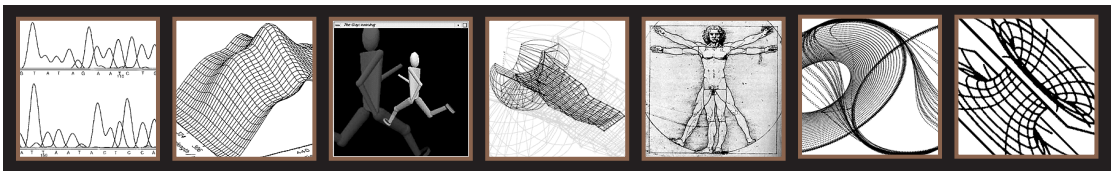
Harvey Mudd College
301 Platt Boulevard
Claremont, CA 91711
www.hmc.edu

Presentation Days 2008



A Celebration of Student Projects

May 5, 6 & 7

Harvey Mudd College
Claremont, California

The liberal arts college of engineering, science and mathematics

Presentation Days 2008
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 and Social Sciences are displaying their photographs, while students in the Computer Science Department will be examining XO, the computer developed by the One Laptop per Child Foundation, and biology students will be debating the ethics of gene therapy. New this year, MuCC has organized a display of artwork created by "developing scientist-citizens." The results of the Introduction to Engineering Design projects, involving 17 teams of first-year and sophomore students, will also be presented. The Harvey Mudd College Electronic Music ensemble will perform new works, and the Jazz Improvisation class will perform tunes written by saxophonist Benny Golson.

The keynote speaker for Presentation Days 2008 is Vin de Silva, assistant professor of mathematics at Pomona College. Professor De Silva's joint work with Robert Ghrist on the topology of robotic sensor networks was cited by Scientific American magazine as one of the fifty leading scientific contributions of the year. His talk on "Swarms of Blind Robots: An Exploration in Applied Algebraic Topology," will be held Monday, May 6, 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.

The Presentation Days Committee consists of Robert Drewell, Ann Esin, Stephanie Graham, Esther Hughes, Catherine McFadden, Nick Pippenger, Paul Steinberg and Gerald Van Hecke '61, and is chaired by Robert Keller.

Schedule
Monday, May 5

All Day Artwork Exhibits by Mudd Creative Collective (MuCC), Galileo Hall Foyer

All Day Humanities and Social Sciences Art 50 and Art 100 Photography Exhibit, Galileo Hall Foyer

All Day Humanities and Social Sciences Art 150 Photography Exhibit, HSS Parsons Hall Gallery, first floor, Parsons Hall

	BIOLOGY Beckman B126	CHEMISTRY Galileo-Pryne	HUMANITIES & SOC SCI Galileo-McAlister	MATHEMATICS Beckman B126	PHYSICS Galileo-Edwards	ENGINEERING Jacobs B132	ENGINEERING Jacobs B134
9:00 A.M.	Shayni Saftler	Chem 171, Adv. Organic Synthesis I (4 presentations)				E80 I (2 presentations)	E80 II (2 presentations)
9:15 A.M.	Kelly Walsh				Peter Scherpelz		
9:30 A.M.	Lindsay Wray				Hyung Joo Park		
9:45 A.M.	Yu-Loung Chang				Howard Yu		
10:00 A.M.	Reception–Galileo Foyer						
10:15 A.M.							
10:30 A.M.		Chem 171, Adv. Organic Synthesis II (6 presentations)	Science and Citizenship I	Tim Sweda	David Coats	E80 III (3 presentations)	E80 IV (3 presentations)
10:45 A.M.				Michael Ernst, Sean Plott	Meredith Rawls		
11:00 A.M.				Sean Plott	Shelley DeFord		
11:15 A.M.					Clarence Chan		
11:30 A.M.				Interdisciplinary Competition in Modeling			
11:45 A.M.							
NOON	Lunch						
1:00 P.M.			Science and Citizenship II	Kevin Fleming		E80 V (4 presentations)	E80 VI (5 presentations)
1:15 P.M.		Karen C. Brown			Physics 170 Computational Physics/Robot Face-off		
1:30 P.M.		Minseok Jang		Sara Gussin			
1:45 P.M.		Julian Evans					
2:00 P.M.		Andrew Stewart		Kenji Kozai			
2:15 P.M.		Matthew Hoss					
2:30 P.M.		Samuel Sobelman		Andrew Leverentz			
2:45 P.M.							
3:00 P.M.				Gregory Minton			
3:15 P.M.							
3:30 P.M.	Reception–Galileo Foyer						
3:45 P.M.							

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

GUEST SPEAKER: Vin De Silva, assistant professor of mathematics, Pomona College

"Swarms of Blind Robots–An Exploration in Applied Algebraic Topology"

8:00 – 9:30 P.M. Music 84 Jazz Concert—Green Room, Platt Campus Center

Tuesday, May 6

10:30 A.M.– 6:00 P.M. Projects Day, Clinic Presentations

Please see page 12 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.

Schedule
Wednesday, May 7

All Day Humanities and Social Sciences Art 50 and Art 100 Photography Exhibit, Galileo Hall Foyer
Presenters available 2:30–3:30 p.m.

All Day Humanities and Social Sciences Art 150 Photography Exhibit, HSS Parsons Hall Gallery, first floor, Parsons Hall
Presenters available 2:30–3:30 p.m.

	BIOLOGY Beckman B126	**BIOLOGY & CHEMISTRY AND BIOLOGY Galileo-Pryne**	**COMPUTER SCIENCE Galileo-Pryne**	**ENGINEERING Galileo-McAlister**	**ENGINEERING Galileo-Edwards**	**MATHEMATICS Beckman B126**	**PHYSICS Galileo-Edwards**	**HUMANITIES AND SOCIAL SCIENCES Jacobs B134**	**HUMANITIES AND SOCIAL SCIENCES Platt Courtyard**
9:00 A.M.	Bio 082 Bioethics & Embryology Debate			Composite Membranes					
9:15 A.M.				Humidity Effects/Skin			Sean Meenehan		
9:30 A.M.							Sandi Bruce		
9:45 A.M.							Laura Sturch		
10:00 A.M.	Reception–Galileo Foyer								
10:15 A.M.									
10:30 A.M.		Kristen Chellis		Crystalline Boundaries		David Morrison	Michael Gilik	Philosophy 125 Ethical Issues in Science and Engineering I (4 presentations)	
10:45 A.M.		Jennifer Du Mond		Low-Cost 3-D Printer: Choi, Hunt, Pong, et al			Angela Berti		
11:00 A.M.		Andrea Sand				Brian Rice	Eric Baxter		
11:15 A.M.		Sarah Moore		E158 Intro to CMOS VLSI Design			Samuel Eisenberg		
11:30 A.M.						Douglas Rizzolo			
11:45 A.M.									
NOON	Lunch								
1:00 P.M.			Hunter, Miller, Roberts			Parousia Rockstroh		Philosophy 125 Ethical Issues in Science and Engineering II (6 presentations)	
1:15 P.M.				E4 Non-invasive Boroscope Manipulator	E4 Automatic Page-turner for Children's Picture Books				
1:30 P.M.			Adrian Sampson			Tia Sondjaja			
1:45 P.M.			Andrew Hunter						
2:00 P.M.			CS 182-2 Pen-based Computing	E4 Intubation Simulator for Veterinary Students		George Tucker			
2:15 P.M.									
2:30 P.M.						Jason Winerip			
2:45 P.M.									
3:00 P.M.	Reception–Galileo Foyer								
3:15 P.M.	Sara Goetz		IE162 Beyond Calculation: Solar Power for XO; Software Environment/Tool Development for the XO	E4 Assistive Device for Walking on Beach	E4 Quick Attachment & Release for Bicycle Pedals			Philosophy 125 Ethical Issues in Science and Engineering III (5 presentations)	
3:30 P.M.	Margaret Ho								
3:45 P.M.	Ben Schiller				E4 Green Compost Sifter				
4:00 P.M.	HIV/AIDS directed reading		Autonomous Vehicle						Mus 48 Electronic Music Ensemble
4:15 P.M.			CS121 Software Development						
4:30 P.M.									
4:45 P.M.									

7:00 P.M.– Humanities and Social Sciences Concert–Green Room, Platt Campus Center
8:30 P.M. Peter Scherpelz: Senior Cello Recital

8:30 P.M.– Humanities and Social Sciences Concert–Galileo-McAlister
10:00 P.M. Harmony of Sound and Light Final Projects

Monday, May 5, 2008

9:00 a.m.–Noon • Morning Research Presentations

All Day	**Humanities and Social Sciences, Photography Exhibits, Galileo Foyer and Parsons Gallery, see below**
All Day	**Artwork Exhibits, Mudd Creative Consortium (MuCC), Galileo Foyer, see below**
9:00 A.M.	**Biology Presentations, Beckman B126, see page 5**
9:00 A.M.	**Chemistry Presentations, Galileo-Pryne, see page 5**
9:00 A.M.	**Engineering E80 Presentations, Jacobs B132 and Jacobs B134, see page 6**
9:15 A.M.	**Physics Presentations, Galileo-Edwards, see page 7**
10:30 A.M.	**Mathematics Presentations, Beckman B126, see page 6**
10:30 A.M.	**Humanities and Social Sciences Presentations, Galileo-McAlister, see page 6**

Humanities and Social Sciences Poster Session—Galileo Foyer and Parsons Hall

All Day **Art 50 Beginning Black & White Photography**

On display will be work from the Introductory Black and White Photography class. Each student will showcase their best photographs from the semester. Students will be present in the Galileo Hall Foyer to discuss their work between 2:30 and 3:30 on Wednesday, May 7.

Course Instructor: *Phil Marquez, Humanities and Social Sciences*

All Day **Art 100 Beginning Digital Photography**

This show represent the students' best work to date and is arranged according to a theme that has motivated their photography work. Students will be present in the Galileo Hall Foyer to discuss their work between 2:30 and 3:30 p.m. on Wednesday, May 7.

Course Instructor: *Steve Schenck, Humanities and Social Sciences*

All Day **Art 150 Intermediate Black & White Photography**

On display will be work from the Intermediate Black and White Photography class. This exhibition will showcase the photographic style of photomontage. This approach was developed soon after the invention of photography and is the precursor to our modern day Photoshop. Each student will have two framed images on display. Students will be present in HSS Parsons Hall, first floor, to discuss their work between 2:30 and 3:30 p.m. on Wednesday, May 7.

Course Instructor: *Phil Marquez, Humanities and Social Sciences*

All Day **Artwork Exhibits by the Mudd Creative Collective (MuCC): *A Celebration of Creativity and Diversity of Talent***
Organizers: **Aurora Pribram-Jones, Adrian Sampson, David Gross**

Harvey Mudd College strives to create scientists well-versed in all academic disciplines and their interactions. Many of us complement our technical and humanities work with creative projects, either through courses in the arts or through independent projects. In this exhibition, we hope to share with our community this often hidden view into the minds and lives of the developing scientist-citizen by a showing of the visual and structural artwork created in the past year by HMC students. Join us in this search for insight into the uniqueness of the HMC experience, sponsored by the Mudd Creative Collective and featuring student sculpture, painting, drawing, photography, poetry, ceramics and more.

Biology–Beckman B126

9:00 A.M. **Shayni Saftler:** ***Is the foraging success of*** Sceloporus occidentalis ***related to the seasonal availability of prey and individual sprint speed?***

Many studies on the ecological diversity of lizards have pointed out interesting differences in locomotor performance and foraging mode. Surprisingly, however, there is little data on the foraging success of lizards or any other animals. I investigated the foraging success of Western fence lizards (*Sceloporus occidentalis*) in relation to both sprint speed and seasonal variation in prey availability. In particular, I determined the relationship between prey abundance and overall foraging success of fence lizards, the repeatability of foraging success, and the relationship between maximum sprint speed and individual foraging success.

Faculty Adviser: *Stephen Adolph, Biology*

9:15 A.M. **Kelly Walsh:** ***Resolving Taxonomic Ambiguities among the*** **Melithaeid** ***Genera***

Using traditional methods of systematics based on morphological traits, taxonomists have defined 3-5 genera within *Melithaeidae*, a family of Indo-Pacific sea fans. These genera have many transitional species that sometimes share traits of more than one genus. To determine genus boundaries, I sequenced two mitochondrial genes, COI and msh. COI is a common gene used in DNA barcoding to rapidly identify species, while msh is a gene unique to soft corals. I constructed a phylogenetic tree based on sequence similarities to determine if species from each genus formed distinctive groups.

Faculty Adviser: *Catherine McFadden, Biology*

9:30 A.M. **Lindsay S. Wray:** ***Quantifying the Behavior of Rabbit Corneal Fibroblasts on Aligned Collagen Fibers***

In order to be a viable replacement for natural corneal tissue, a tissue engineered (TE) cornea needs to be transparent and mechanically resilient. One necessary element for achieving this level of functionality is a scaffolding material that minimizes backscattered light, supports cellular growth, and maintains the transparent cellular phenotype. Previous studies in the lab have led to the development of a scaffolding material composed of small-diameter, aligned collagen fibers. In order to determine the viability of this scaffolding material for a TE cornea, this project cultured rabbit corneal fibroblasts on the scaffold and quantified their protein expression.

Faculty Adviser: *Elizabeth J. Orwin, Engineering*

9:45 A.M. **Yu-Loung Chang:** ***Exploring Dynein Heavy Chains and Ohnologs in*** Paramecium tetraurelia

Dynein heavy chains, motor proteins responsible for converting chemical energy to mechanical work, are essential in the ciliate *Paramecium tetraurelia.* Present-day *Paramecium* is the result of a recent whole-genome duplication, resulting in ohnologs, identical gene pairs that have since evolved independently. I found 27 different heavy chain genes in all nine classes in *Paramecium* with 11 ohnolog pairs. The protein sequences of ohnolog pairs were found to be well above 90%. Finally, I have examined the sequences flanking the heavy chain genes in order to try to understand why some genes no longer have identifiable ohnolog pairs.

Faculty Adviser: *David Asai, Biology*

10:00 A.M. Reception in Galileo Foyer

Chemistry–Galileo-Pryne

9:00 A.M. **Chemistry 171: Advanced Organic Synthesis I**
Svetlana Borukhova, Andrew Chen, Claire Knezevic, Jonathan Litz, Ken Loh, Rachel Nishimura, Joanne Redford, Margaret Scheuermann, Eva Smith, Anna Wagner

During this session, students in Chemistry 171 will present their individual proposals for the synthesis of complex target molecules, many of which are of medicinal value. The audience may consider themselves members of a grant proposal review committee.

Faculty Adviser: *David Vosburg, Chemistry*

10:00 A.M. Reception in Galileo Foyer

10:30 A.M. **Chemistry 171: Advanced Organic Synthesis II** (Continuation of the preceding)

Engineering–Jacobs B132 and Jacobs B134

9:00 A.M.–3:45 P.M. E80 Experimental Engineering: ***Analysis of Video- and Data-Telemetry from Small Rocket Flights, and Comparison with Model Predictions***

The final assignment in E80 Experimental Engineering is to present the results of a comparison of the experimentally obtained flight data from a series of rocket flights with the predicted results of flight models which use data the students have been obtaining over the course of the semester. Each presentation will last 20 minutes, with breaks observed.

Faculty Advisers: *Erik Spjut, Mary Cardenas, et al.*

Jacobs B132

Scott Butters; Alex Grammar; Benjamin Keller; John Rowley; Brian Bosak; Daniel Bujalski; Chelsea Drenick; Bryan Teague

Roger Billingsley; Jordan Ciciliano; Florian Scheulen; Louis Zellinger; Nicolas Hasegawa; Christina Kneen; Alyssa Pierson; Wesley Ducey; Kevin Hsu; Michael McNeece; Joshua Ray

Daniel Bobrowsky; Alexander Kurtis; Michael Lee; Michelle Walker; Alan Gilder; Austin Lee; Sangho Lee; Jessica Wen; Ian Bullock; Steven Dell; Jaakko Karras; Chen Kwei Lim; Andrew Armas; Shawn Duenas; Dorian Scrima; Jonathan Simkin

Jacobs B134

Corinne Cho; Masato Kocberber; Megan Pham; Jason Wang; Angus Ho; Michael Ho; Jin-Soo Jo; Mobashwir Khan

Nathan Jones; Fu Weng Lam; Raquel Robinson; Anjie Clark; Marc Davidson; Bonchull Koo; Sarah Nitzan; Kevin Ryan Jr.; Rebecca Burns; Marco Fernandez; Cidney Scanlon; Benjamin Smith

Masanori Honda; Jonathan Hubbard; Seung Kyu Kim; Jessica Witt; Robert Best; Carolina de Freitas; Bryan Downs; Benjamin Margolis; Raffi Attarian; Donald Bolton; Elizabeth Ellis; Benyue Liu; William Quinn; Alex Randall; Bruce Yan; Alexander Young; Alexander Krause; Matthew Kurtis; Thomas Oh; Andrew Pozo

Humanities and Social Sciences–Galileo-McAlister

10:30 A.M. **Science and Citizenship I**

Effective communication is essential for social engagement and scientific leadership. 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. These final presentations cover a wide range of topics, from the future of nuclear energy to the intersection of science and religion.

Faculty Adviser: *Paul Steinberg, Humanities and Social Sciences*

Mathematics–Beckman B126

10:30 A.M. **Tim Sweda:** ***Optimal Defensive Investments for Deterring Terrorists***

Since the terrorist attacks of 9/11, policy makers have tried to understand how to deter terrorists and prevent future attacks. Due to limited security resources, it is not always feasible to fully defend a target that is susceptible to attack by terrorists, so it is important to utilize the resources as effectively as possible. Our research explores a game theoretic model of terrorist deterrence in which a defender must defend a single target against an attacker. The optimal investment strategies for each player are determined and characterized, and we examine how the defender's optimal investment changes as the game parameters are varied.

Faculty Adviser: *Susan Martonosi, Mathematics*

Mathematics Presentations continued

10:45 A.M. **Michael Ernst and Sean Plott:** ***Disrupting Terrorist Networks***

Since the 9/11 terrorist attacks, there has been an increased interest in the prevention of such attacks. However, it is often difficult to gain access to any desired key player in a terrorist network. Therefore, our research demonstrates techniques to increase the visibility and accessibility of specific individuals by redirecting information flow. We present a variety of strategies that increase the visibility on a target, forcing them to be more active in the network.

Faculty Adviser: *Susan Martonosi, Mathematics*

11:00 A.M. **Sean Plott:** ***Getting Kinky with Combinatorics***

Pascal's Triangle is one of the most beautiful and famous objects in mathematics, appearing in virtually every branch of mathematical study. In my thesis, I demonstrate an intimate connection between Pascal's Triangle and the well-known Catalan Sequence. Using cute combinatorial techniques, I illustrate the simple yet powerful connections between determinants, restricted lattice paths, and Pascal's "inner" triangles.

Faculty Adviser: *Arthur Benjamin, Mathematics*

11:30 A.M. **Bryce Lampe, Denis Aleshin, and Parousia Rockstroh:** ***A Mathematical Model for Health Care Systems (Interdisciplinary Contest in Modeling)***

We develop a mathematical model to predict key areas for improvement in health care systems. In particular, we establish a framework for comparing the health care systems of different nations. Using a probabilistic model based on this framework, we investigate the effects of various changes to the United States' system. From this we developed a strategy for reform that would most effectively improve the world-rank of the United State's health care system. Notably, our results indicate that the United States should place more emphasis on the prevention of illness, and it should shift toward a more centralized health care system.

Faculty Adviser: *Jon Jacobsen, Mathematics*

Physics–Galileo-Edwards

9:15 A.M. **Peter Scherpelz:** ***Implementing Single Qubit Quantum Secret Sharing***

Quantum secret sharing uses the superposition and entanglement of quantum states to provide improved security in the cryptographic task of secret sharing. We worked to implement a particular quantum secret sharing protocol that only requires sending one qubit (photon) between all of the parties. Our implementation uses spontaneous parametric down-conversion, along with the detection of coincident photons, to produce and detect the qubits being sent. In addition to presenting the protocol, our experimental work, and the primary sources of error, I will also discuss potential attacks against this protocol.

Faculty Adviser: *Theresa Lynn, Physics*

9:30 A.M. **Hyung Joo Park:** ***Explorations of Nonaxisymmetric Shallow Water Wave Behavior in Cylindrical Geometries***

Inspired by results published by Georgios T. Vatistas and Thomas Jansson et. al. on the formation of geometric whirlpools in a bucket of water in which the bottom is rotated at a constant angular frequency, we numerically explore behaviors of nonaxisymmetric flow patterns in a cylindrical container. Using finite difference methods to approximate the system of PDEs that govern shallow water wave behavior, we attempt to explore perturbations of the axisymmetric case and analyze the resulting flow profile and their stabilities.

Faculty Adviser: *Darryl Yong, Mathematics*

9:45 A.M. **Howard Yu:** ***Studying Time-Dependent Magnetization Dynamics Using the Magneto-Optic Kerr Effect***

Exchange coupling between an antiferromagnetic and a ferromagnetic layer is interrupted by a 100 fs laser pulse at 800 nm, allowing the magnetization of the ferromagnet to precess under an externally applied magnetic field. This behavior is described by the Landau-Lifshitz-Gilbert equations. The magnetization dynamics are observed using the time-dependent magneto-optic Kerr effect. We report on measurements of the magnetization precession and how we extract information regarding the exchange coupling.

Faculty Adviser: *Peter N. Saeta, Physics*

Physics Presentations continued

10:00 A.M. Reception in Galileo Foyer

10:30 A.M. **David W. Coats:** ***Immunogold Labeling for Optical Coherence Microscopy During Corneal Tissue Engineering***

The aging of the nation's population and a small percentage of unsuccessful LASIK procedures has dramatically increased demand for tissue-engineered cornea replacements. We report progress in developing a tissue-culture process in which a patient's own cells would be used to fabricate replacement tissue. Optical Coherence Microscopy offers the ability to nondestructively image cells in culture using 90 nanometer diameter gold labeling particles. Monitoring of cell phenotype in tissue culture is essential, and the immunogold labeling process provides cellular information via binding to alpha-5-beta-1 integrin receptors expressed only by specific phenotypes.

Faculty Advisers: *Richard Haskell, Physics, and Elizabeth Orwin, Engineering*

10:45 A.M. **Meredith Rawls:** ***Ups and Downs in the Life of a Cataclysmic Variable: The Long-Term Behavior of CM Phoenicis***

CM Phe is a cataclysmic variable star, a close binary system containing a white dwarf and main sequence donor star in which mass transfers to an accretion disk around the white dwarf. We have photometric and spectroscopic observations of CM Phe spanning nearly nine years. Based on long-term behavior, we classify CM Phe as a VY Scl star, one which is characterized by drops in mass transfer rate. The 6.45 h orbital period of CM Phe is unusually long for VY Scl stars, and it also implies a more massive main sequence star than spectra show. The donor star may have evolved slightly off the main sequence, which is consistent with our radial velocity curve of CM Phe.

Faculty Adviser: *Donald Hoard, Physics*

11:00 A.M. **Shelley M. DeFord:** ***To Teach is to Learn Twice—Interning at Claremont High School***

Throughout the fall 2007 semester, I interned in two physics classes and one physical science class at Claremont High School. My responsibilities began with observing classroom dynamics and offering one-on-one help to students as they solved practice problems at the end of the term, I independently designed and taught an introductory energy lesson to the two physics classes. These experiences helped me to appreciate and respond to a wide range of ability levels in the classroom and to practice teaching physics with creativity and enthusiasm.

Faculty Adviser: *Peter N. Saeta, Physics*

11:15 A.M. **Clarence W. C. Chan:** ***Applying Optical Coherence Microscopy to Frog and Fruit Fly Embryogenesis***
An optical coherence microscope was used to non-invasively and non-destructively generate high-resolution 3-D time-lapse videos of critical events in living and intact frog and fruit fly embryos. Of particular interest was gastrulation (a process shared by all animals), during which the genome of an embryo becomes activated and its cells begin to differentiate, leading to complex cell movements that reorganize the embryo into the ectoderm, mesoderm, and endoderm germ layers. The goal of my project is to better understand the forces, dynamics and underlying mechanisms that govern gastrulation and other key events of embryogenesis in two model organisms.

Faculty Adviser: *Richard C. Haskell, Physics*

12 Noon Lunch Break

1:00 p.m.—5:00 p.m. • Afternoon Research Presentations & Keynote Address

1:00 P.M. **Humanities and Social Sciences Presentations, Galileo-Mcalister, see page 10**

1:00 P.M. **Mathematics Presentations, Beckman B126, see page 10**

1:15 P.M. **Chemistry Presentations, Galileo-Pryne, see page 9**

1:15 P.M. **Physics Presentations, Galileo-Edwards, see page 11**

4:00 P.M. **Presentation Days Keynote Address, Galileo-McAlister, see page 11**

8:00 p.m.—9:30 p.m. • Evening Event

8:00 P.M. **Jazz Concert, Green Room, Platt Campus Center, see page 11**

Chemistry–Galileo-Pryne

1:15 P.M. **Karen C. Brown:** ***Biomimetic, Enantioselective Synthesis of (+) -Davanone***

Davanone, the major component of the essential oil of *Artemisia pallens,* possesses both spasmolytic and fungolytic activity. Our synthesis is the shortest yet, and offers an enantioselective route to related natural products. Key steps are a thiazolium-catalyzed asymmetric epoxide opening and a biomimetic cyclization to form a trisubstituted tetrahydrofuran ring.

Faculty Adviser: *David Vosburg, Chemistry*

1:30 P.M. **Minseok Jang:** ***Excess Functions of Binary Mixtures***

Excess functions of binary mixtures were calculated for hexanol+ hexane, heptane, octane, nonane, and cyclohexanol+hexane, heptane, octane, nonane, cyclohexane, chlorocyclohexane by laser light scattering, density, refractive index and viscosity experiments. The data showed the trend by length of alkane, shape of alcohol, and temperature. Excess Gibbs potential of hexanol+ alkane increases as chain length increase. Excess Gibbs potential of hexanol is greater than the function of cyclohexanol due to steric hindrance. Excess volume of the mixtures varied with the alkane chain length and alcohol shape.

Faculty Adviser: *Gerald Van Hecke, Chemistry*

1:45 P.M. **Julian Evans:** ***Modeling the Endiandric Acid Cascade***

Endiandric acids are racemic natural products from the Australian walnut tree which contain fused and/or bridged rings arising from pericyclic reactions. A linear, polyunsaturated precursor undergoes a cascade of spontaneous 8 pi and 6 pi electrocyclizations and a Diels-Alder reaction to generate the complex tetracyclic structures of endiandric acids B and C. Using density functional theory, I computationally modeled ground states and transition states to better understand the energetics and selectivity of the cascade.

Faculty Adviser: *David Vosburg, Chemistry*

2:00 P.M. **Andrew Stewart:** ***Synthesis of a Multidentate Tethered Ligand***

Nitrogen addition across an unsaturated carbon-carbon bond has been performed using titanium amino alcohol catalysts. To date, the Johnson lab has carried out this reaction with modest success and enantioselectivities of up to 16%. In order to improve enantioselectivity, a chiral, multidentate ligand with a semi-rigid tether was developed. Several synthetic pathways have been proposed to fulfill this goal. Initial results have been promising, but the desired ligand has not yet been synthesized.

Faculty Adviser: *Adam R. Johnson, Chemistry*

2:15 P.M. **Matthew Hoss:** ***NMR Study of an Enantioselective Peptide-Based Acylation Catalyst***

Peptide-based catalysts are able to perform enantioselective reactions. One such peptide-based catalyst (*JACS*, 2006, 128, 16454) was identified after screening libraries of small peptides. The peptide catalyzes the prochiral enantioselective acylation of a diol substrate. To characterize this mechanism of catalysis, a model was generated using NMR-derived distance and dihedral angle constraints. The random search and molecular mechanics algorithms were used to thoroughly search the conformational space of the peptide.

Faculty Adviser: *Dan O'Leary, Chemistry*

2:30 P.M. **Samuel Sobelman:** ***Inhibition of the Shiga toxin: Synthesizing a Gb3 Receptor Analogue***

Food poisoning as a result of ingestion of contaminated produce containing shiga toxin, produced by the bacteria *Shigella dysenteriae,* can cause significant gastrointestinal distress and in severe cases lead to death. This pathogen binds to a trisaccharide receptor (Gb3) expressed on intestinal cell surfaces. Previous work by Nishikawa et al. has shown that a linked tetrapeptide (PPP-tet) is able to bind to the B subunit of shiga toxin, preventing infection. Mindful of this work, and the natural Gb3 shiga toxin target, we endeavor to create a sugar derived Gb3 mimic bound to a polymer backbone that will prevent shiga toxin infection.

Faculty Adviser: *Shenda Baker, Chemistry*

3:30 P.M. Reception in Galileo Foyer

Humanities and Social Sciences–Galileo-McAlister

1:00 P.M. **Science and Citizenship II**
Please see page 6 for a description.

Mathematics–Beckman B126

1:00 P.M. **Kevin Fleming:** ***Boundary Cycles in Random Triangulated Surfaces***

Random triangulated surfaces are created by taking an even number, *n,* of triangles and arbitrarily "gluing" together pairs of edges until every edge has been paired. The resulting surface can be described in terms of its number of boundary cycles, a random variable denoted by *h.* In my thesis, I establish an improved approximation for the expectation of *h* for certain values of *n.* I use a computer simulation to exactly determine the probability distribution of *h* for small values of *n,* and present a method for calculating these probabilities. I also conduct an investigation into the related problem of creating one connected component out of *n* triangles.

Faculty Adviser: *Nicholas Pippenger, Mathematics*

1:30 P.M. **Sara Gussin:** ***Wavelet Sets: An Iterative Construction***

Wavelets are functions that are often used in signal processing as alternatives to Fourier methods. Wavelet sets are defined in terms of Fourier transforms of certain wavelets, but can also be constructed independently without using wavelets. Such methods use set operations and properties of wavelet sets themselves. We examine the convergence properties of an iterative method discovered by Benedetto and Leon in 2001 for constructing wavelet sets in d dimensions.

Faculty Adviser: *Jon Jacobsen, Mathematics*

2:00 P.M. **Kenji Kozai:** ***Intrinsic Properties of Graphs***

Abstractly, a graph is a set of vertices and edges connecting pairs of vertices. A realization of a graph is a drawing in three-dimensional (Euclidean) space that represents the vertices and edges of a graph. Certain properties of special graphs occur in all realizations. This talk looks at characterizations for graphs that have intrinsic topological properties related to knots and links.

Course Instructor: *David Bachman, Pitzer College*

2:30 P.M. **Andrew Leverentz:** ***Dynamics of One-Dimensional Swarms***

A flock of birds and a school of fish are examples of swarms of biological organisms; their collective behavior can facilitate locomotion, feeding and protection from predators. We assume the individuals in these swarms interact pairwise and are susceptible to external factors such as gravity or chemical gradients (arising from pheromones or food sources, for example). This yields an integro-differential equation governing the evolution of the density of the organisms. We classify the long-term dynamics of swarms in terms of the system's parameters. A numerical simulation of the model confirms our predictions.

Faculty Adviser: *Andrew Bernoff, Mathematics*

3:00 P.M. **Gregory Minton:** ***Dot Product Representations of Graphs***

A dot product representation of a graph is an association of a vector with each vertex such that dot products between these vectors determine which vertices are connected by an edge. We are mainly interested in the smallest size, in terms of dimension of the vectors, for such a representation. Dot product representations may be used to model social networks, and are related to other properties of a graph like the independence number. In preceding work, the vectors always had real-valued entries. We extend dot product representations to fields other than the real numbers, especially finite fields. Particular focus is given to the field of the integers modulo two, where every entry is either 0 or 1.

Faculty Adviser: *Kimberly Tucker, Mathematics*

3:30 P.M. Reception in Galileo Foyer

Physics–Galileo-Edwards

1:15 P.M. **Physics 170 Computational Physics/Robot Face-off**

Pairs of students programmed software robots. Each student group represents a dorm. The robots will face off in a virtual arena displayed on a large projector screen in Galileo. The competition proceeds by elimination as each robot is killed by the others due to poorer artificial intelligence coding. The winner is the surviving bot, and hence the corresponding student group. All students are welcome to come and cheer for their dorm robot.

Faculty Adviser: *Vatche Sahakian, Physics*

PRESENTATION DAYS KEYNOTE ADDRESS–Galileo-McAlister

4:00 P.M. **Vin de Silva, Pomona College: *Swarms of Blind Robots – An Exploration in Applied Algebraic Topology***

Classical algebraic topology is one of the phenomenal successes of 20th century mathematics. It is the ideal mathematical tool for studying the geometry of abstract spaces in a floppy, stretchy sort of way, and for answering qualitative questions like "how many holes?" Much of the theory is formidably abstract and requires deep study, but the intuitions behind the theory are human and very natural. In the early 21st century, an era of fast computers and vast collections of scientific data, there has been increasing interest in practical applications of this theory. De Silva will discuss one or two examples, and, in particular, will explain how algebraic topology can be helpful to a swarm of blind robots.

Vin de Silva was born in Ceylon, grew up as a Londoner (south of the river), and has lived in California for several years now. He was fascinated by brightly-colored geometric objects from an early age. Eventually this led to a mathematics degree at Trinity College, Cambridge, followed by a doctorate in symplectic geometry under the supervision of Fields medallist Simon Donaldson at Oxford University. His favorite field of mathematics is topology. Since 2000, his research has focused on applications of topology and geometry to fields outside mathematics. In 2007, his joint work with Robert Ghrist on the topology of robotic sensor networks was cited by Scientific American *magazine as one of the fifty leading scientific contributions of the year. Professor de Silva has taught at Pomona College, in the mathematics department, since 2005.*

Humanities and Social Sciences Jazz Concert–Green Room, Platt Campus Center

8:00 P.M.–
9:30 P.M. **Music 84 Jazz Concert, Featuring the Music of Benny Golson**

Students will improvise in small groups on tunes written by Benny Golson, the famous composer and saxophonist. Selections include: "Five Spot After Dark"; "Whisper Not"; "Are You Real?"; "Killer Joe"; "I Remember Clifford"; "Along Came Betty"; "Blues March."

Performers: **Chris Alvino, Jesse Bellister, Bob Chen, Bain Compoowong (Pitzer), Gerald Daigle (Pomona), Keith Ingram, Stephen Lee, Trevin Murakami, Graham Orr, Philip Paulson (Pitzer), Aurora Pribram-Jones, Bryan Teague, Ben Tupper (Pomona), Courtney Wai (Scripps)**

Instructor: *Robert Keller, Computer Science*

Tuesday, May 6, 2008

PROJECTS DAY: Presentations of Computer Science, Engineering, Mathematics and Physics Clinic Projects

10:30 A.M. **Registration and Poster Viewing–Linde Activities Center**

1:00 P.M. **General Session–Galileo-McAlister**
Welcome: Maria Klawe, president
Remarks: Patrick Little, director, Engineering Clinic
Milestone Awards: Robert J. Cave, vice president for academic affairs and dean of faculty
Milestone Award Recipients: The Aerospace Corporation, Center for Integration of Medicine and Innovative Technology (CIMIT), Cardinal Health, DIRECTV Inc., Sun Microsystems

1:30–5:00 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

Bluebeam Software, Inc., *A Web-Based PDF Management and Organization Solution*

D4 Networks, LLC, *A Web-Based Implementation of a Reservation and Scheduling System for Efficient Per-Seat Pricing for Air Taxi Service*

Fair Isaac Corporation, *Visualizing Proof Search*

Microsoft Corporation, *CPU and GPU Based Image Processing for Digital Photographers*

QUALCOMM, *FLO Analysis Tool (FLOAT)*

RealNetworks, Inc., *Development and Characterization of a Real-Time Video Streaming System*

Engineering Clinic

9:Fish Surfboards, *Riding the Green Wave: Eco-Friendly Surfboard Manufacturing*

Aerospace Corporation, *Spaceborne Emergency Distress Beacons*

AeroVironment, Inc., *Meteorological Payload for Small Unmanned Aerial Systems*

Alejo Engineering Inc., *Coordination of the Safety and Mission Assurance Activities on the Crew Exploration Vehicle Program*

Applied Biosystems, *Design, Building, and Validation of a Low-Cost Real-Time Polymerase Chain Reaction Instrument for Copying and Quantifying DNA*

Cardinal Health (2 projects), *Bubble Formation and Kinetics in IV Delivery Systems; Drug Verification for an IV System Using Spectroscopic Methods*

CIMIT, *Blast Armor Using Machine-Augmented Composite Material*

CTG Energetics, Inc., *Campus Sustainability Database*

DIRECTV, *Field Portable Test Kit*

Firestone Center for Restoration Ecology, *Vertical Axis Wind Turbine for Remote Research*

Honeywell, *Analysis of Two-Phase Flow in OBIGGS Distribution Systems*

Lawrence Livermore National Laboratory, *Optimizing a Water-Based Muon Detector*

Los Alamos National Laboratory, *Ultra-Low Magnetic Resonance Imaging System*

Northrop Grumman Corporation, *Creating a More Environmentally-Friendly Aerospace Industry: Lead-Free Design and Manufacturing*

Engineering Clinic, continued

Opto-22, *Wireless I/O Commissioning System*

Orthodyne Electronics, *Develop and Validate a Mathematical Model of a Wire Bonder Structure for Use in the Development of Future Platforms*

Raytheon Space & Airborne Systems, *Satellite Payload Test Bed for Radiation Hardness Testing*

Southern California Edison–Innovation, *Acetylene Gas Monitoring in Distribution Transformers*

Southwest Research Institute, *Balloon-Borne Telescope*

Space Systems/Loral, *Low-Shock Solution for Satellite Solar Array Deployment*

SRI International, *Ad-Hoc In-Building Tracking System*

Sun Microsystems, *Building Ships for Fleet*

Trex Enterprises Corporation, *Active Millimeter-Wave Imaging Using Fourier Telescopy*

KGI/Engineering Clinic

Gilead Sciences, *Automated Visual Inspection Project*

Mathematics Clinic

Beckman Coulter, Inc., *Modeling Bead-Based Immunoassays*

Citadel Investment Group, *Investigating Returns to Pairs Trading Strategies*

Laserfiche, *Automated Dewarping Algorithms for Enhancing Camera-Based Document Acquisition*

WorldQuant, LLC, *Efficient Stock Trading*

Physics/Engineering Clinic

HMC Physical Plant & Campus Planning Committee of the Board of Trustees–Sustainability Clinic, *Guiding Sustainability at HMC*

Physics/Mathematics Clinic

Southwest Research Institute, *Modeling the Performance of a Jupiter Bound Electron Sensor in Strong Magnetic Fields*

For times and locations, please see Projects Day program, or visit www.hmc.edu/academicsclinicresearch/clinicprogram1/projectsday.html

Wednesday, May 8, 2008

9:00 a.m.–Noon
Morning Research Presentations

All Day	**Chemistry Posters, Galileo Foyer, see below**
All Day	**Engineering Posters, Galileo Foyer, see page 15**
All Day	**Humanities and Social Sciences Photography Exhibits–Galileo Hall Foyer and Parsons Hall Gallery, see page 15**
9:00 A.M.	**Biology Presentations, Beckman B126, see pages 15 & 16**
9:00 A.M.	**Engineering E80 Presentations, Galileo-McAlister, see pages 16–17**
9:15 A.M.	**Physics Presentations, Galileo-Edwards, see pages 18–19**
10:30 A.M.	**Chemistry and Biology, Galileo-Pryne, see page 16**
10:30 A.M.	**Humanities and Social Sciences Presentations, Jacobs B134, see page 17**
10:30 A.M.	**Mathematics Presentations, Beckman B126, see page 18**

Chemistry Research Posters–Galileo Foyer

All Day **Chemistry Research Posters**

Karen C. Brown: ***Towards a biomimetic synthesis of (+) -davanone***

Joanne Redford: ***Transition metal-mediated synthesis of pyrroles from dienyl azides***

Joshua Cobb: ***Nonideality in the binary phase diagrams of homologous 4′-n-alkyl-4-cyanobiphenyls***

Terence Wong: ***Palladium pi-allyl route to the endiandric acid cascade***

Jonathan Litz and Matthew Garber: ***Non-covalent interactions of azo dyes with anionic surfactant micelles***

Taylor Neiman: ***Self assembly of nanoscopic structures in 2-D using diblock copolymers: Effect of blending with a dye***

Seanna Vine: ***DFT modeling of the transition state topologies of the amide-acetal Claisen rearrangement***

Lauren Hughs: ***Asymmetric catalysis with sterically bulky titanium amide alkoxide complexes***

Kristen Chellis: ***Determining the binary phase diagram of biologically relevant liquid crystals***

Minseok Jang: ***Excess functions of binary mixtures***

Alison Lee and Christina Synder: ***Determination of the binary phase diagram of n-decyl—D-glucoside in water***

Poster Sessions continued

All Day **Engineering Posters–Galileo Foyer**

Ryan Quarfoth: ***Finite Element Modeling of a Novel Aluminum Rolling Process***

Rolled aluminum sheet is widely used in industrial, commercial and household products. The ductility and strength of the material are of significant importance to engineers using these sheets. A new aluminum sheet was developed that consists of alternating layers of high-purity aluminum (ductile) and an aluminum scandium alloy (strong) that holds promise for improved composite properties. After rolling, the layers show shear bands that can affect these properties. This project is attempting to recreate the localized shear bands using finite element modeling of the aluminum and of the rolling process.

Faculty Adviser: *Lori Bassman, Engineering*

Annika Eberle and Kenny Quinn: ***Development of Helix Structures in Tendril-Bearing Plants***

Plant tendrils are specialized structures that grasp supporting objects and coil to contract, drawing the plant stem closer to the support while forming helical structures. When anchored by a stem on one end and by a supporting object on the other, a tendril must maintain zero net twist along its length by forming reversals in the direction of winding. An ANSYS finite element model that reproduced the stages of coiling qualitatively and the investigation of experiments to determine growth rates to confirm the model are presented.

Faculty Adviser: *Lori Bassman, Engineering*

All Day **Humanities and Social Sciences Photography Exhibit—Galileo Hall Foyer**

Art 50 Beginning Black and White Photography and Art 100 Beginning Digital Photography
See Monday, May 5, description on page 4. Students will be present to discuss their work between 2:30 and 3:30 p.m. today.

All Day **Humanities and Social Sciences Photography Exhibit—HSS Parsons Hall Gallery, First Floor**

Art 150 Intermediate Black & White Photography
See Monday, May 5, description on page 4. Students will be present to discuss their work between 2:30 and 3:30 p.m. today.

Biology–Beckman B126

9:00 A.M. **Bio 082 Bioethics and Embryology Debate:** ***Gene therapy should be used to produce the best possible embryo***
John Allen, Christina Kneen, Hallie Kuhn, Peter Mawhorter, Stephanie McCarty, Andrew Nevarez, Donna Phu, Maureen Ruiz, Christina Snyder, Camille Sultana

One of the critical challenges in modern science is our ability to shape human development. This has brought embryology into the public domain. Based on our current scientific understanding of human development we now have the ability to manipulate human genes and embryos in ways unimaginable until recently. The questions we now face are: Even if we can do these things, should we do them? Under what conditions should such procedures be allowed or forbidden? Do we wish to support the research that makes such procedures possible? In this public debate we will explore these questions and address the future role of genetic engineering in humans.

Faculty Adviser: *Robert Drewell, Biology*

10:00 A.M. Reception Galileo Foyer

Biology/Chemistry and Biology–Galileo-Pryne

10:30 A.M. **Kristen Chellis:** ***Determining the Binary Phase Diagram of Biologically Relevant Liquid Crystals***

Alkylglucosides are amphiphilic molecules that form liquid crystal phases in mixtures with water. They are green surfactants and the phases they form have applications in drug delivery and cosmetics. Previous phase diagrams of the n-octyl-ß-D-thioglucoside and water system were incomplete, as they did not include two phase regions. Fluorescence spectroscopy with a prodan probe was used to determine the phase diagram of this system. Through analysis of the fluorescence spectrum of a sample the phases present can be determined.

Faculty Advisers: *Kerry Karukstis and Gerald Van Hecke, Chemistry*

10:45 A.M. **Jennifer Du Mond:** ***The Role of the Intraflagellar Transport Protein IFT140 During Ciliogenesis in*** **Tetrahymena thermophila**

Intraflagellar transport proteins serve as rafts to carry the motor proteins, tubulins, and other ciliary particles during maintenance and growth of cilia. IFT140 is a protein in complex A, which is involved in retrograde transport, and has previously been shown to be essential to ciliogenesis in *Chlamydomonas reinhardtii* and *Caenorhabditis elegans.* To examine the role of IFT140 in the ciliated organism *Tetrahymena thermophila,* a macronuclear knockdown cell line was created. The mutant cell line will be examined by immunofluorescence confocal microscopy for quantity and length of cilia and by timed exposure darkfield microscopy for velocity and linearity of swimming.

Faculty Adviser: *David Asai, Biology*

11:00 A.M. **Andrea Sand:** ***Characterization of Dynein 2 Light Intermediate Chain (D2LIC) Utilizing RNA Interference (RNAi) in*** **Tetrahymena thermophila**

D2LIC is a light intermediate chain protein found on the dynein 2 motor protein complex. The loss of function phenotype for D2LIC in the single celled ciliate, *Tetrahymena thermophila,* has been previously characterized through genetic knock-out techniques, which showed fewer and shorter cilia on the cells. Monster cells, aggregates of incompletely divided cells, were observed in culture. My project is to exploit the RNA interference (RNAi) pathway as an alternative strategy for modulating gene expression. Monster cells were observed after RNAi induction, demonstrating success in developing this method to relate gene expression and cellular phenotype.

Faculty Adviser: *David Asai, Biology*

11:15 A.M. **Sarah Moore: Amylin Pharmaceuticals:** ***Evaluation of Drug Delivery Systems for Chronic Therapy in Diabetes and Obesity***

My Team Master's Project Team at KGI worked with Amylin Pharmaceuticals to evaluate implantable drug delivery systems for chronic therapy of diabetes and obesity. We analyzed currently implantable drug delivery systems as well as injectable depot systems and their potential usage with Amylin's existing diabetes drugs SYMLINTM and BYETTATM. We also looked at the market acceptance of such devices through a survey of both doctors and patients.

Faculty Adviser: *David Asai and Karen Moynihan, Biology*

12 Noon Lunch

Engineering–Galileo-McAlister

9:00 A.M. **Lupita Bermudez, Susan Kim, Michael Kai Mayeda, Gena Urowsky, and Seanna Vine:** ***Tunable Composite Membranes for Energy-Efficient Gas Separation***

Chemical separations currently comprise 15% of the world's total energy consumption, driving research in more energy-efficient separation techniques such as gas separation membranes. Our research focuses on nano- and micro-composite inorganic/organic membranes for gas separations. The gas permeability of a polymer film typically decreases in proportion to the volume fraction of added impermeable spheres, but recent research has shown that when the composite size is reduced from microscale to nanoscale, polymeric membrane can actually increase the membrane's permeability. We are studying this transition via experiments and molecular modeling.

Faculty Adviser: *Nancy Lape, Engineering*

Engineering Presentations continued

9:30 A.M. **Lucia Cheung, Masanori Honda, Jaakko Karras, Kathleen Wang and Jessica Wen:** ***Humidity Effects on the Barrier Behavior of Human Skin: Experiments and Finite Element Modeling***

Human skin provides a two-way barrier preventing potentially harmful chemicals or diseases from entering the body while slowing water as it exits the body. These barrier effects are mainly due to the skin's outer-most layer of skin, called the stratum corneum (SC): the SC is composed of many corneocyte "flakes" in a lipid bilayer continuum. The structure and permeability of the SC has been shown to depend strongly on humidity, but the resulting effects on drug and toxin transport have not been well-studied. We are examining the effects of varying hydration on transport rates and pathways via in vitro experiments and finite element modeling.

Faculty Adviser: *Nancy Lape, Engineering*

10:00 A.M. Reception in Galileo Foyer

10:30 A.M. **Benyue Liu, Kevin King:** ***Visualization and Analysis of Three Dimensional Crystalline Boundaries***

Three dimensional (3-D) electron backscatter diffraction is a new, powerful crystallographic analysis method. Quantifying crystalline boundary orientations in 3-D provides insight into microstructure systems that cannot be gained from two-dimensional representations. The focus of this project is development of rigorous 3-D data analysis and visualization methods. An example model of crystalline boundaries constructed from data taken in a cold rolled steel shows evidence of multiple active slip planes.

Faculty Adviser: *Lori Bassman, Engineering*

10:45 A.M. **Jason Choi, Martin Hunt, Chris Pong, Jeffrey Rubinstein, Elton Wong, Ian Bullock, Jason Kang:** ***Building a Low-Cost 3-D Printer***

The team will discuss its construction of a low-cost 3-D printer based on the RepRap (replicating rapid-prototyper) design. This design is intended to substantially lower the cost of conventional 3-D printing devices, as well as produce a device capable of printing most the parts needed to construct another 3-D printer (a nearly self-replicating device). The team will discuss the various mechanical, electrical, and software tasks involved in constructing the 3-D printer, and comment on design recommendations for improving the device. The team will then demonstrate the operation of its finalized working device. (Strategic Vision Iinitiative-funded student research project)

11:15 A.M. **E158 Introduction to CMOS VLSI Design**

Fourteen students are designing a 6502 microprocessor and building it as a custom-integrated circuit. This is the major design project for the class, occupying half of the semester.

Instructor: *David Money Harris*

Humanities and Social Sciences–Jacobs B134

10:30 A.M. **Philosophy 125 Ethical Issues in Science and Engineering**
Steven Berler, Asaf Bernstein, Michael Buchanan, Andrew Chung, Jeffry Clark, David Coats, Margaret Ho, Russell Klare, Shannon McKenna, Eric Nacsa, Christopher Nield, Scott Parkey, Eric Peterson, Jeffrey Rubinstein, Oksana Sergeeva
Students will make a diverse set of presentations on ethical issues arising in the practice of engineering, the natural and formal sciences, and science-related professions such as medicine. Topics discussed will span issues in bioethics, Internet privacy, the ethics of weapons research and other issues. Presentations will explore current work in these areas by philosophers and other scholars. Each presentation will be followed by a brief period for questions.

Instructor: *Darryl Wright, Humanities and Social Sciences*

Mathematics–Beckman B126

10:30 A.M. **David R. Morrison:** ***Where Have All the Cars Gone? A Model for Determining Traffic Flow throughout a Road Network***

Congestion and over-saturated roads pose significant problems and create delays in every major city in the world. Before this problem can be addressed, we must know how much traffic is flowing over the links in the network. We transform a road network into a directed graph D=(V,E) with a network flow function, and ask the question, "What subset M of vertices (intersections) can we monitor such that if we know the flow passing through these vertices, we can calculate the flow everywhere in the graph?" To minimize the cost of placing sensors, we seek the smallest number of monitored vertices.

Faculty Adviser: *Susan Martonosi, Mathematics*

11:00 A.M. **Brian Rice:** ***Rigid Divisibility Sequences***

Consider a sequence of integers {a_n} obtained by iterating a polynomial f(x), so that each term is equal to the value of the polynomial at the previous term (i.e., a_n = f(a_{n-1})), and the first term of the sequence is the constant term of the polynomial. For some polynomials, this sequence satisfies certain strong conditions concerning the powers of primes that divide its terms, and is called a rigid divisibility sequence. I give several original results concerning the polynomials that generate rigid divisibility sequences.

Faculty Adviser: *Nicholas Pippenger, Mathematics*

11:30 A.M. **Douglas Rizzolo:** ***Approximating Solutions to Differential Equations via Fixed Point Theory***

One of the most elegant ways to prove that a differential equation has a solution is to pose it as a fixed point problem: find a function f such that x is a solution if and only if f(x)=x. One result for proving that a fixed point exists is Schauder's fixed point theorem, which is broadly applicable in proving the existence of solutions to differential equations, including the Navier-Stokes equations under certain conditions. I will outline a semi-constructive proof of Schauder's theorem that has been developed by Professor Francis Su and myself, and show its use in approximating the solutions of differential equations.

Faculty Adviser: *Jon Jacobsen, Mathematics*

12 Noon Lunch

Physics–Galileo-Edwards

9:15 A.M. **Sean Meenehan:** ***Modeling and Measuring the Generation of Second harmonic light in a Laser-Droplet Interaction***

When an intense optical pulse interacts with matter, nonlinear processes can be driven. We model the second-order nonlinear response of a material that is irradiated by such a pulse in the regime where the target material and the pulse wavelength are of similar scale. Predictions of the model are compared with experimental measurements.

Faculty Adviser: *Tom Donnelly, Physics*

9:30 A.M. **Sandi Bruce:** ***Angular Dependence of Second Harmonic Generation from Mie Regime Water Droplets***

An ultrafast Ti:Sapph laser pulse was used to irradiate an aerosol of micron-scale water droplets, and the resulting angular scattering intensity of second harmonic emission was measured. Second harmonic light is generated through a nonlinear interaction between the laser and the wavelength scale droplets. Droplets were created using frequency-tuned piezoelectric crystals submerged in water. This technique gave us predictable and controllable particle sizes to work with.

Faculty Adviser: *Tom Donnelly, Physics*

Physics Presentations continued

9:45 A.M. **Laura Sturch:** ***The Secret Identities of X-ray Sources in the Small Magellanic Cloud: Optical and Infrared Observations of X-ray Source Counterparts***

We present ground-based optical, 2MASS near-infrared, and Spitzer Space Telescope mid-infrared observations of the counterparts and local environments of X-ray sources in the Small Magellanic Cloud (SMC). Using modified point-spread-function fitting, we extract stellar magnitudes from the target fields. From these magnitudes, we have constructed broad-band spectral energy distributions (SEDs) spanning optical to mid-infrared wavelengths. Using the SEDs, we characterize the stellar component of the X-ray emitting systems. We also show multicolor mid-infrared images of the environments around the X-ray sources for evidence of the formation of the X-ray emitting system.

Faculty Adviser: *Donald Hoard, Physics*

10:00 A.M. Reception in Galileo Foyer

10:30 A.M. **Michael Gilik:** ***Physics at Claremont High School***

I will discuss my observations as a teaching intern in an introductory physics class at Claremont High School. An overview of the classroom structure and the teacher's instructional technique will be presented. The teacher's emphasis on simplistic formula-based problems increases the difficulty of generating student excitement about the subject material. Another barrier to effective instruction was the application of the same teaching style to two class sections with vastly differing academic backgrounds.

Faculty Adviser: *Peter N. Saeta, Physics*

10:45 A.M. **Angela Berti:** ***Searching the M32 Stellar Fossil Record for Signatures of Galaxy Interaction***

Within the Local group, morphological evidence suggests that M32, a dwarf satellite galaxy may have undergone a recent peri-galacticon passage with M31, the Andromeda galaxy. If so, this recent interaction could be responsible for many of the recently discovered peculiar features seen in both the disk and halo of M31. We attempt to constrain the M32/M31 interaction history by searching for signatures of recent star formation in M32's evolved stellar population. Specifically, we use near-IR (J/H/K) observations from the Palomar 5-meter telescope to create color-luminosity diagrams for M32 stars. By fitting theoretical models to these data, constraints can be placed on both the chemical composition and the age of this population.

Faculty Adviser: *Philip Choi (Pomona)*

11:00 A.M. **Eric Baxter:** ***Modeling the Rotational Evolution of Young Stars***

A long-standing problem in our understanding of young stars is their slow rotation. One popular theory suggests that the stellar magnetic field can effectively lock onto the slowly rotating accretion disk surrounding the star, causing the star to spin down. We explore the feasibility and possible implications of this theory using a model for stellar rotational period evolution that incorporates relevant physical phenomena. With our model, we reproduce many of the important features of the observed distribution of the stellar orbital periods.

Faculty Adviser: *Ann Esin, Physics*

11:15 A.M. **Samuel Eisenberg:** ***Anisotropic Magnetoresistance and Anomalous Hall Effect in Lanthanum-Strontium Cobaltite***

Crystals of the doped perovskite cobaltite $La_{1-x}Sr_xCoO_3$ (LSCO) have the unusual property of separating into a collection of ferromagnetic clusters within a non-ferromagnetic, semiconducting background matrix, despite having a constant chemical composition. The density of these clusters depends on the doping level; LSCO undergoes a percolation transition at $x = 0.17$. This research examines two novel phenomena that arise when LSCO is placed in a magnetic field, over a range of temperatures and doping levels.

Faculty Adviser: *James C. Eckert, Physics*

12 Noon Lunch

1:00 p.m.—5:00 p.m. • Afternoon Research Presentations

1:00 P.M. **Computer Science, Galileo-Pryne, see pages 21–22**

1:15 P.M. **Engineering E4 Presentations, Galileo Halls, see pages 23–24**

1:00 P.M. **Humanities and Social Sciences Presentations, Jacobs B134, see page 25**

1:00 P.M. **Mathematics Presentations, Beckman B126, see page 25**

2:30 P.M. **Humanities and Social Sciences Student Photographers on hand, Galileo Foyer, see page 4**

2:30 P.M. **Humanities and Social Sciences Student Photographers on hand, HSS Parsons Hall Gallery, first floor, see page 4**

3:15 P.M. **Biology Presentations, Beckman B126, see below**

4:00 p.m.—8:30 p.m. • Evening Events

4:00 P.M. **Humanities and Social Sciences, Electronic Music Ensemble, Platt Campus Center Courtyard, page 26**

7:00 P.M. **Humanities and Social Sciences, Senior Cello Recital, Green Room, Platt Campus Center, see page 26**

8:30 P.M. **Humanities and Social Sciences, Harmony of Sound and Light, Galileo-McAlister, see page 26**

Biology–Beckman B126

3:15 P.M. **Sara Goetz:** ***Developing a* Drosophila *S2 Cell System: A Tool for Molecular Dissection of Regulatory DNA Sequences***

The three homeotic genes that comprise the bithorax complex (BX-C) control segment identification in the posterior thorax and abdominal regions during embryonic development. Cis-regulatory modules (CRMs) are non-coding regions of DNA in the BX-C that regulate the expression of the three homeotic genes: *Ultrabithorax (Ubx), abdominal-A (abd-A),* and *Abdominal-B (Abd-B).* The CRMs demonstrate a striking lack of underlying evolutionary conservation, suggesting that they are evolving rapidly. I have developed a cell culture system to obtain rapid results to quantify the functional activities of the CRMs.

Faculty Adviser: *Robert A. Drewell, Biology*

3:30 P.M. **Margaret Ho:** ***Functional Activity of Rapidly Evolving cis Regulatory Modules in the* Drosophila *Bithorax Complex***

The homeotic genes regulate segment identity during development of the embryo and are important in the evolution of animal morphology. The bithorax complex (BX-C) in *Drosophila* contains three homeotic genes, which are regulated in the embryo by *cis*-regulatory modules (CRMs), including enhancers and insulators. The CRMs demonstrate a striking lack of underlying evolutionary conservation, suggesting that they are evolving rapidly. I am testing the functional activity of the CRMs in embryonic transgenic assays.

Faculty Adviser: *Robert A. Drewell, Biology*

3:45 P.M. **Ben Schiller:** ***Non-genic Transcription of cis-regulatory Modules***

Hox genes are highly conserved in animal development and encode for transcription factors that play a critical role in the determination of segment identity. The Hox genes of *Drosophila* are organized into two complexes—the bithorax complex and the Antennapedia complex—which contain a diverse array of *cis*-regulatory modules. Of particular interest is the IAB5 enhancer, located in the BX-C. Extensive non-genic transcription has been observed in the BX-C, including the transcription of IAB5. I will present new data from several species of *Drosophila* investigating the spatio-temporal patterning of this non-genic transcription and its functional role.

Faculty Adviser: *Robert A. Drewell, Biology*

Biology Presentations continued

4:00 P.M. **Bio 198 Directed Reading on HIV AIDS: *The Global HIV-AIDS Pandemic***
Nadia Abuelezam, Sabrina Arora, Julia Chang, Jennifer Du Mond, Rebecca Sedillo, Seanna Vine

One of the biggest challenges facing the world is the global HIV-AIDS pandemic. Currently, an estimated 33 million people are infected with HIV and an estimated 10,000 new infections occur every day. There is no cure, no vaccine, and drug resistance to currently available therapies is spreading. Sadly, most of the current AIDS victims live in the most poor and underdeveloped regions of the world, in those countries least equipped to respond. In this presentation, students from the Directed Reading on HIV-AIDS will share their knowledge of the science of HIV infection and the economic, political and social factors that contribute to the spread of the disease.

Faculty Adviser: *Karl Haushalter, Chemistry*

Computer Science–Galileo-Pryne

1:00 P.M. **Andrew Hunter, Philip Miller, Chris Roberts: *Software Transactional Memory***

Programmers and users are used to getting free performance boosts from new hardware without significant changes to software. However, getting good performance from newer multi-core architectures requires a major shift, to concurrent programming. Writing correct and efficient concurrent programs is challenging, but one promising technique is Software Transactional Memory (STM). We report on our investigation of and changes to the STM implementation provided by the Glasgow Haskell Compiler.

Faculty Adviser: *Christopher Stone, Computer Science*

1:30 P.M. **Adrian Sampson: *Adaptive Parsing***

Computers and the Web are full of structured data — in tables, lists, and forms — intended to be read by people. Their structure, however, makes them ripe for automatic interpretation. Parsing is the process programs use to understand structured data in text. Usually, parsing requires a complete definition of syntax rules. An adaptive parser performs the task with minimal syntactical information; in particular, it requires only information that can be provided by a typical user without the help of a programmer. I developed neural-network techniques to build an adaptive parser.

Faculty Adviser: *Robert Keller, Computer Science*

1:45 P.M. **Andrew Hunter: Emu: *A Compiler for Partial Recursive Functions***

The well-known Church-Turing hypothesis posits that any effectively computable function can be computed by a Turing machine, or by the lambda calculus, or by any number of other equivalent simple foundations for computability. In fact, the term "Turing-complete" gets used commonly to describe programming languages as having the power of a Turing machine, and thus the power of any other language—but we rarely make use of the fundamental models of computation. I will present Emu, a compiler from the well-known Scheme language to the partial recursive functions, and examine what Emu can do to tell us about the nature of computation.

Faculty Adviser: *Robert Keller, Computer Science*

2:00 P.M. **CS182-2 Pen-based Computing**
Ned Burns, Morgan Conbere, Eric Doi, Marty Field, Jason Fennell, Martin Hunt, Joe Simons, Andrew Taylor, Alice Zhu

Pen-based computer interfaces are emerging as a popular interaction platform (e.g., Tablet PCs), but the pen can be awkward to use with an interface designed for a keyboard and mouse. Students in CS182-2: Pen-Based Computing, in addition to students doing pen-based computing research with Professor Alvarado (but not enrolled in CS182-2), will demonstrate creative solutions to unique problems they have identified in the field of pen-based computing. Students will give short overviews of their projects, including live demonstrations (or videos) of their interfaces. During the latter part of the presentation, the audience will be able to try out these interfaces.

Faculty Adviser: *Christine Alvarado, Computer Science*

Computer Science Presentations continued

3:00 P.M. Reception in Galileo Foyer

3:15 P.M. **IE 162 Beyond Calculation**

The topic of the course was the use of computers in the developing world. Computers and computing technology have become pervasive in the developed world, but it is unclear how computers have changed the developing world. We decided to focus on the classroom use of computers in the developing world. Our interests are how computers are supporting or not supporting the improvement of developing countries. We have focused on the XO the laptop developed by the One Laptop per Child (OLPC) Foundation. This foundation's efforts have received wide press coverage. The actual use of these machines for education will be interesting to everyone.

Faculty Adviser: *Mike Erlinger, Computer Science*

Solar Power for the XO
Presenters: **Asa Ellett and Tyler Wolf**

Software Environment and Tool Development for the XO
Presenters: **Morgan Conbere, Andrew Farmer, Alex Hagen, Ben Jencks, Andrew LaMotte-Mitchell, Jay Markello, Joshua Peraza, Adrian Sampson**

4:00 P.M. **Oliver Johnson, Ben Taborsky, David Schimon, Jose Moreno, Max Myers:** ***An autonomous path-following vehicle***

This project set out to develop an inexpensive vehicle that could compete in an autonomous navigation contest, the Mini Grand Challenge. Starting with an existing hardware platform, the team integrated sensors and software in order to avoid obstacles, follow a campus path, reach GPS waypoints, and interact with spectators. This presentation reports on both setbacks and successes of this effort.

Faculty Adviser: *Zachary Dodds, Computer Science*

4:15 P.M. **CS 121 Software Development**

Students in the Software Development class develop software in team projects as part of the course requirements. This year there are two such projects.

ASHMC Voting System
Team: **Hannah Hoersting, Ben Jencks, Daniel Taller, Andrew Robb (CMC), Shaun M. Wallace, Matthew Williams (Pomona)**

The goal of this project was to develop an online voting system to facilitate student elections. Our system allows administrators to set up elections and surveys on various issues easily, and allows for students to vote in these elections online in a secure manner.

Monkey Tree Madness
Team: **Andrew Carman, Robert Eckert, Jose Moreno and Joshua Peraza**

With the advent of cheap technology, computers are making their way into the Third World. However, learning to use them can be challenging. This semester we have created a video game for eventual distribution to Third World countries which is not only fun, but can also be used by teachers in the classroom as a metaphor for file systems. In this presentation we will talk about the motivations, goals and challenges surrounding the development of our game, then we'll let the audience try it out.

Instructor: *Robert Keller, Computer Science*

Engineering–Galileo Halls

1:15 P.M.–
4:30 P.M. **E4 Introduction to Engineering Design Presentations**

1:15 P.M.
McAlister ***Non-invasive Boroscope Manipulator***
Client/Liaison: Western University of Health Sciences, College of Veterinary Medicine, Dr. Carlos Crocker
Faculty Advisers: *Lori Bassman, Nancy Lape, Engineering*

A non-invasive device for manipulating a boroscope (basically an endoscope with a 6' cable) into tortoise burrows would be extremely helpful for telemetry research on Desert tortoises in Joshua Tree National Park. Ideally, this mechanism would also allow for sampling items (grabbing using something akin to uterine mare biopsy forceps: a.k.a. alligator forceps; endoscopic biopsy forceps) from the floor of the burrow (e.g. to sample fecal matter).

Team A: **Joel Brown, Jason Kang, Christopher Ramos, Elliot Smith**
Team B: **Dillon Ayers, Millie Fung, Kramer Straube, Peter Tu**
Team C: **Jin-Hwa Chun, Ashley Nelson, Blake Shaw, Thomas Strizic**

1:15 P.M.
Edwards ***Automatic Page-turner Device for Children's Picture Books***
Client/Liaison: Danbury School/Rachel Lynch
Faculty Advisers: *Lori Bassman, Don Remer, Bob Schaffer, Engineering*

The Danbury School is a local elementary school for orthopedically and health-impaired children. This project aims to help students who have very limited control of their hands read a book much more independently. Board books are children's picture books that have pages just as thick and hard as the cover of the book (usually only 5-10 pages long). An automatic page turner would require a mechanism that is controlled by an electronic "clicker" device (clickers are already used at Danbury). Danbury School can provide "clicker" devices and computers; they need the mechanism that would turn the pages.

Team A: **Christopher Ferguson, Julia Karl, Kirsten McAfee, Eric Nieters**
Team B: **Michelle Hansen, Daniel Ihlenfeldt, Matthew Keeter, Lauren Nishioku**
Team C: **Daniel Ciliske, Roque Muna, Narayan Propato, Eric Stahl-David**
Team D: **Josh Cook, Joanna Ladd, Katherine Maddalena, Yusuke Nakaya, Erin Powers**
Team E: **Timothy Challener, Kevin Chan, Rebecca Glick, Andrew Xue**
Team F: **Ariel Berman, Robert Kennedy, Jennifer Lee, Andrew Macrae**

2:00 P.M.
McAlister ***Intubation Simulator for Veterinary Students***
Client/Liaison: College of Veterinary Medicine, Western University of Health Sciences, Dr. Jose Peralta
Faculty Advisers: *Lori Bassman, Nancy Lape, Engineering*

Develop a non-animal model for training veterinary students in passing an endotracheal tube for the administration of inhalatory anesthesia in a cat/dog/pig. The client is interested in the development of a system that allows training of first-year veterinary students on this important technique in a non-animal model before they work on a live animal. It would be ideal to have a model that not only resembles the anatomy of the animal's oropharynx (i.e., the area at the back of the mouth where the trachea and the esophagus split), but that also allows students to recognize if they are passing the tube in a correct manner (i.e., into the correct orifice).

Team A: **Austin Anderson, Rachid Grimes, Esther Hwang, Jennifer Rinker**
Team B: **Caitlin Jacques, Paige Pruitt, David Rolfe, Hannah Troisi, Allison Wynn**
Team C: **Marie Godla, Susanna Lin, Kristina Runas, Allison Russell**

E4 Presentations continued

3:00 P.M. Reception

3:15 P.M. McAlister

Assistive Device for Walking on the Beach
Client/Liaison: Mickey Bassman
Faculty Advisers: *Don Remer, Bob Schaffer, Engineering*

People who have difficulty walking due to a variety of disabilities and injuries have even more difficulty walking on uneven or unstable ground. The primary user for this project has multiple sclerosis and has the particular goal of continuing to be able to join friends on the beach, but the device could be used by a wide variety of people with long-term or temporary needs for assistance. The device should provide excellent stability for the user to walk on sand under his/her own power. It should fit in the trunk of a car and be inexpensive so that it can be made widely available. A seat would allow the user to rest if needed.

Team A: **Yoichi Sagawa, Brendan Smith, Cameron Taylor, Sarah Yi**
Team B: **Kathleen Ewing, Benjamin Hsieh, Christian Jolivet, Erin Partlan**
Team C: **Doo Hyun Chung, Tae Lee, Cullen McMahon, Cassie Nguyen**
Team D: **Scott Almond, Perry Ellis, Kyle Klipfel, Mohammad Nasir, Kevin Yeung**
Team E: **Ian Jimenez, Jeffrey Lym, Winni Wei, Alexandre Wright**

3:15 P.M. Edwards

Quick Attachment and Release for Bicycle Pedals
Client/Liaison: Danbury School/Mark Anderson
Faculty Adviser: *Bob Schaffer, Engineering*

The Danbury School is a local elementary school for orthopedically and health-impaired children. Adapted physical education is an important part of Danbury students' experiences. Bicycles are used, but placing students on the bicycles and strapping their feet to the pedals is very time consuming. There is a need for an improved device that can be just as effective, but less time consuming. Some students' feet lie on the pedal at an angle so that the foot interferes with the rotation of the pedal and crank. The device also needs to keep the student's foot aligned properly.

Team A: **Brandyn Carlson, Alexander McAuley, Timothy Nguyen, Matthew Phillips**
Team B: **Kyle Baran, Steven Berry, Robert Carrington, Madeleine Ong**

3:45 P.M. Edwards

Green Compost Sifter
Client/Liaison: Pitzer College Garden Club
Faculty Advisers: *Lori Bassman, Nancy Lape, Don Remer, Engineering*

The Pitzer College Garden Club would like an improved compost sifter to sift finished compost, separating fine soil/mulch from sticks and debris. The device would need to fit a space of 10' by 10' (no limit on height) with a maximum useful capacity of 50 cubic feet and be easy to load/unload. It should use minimal human interaction per amount of compost sifted and must be used outside with no electrical power. This could be achieved by using a rotating drum powered by a bicycle; scrap bike frames from Pitzer's green bike program could be provided. Reused materials are preferred.

Team A: **Nicholas Card, Matthew Cummins, Julia Diaz, Georgi Dinolov**
Team B: **Leo Altmann, Skye Berghel, Daniel O'Neil, Claire Robinson, Max Wishman**
Team C: **Yael Mayer, Javier Morquecho, Kevin Renfrow, Arthur Vasek**

Humanities and Social Sciences–Jacobs B134

1:00 P.M. & 3:15 P.M. **Philosophy 125 Ethical Issues in Science and Engineering**

See description on page 17, Wednesday, 10:30 a.m., Humanities and Social Sciences.

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

Humanities and Social Sciences—Galileo Foyer

2:30 P.M. **Art 50 and Art 100 Photography Display**

Students will be present to discuss their work. See Monday, May 5, description on page 4.

Humanities and Social Sciences—HSS Parsons Hall Gallery, first floor, Parsons Hall

2:30 P.M. **Art 150 Photography Display**

Students will be present to discuss their work. See Monday, May 5, description on page 4.

Mathematics–Beckman B126

1:00 P.M. **Parousia Rockstroh:** ***The Length of a Fibonacci Cycle Modulo a Prime***

The Fibonacci numbers reduced modulo an integer exhibit a cyclic structure. It is still an open question what the cycle length will be given a modulus n. We will investigate the structure of the Fibonacci numbers reduced modulo a prime by analyzing the Fibonacci matrix over the field $Z/(p)$. In particular, we will diagonalize the Fibonacci matrix over $Z/(p)$, and show that this produces the best possible bound on the cycle length of the Fibonacci numbers for a certain class of primes.

Faculty Adviser: *Francis Su, Mathematics*

1:30 P.M. **Tia Sondjaja:** ***Understanding Kakutani's Fixed Point Theorem and Sperner's Lemma***

Kakutani's fixed point theorem has many applications in economics and game theory. Sperner's lemma is a combinatorial result concerning the labeling of the vertices. It is known that Sperner's lemma is equivalent to a result called Brouwer's fixed point theorem, of which Kakutani's theorem is a generalization. A natural question that arises, then, is whether we can prove Kakutani's fixed point theorem directly using Sperner's lemma, without going through Brouwer's theorem. I will present the work that I have done in understanding Kakutani's theorem, Sperner's lemma, and how they are related. In particular, we will see how we could use Sperner's lemma to arrive at Kakutani's result.

Faculty Adviser: *Francis Su, Mathematics*

2:00 P.M. **George Tucker:** ***Formation of Labyrinth Patterns in Langmuir Films***

A Langmuir film is a molecularly thin fluid layer on the surface of a subfluid. When dipole-dipole forces are negligible, bounded films relax to energy-minimizing circular domains. We investigate numerically the case where dipole-dipole interactions are strong enough to deform the domain into highly distorted labyrinth-type patterns. Our numerical method is designed to achieve higher accuracy and better stability than previous work and exploits an analytic formulation that removes a singularity in the dipole-dipole forces without resorting to a small cut-off parameter.

Faculty Adviser: *Andrew Bernoff, Mathematics*

2:30 P.M. **Jason Winerip:** ***Linear Complexity of Graphs***

My thesis looks at the linear complexity of graphs, which is a notion of complexity based on the number of operations required to compute the product of the adjacency matrix with an arbitrary vector. I will survey previous work in this area, and present some new bounds for the linear complexity of some families of graphs.

Faculty Adviser: *Nicholas Pippenger, Mathematics*

3:00 P.M. Reception in Galileo Foyer

Humanities and Social Sciences Concert–Courtyard, Platt Campus Center

4:00–5:00 P.M. **Music 48 Electronic Music Ensemble**

The Harvey Mudd College Electronic Music ensemble, which includes Bill Alves, Steven Berler, Eliot Gardepe and Richard Meyer, will perform new works involving electronics by Johnston, Riley, Gardepe and Meyer.

Course Instructor: *Bill Alves, Humanities and Social Sciences*

Humanities and Social Sciences Concert–Green Room, Platt Campus Center

7:00 P.M.–8:30 P.M. **Peter Scherpelz: Senior Cello Recital**

This recital will feature works by Brahms, Schumann, Haydn and others, with Stephen Moss, piano.

Course Instructor: *Roger Lebow*

Humanities and Social Sciences Concert–Galileo-McAlister

8:30 P.M.–10:00 P.M. **Harmony of Sound and Light Screening of Final Projects**

Participating students: **Kate Burgers, Marc Davidson, Christopher Ferguson, Kristine Fong, Field Garthwaite, Rachid Grimes, Helen Highberger, Nathan Jones, Matthew Keeter, Aren Olson, Sean Plott, Austin Quan, Joanne Redford, Kathryn Schmiedicke, Kelly Sinnott, Devin Smith, Emily Snyder and Eric Young**

In this course, students study the arts of form and color in motion, especially in connection to music. For their final projects, students create abstract computer animations with music that will be screened for the first time at this show.

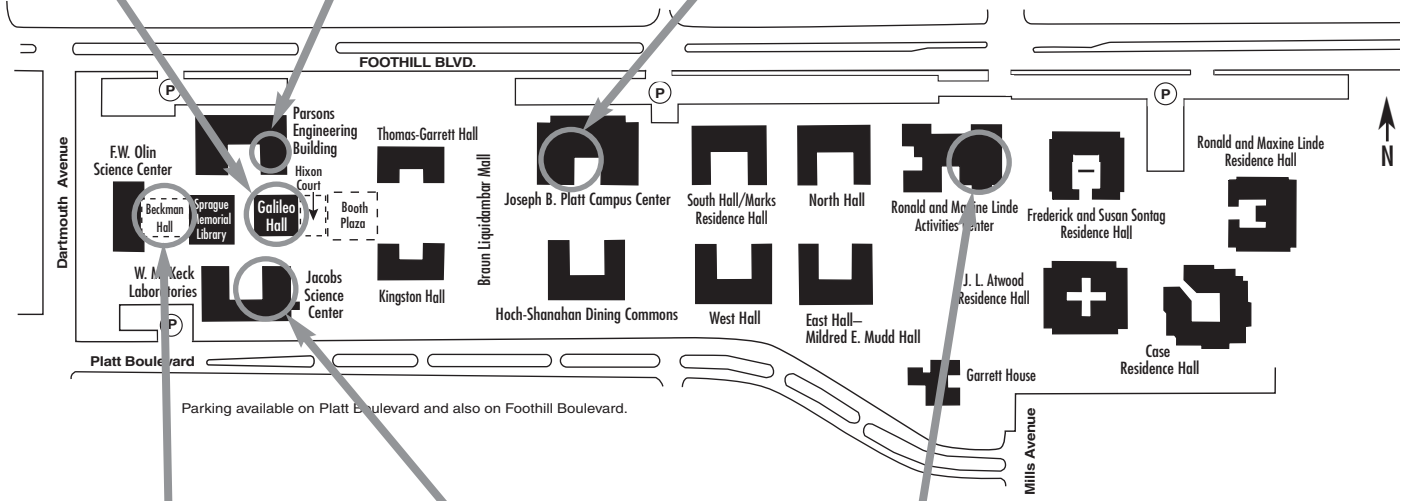
Course Instructor: *Bill Alves, Humanities and Social Sciences*

Thank you for attending.

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

Parsons Hall Gallery, first floor

Joseph B. Platt Campus Center, Green Room
Platt Courtyard



Beckman Hall B126

Jacobs B132
Jacobs B134

Projects Day Poster Sessions

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