different people draw in different ways, and the symbols all look very similar. We present algorithms we have implemented for recognizing hand-drawn symbols, particularly taking advantage of patterns we discovered in the way people draw diagrams under different circumstances.

Faculty Adviser: *Christine Alvarado, Computer Science*Galileo-  
Edwards ENGINEERING**E4: *Stove design for communities in Malawi*****Roxie Bartholomew, Matthew Brown, Sam Ettinger, Stephanie Levins**

In villages and settlements surrounding Malawi's cities, the cooking surface is always over a three stone fire. While the three stones provide a stable perch for a pot, the cost of the wood required to fuel the fire often exceeds the cost of the meager food being prepared. The clay soil throughout the country, which is used to make mud bricks for their one-room shelters, could be used to form a very efficient stove. A simple efficient stove design using the clay soil and a method of demonstrating its efficiency is required in order to encourage acceptance, ultimately providing more funds for needed nutrition and improving the impact on the environment.

Clients: *Pia and Anselm Varni*Faculty Advisers: *Philip Cha, Patrick Little, Elizabeth Orwin '95, Engineering*Galileo-  
McAlister**E4: *Automatic gate-opening device for a chicken coop*****Richard Coronado, Ethan Susca, Spencer Tung, Jia-Shi Zhang**

Design a solar-powered gate-opening device for a chook-yard. It should open itself just after sunrise, stay locked open all day, and close shortly after sunset. Once the sun has set, an adjustable timer should give the chooks maybe half an hour leeway, and the gate then shuts. Chooks usually roost by sunset. The gate only needs to open 45-60 cm wide. Another enhancement would be an adjustable timer on the "opening after sunrise" part. A gate like this would be handy to just give the chooks a few hours in the afternoon to roam free. And then, they get locked up away from foxes each night.

Client: *Rod Shannon*Faculty Advisers: *Lori Bassman, Philip Cha, Patrick Little, Engineering***3:30 P.M.**Galileo-  
Pryne CHEMISTRY**Seanna Vine (work with Lauryn Baranowski, Arjun Kalyanpur, Grant Blackwell, Steven Dell, Ben Margolis): *Advanced Hemostatic Agent Delivery Device, Oregon Biomedical Engineering Institute Clinic***

The HMC Clinic team will design and prototype a device that will deploy a controllable amount of fast-acting hemostatic agent into non-abdominal wounds of varying severity without applying detrimental pressure to the cavity and surrounding tissues. This device should be safe, portable, durable, and disposable, as it will be carried by military medics in a battlefield environment.

Faculty Adviser: *Nancy Lape, Engineering*

Beckman B126 COMPUTER SCIENCE

**Mudd Software Designs (ASHMC-chartered club): *Software as a Community Service***

**Ryan Brewster, Sarah Ferraro, Emma Carlson, Audrey Lawrence, Adam Cozzette, Tyanan McAuley, Richard Porczak, Eric Zhang, Adrian Sampson, Andrew La Motte-Mitchell, Tyler Wolf, Bryce Lampe, Will Scott**

Mudd Software Designs is a community service-oriented software development group at Harvey Mudd. It provides Mudders with real-world experiences to prepare them for programming-based Clinic projects, for summer internships, and for eventual employment after graduation from Mudd. It also fulfills software development needs of other groups on campus. We will present on the projects we have undertaken this year: an online voting system for the student body and a textbook exchange site.

Adviser: *Michael Erlinger, Computer Science*

Galileo- ENGINEERING

Edwards **E4: *Stove design for communities in Malawi*** (See description page 26.)

**Noah Atwi, Ana Derby, Stephen Kwong, Katherine Taylor**

Galileo- **E4: *Automatic gate-opening device for a chicken coop*** (See description page 26.)

McAlister **Isabel Bush, Matthew Davis, Renee Gittins, Joyce Lin**

**3:45 P.M.**

Galileo- CHEMISTRY

Pryne **Maggie Weber: *Arsenic Removal from Groundwater in Rural Cambodia***  
**(Global Clinic Program, Lien Institute for the Environment Group)**

Arsenic concentrations in Cambodian groundwater can be one hundred times greater than the World Health Organization's standard of 10 ppm. However, removal methods used in developed countries are not suitable for rural Cambodia. In collaboration with students from Nanyang Technological University in Singapore, the team adapted methods from current primary research to a rural environment. The adapted methods were tested and the best selected for inclusion in a final proof-of-concept prototype.

Faculty Adviser: *Darryl Yong '96, Mathematics*

Galileo- ENGINEERING

Edwards **E4: *Stove design for communities in Malawi*** (See description page 26.)

**Kathleen Bennett, Winnie Ding, John Grasel, Takumi Ito, David King**

Galileo- **E4: *Automatic gate-opening device for a chicken coop*** (See description page 26.)

McAlister **Alex Hall, My Ho, Shaun Pacheco, Eric Zhang**

**4:00 P.M.**

Beckman B126 COMPUTER SCIENCE

**James Brown: *Computer Science Cluster Administration***

The Computer Science Department computer systems are largely maintained by a student staff. Over the past year, the staff has worked on several large changes to the department computing resources. This presentation will describe the resources managed by staff and will introduce some of these changes.

Faculty Adviser: *Geoff Kuenning, Computer Science*

Galileo- ENGINEERING

Edwards **E4: *Stove design for communities in Malawi*** (See description page 26.)

**Sun Hwi Bang, Allie McDonnell, Johnson Qu, Emma Taborsky**

Galileo- **E4: *Automatic gate-opening device for a chicken coop*** (See description page 26.)

McAlister **Andrew Jennings, Ethan Ritz, Vincent Shieh, Diane Tu**

**4:15 P.M.**

Galileo-      ENGINEERING  
Edwards      **E4: Stove design for communities in Malawi** (See description page 26.)  
**Kristen Schunter, Mary Van Vleet, Yih-Jye Wang, Chauncey Willburn**

Galileo-      **E4: Automatic gate-opening device for a chicken coop** (See description page 26.)  
McAlister      **Lilian de Greef, Mark Ellis, Nick Hill, Nicole Peck**

**4:30 P.M.**

Galileo-      ENGINEERING  
Edwards      **E4: Stove design for communities in Malawi** (See description page 26.)  
**Evann Gonzales, Ozzie Gooen, Katherine Lownsbery, Alexa Noxon**

**7:45 P.M.**

Green Room      RECEPTION

**8:00 P.M.**

Green Room      HMC MUSIC 84, JAZZ CONCERT: THE MUSIC OF TOM HARRELL  
Platt Campus      **Hufsa Ahmad** (electric bass), **Thomas Body** (CMC, piano), **Brandyn Carlson** (trumpet), **Nicole Crisosto** (drums),  
Center      **James Douglass** (Pitzer, drums), **Arthur Eigenbrot** (alto sax), **Paul Hobbs** (piano), **Stephen Lee** (piano), **Keith**  
**Ingram** (alto sax), **Rachid Jabbouri** (Pitzer, guitar), **Nicholas Jones** (Pomona, guitar), **Robert Keller** (instructor,  
fluegelhorn and trumpet), **Graham Orr** (vibraphone), **Zach Shpizner** (Pitzer, guitar), **Ryan Williams** (electric bass)

Students will perform jazz in small combos, improvising on the music of modern jazz trumpet player and composer Tom Harrell. Selections include: "Moon Alley," "April Mist," "Train Shuffle," "Little Dancer," "Sail Away," and "Because I Love You."

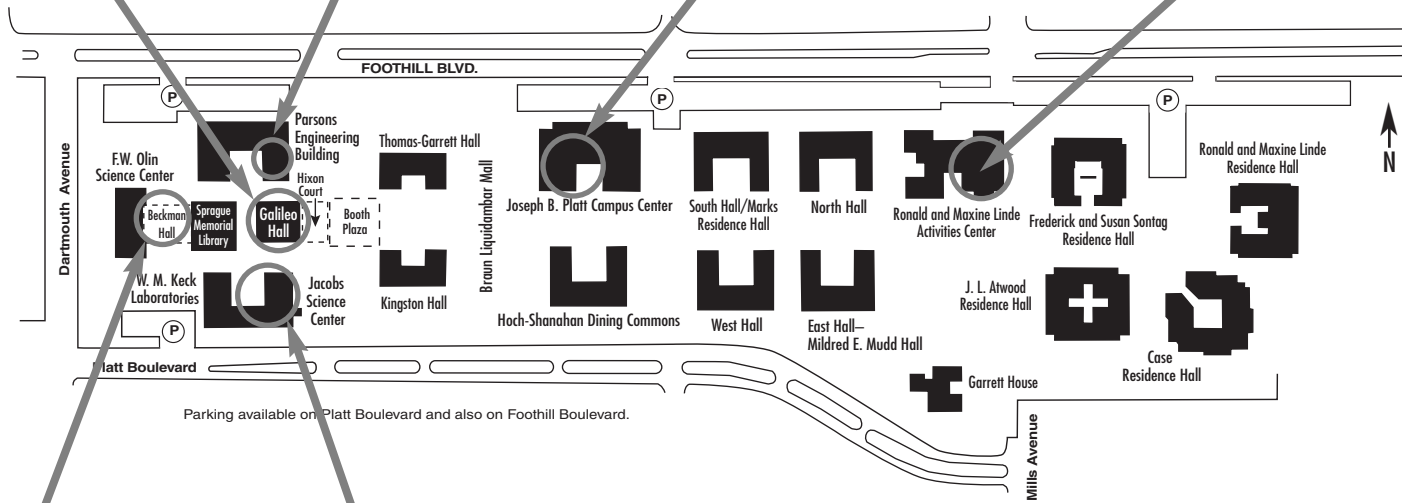
*T h a n k   y o u   f o r   a t t e n d i n g .*

Galileo Hall-Pryne  
 Galileo Hall-McAlister  
 Galileo Hall-Edwards  
 Galileo Hall Foyer

Parsons Hall Gallery, first floor

Joseph B. Platt Campus Center, Green Room

Projects Day Poster Viewing



Beckman Hall B126

Jacobs B132  
 Jacobs B134

HARVEY MUDD COLLEGE  
 301 Platt Boulevard  
 Claremont, CA 91711  
 909/621-8340  
 www.hmc.edu

A Member of The Claremont Colleges