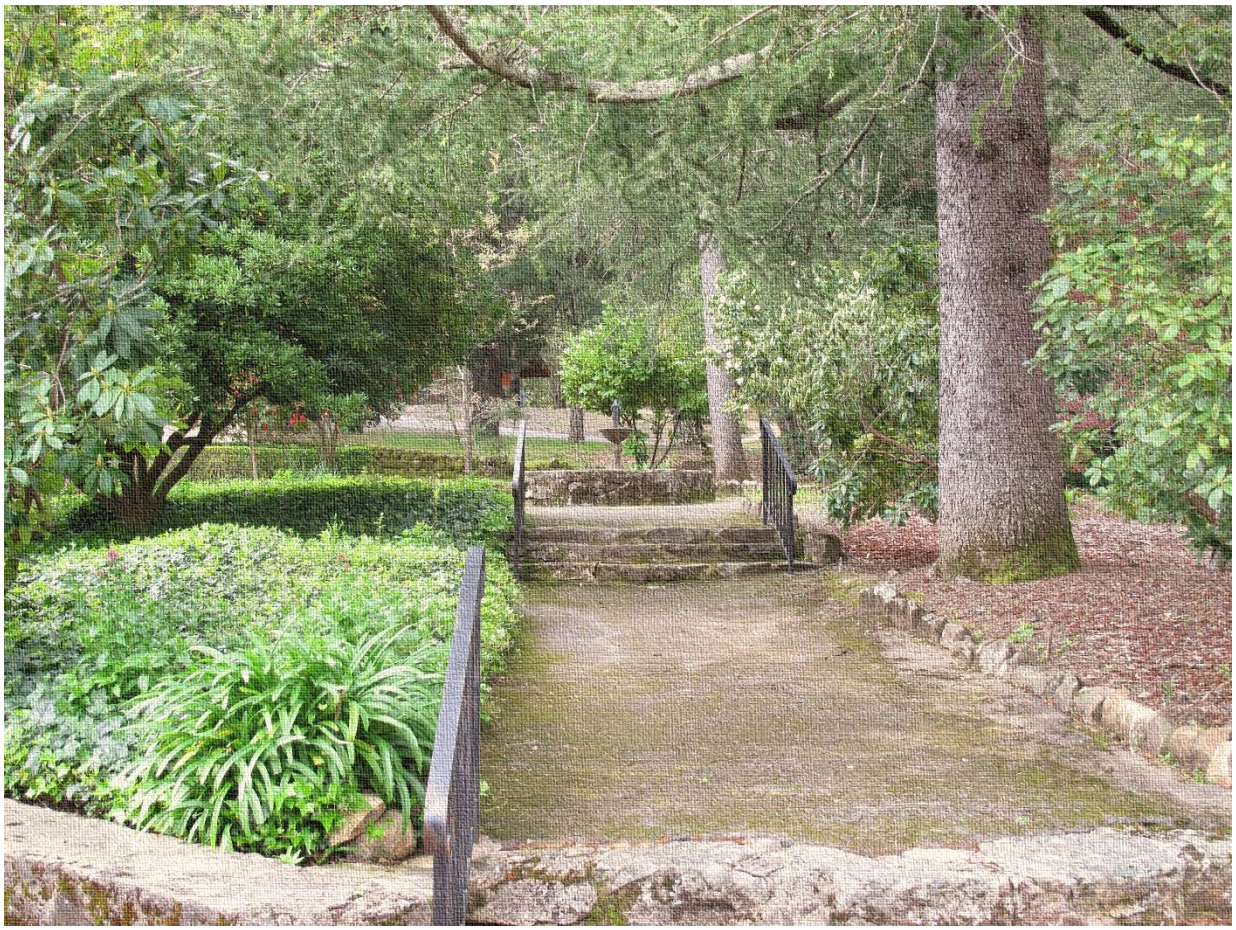
Twenty Third Annual

Biotechnology Training Retreat



Saturday,
March 22, 2014

Christian Brothers Retreat & Conference Center
Napa, CA

Twenty Third Annual Biotechnology Training Retreat

Co-sponsored by:

NIH Training Program in Biomolecular Technology
(NIH-T32-GM08799)

UC Davis Designated Emphasis in Biotechnology
Graduate Program (DEB)

UC Davis Biotechnology Program

2014 Welcome

On behalf of the UC Davis Biotechnology Program, the executive committees of the Designated Emphasis in Biotechnology (DEB) and the NIH Training Grant in Biomolecular Technology, we thank you for joining us as we honor our **2013-14 fellows and their preceptors**, as well as **our industry affiliates**. We also welcome the faculty and trainees associated with the NSF CREATE-IGERT Training Program (directed by Karen McDonald) as they are members of the DEB program as well. The DEB graduate program continues to grow to over 200 students from 30 graduate programs. The list of our current students is listed on the DEB website (www.deb.ucdavis.edu).

Many thanks go out to the Biotech Team. The logistics of this retreat have been expertly overseen by **Marianne Hunter**, Assistant Director of Administration, our Program Assistants**, Jacki Baladerama and Jacqueline Phillips,** and Associate Director, **Dr. Denneal Jamison-McClung.** Without their dedicated service, this annual event would not happen.

It is a pleasure to introduce our current Biotechnology Fellows. Our **NIH Fellows** include: **Kristin Beck,** BMCDB (preceptor is Ian Korf); **Nicholas Bokulich**, Food Science (preceptor is David Mills), **Casey Boosalis,** MCIP (preceptor is Pam Lein), **Jennifer Lee,** Biomedical Engineering (preceptor is Kyriacos Athanasiou); **Amelia Manlove,** Chemistry (preceptor is Sheila David), **Abigail "Abby" Yu,** Genetics (preceptors are David Segal and Ian Korf) and **Wade Zeno**, Chemical Engineering (preceptor is Marjorie Longo). Our four **Biotechnology Fellows** (industry and campus fellowships) include: **Christopher Chapman**, Biomedical Engineering (preceptor is Erkin **Şeker**); **Siobhan Halloran**, Chemical Engineering (preceptor is Bill Ristenpart); **Allison Hoch,** Biomedical Engineering (preceptor is J. Kent Leach)**;** and **Keith Dunaway,** Genetics (IGG) (preceptor is Janine LaSalle).

NSF CREATE-IGERT Trainees receiving traineeships during our final program year 2013-2014 are: Mitch Harkenrider (Ronald Lab); Erica Vonasek (Nitin Lab); and Natasha Worden (Drakakaki Lab). Due to the limited time for oral presentations, we may showcase research performed by these students, as well as other students in the DEB program, in the poster session.

We will be selecting our **2014-15 NIH Fellows** in May. Nomination forms are on the web at www.deb.ucdavis.edu and the application deadline is **Wednesday, April 23rd.** Remember, you must be a member of the DEB to be eligible for funding, since it is the formal training program for the NIH training grant.

In regard to DEB internships, we placed close to 30 students in 2013-spring 2014. They include: 1) **Amyris:** James **"**Mitch" Ellmore; 2) **Aqua Bounty:** Caitlin Cooper; 3) **Buck Institute**: Barbara Bailus; 4) **Celgene SF:** Emily Mills; 5) **Dairy**

Research Institute in Chicago: Elieke Demmer; 6) **Genencor** (DuPont): Rena Goodman Mizrahi and Richard Osibanjo; 7) **Genentech**: Roberto Barroza and Diana Lac (regulatory affairs); Jesse Bakke, Jared Moore, Alice Ngo, Amy Shroeder, Christian Siltanen, Chelsea Snyder and Nancy Zeng (Quality); 8) **Igenica:** Anna Erickson; 9) **Monsanto-Calgene campus**: Barbara Blanco Ulate; Hossein Gouran and Natasha Worden; 10) **Novozymes:** Patricia Castillo; 11) **OncoMed Pharmaceuticals**: Dipali Patel; 12) **S.I. Bone:** Regina MacBarb; 13) **Sutro Pharmaceuticals**: Elenor Castillo; 14) **UC Davis Office of Research- Corporate Relations**: Mitch Harkenrider; 15) **Thien Sinh Research & Development Co. in Viet Nam:** Karen LeGrand; 16) **Vital Connect:** Katherine Walker. We would like to thank all of our industry and government affiliates for their support of our training program. With the rapid growth of the DEB, we are going to need even more training sites in the near future.

A number of our students graduated in 2013 with their PhDs in one of 30 disciplines along with a Designated Emphasis in Biotechnology. Our graduates have found positions in both academia and industry. Please see our **2013 Biotech Times** (link is found on our Program's homepage) for more information. We hope they stay connected and even present a Biotech Seminar in the Future!

Thank you for coming to our annual biotechnology training retreat. Please enjoy the day. It is a great opportunity to immerse yourself in new research findings as well as network across disciplines.

All the Best,

Judith "Judy" Kjelstrom
Director,
UC Davis Biotechnology Program

Associate Vice Chancellor Paul Dodd, Martina Newell-McGloughlin, Judy Kjelstrom

NIH Training Program in Biomolecular Technology
(NIH-1-T32-GM08799)

Bruce D. Hammock, Director
Martina Newell-McGloughlin, Co-Director
Karen McDonald, Co-Director

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Annaliese Franz (Chemistry)
Ian Kennedy (Mechanical & Aeronautical Engineering)
Tonya Kuhl (Chemical Engineering)
J. Clark Lagarias (Molecular & Cellular Biology)
Kit Lam (MED: Internal Medicine (Hemotology/Oncology)
Atul Parikh (Applied Science)

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Vishva Dixit, Genentech
Tim Conner, Monsanto, Calgene Campus

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Designated Emphasis in Biotechnology (DEB) Graduate Program

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UC Davis Biotechnology Program

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Director

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UC Davis Twenty Third Annual Biotechnology Training Retreat
March 22, 2014
Christian Brothers Retreat & Conference Center

Morning Schedule

6:45 am – Bus departs Davis, Parking Lot #41

8:00 – 8:30 am	**Registration/Continental Breakfast**
8:30 – 8:45 am	**Welcome** Martina Newell-McGloughlin Co-Director, NIH Training Grant in Biomolecular Technology
8:45 – 12:05 pm	**Morning Session** Martina Newell-McGloughlin Co-Director, NIH Training Grant in Biomolecular Technology
8:55 – 10:30 am	**Presentations** 8:55 am Kristen Beck ..... *Mentor: Ian Korf* 9:20 am **Amanda Fischer** ..... ***Novozymes*** 9:40 am Casey Boosalis..... *Mentor: Pam Lein* 10:05 am Jennifer Lee ..... *Mentor: Kyriacos Athanasiou*
10:30 – 10:45 am	**Break / Poster Viewing**
10:45 – 12:05 pm	**Presentations** 10:45 am **Yao Luo** ..... ***Monsanto-Calgene*** 11:05 am Amelia Manlove ..... *Mentor: Sheila David* 11:30 am Abigail "Abby" Yu ..... *Mentor: Segal/Korf* 11:55pm Martina Newell-McGloughlin ..... *Bioethics Question (Handout)*

Afternoon Schedule

12:05 – 1:05 pm	**Lunch / Poster Viewing**
1:05 – 1:20 pm	**Photo Taking for NIH/Biotech Fellows & CREATE-IGERT Trainees**
1:20 – 4:50 pm	**Afternoon Session Chair** Karen McDonald Co-Director, NIH Training Grant in Biomolecular Technology
1:20 – 2:55 pm	**Presentations** 1:20 pm Martina Newell-McGloughlin ..... *Bioethics Question (Discussion)* 1:40pm Wade Zeno ..... *Mentor: Marjorie Longo* 2:05 pm **Christopher Murriel**..... ***OncoMed Pharmaceuticals*** 2:20 pm Christopher Chapman..... *Mentor: Erkin Şeker* 2:45 pm **Erik Zimmerman**..... ***Sutro Biopharma, Inc.***
3:00 - 3:20 pm	**Short Break (20 min)**
3:20 – 4:50 pm	**Presentations** 3:20 pm Siobhan Halloran..... *Mentor: Bill Ristenpart* 3:45 pm Allison Hoch..... *Mentor: J. Kent Leach* 4:10 pm Keith Dunaway..... *Mentor: Janine LaSalle* 4:35 pm **Maggie Ostrowski**..... ***Agilent Technologies***
4:50 pm	**Closing Remarks** Martina Newell-McGloughlin Co-Director, NIH Training Grant in Biomolecular Technology

5:20 pm – Bus departs Napa

2014 Poster Titles

A. **"Detection of Non-Enzymatic Collagen Crosslinks in Engineered Cell-Secreted Extracellular Matrices by Time Resolved Fluorescence Spectroscopy"**
Debika Mitra*, Hussain Fatakdawala, Laura Marcu, J. Kent Leach
Department of Biomedical Engineering, University of California, Davis

B. **"Producing Potent Antibody Drug Conjugates Using Cell-Free Protein Synthesis"**
Erik S. Zimmerman, Elenor Castillo*, Tyler H. Heibeck, Ayinash Gill, Xiaofan Li, Christopher J. Murray, Mary Rose Madlansacay, Cuong Tran, Nathan T. Uter, Gang Yin, Patrick J. Rivers, Alice Y. Yam, Willie D. Wang, Alexander R. Steiner, Sunil U. Bajad, Kalyani Penta, Wenjin Yang, Trevor J. Hallam, and Aaron K. Sato
Sutro Biopharma, Inc.

C. **"Effect of Strain Rate on the Mechanical Behavior of Red Blood Cells at a Constriction"**
Jordan Mancuso*, William D. Ristenpart
Department of Chemical Engineering and Materials Science, University of California, Davis

D. **"Conductance-Structure Modulation in Single DNA Duplexes"**
Juan Manual Artés, Yuan Li, and Josh Hihath
Department of Electrical and Computer Engineering, University of California, Davis

E. **"Mechanical Response of Red Blood Cells Entering a Constriction"**
Nancy F. Zeng* and William D. Ristenpart
Department of Chemical Engineering and Materials Science, University of California, Davis

F. **"Molecular Release From Nanoporous Gold Thin Films"**
Özge Kurtuluş*[1], Pallavi Daggumati[2], and Erkin Şeker[2]
[1]Department of Chemical Engineering and Materials Science, University of California, Davis
[2]Department of Electrical and Computer Engineering, University of California, Davis

G. **"Electrochemical Detection of Nucleic Acids Using Nanoporous Gold Sensors"**
Pallavi Daggumatic and Erkin Şeker
Department of Electrical Engineering, University of California, Davis

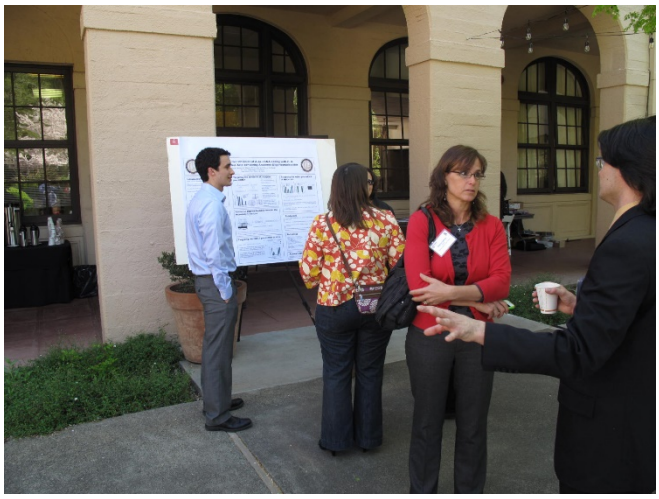
***DEB Graduate Student**

H. **"Modulating Endothelial Cell Response with Sip and Hypoxic Stress"**
Priscilla A. Williams* and Eduardo A. Silva
Department of Biomedical Engineering, University of California, Davis

I. **"Expression of Recombinant Human Butyrylcholinesterase in Nicotiana Benthamiana and Its Postproduction *in vitro* Glycosylation Modification"**
Salem Alkanaimsh[1], Lucas Arzola*[1] , Bryce Hashimoto[1] , Andrés Guerrero[2], Yanhong Li[2], Min Sook Hwang[3], Aye Tu[4], My Phu[4], Abhaya M. Dandekar[4], Bryce W. Falk[3], Xi Chen[2], Carlito Lebrilla[2], Somen Nandi[5], Raymond Rodriguez[5], and Karen A McDonald[1]
[1]Department of Chemical Engineering and Materials Science, University of California, Davis
[2]Department of Chemistry, University of California, Davis
[3]Department of Plant Pathology, University of California, Davis
[4]Department of Plant Sciences, University of California, Davis
[5]Department of Molecular and Cellular Biology, University of California, Davis

J. **"Binding Affinity of Iron Oxide Based Pet/MRI Probe to Macrophage Scavenger Receptor in Vulnerable Atherosclerotic Plaques"**
Tang Tang*, Chuqiao Tu, Angelique Louie
Department of Chemistry, University of California, Davis

K. **"Modeling the Circadian Oscillator Protein Network in *Drosophila Melanogaster*"**
Vu H. Lam*, Ying H. Li, Johnathan Diehl, and Joanna C. Chiu
Department of Entomology and Nematology, University of California, Davis



***DEB Graduate Student**

2014 Presentation Titles

1. **"Novel Methods in Milk Proteomics: What's Human About the Human Milk Proteome?"**
   Kristen Beck*, Darren Weber, Jennifer Smilowitz, Brett Phinney, Ian Korf, Danielle Lemay
   Department of Biomedical Engineering, University of California, Davis

2. **"Industrial Enzyme Production Using Microbes"**
   Amanda Fischer*, PhD
   Fungal Expression Department, Novozymes, Inc., Davis, California

3. **"Application of High(er) Throughput Technology for Drug Discovery"**
   Casey Boosalis*, Donald Brunn, and Pamela Lein
   Department of Molecular, Cellular, & Integrative Physiology, University of California, Davis

4. **"Sequential Application of Clinically Relevant Thyroid Hormones Enhances Neocartilage Development in an *in vitro* Model"**
   Jennifer K. Lee*, Courtney A. Gegg, Jerry C. Hu, A. Hari Reddi, Kyriacos A. Athanasiou
   Department of Biomedical Engineering, University of California, Davis

5. **"What's Next? New Technologies in Agriculture"**
   Yao Luo, PhD
   Monsanto, Calgene Campus, Davis, CA

6. **"Substrate Recognition Requirements of the Base Excision Repair DNA Glycosylase MutY"**
   Amelia Manlove*, Paige McKibbin, Tyler Allred, and Sheila S. David
   Department of Chemistry, University of California, Davis

7. **"Using Artificial Transcription Factors as aNovel Tool for Malaria Research"**
   Abigail Yu*, Shirley Luckhart, Ian F. Korf, and David J. Segal
   Department of Molecular and Cellular Biology, University of California, Davis

8. **"The Ethics of Playing Cross Disciplinary Policeman" - Ethics Discussion**
   Martina Newell-McGloughlin, DSc
   Co-Director of NIH Training Grant in Biomolecular Technology, University of California, Davis

***DEB Graduate Student**

9. **"Investigation of Nanolipoprotein Particles Entrapped Within Nanoporous Silica: A Novel Platform for Immobilization of Integral Membrane Proteins"**
Wade Zeno*, Subhash Risbud, and Marjorie Longo
Department of Chemical Engineering and Materials Science, University of California, Davis

10. **"Targeting NOTCH and WNT Signaling Pathways to Reduce Cancer Stem Cell Frequency"**
Christopher L. Murriel, PhD
OncoMed Pharmaceuticals, Inc., Redwood City CA

11. **"Advanced Material Screening Platforms for Neuroengineering Applications"**
Christopher Chapman*[1], Hao Chen[2], Marianna Stamou[2], Monika Biener[3], Pamela J. Lein[2], Erkin Şeker[4]
[1]Department of Biomedical Engineering, University of California, Davis
[2]Department of Molecular Biology, University of California, Davis
Lawrence Livermore National Laboratory, Livermore, CA
[4]Department of Electrical and Computer Engineering, University of California, Davis

12. **"Producing Potent Antibody Drug Conjugates Using Cell-Free Protein Synthesis"**
Erik Zimmerman, Elenor Castillo*, Tyler H. Heibeck, Avinash Gill, Xiaofan Li, Christopher J. Murray, Mary Rose Madlansacay, Cuong Tran, Nathan T. Uter, Gang Yin, Patrick J. Rivers, Alice Y. Yam, Willie D. Wang, Alexander R. Steiner, Sunil U. Bajad, Kalyani Penta, Wenjin Yang, Trevor J. Hallam, and Aaron K. Sato
Sutro Biopharma, Inc., South San Francisco, CA

13. **"Airborne Disease Transmission in Indoor Environments"**
Siobhan K. Halloran* and William D. Ristenpart
Department of Chemical Engineering and Materials Science, University of California, Davis

14. **"Enhancing the Therapeutic Value of Mesenchymal Stem Cells"**
Allison I Hoch*[1,2], Vaishali Mittal[1], Ivan Martin[2,3], J. Kent Leach[1,4]
[1]Department of Biomedical Engineering, University of California, Davis
[2]Department of Biomedicine, University Hospital Basel, Basel, Switzerland
[3]Department of Surgery, University Hospital Basel, Basel, Switzerland
[4]Department of Orthopaedic Surgery, School of Medicine, University of California, Davis

15. **"Epigenomic Effects of Persistent Organic Pollutants and DNA Duplication"**
Keith Dunaway*, Saharul Islam, Ian Korf, and Janine LaSalle
Department of Medical Microbiology and Immunology, University of California, Davis, CA

16. **"Research Enabled by Complex DNA Library Synthesis**
Maggie Ostrowski, PhD, Kristen Bernick, Robert Ach
Agilent Technologies, Agilent Technologies, Inc. Santa Clara, CA

***DEB Graduate Student**

Oral Presentation Abstracts

NIH FELLOW: Kristen Beck

NOVEL METHODS IN MILK PROTEOMICS: WHAT'S HUMAN ABOUT THE HUMAN MILK PROTEOME?

Presenter: Kristen Beck*

Authors: **Kristen Beck***, Darren Warren, Jennifer Smilowitz, Brett Phinney, Ian Korf Danielle Lemay

Affiliations: Department of Biomedical Engineering, University of California, Davis

Preceptor: Ian Korf

Milk is established as one of the most optimal food sources a newborn infant can receive. It provides a variety of health benefits such as increased growth and decreased disease rates, and recent studies have also shown its potential to contain differentially abundant protein markers for breast cancer and HIV transmission. Yet, despite its central role in neonatal nutrition and biomedical research, a comprehensive description of milk's protein contents is still not available. The most advanced proteomic studies have only identified a fraction of the total transcripts produced by the mammary gland during lactation. Therefore, we have developed a small-volume high throughput method that utilizes LC-MS/MS. Results from this method returned a 65% increase in unique proteins identified in human milk and an 11,000% increase for macaque milk. Furthermore, we have begun to integrate novel non-invasive RNA-Sequencing of milk with the peptide-to-protein assignment process required after mass spectrometry. Results from this method are expected to greatly expand the comprehensive description of milk proteins beyond what either technique could accomplish individually and will provide a tool that is broadly applicable to other research fields. Our comparative analyses of the quantitative proteomics data between the two aforementioned species highlights differences in protein abundance, sequence variation, and amino acid substitution rates between the species. This will yield the first cross-species comparison of milk's protein contents and provides insights into variation of the first nutritional exposure for a subset of biomedically and agriculturally relevant species.

*DEB Graduate Student

COMPANY AFFILIATE: Novozymes, Inc.

INDUSTRIAL ENZYME PRODUCTION USING MICROBES

Presenter: Amanda Fischer, PhD

Authors: **Amanda Fischer, PhD**

Affiliations: Novozymes, Inc.
1445 Drew Ave.
Davis, CA – 95618

Novozymes is a biotech company that produces industrial enzymes, microorganisms, biopolymers and other proteins that allow our industrial customers to achieve more efficient use of their raw materials, reduce water and energy consumption, and replace traditional chemicals with more sustainable alternatives. Novozymes' bio-solutions enable everything from the removal of trans-fats in food to advancements in renewable energy sources. Our never-ending exploration of nature's potential is evidenced by over 6,000 patents – an indication of what is possible when nature and technology join forces in biotechnology. Novozymes enzymes are used in over 700 products, with a wide variety of applications ranging from household care (laundry & dishwashing detergents), food and beverage (beer to bread), bioenergy production (starch-based and cellulosic ethanol, biodiesel and biogas) and agriculture (enzymatic pesticides and microbial yield and fertility enhancers) to name a few. I will discuss the many creative ways in which enzymes have successfully been adapted for use in industrial processes and touch on how our enzymes are produced using microbial expression hosts.

NIH FELLOW: Casey Boosalis

APPLICATION OF HIGH(ER) THROUGHPUT TECHNOLOGY FOR DRUG DISCOVERY

Presenter: Casey Boosalis*
Authors: **Casey Boosalis***, Donald Brunn, Pamela Lein
Affiliations: Department of Molecular Cellular, & Integrative Physiology
University of California, Davis
Preceptor: Pam Lein

As one of the laboratories participating within the CounterACT (Countermeasures Against Chemical Threats) Center of Excellence, our group is focused on elucidating the molecular and cellular mechanisms by which seizurogenic chemicals cause persistent neurological damage. Organophosphorus anticholinesterases (OPs) are a diverse group of chemicals developed as insecticides and nerve agents. Acute OP intoxication can lead to the subsequent inhibition of acetylcholinesterase (AChE), which ultimately can result in seizures and/or respiratory failure. Acute OP poisoning is a serious global public health concern that is complicated by the fact that current treatment measures result in additional medical risks. More than 1 million reported cases of poisonings and 300,000 intentional deaths (including 1/3 of the world's suicides) are linked to acute OP poisonings annually. These alarming statistics underscore the need for improved therapeutic approaches. Parathion is a potent seizurogenic OP insecticide and is known to be toxic to non-target organisms including humans. It is commonly used in cases of intentional poisoning and has been used as a chemical warfare agent. Our goal is to investigate the mechanisms underlying the delayed neurotoxic effects of parathion in individuals that survive acute intoxication by combining both *in vivo* and *in vitro* studies. By utilizing a rat model for studying acute parathion intoxication *in vivo*, we will be able to examine *ex vivo* tissue in parallel with *in vitro* cell culture screening studies. By using powerful high-throughput screening equipment we can efficiently assess the mechanisms linked to the brain damage associated with acute parathion intoxication. Eventually, we will apply this high throughput technology to rapidly and effectively screen for drugs, or combinations thereof, which should provide for more effective treatment options for protecting the brain against long-term neurologic sequelae of acute OP intoxication.

*DEB Graduate Student

NIH FELLOW: Jennifer Lee

SEQUENTIAL APPLICATION OF CLINICALLY RELEVANT THYROID HORMONES ENHANCES NEOCARTILAGE DEVELOPMENT IN AN *IN VITRO* MODEL

Presenter: Jennifer Lee*

Authors: **Jennifer K. Lee***, Courtney A. Gegg, Jerry C. Hu, A. Hari Reddi, Kyriacos A. Athanasiou

Affiliations: Department of Biomedical Engineering, University of California, Davis

Preceptor: Kyriacos Athanasiou

Parathyroid hormone (PTH) and the tri-iodothyronine (T3) and thyroxine (T4) hormones play essential roles in coordinating growth plate cartilage development: PTH maintains chondrocytes in a proliferative state, while T3, the activated form of T4, promotes the transition from proliferation to hypertrophy (Williams et al., J Endocrinol 1998). PTH has recently emerged as a potential anabolic agent to improve cartilage repair in the joint, when applied within a specific concentration range (Orth et al., Osteoarthritis and Cartilage 2013). Motivated by the use of PTH in animal models of clinical repair, this study sought to apply PTH to chondrocytes in an *in vitro* model of scaffold-free neocartilage development. To explore the potential effects of other thyroid hormones, T3 and T4 were also employed in this tissue engineering system to promote increased biomechanical and biochemical neotissue properties. The hypothesis motivating this study was that thyroid hormones will influence the morphological organization of chondrocytes within neocartilage and, in turn, the mechanical properties. Phase 1 of this study applied PTH, T3, or T4 at 100ng/mL during week 1 or 3 of a 4-week culture period. Compared to untreated controls, PTH did not cause significant changes, while T3 application at week 1 yielded significant increases—for example, a 1.7-times increase in aggregate modulus and a 1.9-times increase in collagen content, both over controls. T4 application at week 1 similarly resulted in significant increases (up to 1.9-times controls). As T3 is known to promote the transition of proliferative growth plate cells to a hypertrophic phenotype during development, T3-treated constructs were evaluated via histology for evidence of hypertrophy and were found to faintly stain for collagen type X. Because T3 treatment during week 1 of construct culture most significantly improved construct properties but caused possible collagen type X deposition in Phase 1 of this work, Phase 2 sought to apply PTH after T3 sequentially to reduce the

potential for hypertrophy. Sequential hormone application was motivated by PTH's potential effects in mediating cartilage repair and chondrocyte maturation. For Phase 2, T3 (100ng/mL) was applied during week 1, followed by no PTH or PTH (25ng/mL) during week 2, week 3, or weeks 2-4 of a 4-week culture period. T3 application, irrespective of sequential PTH application regimens, again significantly increased biomechanical and biochemical properties. Excitingly, the beneficial effects of T3 application were not mitigated by sequential PTH application. Moreover, increasing PTH treatment duration post-T3 application reduced collagen X staining intensity and the hypertrophic morphology was not apparent. These results demonstrate that the thyroid hormones, critical to skeletal development and also recently identified as possible therapeutic agents, can be applied sequentially in an *in vitro* model of articular chondrocyte-based, scaffold-free cartilage development to significantly enhance neocartilage biomechanical and biochemical properties while reducing the potential for hypertrophy.

*DEB Graduate Student

COMPANY AFFILIATE: Monsanto, Calgene Campus

WHAT'S NEXT? NEW TECHNOLOGIES IN AGRICULTURE

Presenter: Yao Luo, PhD

Authors: **Yao Lu, PhD**

Affiliations: Monsanto, Calgene Campus
1920 Fifth Street
Davis, CA 95616

Monsanto is a leading agriculture company focused on agriculture and supporting farmers around the world in their mission to produce more while conserving more. Our company has multiple R&D pipelines including breeding, biotechnologies, agronomics, biologics and chemistry. The combination of these modern technologies will enable us to adapt rapid climate change, give better weed and insect control and perform smart farming practices. Today I will share some technologies that we developed to help corn growers to achieve great results in the field.

NIH FELLOW: Amelia Manlove

SUBSTRATE RECOGNITION REQUIREMENTS OF THE BASE EXCIXION REPAIR DNA GLYCOSLYLASE MUTY

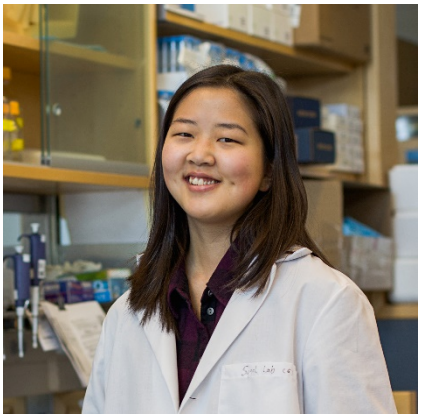
Presenter: Amelia Manlove*
Authors: **Amelia Manlove***, Paige McKibbin, Tyler Allred, Sheila S. David
Affiliations: Department of Chemistry and Materials Science, University of California, Davis
Preceptor: Sheila S. David

DNA is routinely damaged by the reactive byproducts of cellular reactions. Throughout the lifetime of a cell as well as across generations of cells, the remarkable stability of cellular DNA is achieved by a variety of DNA repair mechanisms, such as the base excision repair (BER) pathway. The David laboratory focuses on the DNA glycosylases that initiate the BER pathway, and on how their functions affect cellular health. These enzymes have evolved to recognize and cleave specific types of damaged bases from DNA. However, in the case of the unique BER glycosylase MutY, the target is an undamaged adenine base mispaired to a common damaged base, 8-oxoguanine (OG). This enzyme plays a crucial role in preventing mutagenesis, and is known to act as a tumor suppressor in humans. Because cellular targeting of DNA damage can have profound implications for both the development and the treatment of cancer, we are investigating the way that MutY glycosylases locate individual OG:A mispairs among undamaged cellular DNA, using substrate base analogs and enzyme variants. These studies have begun to demonstrate how MutY's efficiency influences mutagenesis and cell survival under conditions of oxidative stress, and on how we might modulate these repair pathways to our benefit in the battle against cancer.

*DEB Graduate Student

NIH FELLOW: Abigail "Abby" Yu

USING ARTIFICIAL TRANSCRIPTION FACTORS AS A NOVEL TOOL FOR MALARIA RESEARCH



Presenter: Abigail Yu*
Authors: **Abigail Yu***, Shirley Luckhart, Ian Korf, David J. Segal
Affiliations: Department of Molecular and Cellular Biology, University of California, Davis
Preceptors: Ian F. Korf and David J. Segal

Malaria is a debilitating disease caused by the parasitic protists *Plasmodium.* Each year, there are over 120 million clinical cases, as well as 600,000 deaths. Emerging drug-resistant *Plasmodium* populations threaten current treatments. Thus, greater understanding of *Plasmodium* biology is needed, both for treatment and prevention.

Artificial transcription factors (ATFs) enable precise regulation of target genes by combining DNA-binding proteins, such as TAL effectors, and effector domains (EDs) to activate or repress genes. Cell-penetrating peptides (CPPs) can be employed to transport proteins across cellular membranes without the use of electroporation or harsh transfection reagents. This gives us the flexibility to target regions that are normally "undruggable," and exploit the genetic differences between human and Plasmodium. We engineered ATFs to target genes in *Plasmodium falciparum (Pf)*, the deadliest specie. We target the *var* gene family, which encodes for PfEMP1: a highly polymorphic membrane protein displayed on the outside of infected red blood cells that determines pathology and allows evasion of the host immune response. *Var* members are monoallelically expressed, despite maintaining approximately 60 different members per genome. We have designed CPP-ATFs targeted to the 5' UTR of one *var* group, PFL1960w. Fluorescence microscopy reveals effective protein transport into parasites, while early RT-PCR results suggest changes in PFL1960w expression. With continued workflow refinements, we hope to demonstrate a clear multiallelic expression of *var* members.

*DEB Graduate Student

Bioethics Discussion

Written and Presented by

Martina Newell-McGloughlin
Co-Director of NIH Training Program
In Biomolecular Technology (NIH-T32-GM08799)

ETHICS QUESTION

THE ETHICS OF PLAYING CROSS DISCIPLINARY POLICEMAN

THE ETHICS OF PLAYING CROSS DISCIPLINARY POLICEMAN

New York University physicist Alan Sokal, frustrated by what he considered the misuse of science by academic philosophers and literary critics, decided to play a meaningful prank. After studying the arcane jargon of postmodernism, he cooked up a superficially au courant but patently ill-founded paper called "Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity" and submitted it to the journal Social Text (Duke University), edited by a collective of academic celebrities. It proposed that quantum gravity is a social and linguistic construct. Wooed by the article's apparent endorsement of their approach (and evidently unschooled in basic science!), the editors accepted and published the paper. On its date of publication, Sokal revealed in *Lingua Franca* (see below) that the article was a hoax, identifying it as "a pastiche of left-wing cant, fawning references, grandiose quotations, and outright nonsense...structured around the silliest quotations [by postmodernist academics] he could find about mathematics and physics".

- Was this an ethical action by Sokal?
- What does this say about peer review? - Who should have been “peer” reviewers?
- Is Sokal an appropriate role model for his own students?
- Read his explanation – Did he make an adequate case for his actions in your opinion?
- And if you think this no longer happens – check out the final link on the last page - warning there is some questionable language in the article but it *was* published in Nature!!

A Physicist Experiments With Cultural Studies

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The displacement of the idea that facts and evidence matter by the idea that everything boils down to subjective interests and perspectives is -- second only to American political campaigns -- the most prominent and pernicious manifestation of anti-intellectualism in our time.

-- Larry Laudan, *Science and Relativism* (1990)

For some years I've been troubled by an apparent decline in the standards of intellectual rigor in certain precincts of the American academic humanities. But I'm a mere physicist: if I find myself unable to make head or tail of *jouissance* and *différance*, perhaps that just reflects my own inadequacy.

So, to test the prevailing intellectual standards, I decided to try a modest (though admittedly uncontrolled) experiment: Would a leading North American journal of cultural studies -- whose editorial collective includes such luminaries as Fredric Jameson and Andrew Ross -- publish an article liberally salted with nonsense if (a) it sounded good and (b) it flattered the editors' ideological preconceptions?

The answer, unfortunately, is yes. Interested readers can find my article, ``Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity,'' in the Spring/Summer 1996 issue of *Social Text*. It appears in a special number of the magazine devoted to the ``Science Wars.''

What's going on here? Could the editors *really* not have realized that my article was written as a parody?

In the first paragraph I deride ``the dogma imposed by the long post-Enlightenment hegemony over the Western intellectual outlook'':

that there exists an external world, whose properties are independent of any individual human being and indeed of humanity as a whole; that these properties are encoded in ``eternal'' physical laws; and that human beings can obtain reliable, albeit imperfect and tentative, knowledge of these laws by hewing to the ``objective'' procedures and epistemological strictures prescribed by the (so-called) scientific method. Is it now dogma in Cultural Studies that there exists no external world? Or that there exists an external world but science obtains no knowledge of it?

In the second paragraph I declare, without the slightest evidence or argument, that ``physical `reality' [note the scare quotes] ... is at bottom a social and linguistic construct.'' Not our *theories* of physical reality, mind you, but the reality itself. Fair enough: anyone who believes that the laws of physics are mere social conventions is invited to try transgressing those conventions from the windows of my apartment. (I live on the twenty-first floor.)

Throughout the article, I employ scientific and mathematical concepts in ways that few scientists or mathematicians could possibly take seriously. For example, I suggest that the ``morphogenetic field'' -- a bizarre New Age idea due to Rupert Sheldrake -- constitutes a cutting-edge theory of quantum gravity. This connection is pure invention; even Sheldrake makes no such claim. I assert that Lacan's psychoanalytic speculations have been confirmed by recent work in quantum field theory. Even nonscientist readers might well wonder what in heavens' name quantum field theory has to do with psychoanalysis; certainly my article gives no reasoned argument to support such a link.

Later in the article I propose that the axiom of equality in mathematical set theory is somehow analogous to the homonymous concept in feminist politics. In reality, all the axiom of equality states is that two sets are identical if and only if they have the same elements. Even readers without mathematical training might well be suspicious of the claim that the axiom of equality reflects set theory's ``nineteenth-century liberal origins.''

In sum, I intentionally wrote the article so that any competent physicist or mathematician (or undergraduate physics or math major) would realize that it is a spoof. Evidently the editors of *Social Text* felt comfortable publishing an article on quantum physics without bothering to consult anyone knowledgeable in the subject.

The fundamental silliness of my article lies, however, not in its numerous solecisms but in the dubiousness of its central thesis and of the ``reasoning'' adduced to support it. Basically, I claim that quantum gravity -- the still-speculative theory of space and time on scales of a millionth of a billionth of a billionth of a billionth of a centimeter -- has profound *political* implications (which, of course, are ``progressive''). In support of this improbable proposition, I proceed as follows: First, I quote some controversial philosophical pronouncements of Heisenberg and Bohr, and assert (without argument) that quantum physics is profoundly consonant with ``postmodernist epistemology.'' Next, I assemble a pastiche -- Derrida and general relativity, Lacan and topology, Irigaray and quantum gravity -- held together by vague rhetoric about ``nonlinearity'', ``flux'' and ``interconnectedness.'' Finally, I jump (again without argument) to the assertion that ``postmodern science'' has abolished the concept of objective reality. Nowhere in all of this is there anything resembling a logical sequence of thought; one finds only citations of authority, plays on words, strained analogies, and bald assertions.

In its concluding passages, my article becomes especially egregious. Having abolished reality as a constraint on science, I go on to suggest (once again without argument) that science, in order to be ``liberatory,'' must be subordinated to political strategies. I finish the article by observing that ``a liberatory science cannot be complete without a profound revision of the canon of mathematics.'' We can see hints of an ``emancipatory mathematics,'' I suggest, ``in the multidimensional and nonlinear logic of fuzzy systems theory; but this approach is still heavily marked by its origins in the crisis of late-capitalist production relations.'' I add that ``catastrophe theory, with its dialectical emphases on smoothness/discontinuity and metamorphosis/unfolding, will indubitably play a major role in the future mathematics; but much theoretical work remains to be done before this approach can become a concrete tool of progressive political praxis.'' It's understandable that the editors of *Social Text* were unable to evaluate critically the technical aspects of my article (which is exactly why they should have consulted a scientist). What's more surprising is how readily they accepted my implication that the search for truth in science must be subordinated to a political agenda, and how oblivious they were to the article's overall illogic.

Why did I do it? While my method was satirical, my motivation is utterly serious. What concerns me is the proliferation, not just of nonsense and sloppy thinking *per se*, but of a particular kind of nonsense and sloppy thinking: one that denies the existence of objective realities, or (when challenged) admits their existence but downplays their practical relevance. At its best, a journal like *Social Text* raises important questions that no scientist should ignore -- questions, for example, about how corporate and government funding influence scientific work. Unfortunately, epistemic relativism does little to further the discussion of these matters.

In short, my concern over the spread of subjectivist thinking is both intellectual and political. Intellectually, the problem with such doctrines is that they are false (when not simply meaningless). There *is* a real world; its properties are *not* merely social constructions; facts and evidence *do* matter. What sane person would contend otherwise? And yet, much contemporary academic theorizing consists precisely of attempts to blur these obvious truths -- the utter absurdity of it all being concealed through obscure and pretentious language.

Social Text's acceptance of my article exemplifies the intellectual arrogance of Theory -- meaning postmodernist *literary* theory -- carried to its logical extreme. No wonder they didn't bother to consult a physicist. If all is discourse and ``text,'' then knowledge of the real world is superfluous; even physics becomes just another branch of Cultural Studies. If, moreover, all is rhetoric and ``language games,'' then internal logical consistency is superfluous too: a patina of theoretical sophistication serves equally well. Incomprehensibility becomes a virtue; allusions, metaphors and puns substitute for evidence and logic. My own article is, if anything, an extremely *modest* example of this well-established genre.

Politically, I'm angered because most (though not all) of this silliness is emanating from the self-proclaimed Left. We're witnessing here a profound historical *volte-face*. For most of the past two centuries, the Left has been identified with science and against obscurantism; we have believed that rational thought and the fearless analysis of objective reality (both natural and social) are incisive tools for combating the mystifications promoted by the powerful -- not to mention being desirable human ends in their own right. The recent turn of many ``progressive'' or ``leftist'' academic humanists and social scientists toward one or another form of epistemic relativism betrays this worthy heritage and undermines the already fragile prospects for progressive social critique. Theorizing about ``the social construction of reality'' won't help us find an effective treatment for AIDS or devise strategies for preventing global warming. Nor can we combat false ideas in history, sociology, economics and politics if we reject the notions of truth and falsity.

The results of my little experiment demonstrate, at the very least, that some fashionable sectors of the American academic Left have been getting intellectually lazy. The editors of *Social Text* liked my article because they liked its *conclusion*: that ``the content and methodology of postmodern science provide powerful intellectual support for the progressive political project.'' They apparently felt no need to analyze the quality of the evidence, the cogency of the arguments, or even the relevance of the arguments to the purported conclusion.

Of course, I'm not oblivious to the ethical issues involved in my rather unorthodox experiment. Professional communities operate largely on trust; deception undercuts that trust. But it is important to understand exactly what I did. My article is a theoretical essay based entirely on publicly available sources, all of which I have meticulously footnoted. All works cited are real, and all quotations are rigorously accurate; none are invented. Now, it's true that the author doesn't believe his own argument. But why should that matter? The editors' duty as scholars is to judge the validity and interest of ideas, without regard for their provenance. (That is why many scholarly journals practice blind refereeing.) If the *Social Text* editors find my arguments convincing, then why should they be disconcerted simply because I don't? Or are they more deferent to the so-called ``cultural authority of techno science'' than they would care to admit?

In the end, I resorted to parody for a simple pragmatic reason. The targets of my critique have by now become a self-perpetuating academic subculture that typically ignores (or disdains) reasoned criticism from the outside. In such a situation, a more direct demonstration of the subculture's intellectual standards was required. But how can one show that the emperor has no clothes? Satire is by far the best weapon; and the blow that can't be brushed off is the one that's self-inflicted. I offered the *Social Text* editors an opportunity to demonstrate their intellectual rigor. Did they meet the test? I don't think so.

I say this not in glee but in sadness. After all, I'm a leftist too (under the Sandinista government I taught mathematics at the National University of Nicaragua). On nearly all practical political issues -- including many concerning science and technology -- I'm on the same side as the *Social Text* editors. But I'm a leftist (and feminist) *because* of evidence and logic, not in spite of it. Why should the right wing be allowed to monopolize the intellectual high ground?

And why should self-indulgent nonsense -- whatever its' professed political orientation -- be lauded as the height of scholarly achievement?

Alan Sokal is a Professor of Physics at New York University. He is co-author with Roberto Fernández and Jürg Fröhlich of *Random Walks, Critical Phenomena, and Triviality in Quantum Field Theory*(Springer, 1992), and co-author with Jean Bricmont of the forthcoming *Les impostures scientifiques des philosophes (post-)modernes*.

SIDEBAR: EXCERPT FROM ARTICLE

Thus, general relativity forces upon us radically new and counterintuitive notions of space, time and causality; so it is not surprising that it has had a profound impact not only on the natural sciences but also on philosophy, literary criticism, and the human sciences. For example, in a celebrated symposium three decades ago on *Les Langages Critiques et les Sciences de l'Homme*, Jean Hyppolite raised an incisive question about Jacques Derrida's theory of structure and sign in scientific discourse ... Derrida's perceptive reply went to the heart of classical general relativity:

The Einsteinian constant is not a constant, is not a center. It is the very concept of variability--it is, finally, the concept of the game. In other words, it is not the concept of some*thing*--of a center starting from which an observer could master the field--but the very concept of the game ...

In mathematical terms, Derrida's observation relates to the invariance of the Einstein field equation $G_{\mu\nu} = 8\pi T_{\mu\nu}$ $G_{\mu\nu} = 8\pi G T_{\mu\nu}$ under nonlinear space-time diffeomorphisms (self-mappings of the space-time manifold which are infinitely differentiable but not necessarily analytic). The key point is that this invariance group ``acts transitively'': this means that any space-time point, if it exists at all, can be transformed into any other. In this way the infinite-dimensional invariance group erodes the distinction between observer and observed; the π of Euclid and the G of Newton, formerly thought to be constant and universal, are now perceived in their ineluctable historicity; and the putative observer becomes fatally de-

centered, disconnected from any epistemic link to a space-time point that can no longer be defined by geometry alone.

- Maxin Lott, Fox News

That hoax was perpetuated in 1995 yet today some 120 papers published in established scientific journals over the last few years have been found to be frauds, created by nothing more than an automated word generator that puts random, fancy-sounding words together in plausible sentence structures!!

The following was submitted by an MIT graduate student – (commentary by Nature)!!

Stribling Jeremy, D. A., and Maxwell Krohn, (2005), Rooter: A Methodology for the Typical Unification of Access Points and Redundancy (completely computer generated fake paper), in: 9th World Multi-Conference on Systemics, Cybernetics and Informatics (WMSCI),, Nagib Callaos from Venezuela Paper not peer reviewed. paper withdrawn, pp. World Multi-Conference on Systemics, Cybernetics and Informatics (WMSCI),, Florida, http://pdos.csail.mit.edu/~strib/docs/fake/rooter.pdf AND http://www.ask-force.org/web/Peer-Review/Stribling-Rooter-Methodology-Typical-Unification-.pdf comments see http://www.ask-force.org/web/Peer-Review/Ball-Computer-Conference-welcomes-gobblegook-paper-2000.pdf

NIH FELLOW: Wade Zeno

INVESTIGATION OF NANOLIPOPROTEIN PARTICLES ENTRAPPED WITHIN NANOPOROUS SILICA: A NOVEL PLATFORM FOR IMMOBILIZATION OF INTEGRAL MEMBRANE PROTEINS

Presenter: Wade Zeno*

Authors: **Wade Zeno***, Subhash Risbud, Marjorie Longo

Affiliations: Department of Chemical Engineering, University of California, Davis

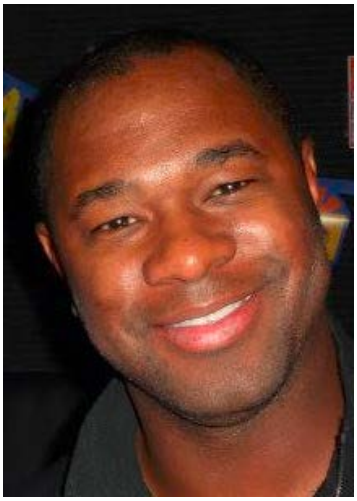
Preceptor: Marjorie Longo

Entrapment of integral membrane proteins (IMPs) in transparent, nanoporous silica gels has proven to be a challenge, as current and previous techniques utilize liposomes as biological membrane hosts. The instability of liposomes in nanoporous gels is attributed by their size (~150 nm) and altered structure and lipid dynamics upon entrapment within the nanometer scale pores (5-50 nm) of silica gel. This ultimately results in disruption of protein activity. We intend to overcome these barriers by using nanolipoprotein particles (NLPs) as biomembrane hosts. NLPs are discoidal patches of lipid bilayer that are belted by amphiphilic scaffold proteins and have an average thickness of 5 nm, with diameters ranging from 10-15 nm. The IMP-NLP complexes are synthesized in a cell-free environment, which circumvents traditional protein reconstitution in membranes. Bacteriorhodopsin - a robust IMP protein that indicates its proper conformation via distinct purple coloration – will serve as a model IMP for this system. The spectral and physical properties of bacteriorhodopsin-NLPs intended for entrapment within the gel are examined, as well as the phase behavior of the lipids within the NLP, to ensure proper functionality of the system. This bio-inorganic hybrid nanomaterial possesses a variety of viable applications. The success of this work could lead to the development of novel platforms in several areas, including high-throughput drug screening, chromatography, and biosensors.

***DEB Graduate Student**

COMPANY AFFILIATE: OncoMed Pharmaceuticals, Inc.

TARGETING NOTCH AND WNT SIGNALING PATHWAYS TO REDUCE CANCER STEM CELL FREQUENCE



Presenter: Christopher Murriel, PhD

Authors: **Christopher Murriel, PhD**

Affiliations: OncoMed Pharmaceuticals, Inc.
Redwood City, CA

Accumulating evidence suggests that tumor growth, recurrence and metastasis are driven by a subset of highly tumorigenic cells referred to as cancer stem cells (CSCs) or tumor initiating cells. Several investigators have demonstrated that CSCs are relatively resistant to chemotherapy and that tumor recurrence and the development of drug resistance after chemotherapy are mediated by residual cancer stem cells. We previously demonstrated that targeting Notch with a novel anti-DLL4 antibody and Wnt signaling with an antibody against Fzd receptors (18R5) or the Wnt binding antagonist Fzd8-Fc inhibited tumor growth and decreased cancer stem cell frequency. Using various patient-derived xenograft tumor models (PDX), we found that residual tumors after conventional chemotherapy could enrich the cancer stem cell population. More importantly, as shown by *in vivo* limiting dilution analyses, treatment with anti-DLL4 or anti-Wnt agents decreased cancer stem cell frequency and delayed tumor recurrence. Gene expression analysis demonstrated that anti-DLL4 and anti-Wnt genes the expression of many genes associated with EMT, multidrug resistance, DNA repair, and the Notch and Wnt pathways while inducing differentiation markers as assessed by immunohistochemical analysis. Therefore, our findings provide a rationale to target cancer stem cells through interference with Notch and Wnt signaling pathway as a therapeutic approach in patients who are refractory to chemotherapeutic agents.

BIOTECH FELLOW: Christopher Chapman

ADVANCED MATERIAL SCREENING PLATFORMS FOR NEUROENGINEERING APPLICATIONS

Presenter: Christopher Chapman*

Authors: **Christopher Chapman***[1], Hao Chen[2], Marianne Stamon[2], Monika Biener[3], Pamela J. Lein[2], Erkin Şeker[4]

Affiliations: Department of Biomedical Engineering, University of California, Davis
Department of Molecular Biosciences, University of California, Davis
Department of Electrical and Computer Engineering, University of California, Davis
Lawrence Livermore National Laboratory, Livermore, CA

Preceptor: Erkin Şeker

Implantable neural electrodes are emerging as effective therapies for many devastating neurological disorders such as Parkinson's, paralysis, and depression. A major obstacle in long term reliability of these devices has been the undesired encapsulation of electrodes by glial cells, which weakens the neuron-electrode coupling necessary for high-fidelity recordings and stimulation. Therefore, there is an unmet need for electrode coatings that can both improve signal-to-noise ratio and mitigate adverse tissue response (gliosis) following implantation. Nanoporous gold (np-Au), with its high effective surface area, tunable nanostructure, and compatibility with conventional microfabrication techniques, is a promising new biomaterial to address these challenges. The objective of this project is to develop a high-throughput material screening platform in order to assess the effects of varying degrees of nanostructure on electrode performance and neuronal cell functionality. Here, we report the use of a selective laser annealing approach to create miniaturized material libraries as the foundation for investigating optimal electrode nanostructures. In tandem, we employ a cortical neuron-glia co-culture model for identifying cytotoxic elements in np-Au electrodes and demonstrate drastic improvement in electrode biocompatibility via atomic layer deposition techniques. We expect this platform to pave the way to rapid screening of nanoporous electrode coatings for advanced neuroengineering applications.

*DEB Graduate Student

COMPANY AFFILIATE: Sutro Biopharma, Inc.

PRODUCING POTENT ANTIBODY DRUG CONJUGATES USING CELL-FREE PROTEIN SYNTHESIS

Presenter: Erik Zimmerman, PhD

Authors: **Erik Zimmerman**, Elenor Castillo*, Tyler H. Heibeck, Avinash Gill, Xiaofan Li, Christopher J. Murray, Mary Rose Madlansacay, Cuong Tran, Nathan T. Uter, Gang Yin, Patrick J. Rivers, Alice Y. Yam, Willie D. Wang, Alexander R. Steiner, Sunil U. Bajad, Kalyani Penta, Wenjin Yang, Trevor J. Hallam, and Aaron K. Sato

Affiliations: Sutro Biopharma, Inc.
South San Francisco, CA

Sutro Biopharma uses a proprietary, cell-free, coupled transcription-translation system to produce cutting edge protein therapeutics. These products include therapeutic antibodies, bispecific antibodies, antibody-drug conjugates, peptides, and vaccines. The open nature of this expression platform allows us to add components that are absent from cell-based expression platforms. We have integrated a system for incorporation of non-natural amino acids that allows co-translational incorporation of amino acids with azide side chains. This enables site-specific conjugation of chemical moieties to a protein of interest via a "click" chemical reaction. We have employed this platform for the production of tumor-antigen-specific antibodies armed with a highly potent cytotoxin. These antibody-drug conjugates are highly potent in tumor cell killing and in vivo tumor regression models.

BIOTECH FELLOW: Siobhan K. Halloran

AIRBORNE DISEASE TRANSMISSION IN INDOOR ENVIRONMENTS

Presenter: Siobhan K. Halloran*
Authors: **Siobhan K. Halloran***, and William D. Ristenpart
Affiliation: Department of Chemical Engineering and Materials Science, University of California, Davis
Preceptor: William D. Ristenpart

Airborne disease transmission and the possibility of a future pandemic spread by expelled respiratory aerosols exist as prominent public health issues. The Wells-Riley equation, an epidemiological model developed using a probabilistic approach, has long been employed to predict transmissibility of airborne infections. There is much confusion, however, surrounding the dosage input of the model, the "quantum," which conflates the number of pathogens inhaled by exposed susceptibles with internal screening mechanisms that fight infection. Furthermore, the Wells-Riley model implicitly assumes that the room air is perfectly mixed, and that pathogen laden expiratory particles are evenly distributed throughout the space. Here we address both issues by developing a model predicated on fundamental conservation equations, an approach common in engineering but heretofore less used in disease transmission modeling. This approach allows for model inputs, such as airborne pathogen concentration, to be considered separately and linked to physically meaningful parameters. We also demonstrate that our model can be generalized for more realistic residence time distributions, to account for uneven mixing effects prior to the establishment of a steady state airborne pathogen concentration. Our method, which utilizes equations that are readily adaptable for risk assessment in non-ideal scenarios, lays the groundwork for more rigorous considerations of infectious disease transmissibility.

*DEB Graduate Student

BIOTECH FELLOW: Allison Hoch

ENHANCING THE THERAPEUIC VALUE OF MESENCHYMAL STEM CELLS

Presenter: Allison Hoch*

Authors: **Allison I. Hoch*[1,2]**, Vaishali Mittal[1], Ivan Martin[2,3], J. Kent Leach[1,4]

Affiliations: [1]Department of Biomedical Engineering, University of California, Davis
[2]Department of Biomedicine, University Hospital Basel, Basel, Switzerland
[3]Department of Surgery, University Hospital Basel, Basel, Switzerland,
[4]Department of Orthopaedic Surgery, School of Medicine, University of California, Davis

Preceptor: J. Kent Leach

The discovery that mesenchymal stem cells (MSC) can differentiate toward bone, cartilage, and fat and secrete potent growth factors poses an exciting alternative to the grafting standard. In the autograft, clinicians insert a piece of the patient's own healthy tissue into the damaged region, yet this is a problem because the patient still suffers from the harmful effects of an additional surgery. While MSC can circumvent this crucial limitation, they still require improvements. First, only a small number of MSC can be extracted from the bone marrow, yet a large number of cells is required to treat non-union bone defects and myocardial infarctions. My research has increased MSC number using 3D bioreactors, which mimic the native bone marrow environment by imparting physiologically relevant shearing forces. Moreover, 3D bioreactor culture enables MSC to retain their utmost therapeutic value during expansion as determined by strong differentiation capacity and high colony-forming unit efficiency (CFE). Second, MSC exhibit the dual function of mineral production and angiogenic growth factor secretion, which are both required to heal a bone defect. My research has demonstrated these processes are intertwined in a delicate tradeoff and has elucidated timelines to achieve an optimal balance. Finally, my future research seeks to reduce MSC apoptosis in the harsh environment of diseases and defects because surviving stem cell number is portent of clinical success. By translating scientific discoveries from the laboratory to the clinic (bench-to-bedside), the true therapeutic value of mesenchymal stem cells can be realized and become commonplace in health care.

***DEB Graduate Student**

BIOTECH FELLOW: Keith Dunaway

EPIGENOMIC EFFECTS OF PERSISTENT ORGANIC POLLUTANTS AND DNA DUPLICATION

Presenter: Keith Dunaway*
Authors: **Keith Dunaway***, Saharul Islam, Ian Korf, Janine LaSalle
Affiliations: Department of Medical, Microbiology & Immunology, University of California, Davis
Preceptor: Janine LaSalle

Autism is a neural development disorder characterized by impaired social interaction and communication. According to the CDC, 1 in 88 children are afflicted with autism in the United States, a rate which has skyrocketed from 1 in 150 children just ten years prior. Genomic copy number variations are de novo events found frequently in autism and the causes of these events are due in part to environmental factors, such as exposure to toxins. Polychlorinated Biphenyls (PCB) are a class of widely distributed persistent organic pollutants (POP) which were banned from industrial use in the 1970s due to their negative effects on the developing brain and disruption of neurotransmitter systems, endocrine systems, and intracellular signaling pathways. Our lab has recently found an unexpected association between PCB-95 exposure and maternal duplication of chromosome 15q11-13 (Dup15q), phenotypically characterized as an autism spectrum disorder. I performed a genome-wide assay of DNA methylation on post mortem human brain tissue of individuals diagnosed with Dup15 syndrome and exposed to PCB-95. To analyze this next generation sequencing data, I used existing bioinformatic tools as well as developed new ones to discover a novel relationship between the duplication of human chromosome 15 and global methylation changes. I further examined this relationship using a Dup15q cell line to determine if PCB-95 exposure, chromosomal 15 duplication, or a combination of the two caused hypomethylation. My findings support the idea that genome duplication could cause genome-wide hypomethylation and could aid clinical research by pinpointing methylation markers to assay autism risk.

*DEB Graduate Student

COMPANY AFFILIATE: Agilent Technologies, Inc.

RESEARCH ENABLED BY COMPLEX DNA LIBRARY SYNTHESIS

Presenter: Maggie Ostrowski, PhD

Authors: **Maggie Ostrowski**, Kristen Bernick, Robert Ach

Affiliations: Agilent Technologies, Inc.
Santa Clara, CA

Agilent Laboratories performs cutting edge research at the interface of engineering, medicine, chemistry and informatics. By bringing together talented scientists across interdisciplinary research programs, we invent measurement technologies that enable the next wave of molecular research. One example of enabling technology developed at Agilent Labs is complex DNA library synthesis. I will describe the technology and present key research enabled by the technology in the fields of diagnostics, stem cell biology and synthetic biology.

Poster Abstracts

A. DETECTION OF NON-ENZYMATIC COLLAGEN CROSSLINKS IN ENGINEERED CELL-SECRETED EXTRACELLULAR MATRICES BY TIME-RESOLVED FLUORESCENCE SPECTROSCOPY

Debika Mitra*, Hussain Fatakdawala, Laura Marcu, J. Kent Leach
Department of Biomedical Engineering, University of California, Davis, CA

The extracellular matrix (ECM) serves as the cellular instruction manual, directing cell behavior such as adhesion, differentiation, and survival. Aging, diabetes, and osteoporosis have been correlated with the formation of pentosidine (PENT) crosslinks in collagen, the predominant mammalian ECM protein. These crosslinks alter cell response by modifying the biophysical properties of the underlying ECM. Current techniques for studying PENT are destructive, and many researchers only examine collagen films rather complex ECMs representative of *in vivo* microenvironments. We addressed these two challenges by exposing cell-secreted decellularized matrices (DMs) to ribose treatment and using non-destructive Time-Resolved Fluorescence Spectroscopy (TRFS) to detect the presence of PENT crosslinks in DMs. The Leach laboratory has previously developed a novel method to produce DMs that preserve the complexity of a native ECM, while providing a biomimetic, tunable cellular substrate. Human mesenchymal stem cells (MSCs) were cultured for up to 10 days on tissue culture plastic and then decellularized, leaving behind the cell-secreted DM. PENT crosslink formation was then induced by incubating DMs in the presence of ribose for 14 days. TRFS (pulsed N_2 laser excitation 337 nm, 360-600 nm emission) was used to detect PENT formation. Lifetime values above 400 nm were significantly different ($p<0.05$) between control and ribose-treated DMs. The lifetime value at 450nm emission was 4.4 ns and 3.8 ns for control and ribose-treated DMs, respectively. A characteristic blue shift in peak emission (control DM: 425 nm, ribose-treated DM: 405 nm) was also observed in response to ribose culture, presumably due to PENT formation. We are validating this optical imaging method against standard approaches such as HPLC as a more efficient method for crosslink detection. We are also examining the osteoblastic response of undifferentiated MSCs, a critical cell population that contributes to bone formation and repair, to determine the impact of crosslink formation on osteogenesis. This study will serve as a proof-of-principle that DMs provide an improved platform to study the role of collagen crosslinks in cell-ECM interactions, and optical imaging provides an invaluable tool to probe the dynamic formation of crosslinks.

*DEB Graduate Student

B. PRODUCING POTENT ANTIBODY DRUG CONJUGATES USING CELL-FREE PROTEIN SYNTHESIS

Erik S. Zimmerman, Elenor Castillo*, Tyler H. Heibeck, Avinash Gill, Xiaofan Li, Christopher J. Murray, Mary Rose Madlansacay, Cuong Tran, Nathan T. Uter, Gang Yin, Patrick J. Rivers, Alice Y.Yam, Willie D. Wang, Alexander R. Steiner, Sunil U. Bajad, Kalyani Penta, Wenjin Yang, Trevor J. Hallam, and Aaron K. Sato
Sutro Biopharma, Inc., South San Francisco, CA

Sutro Biopharma uses a proprietary, cell-free, coupled transcription-translation system to produce cutting edge protein therapeutics. These products include therapeutic antibodies, bispecific antibodies, antibody-drug conjugates, peptides, and vaccines. The open nature of this expression platform allows us to add components that are absent from cell-based expression platforms. We have integrated a system for incorporation of non-natural amino acids that allows co-translational incorporation of amino acids with azide side chains. This enables site-specific conjugation of chemical moieties to a protein of interest via a "click" chemical reaction. We have employed this platform for the production of tumor-antigen-specific antibodies armed with a highly potent cytotoxin. These antibody-drug conjugates are highly potent in tumor cell killing and in vivo tumor regression models.

*DEB Graduate Student

C. EFFECT OF STRAIN RATE ON THE MECHANICAL BEHAVIOR OF RED BOOD CELLS AT A CONSTRICTION

Jordan Mancuso*, William D. Ristenpart
Department of Chemical Engineering and Materials Science, University of California, Davis

We are interested in investigating the effects of strain rate on the mechanical behavior of red blood cells (RBCs) as they enter a constriction where the velocity and corresponding shear stress suddenly increase. Prior work with microfluidic devices has established the mechanical response of RBCs undergoing a sudden increase in shear stress at the entrance of a constriction with a fixed geometry: specifically, the channel decreases from 100 μm to 20 μm in width at a taper angle of 60 degrees. Although the taper angle affects the rate at which the fluid velocity increases, to date little is known about how the acceleration affects the RBC mechanical behavior. Here we describe preliminary experimental efforts assessing how changing the taper angle and corresponding strain rate affects the RBC behaviors. This work will focus on investigating multiple angles of constriction from 0 degrees (no constriction) to 90 degrees. The results are expected to shed light on RBC behavior at atherosclerotic or other constrictions in vivo.

*DEB Graduate Student

D. CONDUCTANCE-STRUCTURE MODULATION IN SINGLE DNA DUPLEXES

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DNA is one of the most fascinating biomolecules used in nanoscience today. First, it is a promising molecule for applications in molecular electronics. It was noticed early that the structure of double-stranded DNA (dsDNA) provides a pi-stacking structure that could potentially lead to efficient conduction along the chain. Secondly, DNA has self-assembly properties, and recent advances in DNA origami have demonstrated its utility for creating nanostructures. These properties suggest that it may be possible to design hybrid DNA-based materials with tunable electrical properties. Moreover, DNA is currently used in the diagnosis of many diseases. A clear picture of the electrical conductivity of this molecule could open the doors for the design of diagnostic tools that could be read electronically; improving the sensitivity and reducing costs.

Although results of DNA conductance reported in the literature span a huge range and differ by orders of magnitude, some consensus has been achieved in the charge transport mechanism, being found to be tunneling in short molecules and hopping in longer DNA molecules. Besides length, other factors influence DNA conductance. Sequence can modulate conductance, as some bases participate in the charge transport process. The presence of single nucleotide polymorphisms (SNP) has been reported to modulate conductance as well. But, to date, conductance modulation by structure in different DNA forms has not been studied.

Herein we report conductance measurements of short dsDNA molecules using the STM-break junction method. We study dsDNA conductance as function of length, sequence and structure. The structure is changed from B-form to A-form by adding ethanol during the experiment. Results demonstrate that A-form dsDNA is ~10 times more conductive than B-form in GC rich sequences.

E. MECHANICAL RESPONSE OF RED BLOOD CELLS ENTERING A CONSTRICTION

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Most work on RBC dynamic response to hydrodynamic stress has focused on linear velocity gradients. Relatively little experimental work has examined how individual RBCs respond to pressure driven flow in more complex geometries, such as in an abrupt contraction. Here, we establish the mechanical behaviors of RBCs undergoing a sudden increase in shear stress at the entrance of a narrow constriction. We pumped RBCs through a constriction in an *ex vivo* microfluidic device and used high speed video to visualize and track the flow behavior of more than 4,400 RBCs. We show that approximately 85% of RBCs undergo one of four distinct modes of motion: stretching, twisting, tumbling, or rolling. Intriguingly, an average of about 30% of the cells exhibited twisting (rotation around the major axis parallel to the flow direction), a mechanical behavior that is not typically observed in linear velocity gradients. We present detailed statistical analyses on the dynamics of each motion and demonstrate that the behavior is highly sensitive to the location of the RBC within the channel. Finally, we show that the observed rotations of tumbling, twisting, and rolling motions can be rationalized simply in terms of rigid body rotation.

*DEB Graduate Student

F. MOLECULAR RELEASE FROM NANOPOROUS GOLD THIN FILMS

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Nanoporous gold thin films, produced by a dissolution-based self-assembly process, have become a popular material for several applications such as sensor platforms, catalysis, and recently biomedical devices owing to their large effective surface area, tunable porosity, biocompatibility, and ease of surface modification with thiol-based chemistry. Despite the demonstration of its potential as a drug delivery platform, the relationship between drug release kinetics and pore morphology is lacking and is necessary for designing drug delivery platforms with a well-defined release profile. We have conducted a detailed study of the release of a fluorescent probe (fluorescein) as a small-molecule drug surrogate from sputter-deposited nanoporous gold thin films. We investigated the control over the capacity and release kinetics by creating films with different thicknesses and pore morphologies. Film thicknesses ranging from 380 nm to 960 nm were obtained by varying the sputter deposition time and different pore morphologies with pores sizes spanning 20 nm to 150 nm were obtained by thermal treatment of the films. Treatment temperatures ranging from 200°C to 400°C resulted in preferential expansion of cracks and formation of porous islands, where the average feature sizes were between 200 and 500 nm. Loading capacity of the thin films showed a high correlation with the effective surface areas (determined by electrochemical methods) of the films, while the release kinetics were mainly dictated by micro- and nano-scale morphological features. Samples with cracks exhibited faster molecular release compared to their intact counterparts. This study reports the techniques for tuning loading capacity and molecular release by modulating thin film properties. We expect this work to assist in integrating tunable porous films with disordered pore morphology into miniaturized drug release platforms.

*DEB Graduate Student

G. ELECTROCHEMICAL DETECTION OF NUCLEIC ACIDS USING NANOPOROUS GOLD SENSORS

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Nanoporous gold thin films, produced by a dissolution-based self-assembly process, offer high effective surface area, electrical conductivity, catalytic activity, tunable pore morphology, and compatibility with conventional micropatterning techniques. These properties are critical for a number of technologically important applications including biosensors, fuel cells, and photonics. In particular, nanoporous gold thin films are an excellent choice for nucleic acid based bioanalytical sensors owing to their ease of surface functionalization. The sensor performance can be enhanced by leveraging the probe-target interactions within nanostructured thin film. Tunable pore morphology is an important requirement to understand the interaction of nucleic acids with nanopores in different size scales. Having a library of structures with varying morphology will help in expanding the dynamic range of detection. To this end, we are investigating different techniques for estimating DNA probe grafting density on nanoporous gold films with varying morphologies and also developing methods for efficient detection of target hybridization. Chronocoulometry technique was adopted using ruthenium hexamine chloride as the redox marker to estimate the probe grafting density on gold control substrates and nanoporous gold electrodes. A double redox marker system with ruthenium hexamine chloride and potassium ferrocyanide was employed to enable catalytic signal amplification during target hybridization. An enhancement in probe density was observed in nanoporous gold films compared to planar gold films. This poster reports on the fabrication of the nanoporous gold sensors and its characterization for electrochemical sensing applications.

H. MODULATING ENDOTHEILIAL CELL RESPONSE WITH S1P AND HYPOXIC STRESS

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Therapeutic angiogenesis provides a promising approach to treating ischemic diseases. Angiogenic factors, including chemotactic molecules and blood vessel forming cells, are delivered to hypoxic tissue to stimulate neovessel formation. Our work pursues the promising idea of locally delivering sphingosine-1-phosphate (S1P) to efficiently recruit circulating blood vessel forming endothelial progenitor cells (EPCs) and promote subsequent angiogenesis in restoration of blood flow to ischemic tissue. S1P is a bioactive lysophospholipid that augments endothelial cell (EC) proliferation, migration, apoptosis, and differentiation to regulate vascular stabilization. Both hypoxic stress and local S1P concentration modulate the S1P receptor (S1PR1-5) profile on the surface of ECs and are thus hypothesized to influence the overall response to S1P presence. Vascular endothelial growth factor (VEGF) is a critical factor in orchestrating angiogenesis and vascular permeability. Here, we addressed the hypothesis that an interaction exists between S1P, VEGF, and hypoxic stress on the angiogenic response of ECs *in vitro*. Immunocytochemical staining confirmed that both ECs and EPCs express S1PR1 under both normoxia (20% oxygen) and hypoxia (1% oxygen). The angiogenic response of mature HMVEC-d was assessed via proliferation, migration, and 3D sprouting from microcarrier beads within a fibrin-based gel. We found that VEGF stimulation (0.25 ng/mL) with or without 0.15 uM S1P resulted in significantly greater proliferation than basic media with no growth factors under both normoxia and hypoxia. Migration after 24h was significantly increased in media with VEGF or both VEGF and S1P under normoxia for both cell populations. Hypoxic stress did not significantly impact the migratory response. Further, the presence of S1P supplemented with VEGF or with full growth media led to a considerable increase in the number of sprouts per bead. In conclusion, our findings suggest that S1P stimulation works in cooperation with VEGF to increase the angiogenic activity of mature and progenitor vascular ECs.

*DEB Graduate Student

I. EXPRESSION OF RECOMBINANT HUMAN BUTYRYLCHOLINESTERASE IN NICOTIANA BENTHAMIANA AND ITS POSTPRODUCTION IN-VITRO GLYCOSYLATION MODIFICATION

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Human butyrylcholinesterase (hBChE EC 3.1.1.8) is a 574 amino acid cholinesterase-hydrolyzing enzyme. Organophosphates (OP) are highly toxic inhibitors of the acetylcholine-hydrolyzing enzymes like hBChE. The resulting accumulation of acetylcholine can lead to respiratory collapse and death. Current therapies are based on elevating the serum levels of OP bioscavengers like BChE. The major limitation of this therapy is high cost, with plasma-derived hBChE costing more than $10,000/treatment. Limitations like cost and availability necessitate an alternative expression platform capable of large scale, low-cost production of a fully active and efficacious recombinant hBuChE (rhBChE). The development of an effective rhBChE is a pressing national security concern in terms of protecting the nation's warfighters and civilian population from the threat of attack with OP agents.

We describe the use of viral amplicon-based gene expression systems based on either Tobacco mosaic virus (TMV) and Cucumber mosaic virus (CMV) to express functional rhBChE in Nicotiana benthamiana using transient agroinfiltration. Because hBChE is a glycoprotein with nine potential N-glycosylation sites, the glycan structures of the plant-made rhBChE were also characterized. For each expression system, two constructs were made to target the protein to the apoplastic compartment (Apo) of the plant cell or to retain the protein at the endoplasmic reticulum (ER). As expected the variation in subcellular localization resulted in different glycosylation patterns of the recovered butyrylcholinesterase. Retaining the protein at the ER yields a high mannose N-glycans structure, while targeting the protein to the apoplastic compartment yields a complex N-glycan structure.

In each of the four different constructs (Apo-TMV, ER-TMV, Apo-CMV and ER-CMV), a 3X FLAG tag is used at N-terminal of the protein for protein identification and purification.

Here, we report the expression level of the four different expression systems and the N-glycan structure of the ER retained and apoplast targeted proteins. Six days post infiltration, the expression level of functional rhBChE using the ER-TRBO, Apo-TRBO, ER-CMVar and Apo-CMVar expression systems are 14.6, 6.6, 0.74 and 2.9 mg/kg FW respectively. The extract was filtered with 0.22 um and concentrated by 30 kDa MWCO. DEAE- Cellulose and affinity anti FLAG were used to remove the polyphenolics and capture the tagged protein respectively. The glycan structure of purified ER-retained butyrylcholinesterase reveals almost all the N-glycan having a high mannose structure with insignificant amount of paucimannosidic-type N-glycan. While, the glycan structure of Apo targeted protein reveals a mixture of N-glycans consisting mainly of complex N-glycans (39%), high mannose structure (25%), and paucimannosidic-type N-glycan (36%). We found all nine sites occupied by typical plant glycans.

It is also known that plants are incapable of sialylating glycoproteins naturally and that sialylation is essential for the normal serum half-life of proteins. To increase the number of sialic acid residues per rhBChE molecule, we systematically added GlcNAC, galactose and sialic acid to branch-termini of plant N-glycans using multistep enzymatic reactions (i.e., in vitro sialylation). Redecoration takes place in 3 steps by adding N-Acetylglucosamine, glactose, and sialic acid by specific human GnT1, bovine 1,4 GalT, and $\alpha - 2{,}6$ sialyltransferase. The overall yield of the sialylated species is at least 10% and likely as high as 30%.

*DEB Graduate Student

J. BINDING AFFINITY OF IRON OXIDE BASED PET/MRI PROBE TO MACROPHAGE SCAVENGER RECEPTOR IN VULNERABLE ATHEROSCLEROTIC PLAQUES

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To date, most of the approved clinical MRI contrast agents are non-specific for targeting, which can result in a high background and low sensitivity for imaging. Nanoparticle agents based on iron are attractive for increasing sensitivity, and targeted MRI agents have been vigorously investigated, but there has been very little characterization of the binding affinity of targeted nanoparticle agents to their molecule of interest. It would be highly desirable to know if nanoparticles can bind to targeted cells with high specificity and affinity, to better understand how to optimize targeted nanoparticle agents. Our group has previously reported PET/MRI probes targeted to macrophages accumulated in vulnerable plaques. Herein, we demonstrate a multimodal probe with improved targeting to macrophages via the scavenger receptor A (SR-A) and investigate the binding affinity of the probe to SR-A by radiolabelling the probe with ^{111}In. We also show the effect of different degrees of surface sulfation on the probe uptake by macrophages. The probe is sulfated dextran coated iron oxide nanoparticles, conjugated to a chelator for ^{64}Cu, a PET tracer. The nanoparticles are about 60 nm in hydrodiameter, with sulfur content up to 11% in mass. In vitro biocompatibility studies indicate that the probe is nontoxic to cells. Detailed binding assays show the high affinity of probe to SR-A and the differences in K_d caused by different levels of sulfation. Uptake studies illustrate that higher degrees of sulfation resulted in much higher uptake efficiency. We present that the probe can be specifically and avidly taken up by macrophages via SR-A, much more efficiently than non-sulfated analogues, which makes it a promising imaging probe for vulnerable atherosclerotic plaques.

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K. MODELING THE CIRCADIAN OSCILLATOR PROTEIN NETWORK IN *DROSOPHILA MELANOGASTER*

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Organisms, from bacteria to mammals, rely on the circadian clock for timekeeping and orchestrating daily rhythms of physiology and behavior to coordinate with the environment and maximize survival. Central oscillator function relies on dynamic and temporal changes in the circadian interactome centered around a number of core transcriptional regulators. In *Drosophila melanogaster,* these core proteins are PERIOD (PER), TIMELESS (TIM), CLOCK (CLK), and CYCLE (CYC). Temporal changes in protein-protein interactions (PPIs) between PER, TIM, CLK, and CYC and other cellular complexes, such as those responsible for light entrainment, protein posttranslational modifications, proteasome degradation, localization, and chromatin remodeling, directly regulate the cycling of clock protein abundance and function, and determine the timing for which they are active as regulators of the circadian transcriptome. To better understand the interface between the oscillator and cellular protein complexes, we modeled the complex design of the *Drosophila* circadian PPI networks by establishing cellular interactomes of PER, TIM, CLK, and CYC using affinity purification (AP) and label-free quantitative mass spectrometry (MS) and generated protein networks centering around these core circadian proteins in *Drosophila* S2 cell nucleus and cytoplasm. Furthermore, we developed a data analysis pipeline to model AP-MS protein network data and annotate the resulting protein networks by incorporating published PPIs, knowledge about CRAPome, i.e. common AP-MS contaminants, as well as coexpression data in circadian clock neurons.

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AgraQuest, Inc. (now a Bayer company)

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AgraQuest is a biotechnology company that focuses on, discovering, developing, manufacturing and marketing effective, safe and environmentally friendly natural pest management products for the agricultural, institutional and home & garden markets

Fast. Nimble. Small. Competitive. These words not only describe a hummingbird, the symbol on AgraQuest's logo, but also embody the company's style and culture. And, like the hummingbird searches for nectar from a flower, AgraQuest searches for pesticidal products from naturally occurring microorganisms.

The founders of AgraQuest believed that the natural world was fertile ground for the search and discovery of new products for pest management. More than 50% of human drugs are derived from natural sources like plants and microorganisms; but only 7% of all pesticides are derived from these sources. Since 1995, AgraQuest has proven that the natural world is an untapped source of new, and natural, pesticidal products. After discovering and screening over 20,000 microorganisms, AgraQuest has developed and commercialized a line of innovative, effective, natural products for pest management.

Amgen, Inc

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Amgen is a leading human therapeutics company in the biotechnology industry. For 25 years, the company has tapped the power of scientific discovery and innovation to dramatically improve people's lives. Amgen pioneered the development of novel products based on advances in recombinant DNA and molecular biology and launched the biotechnology industry's first blockbuster medicines. Today, as a Fortune 500 company serving millions of patients, Amgen continues to be an entrepreneurial, science-driven enterprise dedicated to helping people fight serious illness.

Over the past quarter century, Amgen has pioneered the methods by which human proteins that play a role in disease processes are identified, isolated, produced in quantity and used as therapeutics. Today, Amgen has research programs in inflammation, metabolic disorders and osteoporosis, neurology, oncology and hematology. The company has R&D facilities in Thousand Oaks, CA; San Francisco, CA; Cambridge, MA; Cambridge, UK; Regensburg, Germany; and Seattle, WA. With expertise in proteins, small molecules, antibodies, peptibodies, and nucleic acids, Amgen's scientists can pursue the study of disease, choose the best target for a disease and then use the modality most likely to have an effect on that target. This approach positions Amgen as one of the only companies with capabilities across a range of modalities. Mastering the tools of therapeutic development, as they emerge, is crucial to Amgen's ongoing success. Accordingly, the company has invested at least 20 percent of product sales in research and development each year since 1994—a total of approximately $2.0 billion in 2004.

Amyris, Inc.

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Amyris Biotechnologies is focused on translating the promise of synthetic biology into solutions for real-world problems. Applying advances in molecular biology and chemistry, we have engineered microbes capable of cost-effectively producing high-value, complex molecules that are currently available only in small quantities through extraction from natural resources. We are employing these living microbial chemical factories to produce new pharmaceuticals, specialty chemicals, and biofuels.

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Bayer HealthCare is a globally active company with sites on all five continents. The Company markets products from its four divisions: Animal Health, Bayer Schering Pharma, Consumer Care, and Diabetes Care via regional and national distribution companies. More than 50,000 people are employed by Bayer HealthCare worldwide.

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BioMarin Pharmaceutical, Inc.

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Approval of Aldurazyme® (laronidase), the first specific therapy approved for the treatment of mucopolysaccharidosis I (MPS I), reflects the company's commitment and ability to execute its business strategy. Today, with two approved products on the market and a fully-integrated infrastructure in place, BioMarin is positioned to realize continued success in providing patients with innovative therapeutics for serious diseases.

Celgene Corp.

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Our life sciences and chemical analysis business provides application-focused solutions that include instruments, software, consumables and services that enable customers to identify, quantify and analyze Celgene is a global biopharmaceutical company committed to improving the lives of patients worldwide.

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There are more than 300 clinical trials at major medical centers using compounds from Celgene. Investigational compounds are being studied for patients with incurable hematological and solid tumor cancers, including multiple myeloma, myelodysplastic syndromes, chronic lymphocyte leukemia (CLL), non-Hodgkin's lymphoma (NHL), myelofibrosis, small cell lung cancer and prostate cancer.

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***DEB Graduate**

Cytokinetics, Inc.

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Cytokinetics is led by a team of seasoned industry veterans working collaboratively and with a shared objective to create the next great biopharmaceutical company. Our management team is comprised of expert Research and Development and business executives who bring considerable prior experience to bear on the challenges and opportunities associated with our ambitious plans. We have assembled a cohesive professional team and through the top-flight activities and steadfast execution of our organization, we are well-equipped to advance Cytokinetics forward and to accomplish great things.

Our Board of Directors is comprised of highly experienced industry professionals, investors and senior members of company management. The Cytokinetics Board works diligently to ensure proper governance around a well-considered strategic course for the business and closely monitors our progress in line with those plans. Each member of the Board works as a steward to ensure our shareholders and other stakeholders are well served by company decisions and their interests are foremost in their minds and in line with company activities. Good governance and proper oversight is key to ensure Cytokinetics is properly delivering on the confidence entrusted in us every day

Cytokinetics was founded by cell biology pioneers who are leaders in the field of cytoskeletal biology and pharmacology. Early on, this team of forward-thinking scientists set out a vision for translating their expertise into new insights and approaches to novel drug discovery. Informed by an expanded team of consultants who represent leading scientific and medical thinkers in the fields of chemistry and drug discovery and development, our activities have been guided by the invaluable assistance of some of the world's key opinion leaders who share our goals and also take enormous pride in our successes.

Genencor (A Danisco Division)

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A Danisco Division, Genencor is amongst the largest developers and manufacturers of industrial enzymes and the second largest biotechnology company in the world.

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As a Catalyst of the Biobased Economy[sm], Genencor is committed to contributing to a sustainable industrial system that relies on renewable resources to produce effective, environmentally friendly products. Our focus on research and development and sustainability is making this happen by driving the application of biotechnology into new areas.

Genentech, Inc.

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Genentech is a leading biotechnology company that discovers, develops, manufactures, and commercializes biotherapeutics for significant unmet medical needs. A considerable number of the currently approved biotechnology products originated from, or are based on, Genentech science. Genentech manufactures and commercializes multiple biotechnology products directly in the United States and licenses several additional products to other companies. The company has headquarters in South San Francisco, Calif., and is traded on the New York Stock Exchange under the symbol DNA.

Corporate Overview

Genentech, the founder of the biotechnology industry, is a company with a quarter-century track record of delivering on the promise of biotechnology. Today, Genentech is among the world's leading biotech companies, with multiple protein-based products on the market for serious or life-threatening medical conditions and over 30 projects in the pipeline. With its strength in all areas of the drug development process — from research and development to manufacturing and commercialization — Genentech continues to transform the possibilities of biotechnology into improved realities for patients.

Marketed Products:

Delivering innovative medicines to patients with serious or life-threatening medical conditions is what Genentech is all about. Since its beginning in 1976, the company has focused its drug discovery efforts on therapies that would fill unmet needs. Today, Genentech manufactures and commercializes multiple protein-based biotherapeutics for serious or life-threatening medical conditions — giving Genentech one of the leading product portfolios in the biotech industry.

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As a biotechnology leader, Genentech has a long-standing tradition of reinvesting a significant percentage of revenues back into research and development — a practice that has proved successful in transforming promising candidates into important new products. With the projects below under way, Genentech's development pipeline has never been more robust and promising. More than half of Genentech's pipeline is composed of potential antibody therapies.

Marrone Bio Innovations, Inc.

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Vision

We will be the world leader in natural product innovation. We will make natural, effective, safe, environmentally friendly products the mainstream future of pest management.

Values

1. We believe in sustainable business practices economically viable, socially equitable and environmentally responsible.
2. We encourage entrepreneurial attitudes and agility, and believe that ideas, out of the box thinking and creativity are the lifeblood of innovation. Our decisions and products are based on sound science, statistically vetted data, market research, direct contact with customers and good financial analysis.
3. We communicate openly and honestly, respect the views of others and minimize internal politics. Empowered employees, treated fairly, are productive employees. We involve all employees in the company's strategy, goal setting and decision-making.
4. We believe in diversity. A diverse work force and diverse opinions working together in teams result in better decision- making.
5. We have a culture of accountability, continuous learning, coaching, and mentoring for personal and professional growth.
6. We conduct all business dealings with integrity, treating all stakeholders, collaborators and trade partners with respect, fairness and honesty at all times and expect the same in return.

Monsanto Company – Calgene Campus

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Calgene was founded in 1980 and is perhaps best known for the development of the first commercialized genetically engineered food, the FLAVR SAVR tomato. Monsanto acquired Calgene in 1997 and it is now a research and development site within Monsanto AG. Current research at Calgene focuses primarily on improving quality traits for feed and food, as well as nutritional approaches for the enhancement of health. Calgene has approximately 100 employees and it is the primary site within Monsanto for the canola biotech pipeline. Current projects include increasing the value of field crops by optimizing the micronutrient and oil profile of the grain. Several genomic-based approaches are being utilized for gene discovery. Functionality of candidate genes is then assessed in model systems. Examples of the use of genomic-based approaches to identify interesting gene leads will be presented.

Monsanto provides a wide array of integrated solutions to help meet the needs of growers and commercial customers who need to control unwanted vegetation safely and effectively. Monsanto also provides products to the dairy industry to increase the efficiency of milk production, and seeds for several cropping systems.

***DEB Graduate**

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Mission

Novartis strives to be a leading biotechnology company by creating products that transform human health worldwide. We aim to prevent and treat diseases and improve people's lives.

Leadership Strategy

We will accomplish our mission through technological leadership, product-oriented research, superior manufacturing, and commercial strategies that create and expand markets.

Ethical Standards

We adhere to the highest legal and ethical principles in the conduct of all aspects of our business. We are committed to adhering to proven standards of financial and operational performance.

Values

Our purpose is to find solutions to human suffering caused by disease. Because disease does not wait for solutions, we are driven by a sense of urgency. As a result, our environment is intense, challenging, and focused on creating value for those who use our products and delivering sustained profitable growth for those who invest in our company.

Quality

Our goal at Novartis is to deliver quality products and services on time to all customers, internal and external. We provide employees with training and resources to meet or exceed customer requirements. We monitor processes and products to identify opportunities for continuous improvement.

*DEB Graduate

Novozymes, Inc

Contact:
Debbie Yaver, Ph.D., Director

1445 Drew Ave.
Davis, CA 95616
(530) 757-8100
www.novozymes.com

Enzymes are the natural solution to industrial problems. With enzymes we can reduce the consumption of water, energy and harmful chemicals and still make production more efficient. Novozymes is the world leader in enzyme solutions. Based on an advanced biotech platform we produce and sell more than 500 enzyme products in 120 countries. Since 1941 Novozymes has introduced almost every new industrial enzyme on the market, making us the world's largest manufacturer of enzymes today. With our minds set on innovation, we will continue to be so in the future.

Novozymes has introduced, with few exceptions, every new enzyme to the industry, from lipases, which remove grease stains during washing, to amylases, which are used to manufacture sweeteners. In our work we use the following technologies: microbiology, bioinformatics, gene technology, protein chemistry, computer chemistry, directed evolution, fermentation and recovery technology.

OncoMed Pharmaceuticals, Inc.

Contact:
Paul Hastings, Ph.D., President and CEO
John Lewicki, Ph.D., Vice President, Research & Development

800 Chesapeake Drive
Redwood City, CA 94063
(650) 995-8200
www.oncomed.com

OncoMed Pharmaceuticals is a biotechnology company dedicated to improving cancer treatment, by developing monoclonal antibodies that target the biologic pathways critical to tumor initiating cells, also known as "cancer stem cells". We are leveraging our understanding of these tumor initiating cells to discover and develop novel therapeutics that could provide important alternatives for the treatment of cancer.

Tethys Bioscience, Inc.

Contact:
Edward J. Moler, Ph.D., Associate Director; Biostatistics and Informatics

5858 Horton Street, Suite 550
Emeryville, CA 94608
(510) 724-3260
www.tethysbio.com/index.html

Tethys Bioscience is dedicated to the discovery, development and commercialization of novel biological markers — biomarkers — that provide a practical tool to address the growing global challenge of chronic metabolic diseases such as diabetes.

By developing new tests that use protein and other bloodborne biomarkers to identify people at high risk for devastating and preventable diseases, we can arm patients and physicians with knowledge they can use to help prevent disease progression. These biomarkers give a snapshot of an individual's current risk, which may be modifiable. Our goal is to provide clinicians with an objective and convenient means to risk-stratify their patients and help them focus appropriate intervention strategies on those most likely to benefit. Our research strategies lead to sets of biomarkers that can be used to quantify the level of an individual's risk.

We approach the market with a unique combination of strengths:

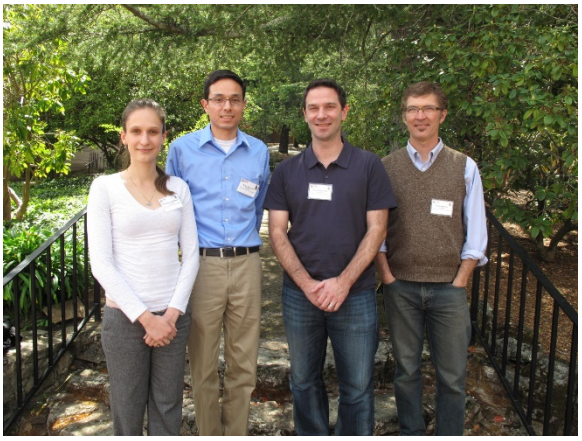
- A research, management and commercialization team with extensive experience in diagnostic innovation
- Alliances with world-class researchers and partners
- A solid financial foundation

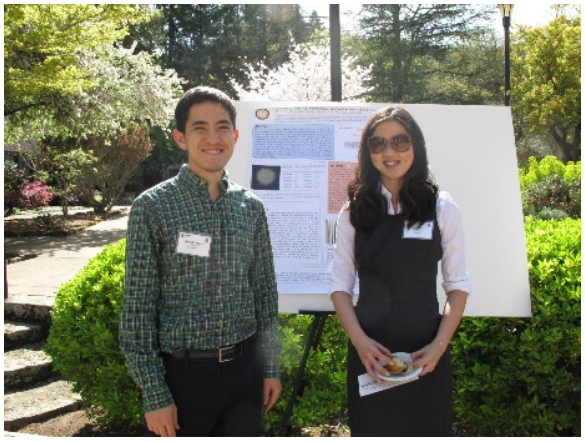
The company has become a pioneer in the discovery, development and value creation of novel biological markers for the clinical diagnostics marketplace: ***Biomarkers***. The company believes there is a large unmet need in both the discovery of potentially important biomarkers and the eventual use of them in routine clinical practice for many significant diseases.

Tethys Bioscience has built expertise, created significant intellectual property, and is executing its business plan around three key areas: ***Biomarker Discovery, Clinical Validation and ValueCreation***. Tethys is focused upon introducing products that yield significant savings to the health care system and improve the quality of life for patients.

- Biomarker discovery efforts are focused on applying advanced research tools to identify important biomarkers associated with diseases that affect many people and are very costly to health care systems throughout the world today.
- Clinical validation involves a complex process that results in defining a set of new biomarkers and the application of the resulting test to enhance current clinical practice.
- Value creation encompasses the use of sophisticated health economic analyses to define appropriate performance criteria for new biomarkers and the execution of market development strategies to drive the adoption of new biomarkers in clinical practice.

Participants





Retreat Participants

NIH Fellows 2013 - 2014	
Kristen Beck	Biochemistry, Molecular, Cellular & Developmental Biology
Casey Boosalis	Molecular, Cellular & Integrative Physiology
Jennifer Lee	Biomedical Engineering
Amelia Manlove	Chemistry
Abigail Yu	Genetics
Wade Zeno	Chemical Engineering
Biotech Fellows 2013 - 2014	
Christopher Chapman	Biomedical Engineering
Siobhan Halloran	Chemical Engineering
Allison Hoch	Biomedical Engineering
Keith Dunaway	Genetics
Graduate Students/Post-docs	
Marjannie Akintunde	DEB, Immunology
Salem Alkanaimsh	Chemical Engineering
Lisa Anderson	DEB, Chemistry
Doug Banda	DEB, Chemistry
Andrew Burch	DEB, Chemistry
Anna Case	DEB, Chemistry
Nicole Chaffee	DEB, Chemistry
Nicole Coggins	DEB, Molecular, Cellular & Integrative Physiology
Adam Contreras	DEB, Biochem, Mol. & Cellular Developmental Biology
Jasmine Corbin	DEB, Chemical Engineering & Materials Science
Pallavi Daggumati	Electrical and Computer Engineering
Ailsa Dalgliesh	DEB, Molecular, Cellular & Integrative Physiology
Tatiana Dorofeeva	Electrical and Computer Engineering
Doug Gettel	DEB, Chemical Engineering
Bryce Hashimoto	Chemical Engineering
Kalimuthu Karuppanan	Chemical Engineering
Özge Kurtuluş	DEB, Electrical and Computer Engineering
Rosanna Kwok	DEB, Entomology and Nemotology
Vu Lam	DEB, Entomology and Nemotology
Hannah Ledford	Molecular, Cellular & Integrative Physiology
Ying Li	Entomology and Nemotology
Nicholas Liu	Chemical Engineering
Jordan Mancuso	DEB, Chemical Engineering

Debika Mitra	DEB, Biomedical Engineering
Chuong Nguyen	DEB, Pharmacology & Toxicology
Jennifer Nill	Chemical Engineering
Nicole Nozzi	DEB. Chemistry
John Oliver	DEB, Chemistry
Mario Parks	DEB, Immunology
Gabriel Rodriguez	DEB, Chemistry
JohnPatrick Rogers	DEB, Chemistry
Guy Shani	DEB, Microbiology
David Silberstein	Chemical Engineering
Tang Tang	DEB, Chemistry
Gina Turco	Biochem, Mol. & Cellular Developmental Biology
Juan Manuel Artes Vivancos	Electrical and Computer Engineering
Kay Watt	DEB, Genetics
Priscilla Williams	DEB, Biomedical Engineering
Le Yee	DEB, Biomedical Engineering
Garrick Yuen	DEB, Biochem, Mol. & Cellular Developmental Biology
Nancy Zeng	DEB, Chemical Engineering
UC Davis Faculty	
Kyriacos Athanasiou	DEB, Biomedical Engineering
Joanna Chiu	DEB, Entomology and Nematology
Sheila David	DEB, Chemistry
Gina Durante	Office of Research
Annaliese Franz	DEB, Chemistry
Ian Korf	DEB, Molecular, Cellular Biology & Genome Center
Janine LaSalle	DEB, Medical Microbiology
Kent Leach	DEB, Biomedical Engineering
Marjorie Longo	DEB, Chemical Engineering & Materials Science
Karen McDonald	DEB, Chemical Engineering & Materials Science
Janice Morand	UCD Internship and Career Center
Martina Newell-McGloughlin	Co-Director T32 Grant, International Biotechnology
William Ristenpart	DEB, Chemical Engineering & Materials Science
Alan Rose	DEB, Molecular and Cellular Biology
David Segal	DEB, Genome Center
Erkin Şeker	DEB, Electrical & Computer Engineering
Cheemeng Tan	DEB, Biomedical Engineering
Yohei Tashiro	Chemistry

Industry	
Amanda Fischer	Novozymes
Kevin Holden	REG Life Sciences
Yao Luo	Monsanto, Calgene Campus
Christopher Murriel	OncoMed Pharmaceuticals, Inc.
Maggie Ostrowski	Agilent Laboratories
Elena Popova	REG Life Sciences
Erik Zimmerman	Sutro Biopharma, Inc.
Guests	
Dayna Fabry	James C. Enochs High School
Bernadette Galvan	James C. Enochs High School
Jennifer McKinney	James C. Enochs High School
Yin Wu	Linear Technologies
Biotechnology Program	
Jacqueline Balderama	Biotechnology Program, Event Manager
Marianne Hunter	Biotechnology Program, Assistant. Director Administration
Denneal Jamison-McClung	Biotechnology Program, Associate Director
Judy Kjelstrom	Biotechnology Program, Director
Jacqueline Phillips	Biotechnology Program, Program Associate

www.biotech.ucdavis.edu

The Mission of the Biotechnology Program:

The Biotechnology Program was created in 1986, to assist in the organization of university activities related to biotechnology and to coordinate such activities with other efforts on the Davis campus. It is a central facility of the Office of Research. The Program's missions include:

- Promoting and coordinating the development of biotechnology and biotechnology - related research on the campus;
- Assisting with development of new and improved facilities for biotechnology research;
- Promoting research interactions between faculty and private industry and public agencies;
- Recommending and implementing curriculum development and training in biotechnology;
- Serving as an information and education resource on biotechnology for the campus and the public.

The Program serves as the **Administrative Home** for educational programs:

- Designated Emphasis in Biotechnology (**DEB**) graduate program
  www.deb.ucdavis.edu
- Advanced Degree Program (**ADP**) for corporate employees
  A PhD program for the working professional
- NIH Training Program in Biomolecular Technology for PhD students
- BioTech SYSTEM – K-14 educational consortium

Biotechnology Program Office:

Dr. Judith Kjelstrom - Director
Dr. Denneal Jamison-McClung – Associate Director
Marianne Hunter – Assistant Director, Administration
Jacki Balderama – Event Manager
Jacqueline Phillips – Program Associate
Office Location: 0301 Life Sciences
Telephone: (530) 752-3260 (main line) FAX: (530) 752-4125
Email: biotechprogram@ucdavis.edu

- The DEB provides a formal accreditation (on diploma & transcript) to reflect interdisciplinary biotechnology training.
- Not all of the DEB students will be funded by the NIH Biotechnology Training Program.

The fellows are a select subset based on a highly competitive nomination & selection process:

1. Nomination by a Faculty Trainer and completion of an application by the student.
2. Ranking by the Executive Committee of the NIH Biotechnology Training Program is based on: academic merit; quality of the research; interdisciplinary nature of research; and willingness to complete an internship.

Information about the NIH Biotechnology Training Grant is publicized on the DEB (http://www.deb.ucdavis.edu/NIHTG/nihinfo.cfm) website.

NIH Training Grant Faculty

Director: Bruce Hammock	
Co-Directors: Karen McDonald and Martina Newell-McGloughlin	
Kyriacos Athanasiou	Biomedical Engineering
Shota Atsumi	Chemistry
Enoch Baldwin	Molecular & Cellular Biology
Peter Beal	Chemistry
David Block	Chemical Engineering
Alan Buckpitt	VM: Molecular Biosciences
Joanna Chiu	Entomology
Brett Chromy	Pathology
Abhaya Dandekar	Plant Sciences-Pomology
Sheila David	Chemistry
Elva Diaz	Pharmacology
Marc Facciotti	Biomedical Engineering
Roland Faller	Chemical Engineering & Materials Science
Annaliese Franz	Chemistry
Bruce German	Food Science & Technology
Paul Henderson	Internal Medicine, Hematology & Oncology
Ian Kennedy	Mechanical & Aeronautical Engineering
Patrice Koehl	Computer Science; Genome Center & Bioinformatics Program
Ian Korf	Molecular & Cellular Biology, Genome Center & Bioinformatics Program
Tonya L. Kuhl	Chemical Engineering
Kit S. Lam	MED: Internal Medicine; Hematology & Oncology
Donald Land	Chemistry
Kent Leach	Biomedical Engineering
Julie Leary	Chemistry
Carlito Lebrilla	Chemistry
Harris Lewin	Evolution & Ecology
Marjorie Longo	Chemical Engineering
Juan Medrano	Animal Science
Richard Michelmore	Plant Sciences – Vegetable Crops
David Mills	Viticulture & Enology
Lorena Navarro	Microbiology
John Newman	Nutrition
Jan Nolta	Internal Medicine, Hematology & Oncology

Tingrui Pan	Biomedical Engineering
Rebecca Parales	Microbiology
Atul Parikh	Applied Science
Alex Revzin	Biomedical Engineering
William Ristenpart	Chemical Engineering & Materials Science
David Rocke	Applied Science
David Segal	Pharmacology
Jared Shaw	Chemistry
Scott Simon	Biomedical Engineering
Daniel Starr	Molecular & Cellular Biology
Ilias Tagkopoulos	Computer Science
Jean VanderGheynst	Biological & Agricultural Engineering
John Voss	Biological Chemistry
Bart Weimer	Population Health & Reproduction
Heike Wulff	Pharmacology and Toxicology

NIH Training Program in Biomolecular Technology

The DEB is a **formal training program** for the NIH Training Grant.

The DEB provides **training and a structure for interdisciplinary interactions**, in addition to established graduate programs.

The DEB provides a **formal accreditation** (on diploma & transcript) to reflect interdisciplinary biotechnology training.

Not all of the DEB students will be part of the NIH Biotechnology Training Program. The fellows are a **select subset** based on a highly competitive nomination & selection process:

- Nomination by a Faculty Trainer and completion of an application by the student.

- Ranking by the Executive Committee of the Program based on academic merit, quality of the research, interdisciplinary nature of research, and a willingness to complete an internship.

Designated Emphasis in Biotechnology Program (DEB)

Goals and Mission of the DEB

The Designated Emphasis in Biotechnology (DEB) is an inter-graduate group program that allows Ph.D. students to receive and be credited for training in the area of biotechnology. The DEB provides a nurturing interactive environment to promote integration of multiple disciplinary approaches to the conduct of research and to promote learning in biotechnology. The mission is to prepare well-educated students to approach problems with creativity and flexibility. The program will provide tools for the students to be leaders, visionaries, entrepreneurs, researchers and teachers in the broad area of biomolecular technology.

DEB Mission:

- To provide well-coordinated, cross-disciplinary training of graduate students in critical areas of biomolecular technology research.
- To promote interdisciplinary research environments that integrate basic biological science, engineering and computational disciplines.
- To allow cross-disciplinary training and trainee experience in a biotechnology company or cross-college laboratory.

Students come from a wide array of disciplines: Participating graduate programs currently include **29 programs**: Agricultural & Environmental Chemistry; Animal Biology; Applied Science Engineering; Biochemistry, Molecular, Cellular & Developmental Biology; Biological Systems Engineering; Biomedical Engineering; Biophysics; Chemistry; Chemical Engineering; Civil & Environmental Engineering; Comparative Pathology; Computer Science, Electrical & Computer Engineering; Entomology; Food Science Technology; Genetics; Immunology; Materials Science & Engineering; Mechanical & Aeronautical Engineering; Microbiology; Molecular, Cellular and Integrative Physiology; Neurosciences; Nutritional Biology; Pharmacology and Toxicology; Plant Biology; Plant Pathology; Soils & Biogeochemistry; and Statistics. The DEB program supplements a student's Ph.D. curriculum and those completing the program will obtain an official designation on their diploma & transcript indicating a qualification in biotechnology. Example: **Doctoral Degree in Microbiology with a Designated Emphasis in Biotechnology**

Brief History:

The DEB was formally established in 1997 as an outgrowth of the first NIH Training Grant in Biotechnology (funded in the early 1990s). The DEB became the formal training program for the current NIH Training Grant in Biomolecular Technology (1-T32-GM08799: July 1, 2002-June 30, 2017). The DEB provides a very effective multidisciplinary biotechnology concentration, which includes exposure to bioethics, business and legal aspects of biotechnology as well as a 3-6 month internship in a biotechnology company or research laboratory in another college or national laboratory. As of 2012, the DEB has 29 affiliated graduate groups or departmentally based graduate programs. The number of students in the Designated Emphasis in Biotechnology has increased dramatically over the last several years and now boasts over 230 members, with many being first year students. We have graduated 127 students with a DEB notation on their diplomas as of 2011.

Program Administration:

The administrative home for the DEB and the NIH Training Grant in Biomolecular Technology is the UC Davis Biotechnology Program. Dr. Judith Kjelstrom serves as the DEB and NIH Training Grant program coordinator for the DEB, in addition to directing the Biotechnology Program. She works closely with the DEB chair, Katayoon Dehesh (Department of Plant Biology) and the rest of the executive committee: Karen McDonald (Chemical Engineering and Materials Science), Abhaya Dandekar (Plant Sciences), Robert Rice (Environmental Toxicology) and David Rocke (Applied Science/Biostatistics) to oversee the day-to-day activities of the graduate program.

Course Work:

The DEB has a required core curriculum for students regardless of whether their graduate major is in biological science, engineering, statistics, etc. A key feature of the DEB is its requirement for a research internship at a cooperating biotechnology company or a cross-college site. When the students complete their Ph.D. requirements as well as the DEB requirements, their diploma notes not only their graduate major, but also that they have completed the DEB (e.g., "Ph.D. in Chemical Engineering with a Designated Emphasis in Biotechnology").

We have created a website for the Designated Emphasis in Biotechnology (http://www.deb.ucdavis.edu/) to advertise the program as well as the NIH Training Grant. The announcement of the grant is on the site. Program information, forms, pictures and other pertinent information is listed on the site. We have linked the website to graduate home pages of most of the 23 DEB program affiliates in the Division of Biological Sciences, College of Engineering, College of Letters and Science and the College of Agriculture and Environmental Sciences.

1. Course Requirements:

a. **MCB 263** (2 units): Biotechnology Fundamentals and Application (winter quarter, alternate odd numbered years)

An interdisciplinary course which includes: introduction to modern recombinant DNA technology; rate processes of biological systems, optimization of bioreactor performance; practical issues in biotechnology; and some specific case studies of the development of biotechnology products and

processes. Grading: Letter grade; two one-hour exams, one research paper (team project) on a selected topic relevant to biotechnology, and regular reading assignments.

b. **MCB 282** (variable): Biotechnology Internship (may be done any quarter)

The internship will expose qualified graduate students to research activities in a biotechnology company, to company culture, to legal and business aspects of industry, and to another career option. A minimum of 3 months internship at a local biotechnology company or cross college or national laboratory (i.e. Lawrence Berkeley Laboratory, Lawrence Livermore National Laboratory, etc.). S/U grading; research performance (student report) will be evaluated by the professor in charge and in consultation with the company trainer.

c. **MCB/ECH 294** (1 unit): Current Progress in Biotechnology (fall, winter and spring quarters). Three quarters of seminar are required for the DEB Program.

This course is an interdisciplinary seminar, featuring speakers from industry as well as academia. The students will have an opportunity to discuss the seminar topic with the lecturers, to learn about biotechnology research activities at companies and to network with speaker. Grading: S/U grading, attendance is required, and a summary report on the seminars is required at the end of the quarter.

d. **MIC 292** (1 unit): From Discovery to Product - An Introduction to Biotechnology at the Industrial Level. (winter quarter; even numbered years). MIC 292 is an approved **seminar elective** for the DEB program (may substitute for one quarter of MCB/ECH 294).

This course is designed to provide a unique opportunity to gain insight into basic and applied biotechnology at the industrial level. Lectures are presented by senior scientists from Novozymes Biotech, Inc. in Davis California (http://www.novozymesbiotech.com/). A tour of the industrial facilities will be arranged. Grading: S/U grading, attendance is required, and a summary report on the seminars is required at the end of the quarter.

e. **GGG 296** (2 units): Scientific Professionalism and Integrity (fall quarter) or approved bioethics course.

The course will allow the student to become familiar with their roles and responsibilities as a professional scientist and/or instructor. While some standards of acceptable scientific behavior will be presented in class, most of the time will be spent discussing various "gray zone" scenarios, in which proper conduct is unclear. Grading: S/U grading; active class participation in class discussions is required. **This course is currently highly recommended, but will be required, pending approval.**

2. **Qualifying Exam Requirements**:

The Ph.D. qualifying exam should demonstrate appropriate knowledge with the area of biotechnology. At least one faculty member of the designated emphasis shall participate in the qualifying examination.

3. **Thesis Requirements**:

The dissertation committee shall include at least one faculty member of the designated emphasis. The major professor must be a participating DEB member.

4. **Additional Requirements**:

Regular attendance at the annual Biotechnology Training retreat and at the informal Pizza Chalk Talk Seminars (talks by students and faculty on current research) is expected.

DEB Program Students as of March 2014

Nicholas Aguirre	Molecular, Cellular, & Integrative Physiology
Hannah Aizad	Molecular, Cellular & Integrative Physiology
Brittany Anderson	Chemistry
Johnathon Anderson	Genetics
Leif Anderson	Biomedical Engineering
Lisa Anderson	Chemistry
Liz Anthony	Chemical Engineering
Brian Avanzino	Biochemistry, Molecular, Cellular & Developmental Biology
Mina Azimi	Biochemistry, Molecular, Cellular & Developmental Biology
Jesse Bakke	Nutritional Biology
Douglas Banda	Chemistry
Roberto Barrozo	Immunology
Kristen Beck	Biochemistry, Molecular, Cellular & Developmental Biology
Christopher Beitel	Genetics
Geoffrey Benn	Plant Biology
Marta Bjornson	Horticulture & Agronomy
Matthew Blain-Hartung	Biochemistry, Molecular, Cellular & Developmental Biology
Bárbara Blanco-Ulate	Plant Biology
Stephen Bolus	Plant Pathology
Casey Boosalis	Molecular, Cellular & Integrative Phsysiology
Brandon Brown	Pharmacology & Toxicology
Andrew Burch	Biochemistry, Molecular, Cellular & Developmental Biology
Candace Burke	Immunology
Timothy Butterfield	Plant Biology
Daniel Caddell	Plant Biology
Anna Case	Chemistry
Elenor Castillo	Plant Biology
Patricia Castillo	Immunology
Nicole Chaffee	Bio Organic Chemistry
Pauline JoJo Chang	Electrical & Computer Engineering
Christopher Chapman	Biomedical Engineering
Arnold Chen	Biomedical Engineering
Sum Ying (Annie) Chiu	Biochemistry, Molecular, Cellular & Developmental Biology
Dong hee Chung	Chemistry
Elizabeth Clark	Biochemistry, Molecular, Cellular & Developmental Biology
Nicole Coggins	Molecular, Cellular & Integrative Physiology

Adam Contreras	Biochemistry, Molecular, Cellular & Developmental Biology
Caitlin Cooper	Animal Biology
Jasmine Corbin	Chemical Engineering
Alisa Dalgliesh	Molecular, Cellular and Integrative Physiology
Destiny Davis	Plant Biology
Nicole De Jesus	Biomedical Engineering
Derek Decker	Biophysics
Elieke Demmer	Nutritional Biology
Shuchi Desai	Microbiology
Nithin Dhananjayan	Biophysics
Keith Dunaway	Genetics
James Elmore	Plant Pathology
Marjannie Eloi	Immunology
Kenneth Eum	Molecular, Cellular & Integrative Physiology
Qingwen Fan	Food Science and Technology
Samantha (Chun) Feng	Pharmacology and Toxicology
Kateryna Feoktistova	Biochemistry, Molecular, Cellular & Developmental Biology
Jonathan Flynn	Biochemistry, Molecular, Cellular & Developmental Biology
Zachary Fogassy	Microbiology
Erin Fong	Electrical & Computer Engineering
Michael Fong	Biomedical engineering
Greg Foster	Biomedical Engineering
Amanda Fox	Immunology
Elizabeth Fox	Immunology
Jenna Gallegos	Plant Biology
Iniyan Ganesan	Plant Biology
Anupama Ganesh	Immunology
Doug Gettel	Chemical Engineering
Donald Gibson	Genetics
Donald Gibson	Genetics
Hyrum Gillespie	Genetics
Aiza Cathe Go	Biochemistry, Molecular, Cellular & Developmental Biology
Ben Golomb	Food Science & Technology
Hossein Gouran	Plant Biology
Alex Gulevich	Biochemistry, Molecular, Cellular & Developmental Biology
Pasha Hadidi	Biomedical Engineering
Siobhan Halloran	Chemical Engineering
Mitchell Harkenrider	Plant Biology
Amanda Hildebrand	Biological Systems Engineering
Silvia Hilt	Biochemistry, Molecular, Cellular & Developmental Biology

Pui Yan Ho	Biochemistry, Molecular, Cellular & Developmental Biology
Steve Ho	Biomedical Engineering
Allison Hoch	Biomedical Engineering
Gena Hoffman	Plant Biology
Jonathan Hughes	Microbiology
Hyun Tae Hwang	Pharmacology & Toxicology
Vicki Hwang	Genetics
Roger Jesinghaus	Chemistry
Rogelio Jimenez Espinoza	Chemical Engineering
Liequn "Leah" Jin	Biostatistics
Stefanos Kalomoiris	Biochemistry, Molecular, Cellular & Developmental Biology
Sercan Karav	Food Science & Technology
Rachel Kerwin	Plant Biology
Brenna Kiniry	Microbiology
Angelica Kowalchuck	Genetics
James Kurniawan	Chemical Engineering
Ozge Kurtulus	Chemical Engineering
Timothy Kwa	Biomedical Engineering
Rosanna Kwok	Entomology
Diana Lac	Pharmacology & Toxicology
Vu Lam	Entomology
Jennifer Lee	Biomedical Engineering
Linda Lee	Molecular, Cellular, & Integrative Physiology
Mark Lemos	Plant Biology
Ingrid Leth	Chemical Engineering
Daniel Lewis	Genetics
Zachery Lewis	Microbiology
Furong Liu	Plant Pathology
Alan Lombard	Biochemistry, Molecular, Cellular & Developmental Biology
Simon Lopez	Genetics
Rita Luu	Microbiology
Nicholas Mahoney	Biochemistry, Molecular, Cellular & Developmental Biology
Liro Malgorzata	Biochemistry, Molecular, Cellular & Developmental Biology
Jordan Mancuso	Materials Science
Amelia Manlove	Chemistry
Kevin Martin	Chemistry
Lauren Matelski	Immunology
Philip Matern	Molecular, Cellular & Integrative Physiology
Jordan McEwen	Chemistry
Lucas McKinnon	Plant Biology

Amory Meltzer	Genetics
David Merriam	Microbiology
Emily Mills	Immunology
Debika Mitra	Biomedical Engineering
Angela Monterrubio	Biochemistry, Molecular, Cellular & Developmental Biology
Jared Moore	Chemistry
Jessica Moore	Chemistry
Lucas Moore	Chemistry
Alexi Morris	Chemistry
Akshata Mudinoor	Chemical Engineering
Sucheta Mukherjee	Microbiology
Andrew Murley	Biochemistry, Molecular, Cellular & Developmental Biology
Meghan Murphy	Biomedical Engineering
Bernadette Nera	Biochemistry, Molecular, Cellular & Developmental Biology
Alice Ngo	Chemistry
Tin Ngo	Biochemistry, Molecular, Cellular & Developmental Biology
Chuong Nguyen	Pharmacology & Toxicology
Nicole Nozzi	Chemistry
John Oliver	Chemistry
Nadia Ono	Biochemistry, Molecular, Cellular & Developmental Biology
Gulustan Ozturk	Food Science & Technology
Mario Parks	Immunology
Dipali Patel	Biomedical Engineering
Mira Patel	Chemical Engineering
Maria Peralta	Chemistry
Trisha Pfluger	Biochemistry, Molecular, Cellular & Developmental Biology
Jonathan Pham	Microbiology
Adam Poe	Biochemistry and Molecular Biology
Marc Pollack	Microbiology
Sonia Reveco	Integrative Genetics and Genomics
Juan Reyes	Genetics
Gabriel Rodriguez	Chemistry
JohnPatrick Rogers	Chemistry
Shailise Ross	Chemistry
Amy Schroeder	Biochemistry, Molecular, Cellular & Developmental Biology
Guy Shani	Microbiology
Esther Shin	Pharmacology & Toxicology
Megan Showalter	Biochemistry, Molecular, Cellular & Developmental Biology
Natasha Shroff	Integrative Genetics and Genomics
Christian Siltanen	Biomedical Engineering
Priyashiela Singh	Land, Air, and Water Resources

Chelsea Snyder	Microbiology
Jennie Sotelo	Food science & technology
Alison Stevens	Nutrition
Jessica Stolfi	Dermatology
Scott Strobel	Biological Systems Engineering
Anandkumar (Anand KS) Surendrarao (Rao)	Plant Biology
Ruensern Tan	Biochemistry, Molecular, Cellular & Developmental Biology
Tang Tang	Chemistry
Brandon Tautges	Chemistry
Justin Thomas	Chemistry
Nicholas Thomas	Genetics
George (Kenneth) Todd	Molecular, Cellular & Integrative Physiology
Elyse Towns	Chemistry
Denise Trans	Internal Medicine
Adama Traore	Electrical Engineering
Kim Truong	Pharmacology and Toxicology
Tiffany Tu	Chemical Engineering
Anna Marie Tuazon	Biochemistry, Molecular, Cellular, and Developmental Biology
John Uhrig	Microbiology
Rachel Anne Valenzuela	Chemistry
Erica Vonasek	Biological Systems Engineering
Gordon Walker	Biochemistry, Molecular, Cellular & Developmental Biology
Katherine Walker (nee Byrne)	Biomedical Engineering
Eric Walters	Biological and Agricultural Engineering
Kay Watt	Genetics
Donnelly West	Genetics
Toni West	Biochemistry, Molecular, Cellular & Developmental Biology
Samuel Westreich	Integrative Genetics and Genomics
Damion Whitfield	Microbiology
Priscilla Williams	Biomedical Engineering
John Williamson	Chemistry
Kelsey Wood	Genetics
Natasha Worden	Plant Biology
Le Yee	Biomedical Engineering
Xiaochen (Elllie) Yin	Food Science & Technology
Fei Yian Yoong	Plant Biology
Abigail Yu	Genetics

Benjamin Yuen	Biochemistry, Molecular, Cellular & Developmental Biology
Garrick Yuen	Biochemistry, Molecular, Cellular & Developmental Biology
Nancy Zeng	Chemical Engineering
Wade Zeno	Chemical Engineering
Yuxuan (Eric) Zheng	Chemistry
Steve Zicari	Biological Systems Engineering

DEB Faculty Trainers as of March 2014

Venkatesh Akella	Electrical & Computer Engineering
Rajeevan Amirtharajah	Electrical & Computer Engineering
Paul Ashwood	UCD MIND Institute
Kyriacos Athanasiou	Biomedical Engineering
Shota Atsumi	Chemistry
Matthew Augustine	Chemistry
Alan Balch	Chemistry
Enoch Baldwin	Molecular and Cellular Biology
Abdul Barakat	Mechanical & Aeronautical Engineering
Daniela Barile	Food Science
Diane Barrett	Food Science & Technology
Peter Barry	Center for Comparative Medicine
Stephen Barthold	Pathology, Microbiology & Immunology
Nicole Baumgarth	Department of Pathology, Microbiology and Immunology; CCM, VetMed
Peter Beal	Chemistry
Laurel Beckett	Biostatistics Department of Public Health Sciences
Craig Benham	Biomedical Engineering / Genome Center
Alan Bennett	Vegetable Crops (Plant Science)
Don Bers	Pharmacology
Charles L. Bevins	Microbiology & Immunology
Linda Bisson	Viticulture & Enology
Caroline Bledsoe	Soils and Biogeochemistry
David Block	Viticulture & Enology/Chemcial Engineering & Materials Science
Eduardo Blumwald	Plant Sciences
Sue Bodine	Neurobiology, Physiology and Behavior (NPB)
Laura Borodinsky	Physiology & Membrane Biology UCDMC
Richard Bostock	Plant Pathology
Kent Bradford	Vegetable Crops
Christine Bruhn	Food Science & Technology
Alan Buckpitt	VM: Molecular Biosciences
Sean Burgess	Molecular & Cellular Biology
Judy Callis	Molecular & Cellular Biology
Christopher Calvert	Animal Science

Luis Carvajal-Carmona	Genome Center & Department of Biochemistry and Molecular Medicine
Simon Chan	Plant Biology
Barbara Chapman	Neuroscience
Xinbin Chen	Comparative Oncology
Xi Chen	Chemistry
Hongwu Chen	Biochemistry & Molecular Medicine
Holland Cheng	Molecular & Cellular Biology
Simon Cherry	Biomedical Engineering
Nipavan Chiamvimonvat	Internal Medicine; Division of Cardiovascular Medicine
Joanna Chiu	Entomology
Gitta Coaker	Plant Pathology
Luca Comai	Plant Biology
Douglas Cook	Plant Pathology
Stephen Cramer	Applied Science
Beate Crossley	California Animal Health and Food Safety Laboratory System
Satya Dandekar	MED: Medical Microbiology & Immunology
Abhaya Dandekar	Pomology
Sheila David	Chemistry
Cristina Davis	Mechanical and Aeronautical Engineering
Scott Dawson	Microbiology
Katayoon (Katy) Dehesh	Plant Biology
Wenbin Deng	Cell Biology and Human Anatomy:MED
Elva Diaz	Pharmacology
Zhi Ding	Electrical & Computer Engineering
Georgia Drakakaki	Plant Sciences
Don Durzan	Environmental Horticulture
Jason Eiserich	Nephrology: INT MED
Nael El-Farra	Chemical Engineering & Material Science
Marc Facciotti	Biomedical Engineering
Robert Fairclough	Neurology: MED
Bryce Falk	Plant Pathology
Roland Faller	Chemical Engineering & Material Sciences
Zhiliang (Julia) Fan	Biological & Agricultural Engineering
Katherine Ferrara	Biomedical Engineering
Oliver Fiehn	Genome Center
Vladimir Filkov	Computer Science
Andrew Fisher	Chemistry
Paul Fitzgerald	MED: Cell Biology & Human Anatomy
Annaliese Franz	Chemistry

Christopher Fraser	Molecular and Cellular Biology
David Furlow	Section of Neurobiology, Physiology, and Behavior
Charles Gasser	Molecular & Cellular Biology
Angela Gelli	Pharmacology, SOM
J. Bruce German	Food Science & Technology
Jacquelyn Gervay-Hague	Chemistry
Soheil Ghiasi	Electrical & Computer Engineering
David Gilchrist	Plant Pathology
Tom Gradziel	Pomology
Jeffrey Gregg	MED: Pathology
Leigh Griffiths	Medicine and Epidemiology
Andrew Groover	Plant Biology
Paul Gumerlock	MED: Hematology/Oncology
Ting Guo	Chemistry
Fawaz Haj	Nutrition
Bruce Hammock	Entomology & Cancer Center
Stacy Harmer	Plant Biology
Richart W. Harper	Division of Pulmonary/Critical Care Medicine
Volkmar Heinrich	Biomedical Engineering
Wolf-Dietrich Heyer	Microbiology
David Horsley	Mechanical & Aeronautical Engineering
Krassi Hristova	Soils and Biogeochemistry
You-Lo Hsieh	Textiles & Clothing
Neil Hunter	Microbiology
Kentaro Inoue	Plant Sciences
M. Saif Islam	Electrical & Computer Engineering
Roslyn-Rivkah Isseroff	MED: Dermatology
Tina Jeoh	Biological & Agricultural Engineering
Thomas Jue	MED: Biochemistry
Carl Keen	Nutrition
Darshan Kelley	Western Human Nutrition Research Center, ARS, USDA Dept. of Nutrition
Ian Kennedy	Mechanical & Aeronautical Engineering
Richard Kiehl	Electrical & Computer Engineering
Dan Kliebenstein	Vegetable Crops & Weed Science
Paul Knoepfler	Cell Biology & Human Anatomy
Anne Knowlton	Cardiovascular Division, Department of Medicine & Department of Medical Pharmacology and Toxicology
Patrice Koehl	Computer Science
Ian Korf	Section of Molecular & Cellular Biology
Tonya Kuhl	Chemical Engineering & Material Science

Hsing-Jien Kung	MED: Biochemistry / UC Davis Cancer Center
John Labavitch	Plant Sciences
J. Clark Lagarias	Molecular & Cellular Biology
Kit Lam	MED: Hematology & Oncology
Donald Land	Chemistry
Delmar Larsen	Chemistry
Janine LaSalle	MED: Microbiology & Immunology
Jerold Last	Pulmonary / Critical Care Medicine
Kent Leach	Biomedical Engineering
Julie Leary	Biochemistry & Mass Spectrometry, Dept. of Chemistry
Carlito Lebrilla	Chemistry
Pamela Lein	Molecular Biosciences
Noelle L'Etoile	Center for Neuroscience & Dept. of Psychiatry & Behavioral Sciences
Harris Lewin	Evolution & Ecology
Su-Ju Lin	Center for Genetics & Development & Section of Microbiology - UCD Cancer Center
Bo Liu	Plant Biology
Gang-yu Liu	Chemistry
Marjorie Longo	Chemical Engineering & Material Sciences
Angelique Louie	Biomedical Engineering
Paul Luciw	MED: Pathology
Neville Luhmann, Jr.	Electrical & Computer Engineering
Maria Marco	Food Science & Technology
Laura Marcu	Biomedical Engineering
Verónica Martínez Cerdeño	Department of Pathology and Laboratory Medicine
Karen McDonald	Chemical Engineering & Material Sciences
Frank McNally	Molecular & Cellular Biology
Claude Meares	Chemistry
Juan Medrano	Animal Science
Richard Michelmore	Plant Sciences
Lisa Miller	Department of Anatomy, Physiology and Cell Biology, CNPRC, School of Veterinary Medicine
David Mills	Viticulture & Enology
Maria Mudryj	Medical Microbiology & Immunology
William J. Murphy	Department of Dermatology
James Murray	Animal Science / Genetic Engineering Large Animals
Krishnan Nambiar	Chemistry
Lorena Navarro	Microbiology
Florence Negre-Zakharov	Department of Plant Sciences
John Newman	Nutrition & USDA-ARS-WHNRC

Stephen Noctor	Neuroscience
Jan Nolta	UCDHS: HEMATOLOGY & ONCOLOGY,DEPARTMENT OF : MED
Thomas North	Center for Comparative Medicine
Jodi Nunnari	Molecular and Cellular Biology
Martha O'Donnell	Physiology & membrane Biology; School of Medicine
David Ogrydziak	Food Science & Technology
Tingrui Pan	Biomedical Engineering
Rebecca Parales	Microbiology
Atul Parikh	Biomedical Engineering
Anthony Passerini	Dept. of Biomedical Engineering
Timothy Patten	Chemistry
Niels Pedersen	Department of Medicine and Epidemiology
Ronald Phillips	Chemical Engineering & Material Science
Kent Pinkerton	Pediatrics, School of Medicine
David Pleasure	Neurology and Pediatrics
Jerry Powell	Hemat & Oncol: Med
Ann Powell	Plant Sciences
Robert Powell	Chemical Engineering & Material Science
Martin Privalsky	Microbiology
Jinyi Qi	Biomedical Engineering
Subhadip Raychaudhuri	Biomedical Engineering
Michael Reid	Environmental Horticulture
David Reid	Food Science & Technology
Alexander Revzin	Biomedical Engineering
Robert Rice	Environmental Toxicology
Subhash Risbud	Chemical Engineering & Material Science
William Ristenpart	Chemical Engineering & Materials Science and Dept. of Food Science
David Rocke	Inst. For Data Analysis & Visualization
Ray Rodriguez	Molecular & Cellular Biology
Pamela Ronald	Plant Pathology
Alan Rose	Molecular and Cellular Biology
Pablo Ross	Animal Science
John Rutledge	MED: Endocrinology
Jon Sack	Physiology & Membrane Biology
Earl Sawai	Pathology & Laboratory Medicine
Kate Scow	Land, Air & Water Resources
David Segal	Pharmacology
Justin Seigel	MED: Biochemistry & Molecular Medicine / Chemistry
Erkin Seker	Electrical & Computer Engineering

Barbara Shacklett	Medical Microbiology & Immunology: School of Medicine
Jared Shaw	Chemistry
Kazuhiro Shiozaki	Microbiology
Justin Siegel	Chemistry
Eduardo Silva	Biomedical Engineering
Scott Simon	Biomedical Engineering
Neelima Sinha	Plant Biology
David Slaughter	Biological & Agricultural Engineering
Jay Solnick	MED: Infectious & Immunological Diseases
Daniel Starr	Center for Genetics and Development
Francene Steinberg	Dept. of Nutrition
Ioannis Stergiopoulos	Plant Pathology
Pieter Stroeve	Chemical Engineering & Material Science
Gang Sun	Textiles & Clothing
Ilias Tagkopoulos	Computer Science
Dean Tantillo	Chemistry
Alice Tarantal	Pediatrics, School of Medicine, CA National Primate Center
Flora Tassone	Biochemistry and Molecular Medicine
Steven Theg	Plant Biology
Li Tian	Plant Sciences
Michael Toney	Chemistry
Jose Torres	MED: Medical Microbiology & Immunology
Renee Tsolis	Med Microbiology & Immunology: MED
Richard Tucker	Cell Biology & Human Anatomy
Judy Van de Water	Division of Rheumatology/Allergy and Clinical Immunology
Alison Van Eenennaam	Animal Science
Marta Van Loan	Nutrition
Jean VanderGheynst	Biological & Agricultural Engineering
John Voss	Biochemistry and Molecular Medicine
Bart Weimer	Population Health & Reproduction
Robert Weiss	Internal Medicine: Division of Nephrology, School of Medicine
Valerie Williamson	Nematology
Barry Wilson	Animal Science & Environmental Toxicology
David Wilson	Molecular & Cellular Biology
Matthew Wood	Environmental Toxicology
Reen Wu	MED: Pulmonary / Critical Care Medicine
Stefan Wuertz	Civil & Environmental Engineering
Heike Wulff	Pharmacology

Lifeng Xu	Microbiology
Soichiro Yamada	Biomedical Engineering
Tilahun Yilma	VM: Pathology, Microbiology & Immunology
John Yoder	Plant Sciences
Yohei Yokobayashi	Biomedical Engineering
Glenn Young	Food Science & Technology
Ruihong Zhang	Biological & Agricultural Engineering

The Value of Internships

Over the last 20 years (even before the formal DEB program was established), we have placed pre-doctoral students in a variety of biotechnology companies for their industrial research experience. They include:

Advanced Micro Devices (AMD)
Agilent Technologies
AgraQuest (a Bayer company)
Alza
Amgen
Amyris
Antibodies, Inc.
Aqua Bounty
Bayer
Berlex Biosciences
BioMarin Pharmaceuticals, Inc.
Carollo
Celera AgGen
Cytokinetics
DuPont
Exelixis
Expression Systems
Genencor
Genentech
Hoffmann Eitle
ICOS
Igenica
Institut Charles Sadron
Marone Bio Innovations
Maxygen
Monsanto, Calgene Campus;
Novartis (formerly Chiron)
Novozymes Biotech
Nunhems
OncoMed
Scios
Somagenics
Syntex

Recovery Sciences
Roche Biosciences
Sutro Biopharma
State Water Control Resources Board
Tethys Bioscience, Inc.
Unilever
Ventria Biosciences
and others

Industry Partners gain many things from internships:

- Access to highly talented creative researchers
- Opportunity to gain inside track on future employees
- Through students, further collaboration with scientists on campus
- Participate in the annual retreat to meet UC scientists students, potential interns, other company scientists
- Potential to use UC facilities through the collaboration
- Opportunity to participate in weekly campus seminars

Students gain much from internships:

- Ability to work in a highly creative non-academic environment
- Opportunity to participate in focused team approach to defined research goals
- Ability to use equipment and facilities not available on campus
- Discover the type of environment, which suits future career goals
- Participate in industry seminars
- Enhanced curriculum vitae: reference letters and new skills
- Access to potential employment opportunities

Currently, there are over 200 students enrolled, so we need more Academic-Industry Partnerships.