Twenty Fourth Annual

Biotechnology Training Retreat

Saturday,
March 14, 2015

Christian Brothers Retreat & Conference Center
Napa, CA

Twenty Fourth Annual Biotechnology Training Retreat

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

UC Davis Designated Emphasis in Biotechnology
Graduate Program (DEB)

UC Davis Biotechnology Program

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2015 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 **2014-15 fellows and their preceptors**, as well as **our industry affiliates**. The DEB graduate program continues to grow to close to 250 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 Biotechnology Program team. The logistics of this retreat have been expertly overseen by **Marianne Hunter**, Assistant Director of Administration; **Jacki Balderama** our Event Manager**, Jacqueline Phillips** our Program Assistant, and our Associate Director, **Dr. Denneal Jamison-McClung.** In addition, we are grateful to Professors **Karen McDonald** and **Annaliese Franz** for chairing the sessions today**.**

It is a pleasure to introduce our current Biotechnology Fellows. The **NIH Fellows** include: **Johnathon Anderson,** Integrative Genetics & Genomics (preceptor is Jan Nolta); **Casey Boosalis**, Molecular, Cellular, & Integrative Physiology (preceptor is Pam Lein); **Allison Hoch,** Biomedical Engineering (preceptor is J. Kent Leach); **Nicole Nozzi,** Chemistry Engineering (preceptor is Shota Atsumi); **Christian Siltanen,** Biomedical Engineering (preceptor is Alex Revzin); and **Anna Marie Tuazon,** Biochemistry, Molecular, Cellular & Developmental Biology (preceptor is Luis Carvajal-Carmona). Our four **Biotechnology Fellows** (industry and campus fellowships) include: **Keith Dunaway,** Integrative Genetics & Genomics (preceptor is Janine LaSalle); **Doug Gettel**, Chemical Engineering (preceptor is Atul Parikh); **Rosanna Kwok**, Entomology (preceptor is Joanna Chiu); and **Sam Westreich,** Integrative Genetics & Genomics (preceptors are Ian Korf and David Mills).

We will be selecting our **2015-16 NIH Fellows** in May. Nomination forms are on the web at www.deb.ucdavis.edu and the application deadline is **Friday, April 24rd.** Remember, you must be a member of the DEB to be eligible for funding, since it is the formal training program for the NIH T32 training grant.

In regard to DEB internships, we placed close to 30 students in 2014. They include: 1) **Agilent:** Arnold Chen; 2) **Amplimmune:** Alan Lombard; 3) **Amyris**: Lisa Anderson; 4) **Bayer CropScience:** Ben Golumb; 5) **Celegene S.F.**: Marjannie Eloi-Akintunde, Kateryna Feoktistova, and Emily Mills Ko; 6) **Emory University**: Kevin Martin; 7) **Genentech**: Leif Anderson, Siobhan Halloran, Allison Hoch, Shailise Ross, Christian Siltanen, and Tin Ngo; 9) **Glaxosmithkline**: JohnPatrick Rogers; 10) **Icon Genetics GmbH:** Liz Anthony; 11) **Lawrence Berkeley National Lab:** Rena Mizrahi; 12) **Mendota Bioenergy LLC**: Steve Zicari; 13) **Monsanto, Calgene Campus:** Hossein Gouran and Natasha Worden; 14) **Novozymes:** Jordan McEwen; 15) **Seminis Seed, Woodland**: Timothy Butterfield; 16) **SI-Bone, San Jose:** Regina

MacBarb; 17) **Sutro BioPharma:** Abigail Yu; 18) **Texas Instruments:** Erin Fong; 19) **The Shop@VSP Global, Sacramento:** Meghan Murphy; and 20) **Vital Connect Headquarters:** 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. Ten of our students graduated in 2014 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 **2014 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! We had a number of our graduates return this past year to present an MCB 294 seminar: Dr. Scott Hamilton, Dr. Chris Simmons, Dr. Corey Dodge, Dr. Marisa Wong Medina, Dr. Michael Howland, and Dr. Raquel Orozco.

We lost another one of our stellar DEB students this last fall. **Nicholas Mahoney** from the BMCDB graduate program, was a member of Prof. Chris Fraser's lab. He was a shining light and we all miss him very much. Please see the last page for our *In Memoriam.*

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

All the Best,

Judith "Judy" Kjelstrom, PhD
Director, UC Davis Biotechnology Program

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

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

Executive Committee

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Roland Faller (Chemical Engineering)
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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Judith A. Kjelstrom, Program Coordinator

Designated Emphasis in Biotechnology (DEB) Graduate Program

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Program Coordinator

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UC Davis Twenty Fourth Annual Biotechnology Training Retreat
March 14, 2015
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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** Karen McDonald Co-Director, NIH Training Grant in Biomolecular Technology
8:45 – 12:05 pm	**Morning Session** Annaliese Franz NIH Training Program Executive Committee Member
8:55 – 10:25 am	**Presentations** 8:55 am Johnathon Anderson ..... *Mentor: Jan Nolta* 9:20 am Casey Boosalis..... *Mentor: Pam Lein* 9:45 am Allison Hoch..... *Mentor: J. Kent Leach* 10:10 am **Timothy Conner**..... ..... ***Monsanto***
10:25 – 10:45 am	**Break / Poster Viewing**
10:45 – 11:55 pm	**Presentations** 10:45 am Nicole Nozzi..... *Mentor: Shota Atsumi* 11:10 am Keith Dunaway..... *Mentor: Janine LaSalle* 11:35 am Denneal Jamison-McClung ..... *Bioethics Question (Handout)*

Afternoon Schedule

12:00 – 1:05 pm	**Lunch / Poster Viewing**
1:00 – 1:20 pm	**Photo Taking for NIH/Biotech Fellows**
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 Denneal..... *Bioethics Question* Jamison-McClung..... *(Discussion)* 1:40pm Christian Siltanen ..... *Mentor: Alex Revzin* 2:05 pm **Christopher Murriel**..... ***OncoMed Pharmaceuticals*** 2:20 pm Anna Marie Tuazon..... *Mentor: Luis Carvajal-Carmona* 2:45 pm **Alice Yam**..... ***Sutro Biopharma, Inc.***
3:00 - 3:20 pm	**Short Break (20 min)**
3:20 – 4:50 pm	**Presentations** 3:20 pm Doug Gettel ..... *Mentor: Atul Parikh* 3:45 pm **Jeannie Giacchino**..... ***Bavarian Nordic, Inc.*** 3:55 pm Rosanna Kwok ..... *Mentor: Joanna Chiu* 4:20 pm **Gian Oddone**..... ***Agrinos, Inc.*** 4:25 pm Sam Westreich..... *Mentor: Ian Korf*
4:50 pm	**Closing Remarks** Karen McDonald Co-Director, NIH Training Grant in Biomolecular Technology

5:20 pm – Bus departs Napa

2015 Poster Titles

A. **"eIF4E Promotes Viral IRES Mediated Translation by Stimulating RNA Restructuring by eIF4A"**

Brian Avanzino*[1], Gabriele Fuchs[2], Peter Sarnow[2], and Christopher Fraser[1]
[1]Department of Molecular and Cellular Biology, University of California, Davis
[2]Department of Microbiology and Immunology, Stanford University School of Medicine

B. **"Microfabricated Nanoporous Gold Coatings Promote Cortical Cell Type Dependent Surface Coverage"**

Christopher Chapman*[1], Hao Chen[2], Marianna Stamou[2], Juergen Biener[3], Monika Biener[3], Pamela J. Lein[2], and Erkin Seker[4]
[1]Department of Biomedical Engineering, University of California, Davis
[2]Department of Molecular Biosciences, University of California, Davis
[3]Lawrence Livermore National Laboratory, Livermore, CA 94550
[4]Department of Electrical and Computer Engineering, University of California, Davis

C. **"The Role of Phosphorylation in Regulating SLIMB/ß-TrCP Activity in the Proteosome Pathway"**

Adam Contreras*, Ying Li, Christine Tabuloc, and Joanna Chiu
Department of Entomology, University of California, Davis

D. **"Attenuated Calcium Entry and Cytokine Release to the Environmental Toxicat, PBDE, in Isolate Human PBMCS"**

Marjannie Eloi Akintunde*[1,2], Diptiman D. Boxe[3], Isaac N. Pessah[2,3,4], and Judy Van de Water[1,2,4]
[1]School of Medicine, Division of Rheumatology, Allergy and Clinical Immunology, University of California, Davis
[2]The UC Davis Center for Children's Environmental Health, University of California, Davis
[3]The UC Davis M.I.N.D. Institute, University of California, Davis
[4]Department of Veterinary Molecular Biosciences, University of California, Davis

E. **"Role of Antimicrobial Mucosa Associated Invariant T Cells in the Gut in HIV-1 Infection"**

Anupama Ganesh*[1], Edwin Leeansyah[2], Maire F. Quigley[2], Anders Sonnerborg[3], Jan Andersson[2], Peter W. Hunt[4], Ma Somsouk[5], Steven G. Deeks[4], Jeffrey N. Martin[4], Markus Moll[2], Johan K. Sandberg[2], and Barbara L. Shacklett[1,]
[1]Department of Medical Microbiology and Immunology, University of California, Davis
[2]Department of Internal Medicine, Infectious Diseases, University of California, Davis
[3]Department of Laboratory Medicine, Division of Clinical Virology, Karolinska Institutet,
Karolinska University Hospital Huddinge, Stockholm, Sweden
[4]San Francisco General Hospital, Positive Health Program, University of California, San Francisco
[5]Division of Gastroenterology, San Francisco General Hospital, University of California, San Francisco

F. **"Tuning Molecular Release from Nanoporous Gold Thin Films by Pore Morphology Modification"**

Ozge Kurtulus[1], Pallavi Daggumati[2], Erkin Seker[2]
[1]Department of Chemical Engineering & Materials Science, University of California, Davis
[2]Department of Electrical & Computer Engineering, University of California, Davis

G. **"Rapid Antibody Discovery Platform for Antibody Drug Conjugates and Bispecific Antibodies"**

A. Yam, A. Gill, J. Axup, S. Armstrong, R. Henningsen, M. You, F. Avogadri-Conners, D. Chemla-Vogel, J. Lee, X. Li, A. Gakhal, L. Nguyen, H. Stephenson, M. Tam, J. Yang, R. Stafford, K. Penta, A. Sato, T.J. Hallam
Sutro Biopharma, Inc., San Francisco, California

H. **"Host Diet Changes Ecological Niche Availability for Probiotic *Lactobacillus* in the Digestive Tract"**

Xiaochen Yin* and Maria L. Marco
Department of Food Science and Technology, University of California, Davis

I. **"LC-MS/MS Analysis of Lipid Mediators in Sweat"**

Karen Agrawal*[1], Raja K. Sivamani[2], and John W. Newman[1,3]
[1]Department of Nutrition, University of California, Davis
[2]Department of Dermatology, University of California, Davis
[3]Western Human Nutrition Research Center, ARS-USDA, Davis, California

J. **"Oligomerization of FLAG Tagged Recombinant Butyrylcholinesterase Protein *In Planta*"**

Salem Alkanaimsh[1]*, Kalimuthu Karuppanen[1], Andres Guerrero[2], Carlito Lebrilla[2], Somen Nandi[3], Raymond Rodriguez[3], and Karen A. McDonald[1]
[1]Department of Chemical Engineering & Materials Science, University of California, Davis
[2]Department of Chemistry, University of California, Davis
[3]Department of Molecular and Cellular Biology, University of California, Davis

K. **"Agrobacteria-Mediated Transient Expression and Characterization of a Thermostable ß-Xylosidase in <u>N. Bethamiana</u>"**

Liz Anthony*[1], Minsook Hwang[2], My Phu[3], Bryce W. Falk[2], Abhaya M. Dandekar[3], and Karen A. McDonald[1]
[1]Department of Chemical Engineering & Materials Science, University of California, Davis
[2]Department of Plant Pathology, University of California, Davis
[3]Department of Plant Science, University of California, Davis

l. **"Who's In The Driver's Seat? Identifying Causative Variants of Colorectal Cancer"**

Nicole Coggins*, Luis Carvajal-Carmona, and Dr. Davis Segal
Department of Biochemistry and Molecular Medicine, University of California, Davis

M. **"Development of a Transgenic Rice Cell Suspension Culture for Production of Butyrylcholinesterase"**

Jasmine Corbin*, Bryce Hashimoto, and Karen McDonald

Department of Chemical Engineering and Materials Science, University of California, Davis

N. **"Purification and *N*-Glycan Analysis of Human Recombinant Protein Alpha-1 Antitrypsin"**
Kalimuthu Karuppanan[1], Salem Alkanaimsh[1], Andres Guerrero[2], Carlito Lebrilla[2], 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

O. **"Analysis of Non-Enzymatic Collagen Crosslinks in Engineered Cell-Secreted Extracellular Matrices"**
Debika Mitra*, Hussain Fatakdawala, Laura Marcu, and J. Kent Leach
Department of Biomedical Engineering, University of California, Davis

P. **"Determining the Mechanism of Spindle Positioning in Response to the SRC Polarity Cue"**
Malgorzata J. Liro*and Lesilee S. Rose
Department of Molecular and Cellular Biology, University of California, Davis

***DEB Graduate Student**

2015 Presentation Titles

1. **"Cellular SmartPhones: Secreted Vesicles and Disease**
   Johnathon Anderson*, Missy Pham, and Jan Nolta
   Department of Internal Medicine, Institute for Regenerative Cures, University of California Medical Center

2. **"Application of High(er) Throughput Technology for Assessing and Preventing Persistent Neuroinflammation in a Mouse Model of Tetramethylenedisulfotetramine (TETS)-Induced Status Epilepticus"**
   Casey Boosalis*[1], Donald A. Brunn[1], Dorota Zolkowska[2], Michael A. Rogawski[2], and Pamela J. Lein[1]
   [1]Department of Molecular Biosciences, School of Veterinary Medicine, University of California, Davis
   [2]Department of Neurology, School of Medicine, University of California, Davis

3. **"Biological Substrates to Prevent Dedifferentiation of Osteogenically Induced Mesenchymal Stem Cells"**
   Allison Hoch*[1], Vaishali Mittal[1], Debika Mitra[1], and J. Kent Leach[1,2]
   [1]Department of Biomedical Engineering, University of California, Davis
   [2]Department of Orthopaedic Surgery, School Of Medicine, University of California, Davis

4. **"Cross-Discipline Technologies Solve Ag Challenges"**
   Timothy Connor, PhD
   Monsanto, Davis, CA

5. **"Developing Production of a Plant Alkaloid in a Microbial Host"**
   Nicole Nozzi* and Shota Atsumi
   Department of Chemistry, University of California, Davis

6. **"Hypomethylation of Synaptic Genes Revealed in DUP15q Autism"**
   Keith Dunaway*, M. Saharul Islam, Roy Chu, Rochelle Coulson, Diane I. Schroeder, Paul Lott, Isaac N. Pessah, Makiko Meguro-Horike, Shin-ichi Horike, Ian Korf, and Janine M. LaSalle
   Department of Medical Microbiology and Immunology, University of California, Davis

7. **"ZMapp Can Zap Ebola!... Or, Can It? Mobilizing a Global Response to a Public Health Crisis" - Ethics Discussion**
   Denneal Jamison-McClung
   Associate Director, Biotechnology Program, University of California, Davis

***DEB Graduate Student**

8. **"Heparin Hydrogels For Stem Cell Microencapsulation"**
Christian Siltanen*, Jungmok You, Amranul Haque, and Alexander Revzin
Department of Biomedical Engineering, University of California, Davis

9. **"Therapeutic Approaches Towards Targeting Cancer Stem Cells"**
Christopher L. Murriel, Rene Meisner, Tim Hoey, John Lewicki, and Paul J. Hastings
OncoMed Pharmaceuticals, Inc., Redwood City CA

10. **"Population Isolates From Colombia Enable Discovery of Novel Breast Cancer Risk Genes"**
Anna Marie Tuazon*[1], Carolina Ramirez[2], Paul Lott[1], Angel Criollo[2], Ana Estrada[2], Magdalena Echeverry[2], and Luis Carvajal-Carmona[1]
[1]Department of Biochemistry and Molecular Medicine, University of California, Davis
[2]University of Tolima, Ibague, Colombia

11. **"Rapid Antibody Discovery Platform for Antibody Drug Conjugates and Bispecific Antibodies"**
A. Yam*, A. Gill, J. Axup, S. Armstrong, R. Henningsen, M. You, F. Avogadri-Conners, D. Chemla-Vogel, J. Lee, X. Li, A. Gakhal, L. Nguyen, H. Stephenson, M. Tam, J. Yang, R. Stafford, K. Penta, A. Sato, and T.J. Hallam
Sutro Biopharma, Inc., South San Francisco, CA

12. **"Composition-Dependent Membrane Remodeling in the Broad-Spectrum Virocidal Activity of an HCV NS5A Anchor Peptide Derivative"**
Joshua M. Hanson[1a], Douglas L. Gettel*[1a], Seyed R. Tabaei[3,4], Joshua Jackman[3,4], Min Chul Kim[3,4], Darryl Y. Sasaki[5], Bo Liedberg[3,4], Nam-Joon Cho[3,4,6], and Atul N. Parikh[1,2,3,4,7]
[1]Biophysics Graduate Group, University of California, Davis, California 95616 USA
[2]Department of Chemical Engineering & Materials Science, University of California, Davis
[3]Centre for Biomimetic Sensor Science, Nanyang Technological University
[4]School of Materials Science and Engineering, Nanyang Technological University
[5]Biotechnology and Bioengineering Dept., Sandia National Laboratories
[6]School of Chemical and Biomedical Engineering, Nanyang Technological University
[7]Department of Biomedical Engineering, University of California, Davis
[a]Equal contributions

13. **"Poxvirus-Based Cancer Immunotherapy"**
Jeannie Giacchino*, Alex Franzusoff, and James Breitmeyer
Bavarian Nordic, Inc., Cancer Immunotherapy Division, Mountain View, California

14. **"Temporal Dynamics of Epigenetic Landscape Enable Fine-Tuning of Circadian Transcription"**
Rosanna S. Kwok*, Ying H. Li, Anna J. Lei, and Joanna C. Chiu
Department of Entomology, University of California, Davis, CA

15. **“Agrinos Produces Crop Inputs Designed to Improve Global Agricultural Productivity and Sustainability**
Gian M. Oddone*
Agrinos, Inc.

16. **“A Complete Pipeline for Gut Metatranscriptome Analysis**
Sam T. Westreich*, David A. Mills, Ian Korf, and Danielle G. Lemay
Genome and Biomedical Sciences Facility, University of California, Davis

***DEB Graduate Student**

Oral Presentation Abstracts

NIH FELLOW: Johnathon D. Anderson

CELLULAR SMARTPHONES: SECRETED VESICLES AND DISEASE

Presenter: Johnathon D. Anderson*

Authors: **Johnathon Anderson***, Missy Pham, and Jan Nolta

Affiliation: Department of Internal Medicine, Institute for Regenerative Cures, UC Davis Medical Center

Preceptor: Jan Nolta

Recently a new type of cell to cell communication system has been discovered that is transforming our understanding of how cells talk to each other. This new cell communication system is mediated by small cellularly secreted vesicles called exosomes that contain a variety of different types of protein and RNA. Our lab develops stem cell based therapeutics using a special type of adult stem cell from the bone marrow called a mesenchymal stem cell (MSC). MSC's mediate much of their tissue healing effects through the secretion of a variety of factors. MSCs are actively being investigated for their ability to induce new blood vessel growth (angiogenesis) in a variety of cardiovascular disease indications including peripheral arterial disease (PAD), which effects ~8 million people on the US. To date, most researchers have focused on MSC's ability to induce angiogenesis in models of PAD using the standard model of cell communication (canonical secretory proteins). Here we show that MSC secretion of exosomes increases substantially upon stimulation with a PAD-like microevironment and that these exosomes contain a robust profile of angiogenic factors including pro-angiogenic micro-RNAs and non-secretory proteins.

***DEB Graduate Student**

NIH FELLOW: Casey Boosalis

APPLICATION OF HIGH(ER) THROUGHPUT TECHNOLOGY FOR ASSESSING AND PREVENTING PERSISTENT NEUROINFLAMMATION IN A MOUSE MODEL OF TETRAMETHYLENEDISULFOTETRAMINE (TETS)-INDUCED STATUS EPILEPTICUS

Presenter: Casey Boosalis*

Authors: **Casey Boosalis***[1], Donald A. Brunn[1], Dorota Zolkowska[2], Michael A. Rogawski[2], and Pamela J. Lein[1]

Affiliations: [1]Department of Biosciences, School of Veterinary Medicine, University of California, Davis

[2]Department of Neurology, School of Medicine, 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 focus on elucidating the molecular and cellular mechanisms which seizurogenic chemicals cause persistent neurological damage. TETS is a potent convulsant rodenticide that is considered a credible chemical threat agent. Humans exposed to TETS at high doses can exhibit acute seizures, status epilepticus (SE) and death. Humans that survive acute TETS-induced SE often exhibit persistent neurological sequelae, including spontaneous recurrent seizures. Emerging evidence suggests that persistent neuroinflammation contributes to the pathogenesis of epilepsy; therefore, in this study we assessed neuroinflammatory responses in an animal model of TETS-induced SE. Adult male NIH Swiss mice were injected with riluzole (10 mg/kg ip) 10 min prior to injection with TETS (0.2 mg/kg ip). As indicated by electroencephalography (EEG) and behavioral characterization of seizure activity, TETS-intoxicated animals pretreated with riluzole exhibited > 1 h of continuous clonic seizure activity. In the absence of rescue therapy, ~90% of the animals died by 24 h post-TETS exposure. Administration of diazepam (5 mg/kg ip) or midazolam (0.73 mg/kg im) administered 40 min after the initiation of seizure activity increased survival at 24 h post-TETS to 100% or > 75%, respectively. Preliminary observations suggest that, TETS intoxicated animals rescued by diazepam or midazolam exhibited significant region- and time-dependent reactive astrogliosis and microglial activation as determined by GFAP and Iba-1 immunoreactivity. Our goal is to investigate the mechanisms underlying the delayed neurotoxic effects of animals that survive acute intoxication by combining both *in vivo* and *in vitro* studies. By utilizing the NIH Swiss model for studying TETS intoxication *in vivo*, both in terms of the aforementioned characterization and a battery of behavioral tasks that assess various functions, we will be able to examine subsequent *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 TETS intoxication. Eventually, we will apply this high throughput technology to rapidly and effectively screen for drugs, or combinations thereof, which will allow us to assess the efficacy of candidate therapeutics for stopping TETS-induced SE and protecting against delayed and persistent neurological sequelae.

***DEB Graduate Student**

NIH FELLOW: Allison Hoch

BIOLOGICAL SUBSTRATES TO PREVENT DEDIFFERENTIATION OF OSTEOGENICALLY INDUCED MESENCHYMAL STEM CELLS

Presenter: Allison Hoch*

Authors: **Allison Hoch***[1], Vaishali Mittal[1], Debika Mira[1], J. Kent Leach[1,2]

Affiliations: [1]Department of Biomedical Engineering, University of California, Davis
[2]Department of Orthopaedic Surgery, University of California, Davis

Preceptor: J. Kent Leach

Prior to transplantation, mesenchymal stem/stromal cells (MSCs) can be induced toward the osteoblastic phenotype using a cocktail of soluble supplements. However, the optimal induction duration is unknown and there is little evidence of differentiated MSCs directly participating in bone formation, suggesting that MSCs may revert to an undifferentiated phenotype upon transplantation. Cell-secreted decellularized extracellular matrices (DMs) represent a promising strategy to confer bioactivity and direct cell fate through the presentation of a complex and physiologically relevant milieu. Therefore, we examined the effect of induction duration on cementing the osteoblastic phenotype of MSCs, as well as the capacity of biomimetic DMs to preserve the phenotype upon withdrawal of the induction stimulus. We show that increasing the duration of induction does not preserve the osteoblastic phenotype after the removal of the osteogenic stimulus. Regardless of induction duration, ranging up to 6 weeks, MSCs exhibited up to a 5-fold reduction in osteoblastic markers within 24 hours following stimulus withdrawal. Osteogenically induced MSCs retained their ability to produce oil droplets despite ample mineral production and changes in cell morphology characteristic of osteoblastic differentiation. We further show that seeding osteogenically induced MSCs on DMs sustains the osteoblastic phenotype of MSCs by preserving up to 2-fold more calcium deposition than tissue culture plastic. DMs sustain the phenotype in MSCs at least partially by increasing actin cytoskeletal tension via the ROCK II pathway. MSCs on DMs also secreted 25% more vascular endothelial growth factor (VEGF) secretion, a crucial endogenous proangiogenic factor that is abrogated during MSC osteogenic differentiation and is identified as the primary contribution of MSCs to tissue repair. These results underscore the rationale for deploying MSCs into a bone defect site using biomaterial platforms such as DMs to preserve the in vitro-acquired osteoblastic phenotype to accelerate the process of bone repair.

***DEB Graduate Student**

COMPANY AFFILIATE: Monsanto

CROSS-DISCIPLINE TECHNOLOGIES SOLVE AG CHALLENGES

Presenter: Timothy Conner, PhD

Authors: **Timothy Conner, PhD**

Affiliations: Monsanto Company
Woodland, CA

In Agriculture, biotechnology has made revolutionary changes in how we produce food and how we engage with food. But exactly what is biotechnology and how do we best leverage it? Most biotechnology GM and advanced molecular breeding derived traits today affect agronomic characteristics desired in model plants and crops. We are still now at the early stages of leveraging biotechnology as a tool or in its application in broader ways to support food production. I will present Monsanto's newer platforms and how biotechnology plays a role in solving Agriculture challenges. For more general information on the discussion around Agriculture and technologies visit: www.gmoanswers.com, www.findourcommonground.com and www.discover.monsanto.com.

NIH FELLOW: Nicole Nozzi

DEVELOPING PRODUCTION OF A PLANT ALKALOID IN A MICROBIAL HOST

Presenter: Nicole Nozzi*
Authors: **Nicole Nozzi*** and Shota Atsumi
Affiliations: Department of Chemistry, University of California, Davis
Preceptor: Shota Atsumi

The pursuit of natural products for medicinal applications has always struggled with supplying them in large quantities. Compounds of interest are often produced only in minute quantities in the native host making harvest a laborious process that often raises environmental concerns. Total synthesis of stereochemically rich natural products via chemical synthesis often requires procedures too complex to be industrially viable. Chemical biosynthesis by an engineered microbe provides an attractive alternative for industrial scale synthesis of natural products in cases where source harvesting and chemical synthesis are not economically viable. In a microbial host the specificity of biological catalysts can be exploited with the advantage of simplified product recovery. The tropane alkaloids hyoscyamine and scopolamine are good candidates for an engineered microbial biosynthesis. These compounds are produced naturally in nightshade plants and extracted for commercial use due to the complexity of their chemical synthesis. Hyoscyamine and scopolamine are muscarinic antagonists used clinically for treatment of bradycardia, motion sickness, anesthesia premedication, relaxation of gastrointestinal smooth muscle, bronchodilation, organophosphate poisoning, and reduction of Parkinson's disease symptoms. This work discusses the development of a semi-synthetic pathway in the model host organism *Escherichia coli* for the synthesis of hyoscyamine and scopolamine from the precursor tropinone. This strategy will provide a more economical option for the large scale production of these alkaloids, as well as be a valuable contribution to the development of metabolic engineering and synthetic biology for the biosynthesis of natural products.

***DEB Graduate Student**

NIH FELLOW: Keith Dunaway

HYPOMETHYLATION OF SYNAPTIC GENES REVEALED IN DUP15q AUTISM

Presenter: Keith Dunaway*
Authors: **Keith Dunaway***, M. Saharul Islam, Roy Chu, Rochelle Coulson, Diane I Schroeder, Paul Lott, Isaac N. Pessah, Makiko Meguro-Horike, Shin-ichi Horike, Ian Korf, and Janine M. LaSalle
Affiliations: Department of Medical Microbiology and Immunology, University of California, Davis
Preceptors: Janine LaSalle

Chromosome 15q11-13 duplication syndrome (Dup15q) is one of the most common copy number variations observed in autism-spectrum disorders. Surprisingly, a prior analysis of Dup15q human brain samples showed both DNA hypomethylation measured by LINE-1 pyrosequencing and significantly higher levels of the persistent organic pollutant PCB 95 than controls or idiopathic autism cases. In order to take an unbiased view of the whole methylome, including genic, intergenic, and repetitive regions, we performed MethylC-seq and developed novel bioinformatic analyses. Six Dup15q and matched control cortical (BA19) postmortem samples were used to determine methylation patterns in Dup15q through custom hidden Markov models, demonstrating large-scale hypomethylated domains throughout the genome. We also analyzed percent methylation in repetitive regions, which are normally neglected due to the complexity of their analyses. Using a bioinformatics toolkit we created, LINE-1 hypomethylation in Dup15 brain samples compared to controls was confirmed and analysis of additional repetitive elements is underway. To experimentally model the interaction of Dup15q and PCB 95, human SH-SY5Y neuroblastoma cells containing an additional maternal chromosome 15 (SH-15M) were assayed using MethylC-seq. SH-15M cells exhibited a 2-14% increase of hypomethylated domains spanning across every autosome compared to the parental SH-SY5Y cell line, an effect independent of PCB-95 exposure. Genes within the hypomethylated regions specific to SH-15M were enriched for functions at the postsynaptic cell membrane while those genes in hypomethylated regions specific to PCB 95 exposure were enriched for ion channels, neurotransmitter, and synaptic functions. Transcript levels of 48 autism candidate genes found in these hypomethylated regions were compared them across 48 different cell lines, single-cell clones, and postmortem brain samples by quantitative RT-PCR in the Fluidigm Biomark. Aberrant transcript

levels were observed for multiple glutamate, serotonin, and GABAA receptor genes, with a significant compounding effect of SH-15M and PCB 95 for GRIA1. In summary, we found large-scale epigenomic changes to the brain methylome in Dup15q syndrome that can be modeled in cell culture and further compounded by PCB 95 exposure, altering synaptic gene transcript levels. These results have implications for understanding and treating complex gene-environment interactions in autism-spectrum disorders.

***DEB Graduate Student**

Bioethics Discussion

Written and Presented by

Denneal Jamison-McClung, PhD
Associate Director of the Biotechnology Program

ETHICS QUESTION

ZMAPP CAN ZAP EBOLA! … OR CAN IT?

MOBILIZING A GLOBAL RESPONSE TO A PUBLIC HEALTH CRISIS

ZMapp Can Zap Ebola!... Or, Can It?
Mobilizing a Global Response to a Public Health Crisis

In December 2013, the on-going Ebola outbreak in West Africa began in a rural village in Guinea. Because Ebola had not been reported in West Africa before, average people and health care providers did not recognize the virus symptoms and attributed deaths to more common diseases. As a result, Ebola virus spread unchecked for months before identification, with an early recorded fatality rate of ~85%.

The World Health Organization was notified of the disease outbreak in March 2014, and the investigation into the causative agent revealed a new strain of Ebola virus, *Zaire ebolavirus* (EBOV). Media attention and interest in the developed world has waxed and waned over the course of the outbreak, which is still ongoing. **As of February 2015, over 23,000 people have been infected with more than 9,000 reported deaths** (unreported deaths likely higher).

Genomic studies have revealed that the Ebola strain responsible for the current outbreak evolved in parallel with other strains present in Sub-Saharan Africa and was not introduced from nearby countries having the most recent Ebola outbreaks. The current working hypothesis is that the origin of the current *Zaire ebolavirus* (EBOV) outbreak may be fruit bats in the region, which are known to serve as viral reservoirs. Therefore, the risk of regional disease reemergence, even after the current outbreak is eventually contained, remains high.


http://mashable.com/2014/07/14/ebola-

Containment of an Ebola outbreak is difficult for a number of reasons. There are no widely available treatments and there is no cure. Infected individuals may incubate the virus for up to 21 days without symptoms, though they are not able to infect others until becoming feverish. The virus spreads from infected and deceased victims to their family members via body fluids during care of the sick. By taking part in the cultural tradition of bathing deceased relatives in preparation for burial, new infections were propagating quickly through families and communities in West Africa. Addressing cultural practices has been challenging

for health care officials. Though education efforts have been widespread, as recently as the week of February 15, 2015, 39 "unsafe burials" were reported in Guinea and 45 in Sierra Leone.

During the height of the Ebola outbreak, the need for robust therapeutic treatments and development of an Ebola vaccine became a high priority for global health officials. One of the options under development was **ZMapp, a cocktail of three chimeric monoclonal "plantibodies"** produced in transgenic plant tissue. The purified ZMapp cocktail works via neutralizing antibodies (Nabs), which bind to the Ebola antigens and prevents their biological effects.

Though proving 100% effective in a small nonhuman primate study, ZMapp had not been tested in humans and had not undergone any clinical trials when approved for its first emergency use in two US missionaries, Dr. Kent Brantly and Nancy Writebol in 2014. Both were infected by Ebola while tending patients in West Africa. They were losing their battle against the disease when FDA permission was granted to try ZMapp. Within hours the experimental drug appeared to be working - severe disease symptoms subsided and both health care workers recovered, though effects in one case may have been confounded by a blood transfusion received from an Ebola survivor. **Seven more patients were provided with emergency ZMapp treatment, in addition to standard care, before supplies of the therapeutic were exhausted. In total, nine Ebola patients received ZMapp under varying environmental and therapeutic regimes, and ___ survived.**

To tease out whether ZMapp contributed to an increased survival rate of the "emergency treated" patients, **human clinical trials of ZMapp are now underway via a joint Liberian-US partnership with oversight by the US National Institute of Allergy & Infectious Diseases** (NIAID, Bethesda, MD), which issued a press release on February 27, 2015, "The trial will enroll adults and children of any age who have been admitted to Ebola treatment units in Liberia, health care workers who were infected with Ebola virus in West Africa and have returned to the United States for treatment, and adults and children who may have acquired Ebola infection in the United States through secondary transmission. All participants will provide informed consent prior to enrollment." Using a two-arm comparison with up to 100 participants, both the control group and the experimental group will receive the standard of care (IV fluids, electrolytes, oxygen and blood pressure control, and treatment of secondary infections). ZMapp-treated patients will receive a therapeutic regimen of three intravenous infusions spaced three days apart, in addition to the standard of care. Additional experimental therapeutics will be tested in succeeding two-arm studies, including: Tekmira siRNA from Tekmira Pharmaceuticals Corp; Favipiravir from Toyama Chemical Co. LTD; AVI-7537 from Sarepta; BCX4430 from BioCryst; and convalescent or post-immunization plasma collected from recent Ebola infection survivors.

Breaking News! Ebola Vaccine Progress

On March 7, 2015, the World Health Organization began the first widespread test of an experimental Ebola vaccine, VSV-EBOV (developed by the Government of Canada and licensed by Merck) in Guinea. The US NIH and GlaxoSmithKline have also developed a vaccine that will be tested in a separate study as supplies become available.

Bioethics Questions

On the ethical use of new and experimental therapeutics and vaccines:

- ZMapp was available before the two US missionaries became ill. Should it have been tried sooner on a small group in West Africa? When during a public health crisis should experimental therapeutics or vaccines be deployed?
- If supplies of a therapeutic or vaccine are very limited, as was the case with ZMapp, who should receive the treatment? Health care workers? Everyone in a particular geographic space around the "ground zero" of the outbreak? Immuno-compromised or sensitive groups?
- Given ZMapp's effectiveness in nonhuman primates and possible benefit in a small number of emergency-treated patients, should it still have to undergo clinical trials before being widely used in the fight against Ebola?
- Is it ethical to have an untreated "standard of care" control group for the ZMapp clinical trial given Ebola's high fatality rate?
- During the informed consent process for the ZMapp clinical trials, should patients be given a choice of belonging to the treatment group vs. the control group?
- ZMapp and other Ebola vaccines and therapeutics have been developed, in part, with the support of public funding and by the work of public sector scientists. How should intellectual property and costs associated with the development and delivery of humanitarian vaccines and therapeutics be managed? Public only? Public-private partnership? Private only?
- What does "informed consent" mean in the context of a public health emergency? Can health care providers truly "inform" an average citizen about the development of a therapeutic or vaccine, how it will work in the body and how/why potential side effects may arise? In an emergency, does this matter?

Politics, governance and societal responses to public health crises:

- Was the US/developed nation response to the recent Ebola outbreak in West Africa too slow? If so, was this a breach of bioethical norms? Why or why not?
- As a global community, who is responsible for organizing the response to global public health crises? How do we define when a situation reaches the "crisis" level?

In the US, the Centers for Disease Control and Prevention issued science-based national guidelines for monitoring health care workers that may have been exposed to Ebola, yet different states chose to enact various politically-motivated "public health orders" and quarantine restrictions in 2014.

- Should politicians be held accountable for making policy decisions that do not align with the scientific consensus and CDC guidelines for public safety? On this issue? On any issues affecting public health and safety or human rights?

- In the interest of public health and safety, should healthcare workers returning to the US be held to stricter guidelines than those suggested by the CDC, such as an automatic quarantine and controlled movement for 21 days?

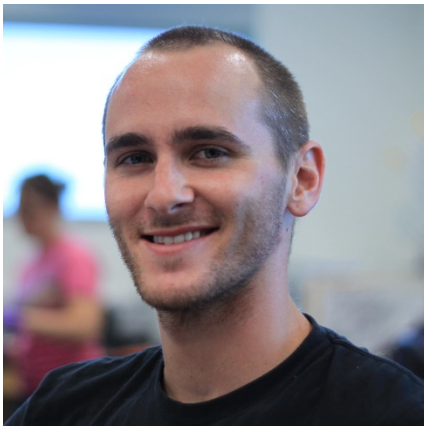
Bioethics Summary – What does the WHO say?
In August 2014, the World Health Organization organized a panel to examine ethical issues around the global response to Ebola and the use of experimental therapeutics. Two main bioethical issues emerged:

- "Whether it is ethical to use unregistered interventions with unknown adverse effects for possible treatment or prophylaxis. If it is, what criteria and conditions need to be satisfied before they can be used?"
- "If it is ethical to use these unregistered interventions in the circumstances mentioned above, then what criteria should guide the choice of the intervention and who should receive priority for treatment or prevention?"

http://www.who.int/csr/disease/ebola/ethics-panel-discussion/en/

NIH FELLOW: Christian Siltanen

HEPARIN HYDROGELS FOR STEM CELL MICROENCAPSULATION



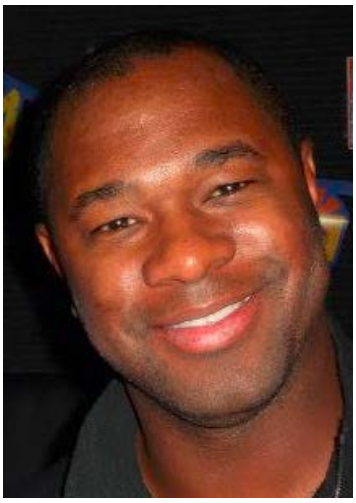
Presenter: Christian Siltanen*
Authors: **Christian Siltanen***, Jungmok You, Amranul Haque, and Alexander Revzin
Affiliations: Department of Biomedical Engineering, University of California, Davis
Preceptor: Alex Revzin

We are interested in developing biomaterials-based technologies for controlling the 3D cellular microenvironment. Hydrogels derived from hybrid biomaterials (consisting of both of natural and synthetic polymers) have gained considerable attention recently, due to the ability to independently control physical/mechanical properties as well as chemical bioactivity within these systems. We have developed a hybrid hydrogel consisting of poly- ethylene glycol (PEG) and heparin, and demonstrated its application in the encapsulation and culture of embryonic stem cells (ESCs). Heparin is a highly sulfated glycosaminoglycan (GAG) with a strong affinity for many biomolecules, including several ECM proteins, cytokines and growth factors (GFs). In this work, we demonstrate heparin-based gels for sequestering and slowly releasing GFs for the directed differentiation of stem cells. Specifically, we show that mouse ESCs encapsulated within hydrogels containing heparin-immobilized Activin A and FGF2 are induced toward a definitive endoderm phenotype more efficiently than in conventional culture with soluble GFs. This work also highlights droplet microfluidics for fabricating cell-laden heparin hydrogel microparticles, using a flow-focusing technique wherein hydrogel precursor solutions are generated as an emulsified template on a microfluidic chip. Microencapsulation using this technique may facilitate future scale-up and handling of stem cells for cell therapies or tissue engineering applications.

***DEB Graduate Student**

COMPANY AFFILIATE: OncoMed Pharmaceuticals, Inc.

THERAPEUTIC APPROACHES TOWARDS TARGETING CANCER STEM CELLS



Presenter: Christopher Murriel, PhD

Authors: **Christopher Murriel, Rene Meisner, Tim Hoey, John Lewicki, and Paul J. Hastings**

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. Using various patient-derived xenograft tumor models (PDX), we found that residual tumors, after treatment with conventional chemotherapy, could enrich the cancer stem cell population. To combat the development of CSC-mediated tumor resistance, we have demonstrated that specifically targeting key members of the Notch and Wnt signaling pathways alters tumor cell growth by altering the expression of many genes that affect 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.

To this end, OncoMed Pharmaceuticals, Inc. is a clinical development-stage biopharmaceutical company focused on discovering and developing first-in-class protein therapeutics targeting cancer stem cells. We currently have six anti-cancer product candidates in clinical development, the most advanced of which are in randomized Phase 2 clinical trials. Demcizumab (anti-DLL4, OMP-21M18), tarextumab (anti-Notch2/3, OMP-59R5), anti-Notch1 (OMP-52M51), and anti-DLL4/VEGF bispecific antibody (OMP-305B83), vantictumab (anti-FZD7, OMP-18R5), and ipafricept (FZD9-Fc, OMP-54F28) each target key cancer stem cell signaling pathways, including Notch and Wnt. OncoMed plans to file an Investigational New Drug application in early 2015 for anti-RSPO3 (OMP-131R10), an antibody targeting a third key cancer stem cell signaling pathway called R-spondin-LGR. OncoMed is also pursuing discovery of additional novel anti-CSC and cancer immunotherapy product candidates. OncoMed has formed strategic alliances with Celgene Corporation, Bayer Pharma AG and GlaxoSmithKline (GSK).

NIH FELLOW: Anna Marie Tuazon

POPULATION ISOLATES FROM COLOMBIA ENABLE DISCOVERY OF NOVEL BREAST CANCER RISK GENES

Presenter: Anna Marie Tuazon*

Authors: **Anna Marie Tuazon***[1], Carolina Ramirez[2], Paul Lott[1], Angel Criollo[2], Ana Estrada[2], Magdalena Echeverry[2], and Luis Carvajal-Carmona[1]

Affiliations: [1]Department of Biochemistry & Molecular Medicine, University of California, Davis
[2]University of Tolima, Ibague Colombia

Preceptor: Luis Carvajal-Carmona

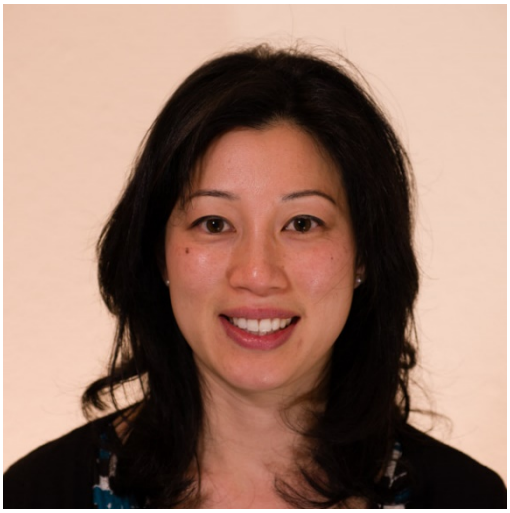
Breast cancer (BC) is the leading cause of cancer incidence among women. While many genes linked to BC susceptibility have been identified, such as *BRCA1* and *BRCA2*, mutations in these genes are very rare and only explain a small fraction of hereditary BC. Moreover, the mutational spectrum in known BC risk genes have not been thoroughly assessed in many minority populations, and there are significant health disparities as a result. Therefore, it is important to identify the remaining BC risk genes that are relevant to diverse populations. Isolated populations, like certain populations from the Central Colombian Andes, have been used in many genetic studies of human disease, with findings that have been relevant to diverse ethnic backgrounds. This is attributed to founder effects in isolates that increase the frequency of otherwise "rare" variants and provide a powerful avenue for novel gene discovery. To begin to address the void in genetic BC risk, we screened BC patients for mutations in known genes using genotyping and targeted sequencing approaches. Strikingly, 28 of 722 unselected cases (4%) harbored the same *BRCA1 3450del4* mutation and clinical data indicate that these individuals originate from a distinct geographic region in Colombia, Neiva. Ten percent of the unselected BC cases in Neiva and the surrounding region harbor the *3450del4* mutation, potentially representing one of the most profound founder effects reported in human populations. We have also identified a number of different pathogenic mutations in *BRCA1*, *BRCA2*, and *PALB2*, many of which have never been reported before. Moreover, thus far, over 500 BC patients that were screened do not harbor mutations in known BC risk genes, and whole exome sequencing of these cases will facilitate novel BC risk gene discovery. By understanding the prevalence of mutations in known risk genes in minority populations and identifying novel risk genes, cancer disparities

can be better addressed and BC screening can be improved. Furthermore, these findings have direct implications in robust and cost-effective targeted screening in regions where there is a high prevalence of particular mutations associated with BC risk.

***DEB Graduate Student**

COMPANY AFFILIATE: Sutro Biopharma, Inc.

RAPID ANTIBODY DISCOVERY PLATFORM FOR ANTIBODY DRUG CONJUGATES AND BISPECIFIC ANTIBODIES



Presenter:	Alice Yam, PhD
Authors:	**A.Yam**, A. Gill, J. Axup, S. Armstrong, R. Henningsen, M. You, F. Avogadri-Conners, D. Chemla-Vogel, J. Lee, X. Li, A. Gakhal, L. Nguyen, H. Stephenson, M. Tam, J. Yang, R. Stafford, K. Penta, A. Sato, T. J. Hallam
Affiliations:	Sutro Biopharma, Inc. South San Francisco, CA

The development of novel antibody therapeutics, especially antibody-drug conjugates (ADCs) and bispecific antibodies, is often a challenging and time-consuming process. Utilizing Sutro's cell-free protein synthesis (CFPS) system, we describe an antibody discovery platform for the selection, screening, and characterization of antibodies for novel drug targets in approximately four weeks. Using ribosome display technology, we can select binders from billion-member libraries and directly screen the clonal output in CFPS. Because CFPS allows the rapid expression of variants at high titers, we have the ability to screen thousands of variants for desirable antibody characteristics such as cell binding, cell internalization, binding affinity, thermostability, and epitope. Top leads can be further optimized for non-natural amino acid incorporation and drug conjugation for the generation of homogeneous ADCs. Alternatively, variants can be combined and evaluated as bispecific antibodies. Sutro's antibody discovery platform enables rapid candidate generation and characterization for making the most efficacious and safe ADCs and bispecific antibodies.

BIOTECH FELLOW: Douglas Gettel

COMPOSITION-DEPENDENT MEMBRANE REMODELING IN THE BROAD-SPECTRUM VIROCIDAL ACTIVITY OF AN HCV NS5A ANCHOR PEPTIDE DERIVATIVES

Presenter: Doug Gettel*

Authors: Joshua M. Hanson[1a], Douglas L. Gettel*[1a], Seyed R. Tabaei[3,4], Joshua Jackman[3,4], Min Chul Kim[3,4], Darryl Y. Sasaki[5], Bo Liedberg[3,4], Nam-Joon Cho[3,4,6], and Atul N. Parikh[1,2,3,4,7]

Affiliation: [1]Biophysics Graduate Group, University of California, Davis, CA
[2]Department of Chemical Engineering & Materials Science, University of California, Davis
[3]Centre for Biomimetic Sensor Science, Nanyang Technological University
[4]School of Materials Science and Engineering, Nanyang Technological University
[5]Biotechnology and Bioengineering Dept., Sandia National Laboratories
[6]School of Chemical and Biomedical Engineering, Nanyang Technological University
[7]Department of Biomedical Engineering, University of California, Davis
[a]Equal contributions

Preceptor: Atul Parikh

Synthetic α-helical (AH) peptides – derived from the membrane anchor domain of the hepatitis C virus nonstructural protein NS5A – represent a class of membrane-active antivirals, which exhibit broad spectrum efficacy against multiple viruses. Their mechanisms of action, however, remain incompletely understood. Here, using protein- and cytosol-free giant unilamellar vesicles, we show that the AH peptide discriminates viral membrane compositions and disrupts membrane integrity in a curvature-dependent manner. Peptide binding induces domain formation and transient permeabilization in cholesterol-enriched model viral membranes. By contrast, single-component membranes produce
global softening characterized by vigorous fluctuations, albeit at substantially higher peptide concentrations. Furthermore, in mixed populations, small vesicles of viral dimensions outcompete the giant ones for AH association. These synergistic – composition- and curvature-dependent –molecular interactions offer new insights into how membrane's

compositional degrees of freedom couple with peptide binding and may explain how virocidal AH peptides derive, at once, both a specificity for broad classes of virions and capacity for broad-spectrum activity.

***DEB Graduate Student**

COMPANY AFFILIATE: Bavarian Nordic, Inc.

POXVIRUS-BASED CANCER IMMUNOTHERAPY

Presenter: Jeannie Giacchino, PhD*

Authors: **Jeannie Giacchino**, Alex Franzusoff, and James Breitmeyer

Affiliations: Bavarian Nordic, Inc. Mountain View, CA

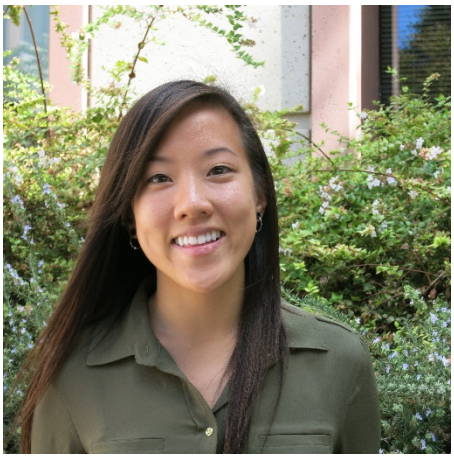
Cancer immunotherapy shows great promise for treating patients with solid tumors, and is expected to become the backbone of future cancer treatment. Bavarian Nordic is an international biotechnology company developing and manufacturing novel cancer immunotherapies and vaccines for infectious diseases. To meet the growing need for innovative cancer therapies, Bavarian Nordic, in collaboration with the National Cancer Institute (NCI), has developed a robust cancer immunotherapy portfolio including PROSTVAC, a product candidate for advanced prostate cancer that is the subject of an ongoing pivotal Phase 3 clinical trial.

Recombinant viral vectors, and poxviruses specifically, show evidence of efficacy as cancer immunotherapy. Administration of these vectors in a heterologous prime-boost regimen, which is well-tolerated with an excellent safety profile as monotherapy, elicits strong anti-cancer killer T cell immune responses. The poxviral vectors are capable of encoding multiple transgenes, including tumor associated antigens (TAAs) and other molecules that enhance immune system activation. One significant advantage of this approach is that upon initiation of tumor killing in response to poxvirus-based immunotherapy, each patient's immune system becomes alerted to and diversifies the immune responses to 'private' antigens specific to that patient's tumor. The emergence of this 'antigen-spread' immune response is proposed to expand protection against tumor escape. We will present data from clinical trials with cancer patients in support of safe and efficacious use of poxvirus-based immunotherapies.

Bavarian Nordic's cancer immunotherapy candidates offer tremendous potential for improved patient outcomes and are also being evaluated in clinical studies in combination with potentially synergistic therapies.

BIOTECH FELLOW: Rosanna Kwok

TEMPORAL DYNAMICS OF EPIGENETIC LANDSCAPE ENABLE FINE-TUNING OF CIRCADIUM TRANSCRIPTION



Presenter: Rosanna Kwok*
Authors: **Rosanna S. Kwok***, Ying H. Li, Anna J. Lei, and Joanna C. Chiu
Affiliations: Department of Entomology, University of California, Davis
Preceptor: Joanna Chiu

Circadian clocks are endogenous timekeeping mechanisms that drive rhythms in organismal physiology and behavior. Mutations in clock genes and circadian disruption are known to be associated with many human health problems including metabolic syndromes, cancer, and depression. Progression of the clock requires temporal changes in levels of mRNAs and proteins of the central molecular oscillator over a circadian cycle. In the *Drosophila* model system, these oscillations are tightly controlled by transcriptional-translational feedback mechanisms orchestrated by key transcription factors CLOCK (CLK) and PERIOD (PER). Despite the well-studied rhythmic interactions of these transcription factors to clock-regulated target gene regions, there still lacks a comprehensive understanding of the epigenetic landscape required to facilitate these interactions. Given the importance of epigenetic state and the impact of disruptions in epigenetic control on human health and disease, we set out to understand the temporal changes in chromatin landscape in the circadian transcriptome, specifically focusing on the regulation at key clock genes. Using mass spectrometry-based proteomics, our laboratory identified the BRAHMA (SWI/SNF) chromatin remodeling complex as an interactor of CLK and PER. Using the versatile genetics of *D. melanogaster* along with molecular biology and biochemical approaches, we characterized the role of BRM in regulating the rhythmic expression of clock genes. Our results show that BRM interacts with CLK and fine-tunes the levels of CLK-dependent transcription to maintain the robustness of the circadian clock. In addition to advancing the understanding of circadian transcriptional control, our research illustrates the importance of understanding temporal progression in the epigenetic control of gene expression.

***DEB Graduate Student**

COMPANY AFFILIATE: Agrinos, Inc.

AGRINOS PRODUCES CROP INPUTS DESIGNED TO IMPROVE GLOBAL AGRICULTURAL PRODUCTIVITY AND SUSTAINABILITY

Presenter: Gian Oddone, PhD

Authors: **Gian Oddone**

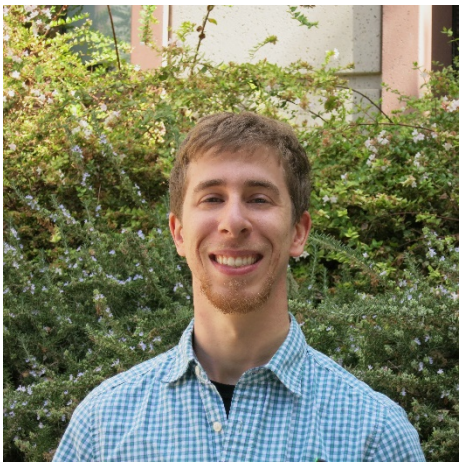
Affiliations: Agrinos, Inc.
Davis, CA

Agrinos is a global leader in biological crop input solutions committed to improving the productivity and sustainability of modern agriculture. Agrinos' range of High Yield Technology (HYT®) products helps farmers to practice profitable agriculture by providing increased crop productivity, improved efficiency of conventional fertilizer and a reduced environmental footprint. Certified as organic and based on Agrinos' proprietary technology, the HYT products provide benefits by strengthening the soil-based microbial ecosystem, stimulating crop development at key points in the growth cycle and boosting natural plant resistance to pathogens and threats. With solutions for a variety of crop categories, the technology comprising the HYT products has demonstrated its value in third-party trials in key agricultural regions worldwide.

***DEB Graduate**

BIOTECH FELLOW: Sam Westreich

A COMPLETE PIPELINE FOR GUT METATRANSCRIPTOME ANALYSIS

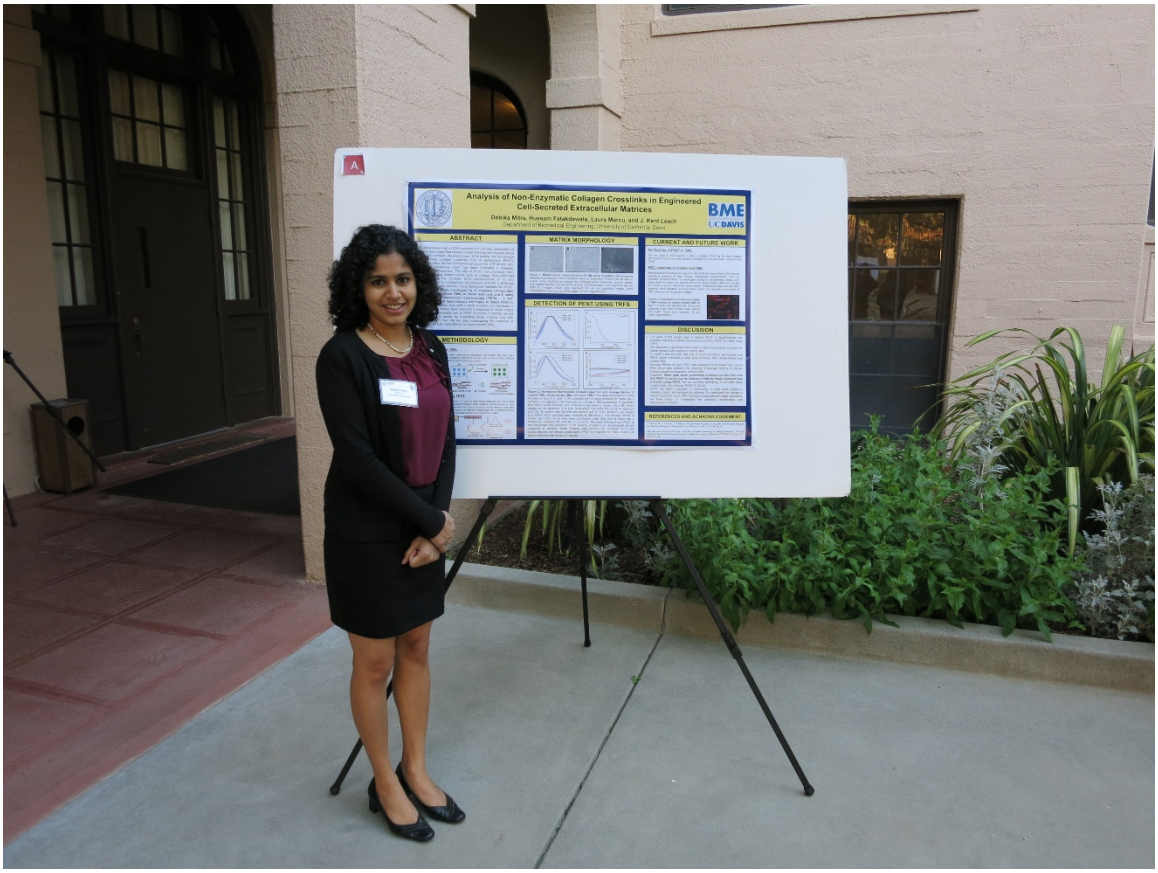


Presenter: Sam Westreich*
Authors: **Sam T. Westreich,** David A. Mills, Ian Korf, and Danielle G. LeMay
Affiliations: Genome & Biomedical Facility, University of California, Davis
Preceptor: Ian Korf

Metatranscriptomics, the examination of RNA transcript profiles across multiple species, is a rapidly growing sub-field of genetics. However, there are no widely accepted protocols for metatranscriptomic analysis, spanning from necessary read length and coverage of RNA-seq to the most efficient methods for annotating obtained reads and condensing raw information into a usable summary. We have developed a set of 'best practices' for setting up a metatranscriptomics experiment, as well as a complete analysis pipeline for processing the raw digital data through incorporation with the MG-RAST annotation engine. Starting with a raw sequence file, this pipeline determines the best reference sequence match and organism of origin for each input read. A custom Python program analyzes this output, creating sorted abundance measures of both the organisms and transcripts present within the sample. These results are now helping to streamline the collection of experimental metatranscriptomic data, from initial RNA-seq to obtaining proper annotation on a per-read basis and condensing raw annotated output into a readable summary of the metatranscriptome's contents. We are currently experimentally confirming the accuracy of these RNA-seq practices with a study of the gut microbiome in rhesus macaques, while concurrently continuing to improve the speed and efficiency of the bioinformatics analysis pipeline.

***DEB Graduate Student**

Poster Abstracts



A. eIF4E PROMOTES VIRAL IRES MEDIATED TRANSLATION BY STIMULATING RNA RESTRUCTURING BY eIF4A

Brian Avanzino*[1], Gabriele Fuchs[2], Peter Sarnow[2], and Christopher Fraser[1]
[1]Department of Molecular and Cellular Biology, University of California, Davis, CA
[2]Department of Microbiology and Immunology, Stanford University School of Medicine

Picornaviruses are small positive-strand RNA viruses that are responsible for a multitude of human diseases ranging from the common cold to poliomyelitis. Viral translation hijacks a subset of cellular translation initiation factors through a unique mechanism mediated by highly structured viral RNA elements called Internal Ribosome Entry Sites (IRESes). Importantly, viral IRESes require restructuring of the viral genome by the cellular helicase protein eIF4A to promote ribosome recruitment and translation initiation. Human eIF4G is required to stimulate the helicase activity of eIF4A, but infection of cells by picornaviruses typically leads to the cleavage of eIF4G by a viral encoded protease. It is not clear how this cleavage event impacts eIF4A helicase activity.

Unexpectedly, despite the fact the viral RNA is uncapped, efficient viral RNA restructuring prior to eIF4G cleavage requires the cellular cap-binding protein, eIF4E. This helicase stimulating function of eIF4E is independent of its cap binding function. Following eIF4G cleavage, the viral IRES can use the cleaved eIF4G for efficient unwinding, while cellular mRNAs cannot. Additionally, picornaviral translation is stimulated by eIF4E prior to eIF4G cleavage in a functional messenger dependent lysate. Furthermore, overexpression of an eIF4E mutant that cannot bind the cap stimulates poliovirus replication *in vivo*. These findings highlight the importance of eIF4A during viral translation and illustrate the complex and dynamic regulation of eIF4A helicase activity during viral infection. These results identify eIF4A and eIF4E as potential antiviral targets.

***DEB Graduate Student**

B. MICROFABRICATED NANOPOROUS GOLD COATINGS PROMOTE CORTICAL CELL TYPE DEPENDENT SURFACE COVERAGE

Christopher Chapman*[1], Hao Chen[2], Marianna Stamou[2], Juergen Biener[3], Monika Biener[3], Pamela J. Lein[2], and Erkin Seker[4]
[1]Department of Biomedical Engineering, University of California, Davis
[2]Department of Molecular Biosciences, University of California, Davis
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A major obstacle in long term reliability of neural electrode coatings has been the undesired aggregation of glial cells onto the surface of the electrode after implantation, which leads to reduced sensor performance. In order to address this issue, this research aims to develop a novel electrode coating that can both mitigate the adverse tissue response (gliosis) and achieve high-fidelity recordings by selective neuron-electrode integration. Nanoporous gold (np-Au) has shown promise as a novel biomaterial for this purpose due to its tunable nanostructure, microfabrication compatibility, and electrical conductivity. Here, we report on the effect of np-Au electrode nanostructure and surface chemistry on neuronal and astroglial surface coverage. Np-Au samples used in this study were fabricated by sputter-deposition of a gold/silver alloy on glass coverslips and subsequent etching of silver to self-assemble the np-Au coatings. Surface chemistry of the samples was modulated without altering the nanostructure by atomic layer deposition of a 2 nm-thick conformal coating of aluminum oxide. Cortical cells (containing both neurons and astrocytes) were harvested from perinatal rats and dissociated. The cortical cells were seeded on different samples (following successive treatments with oxygen plasma, poly-L-lysine, and culture media) and incubated. The cells were subsequently fixed at DIV 7 and stained with DAPI (nucleus), GFAP (astrocyte), and Tubulin-βIII (neuron). Fluorescence-microscopic analysis of cell densities was performed on co-cultures grown on glass, planar-Au and np-Au, and alumina-coated planar Au and np-Au. The co-cultures grown on np-Au and aluminum oxide coated np-Au exhibited a 40-50% decrease in astrocyte density in comparison to that on planar surfaces. In contrast, neuronal density remained unchanged on all samples. Surface chemistry modulation by aluminum oxide did not affect cellular response. The results of this study strongly suggest that the nanoporous gold morphology, but not surface chemistry, plays an important role in differential neuronal and astrocytic response to the underlying coating. Sustained neuronal integration and decreased astrocytic attachment is an important step towards engineering reliable neural electrodes. Our current research efforts focus on engineering biomaterial libraries to screen for electrode properties that enhance the differential response of neurons and astrocytes.

***DEB Graduate Student**

C. THE ROLE OF PHOSPHORYLATION IN REGULATING SLIMB/ß-TrCP ACTIVITY IN THE PROTEOSOME PATHWAY

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Post-translational modification (PTM) such as phosphorylation is an integral step in protein regulation. Poly-ubiquitination is a PTM carried out by E3 Ubiquitin Ligases (E3), which is important for protein degradation and regulation of cellular events. SLIMB is an F-box protein in the *Drosophila* E3 complex with a highly conserved mammalian homologue, β-TrCP. The objective of this investigation was to determine how SLIMB phosphorylation regulates interactions with one of its substrates, PERIOD (PER). PER regulates circadian transcription in animals through conserved mechanisms. Its expression oscillates daily in response to a transcriptional negative feedback loop and SLIMB-mediated degradation. PER PTM regulation is well described, but surprisingly, few studies have characterized how PTM directly regulates SLIMB activity, despite observations that SLIMB is phosphorylated. We mapped phosphorylation sites on SLIMB by affinity purification followed by LC-MS/MS and identified phosphosites that regulate SLIMB-PER interactions. We performed GST pull-down assays with PER and GST-SLIMB mutants harboring phosphomimetic or non-phosphorylatable amino acid substitutions at phosphorylation sites. We have characterized at least one site that can regulate SLIMB-PER binding interactions by its phosphorylation state. Our results denote a PTM that regulates SLIMB activity at this step of the proteasome pathway. These regulatory mechanisms may have important implications in disorders and diseases associated with deficient SLIMB/β-TrCP-mediated protein degradation.

***DEB Graduate Student**

D. ATTENUATED CALCIUM ENTRY AND CYTOKINE RELEASE TO THE ENVIRONMENTAL TOXICANT, PBDE, IN ISOLATE HUMAN PBMCS

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Exposure to the environmental toxicant, polybrominated diphenyl ethers (PBDEs), has been shown to alter immune and neurological function in both animal models. PBDEs are synthetic, lipid soluble persistent organic pollutants (POP), which are known to bioaccumulate in the food chain. Their use as flame-retardants has lead to widespread environmental contamination; PBDEs are ubiquitous in nature and are becoming an environmental health concern. The non-coplanar structure of PBDEs is analogous to polychlorinated biphenyls, another POP which been shown to interfere with proteins related to calcium signaling. It is hypothesized that PBDEs may also interfere with calcium signaling by a similar mechanism. Previous studies have indicated, in children with autism (ASD), PBDE congeners, specifically BDE-47 and BDE-49, may differentially alter immune signaling in isolated PBMCs, but the mechanism of action is currently unknown. Therefore, we propose that the altered immune signaling due by BDE-47 and BDE-49 in ASD subjects may be due to altered calcium signaling or stored operated calcium entry (SOCE). PBMCs were isolated from healthy human volunteers and exposed to the PBDE congeners BDE-49 and -47 (250nM, 24hr). PBMCs were loaded with fluo-4AM, and challenged with ATP (100μM). BDE-49 and 47 significantly decreased the amplitude of ATP mediated calcium transient and its decay ($t_{1/2}$) to baseline, indicating an inhibition of calcium influx via SOCEs. In parallel studies of immune cell activation, PBMCs exposed to BDE-47 and -49 (250nM, 24 hr) were challenged with immune activators (24hr) and cells supernatants were analyzed via Luminex techonlogy. Both PBDEs decreased the production of cytokines. These results are the first to identify inhibition of SOCEs by PBDEs in humans as potential key mechanisms affecting immune signaling and could contribute to the immunotoxicity of PBDEs in children with autism.

***DEB Graduate Student**

E. ANTIMICROBIAL MUCOSA ASSOCIATED INVARIANT T CELLS IN THE GUT IN HIV-1 INFECTION

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The gut mucosal tissue, which houses a large proportion of CD4 T cells, is a major target of HIV-1 in humans. Mucosal Associated Invariant T (MAIT) cells are a matter of interest with regard to HIV-1 infection, since they are present in high numbers in the human gut mucosal tissue, representing 5-10% of the T cell population there. A consequence of HIV-1 transmission in the gut is extensive tissue damage, leading to microbial translocation and increased immune activation. MAIT cells serve as a mucosal defense against bacterial pathogens, producing IFNγ, TNF-α, IL-17 and IL-22 and are known to have antimicrobial activity. Overall, a hypothesis can be made for MAIT cells' role in protective immunity against opportunistic mucosal pathogen infection during HIV-1 infection; and that the loss of MAIT cells or impaired functionality may contribute to the body's inability to respond to HIV-1 infection and certain opportunistic fungal and bacterial infections. Peripheral blood and rectal mucosa biopsies will be obtained from HIV infected individuals, with and without antiretroviral therapy, as well as uninfected individuals, then stained with surface antibodies to study frequency and phenotype of MAIT cells using Flow Cytometry. MAIT cells will also be stained with intercellular cytokines to look at cytokine production and cell functionality during HIV infection. Specific information on markers of homing, activation, exhaustion, and apoptosis will be compared between tissues of comparison groups. Transcript levels of chosen cytokines will be measured using qPCR following ex vivo stimulation. It is anticipated that mucosal MAIT cells from chronic HIV+ individuals may lack production of IFN-g, TNF-a, IL-17, IL-22 and thus have impaired effector function in chronic HIV-1 infection. It is also anticipated that ART may partially restore the ability of mucosal MAIT cells to produce these cytokines, thereby contributing to maintenance of the intestinal barrier and defense against opportunistic infections. This research will help to better understand the host response and control of opportunistic pathogens in the context of HIV immuno-pathogenesis. (Funding: NIH/NIAID grant R01 AI057020)

***DEB Graduate Student**

F. TUNING MOLECULAR RELEASE FROM NANOPOROUS GOLD THIN FILM BY PORE MORPHOLOGY MODIFICATION

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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. RAPID ANTIBODY DISCOVERY PLATFORM FOR ANTIBODY DRUG CONJUGATES AND BISPECIFIC ANTIBODIES

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The development of novel antibody therapeutics, especially antibody-drug conjugates (ADCs) and bispecific antibodies, is often a challenging and time-consuming process. Utilizing Sutro's cell-free protein synthesis (CFPS) system, we describe an antibody discovery platform for the selection, screening, and characterization of antibodies for novel drug targets in approximately four weeks. Using ribosome display technology, we can select binders from billion-member libraries and directly screen the clonal output in CFPS. Because CFPS allows the rapid expression of variants at high titers, we have the ability to screen thousands of variants for desirable antibody characteristics such as cell binding, cell internalization, binding affinity, thermostability, and epitope. Top leads can be further optimized for non-natural amino acid incorporation and drug conjugation for the generation of homogeneous ADCs. Alternatively, variants can be combined and evaluated as bispecific antibodies. Sutro's antibody discovery platform enables rapid candidate generation and characterization for making the most efficacious and safe ADCs and bispecific antibodies.

H. HOST DIET CHANGES ECOLOGICAL NICHE AVAILABILITY FOR PROBIOTIC *LACTOBACILLUS* IN THE DIGESTIVE TRACT

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Diet is a major factor that shapes the human intestinal microbiome. Less understood is the function of diet on the survival and host-microbe interactions of indigested microorganisms that enter the digestive tract in foods and beverages. We previously found that *Lactobacillus plantarum* WCFS1 survived in 10-100-fold higher numbers in mice consuming a high-fat and high-sucrose (HFD) diet compared to mice fed a low-fat, plant-polysaccharide rich chow diet (CD). *L. plantarum* WCFS1 also protected against colitis in mice fed the HFD but not the CD. This work also showed that mice fed a HFD had significantly fewer indigenous *Lactobacillus* inhabitants, suggesting that the HFD may open a niche for *L. plantarum* establishment and persistence in the digestive tract. To elucidate whether this effect is reversible, we fed 16 female BALB/c mice a diet regime consisting of diet switches between HFD and CD. Each intervention lasted five days and was followed by a wash out period of nine days. Half of the mice were fed *L. plantarum* WCFS1 at a dose of 10^9 CFU cells per day during the diet interventions. Quantification of *L. plantarum* WCFS1 in the mouse stools, confirmed that this strain survived in significantly higher numbers (13-fold, on average) during the HFD intervention periods compared to CD. Gut microbiota analysis revealed the distinct bacterial network with this probiotic under different diet backgrounds. These findings show the intestinal persistence of dietary bacteria (probiotic *Lactobacillus*) and their interactions with the indigenous gut microbiota can be directly influenced by host diet.

***DEB Graduate Student**

I. LC-MS/MS ANALYSIS OF LIPID MEDIATORS IN SWEAT

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Sweat is a complex biological fluid with potential diagnostic value for the investigation of disorders of the skin. Previous efforts in sweat testing focus primarily on analysis of ions such as chloride for the diagnosis of cystic fibrosis or xenobiotics such as steroids for doping control testing, though additional small molecules have been detected in this matrix. Collection techniques include non-occlusive absorbent bandages and devices using local stimulation and capillary based collection and analytical techniques include nuclear magnetic resonance (NMR) spectroscopy, liquid chromatography-tandem mass spectrometry (LC-MS/MS) and radioimmunoassay (RIA). With advances in analytical and sweat collection techniques, there has been recent interest in conducting targeted and untargeted metabolomic analyses of sweat with the aim of establishing biomarkers for diseases such as atopic dermatitis as well as understanding the mechanisms of biological processes associated with inflammation and repair mechanisms of the skin. Within the context of atopic dermatitis, analysis by RIA suggests that atopic dermatitis patients have increased levels of oxylipins, in particular prostaglandin E2 (PGE2). Advances in lipid mediator analyses have increased both sensitivity and the breadth of coverage. Adapting existing collection devices and using an LC-MS/MS method, we have currently quantified over 20 oxylipins representing both the cytochrome P450- and lipoxygenase-dependent pathways, and explorations of the endocannabinoid profiles within sweat from a healthy human subject are planned. Some metabolites belonging to these enzymatic pathways have been previously associated with atopic dermatitis using skin biopsies or plasma. Having established and validated an LC-MS/MS method for the analysis of lipid mediators in sweat, our eventual goal is to develop a non-invasive diagnostic method for atopic dermatitis and understand its pathophysiology in order to develop more targeted therapeutic interventions with future expansions into other analytes and disease states.

***DEB Graduate Student**

J. OLIGOMERIZATION OF FLAG TAGGED RECOMBINANT BUTYRYLCHOLINESTERASE PROTEIN *IN PLANTA*

Salem Alkanaimsh[1]*, Kalimuthu Karuppanen[1], Andres Guerrero[2], Carlito Lebrilla[2], Somen Nandi[3], Raymond Rodriguez[3], and Karen A. McDonald[1]
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Butyrylcholinesterase (BuChE) enzyme has been shown to be effective against nerve agent exposure. Butyrylcholinesterase enzyme is a 340 kDa tetramer protein where oligomerization is achieved by proline rich peptides having electrostatic and hydrophobic interaction with the tetramization domain in the C terminal of the BuChE enzyme. Producing a full size functional tetramer protein is an important factor in creating a viable therapeutic agent since circulation is dependent on the quaternary form of the protein. The residence time of the native human BuChE is in days while it is in the order of minutes for monomeric form. A plant viral amplicon gene expression system based on *Tobacco mosaic virus*(TRBO) is used to express functional FLAG tagged BuChE in *Nicotiana benthamiana* leaves using transient agroinfiltration. The protein was produced and purified to homogeneity using anti FLAG affinity gel. Monomers and multimers of purified BuChE were observed on Western blot under reducing and non-reducing conditions. A native gel was run to evaluate an estimation of tetramerization of the pure BuChE. Almost all the pure recombinant protein was in the tetrameric structure. The N-glycans analysis of the pure BuChE reveals a mixture of N-glycans consisting mainly of complex N-glycans (40%), high mannose structure (25%), and paucimannosidic-type N-glycan (35%) indicating that oligomers are assembled during protein folding and not induced purification strategy. To support this observation, a crude extract preparation was analyzed in terms of tetramerization extent. Nearly all the protein was tetramer in the crude extract indicating that plants are capable of folding correctly large proteins. *Nicotiana benthamiana* is known to have Hybrid proline rich proteins as a part of their cell wall structure. Those proteins have proline rich repetitive domain at their N-terminal which might involve in tetramerization of BuChE. FLAG tag was resistant to cleavage and a partial cleavage was attained upon denaturation which plays a role in achieving high tetramerization degree of BuChE protein.

K. AGROBACTERIA-MEDIATED TRANSIENT EXPRESSION AND CHARACTERIZATION OF A THERMOSTABLE ß-XYLOSIDASE IN *N. BENTHAMIANA*

Liz Anthony*[1], Minsook Hwang[2], My Phu[3], Bryce W. Falk[2], Abhaya M. Dandekar[3], and Karen A. McDonald[1]

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[3]Department of Plant Science, University of California, Davis

The Energy Independence and Security Act of 2007 mandates the production of at least 21 billion gallons of "second-generation" biofuels by 2022. Cellulosic biofuels require the derivation of sugars from the plant cell wall. Xylan, a hemicellulose, can be degraded to xylose monomers by a set of synergistic enzymes. A thermostable xylanase, which cleaves β-1,4-xylosidic bonds in the polymer chain has previously been transiently expressed by our group in *N. benthamiana* and sunflower. Here, we report the transient expression of a thermostable β-xylosidase, which cleaves β-1,4-xylosidic bonds in xylo-oligimers into xylose monomers, in *N. benthamiana*. A gene construct was codon optimized containing a β-xylosidase gene from *Thermotoga maritima*, a signal peptide targeting the enzyme to the apoplast, and a 3xFLAG tag for purification. Beta-xylosidase was successfully transiently expressed in *N. benthamiana* using agrobacteria-mediated vacuum infiltration using 35S, TRBO, and CMVar vector systems with expressions ranging from 14 to 124 U/kg fresh weight of plant biomass 6 days post infiltration. Activity was tested on p-nitrophenyl-xylopyranoside (pNPX). Production kinetics were determined at various concentrations of recombinant agrobacteria in the infiltration buffer, with and without a gene silencing suppressor, for each of the vector systems. Optimal activity for the plant-made β-xylosidase was determined to be pH 5-7 and 70ºC on pNPX. This is the first reported expression of a recombinant β-xylosidase in a plant system to our knowledge.

***DEB Graduate Student**

l. WHO'S IN THE DRIVER'S SEAT? IDENTIFYING CAUSATIVE VARIANTS OF COLORECTAL CANCER

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Colorectal Cancer (CRC) is one of the leading causes of mortality in the US, being the third most common cancer among both men and women. While an exact cause of CRC has not yet been elucidated, the existence of a clear heritable genetic component has been established. With the recent surge of data from Genome-Wide Association Studies, a handful of CRC-associated loci have been identified via tagSNPs. While the probability of the tagSNPs themselves being the causative variants is low, the key may lie among the number of single-base variants linked to each tagSNP. It is crucial, in order to enhance our understanding CRC tumorigenesis, to extract these functional variants from the pool of associated SNPs and validate their causative significance within the cell.

This project combines bioinformatics and functional experiments to both identify and assess the role of functional variants in CRC pathogenesis. One of the major hurdles in understanding the role of CRC risk-associated SNPs is the fact that virtually all variants lie in Non-Protein Coding Region, often tens of thousands of bases away from flanking genes. By combining variant data from publically available databases, such as that of the ENCODE project, this research presents a method to prioritize all variants within a set of disease-associated loci based on potential regulatory functionality *in silico*. With this technique, we have identified a handful of SNPs with functional potential that may be functioning specifically in CRC initiation. In parallel, we are in the process of developing a method to effectively produce isogenic cell lines modeling the appropriate variant alleles, utilizing the CRISPR/Cas9 system to stimulate homologous recombination in the presence of a donor template. With this method, transcriptional and regulatory changes within the cell due to the single-base genomic edit can be measured in order to characterize these functional variants. Utilizing this technology, we have begun to create our first SNP model of SNP rs6983267, a known functional variant whose risk SNP promotes CRC development by means of increased binding and activation of WNT signaling pathway elements, c-Myc and β-Catenin. The ultimate goal of this project is to better understand the role of CRC risk-associated variants, the result of which could have substantial clinical relevance in the generation of new therapies and diagnostics for the treatment of CRC.

***DEB Graduate Student**

M. DEVELOPMENT OF A TRANSGENIC RICE CELL SUSPENSION CULTURE FOR PRODUCTION OF BUTYRYLCHOLINESTERASE

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The bioscavenging enzyme butyrylcholinesterase (BuChE) has emerged as an effective therapy against exposure to organophosphorus nerve agents, though its high cost and low availability limit its use. To address the need for a lower cost, scalable process for BuChE production, we have developed a stably transformed cell suspension culture of transgenic *Oryza sativa* (rice) that is capable of producing functional BuChE under a metabolically regulated promoter. After transformation and selection of several cell lines, the transgenic rice callus was transferred from semi-solid to liquid growth media to establish suspension cultures in shake flasks. The suspension cultures were assessed at increasing scale to verify repeatability of the functional BuChE expression levels and cell growth rates for each cell line. Multiple inductions of the same calli were performed to establish the possibility of a semi-continuous operation. These data were used to select a top cell line for scale up to a 5 L bioreactor.

***DEB Graduate Student**

N. PURIFICATION AND *N*-GLYCAN ANALYSIS OF HUMAN RECOMBINANT PROTEIN ALPHA-1 ANTITRYPSIN

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Alpha-1 Antitrypsin (AAT) is a protease inhibitor belonging to the serpin superfamily. It protects tissues from enzymes of inflammatory cells, especially neutrophil elastase. AAT deficiency is one of the most prevalent lethal hereditary diseases, resulting in lung problems such as emphysema or liver disorders. For treatment, an augmentation therapy is proposed, consisting normally of the intravenous injection of AAT once a week. Plasma-derived AAT is currently the only FDA approved source, however due to production constraints, safety concerns and cost, alternative recombinant production methods are being investigated. Plants provide a viable option to traditional microbial and mammalian cell culture technologies for production of recombinant proteins, allowing for cost effective, highly scalable and safe production of recombinant therapeutic proteins. Tobacco plants have been widely used to express proteins in their leafy biomass. Tobacco is an efficient expression host since it is a non-feed/food crop and produces a high biomass yield. Viral-based expression vectors cloned into *Agrobacterium tumefaciens* are very attractive recombinant protein expression tools allowing proteins to be produced to a high level within a short period of time. In the novel chemically inducible viral amplicon expression system referred to as CMViva (Cucumber Mosaic Virus inducible viral amplicon) the open reading frame of the CMV coat protein is replaced with the plant codon optimized gene for the target product.

In this work *Agrobacterium tumefaciens* harboring the CMViva expression system is delivered into *Nicotiana benthamiana* plants via vacuum agroinfiltration. A viral RNA gene silencing suppressor (P19) is co-expressed to improve AAT production. To purify the target molecule from plant biomass, a variety of downstream processing approaches were explored starting with protein extraction using various buffer systems. The extraction buffer was optimized and a basic buffer (50mM Tris, 150mM NaCl, 1mM EDTA, 2mM $Na_2 S_2 O_5$ and pH 8.0) was selected to minimize the phenolic and protease effects and maximize recovery of functional protein. A microfiltration step performed with a 1.2 µm and 0.22 µm filter followed by ultrafiltration with a 30 kDa MWCO filter was used to prepare the extract for affinity chromatography. The purity of the target protein was assessed using SDS-PAGE and its molecular weight was confirmed with Western blot. Isoelectric point (pI) of the purified protein was confirmed with a pH gradient gel. In addition, peptide coverage and amino acid composition was assessed using AAA analysis and MS-MS analysis. Similarly, site specific *N*-

glycan analysis was assessed and which was compared to human AAT control. The production and purification strategies developed can be used as a basis to evaluate the potential of the plant based process for large scale commercial production of AAT.

O. ANALYSIS OF NON-ENZYMATIC COLLAGEN CROSSLINKS IN ENGINEERED CELL-SECRETED EXTRACELLULAR MATRICES

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Diabetic patients suffer from significantly reduced bone healing compared to otherwise healthy patients. The extracellular matrix (ECM) serves as the instruction manual for cellular response to the microenvironment, and hyperglycemia results in the formation of non-enzymatic crosslinks, such as pentosidine (PENT) between collagen fibrils of the ECM. PENT can diminish the biomechanical properties of bone and impair the osteogenic response of bone-forming osteoblasts. Current techniques for studying PENT are destructive, and many studies employ collagen films rather than ECMs representative of *in vivo* microenvironments. Moreover, the effect of PENT on progenitor cells like mesenchymal stem cells (MSCs), which differentiate into osteoblasts, has not been investigated. We addressed these 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. A significant blue shift in peak fluorescence and reduction in average lifetime were observed, indicating the formation of a new autofluorescent biomolecule, presumably PENT, in response to ribose culture. Mass spectrometry analysis showed comparable amounts of collagen in control and crosslinked DMs, providing further evidence that changes in fluorescence are due to the presence of PENT and not changes in collagen content. We are currently confirming the presence of PENT *via* HPLC to validate TRFS as a more efficient method for crosslink detection. Preliminary studies examining the effect of crosslinks on cellular response show that while there was no significant difference in proliferation of MSCs seeded on control and crosslinked DMs, calcium deposition was reduced due to crosslinking. The model system developed here may provide an alternative method to determine the contributions of PENT towards impaired diabetic bone healing.

***DEB Graduate Student**

P. DETERMINING THE MECHANISM OF SPINDLE POSITIONING IN RESPONSE TO THE SRC POLARITY CUE

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Asymmetric divisions produce daughter cells with different fates, and thus are critical for animal development. In asymmetric divisions, the mitotic spindle must be positioned on a polarized axis to ensure the differential segregation of cell fate determinants into the daughter cells. The position of the mitotic spindle not only determines the site of cell division during asymmetric division, but also facilitates the positioning of daughter cells, which is important for tissue and organ formation. The mechanism of spindle positioning has been well characterized in the one-cell *Caenorhabditis elegans* embryo. During this asymmetric division, a cortically localized force generating complex consisting of G**α**, GPR, and LIN-5 (G**α**/GPR/LIN-5) mediates the cortical recruitment of dynactin/dynein that then exerts pulling force on astral microtubules to physically position the spindle along the A/P axis. Additionally, LET-99 inhibits the formation of the G**α**/GPR/LIN-5 complex in a posterior lateral domain of the *C. elegans* one-cell embryo resulting in asymmetric cortical pulling forces that asymmetrically position the spindle to facilitate asymmetric cell division. The cortical force generating complex as well as the intrinsic polarity cues that regulate it play conserved roles in many animals. However, much less is known about spindle positioning in response to extrinsic cell signaling in the multicellular context. An established model for the effects of signaling on spindle positioning is the asymmetrically dividing endomesodermal precursor (EMS) cell in the four-cell *C. elegans* embryo. Partially redundant Wnt and Src cues induce the EMS nuclear-centrosome complex rotation from the left/right (L/R) onto the anterior/posterior (A/P) axis. Single mutations in either Wnt or Src pathway genes often result in late EMS spindle orientation, while double mutants show a complete failure in spindle positioning. I am testing the hypothesis that in the EMS cell, Src and/or Wnt act through the conserved Gα/GPR/LIN-5 complex to recruit dynactin/dynein in a process regulated by LET-99. I used temperature sensitive mutants and a temperature controlled stage to perform careful temperature shifts and imaged EMS divisions at the non-permissive temperature while earlier divisions occurred at the permissive temperature. My single and double mutant analysis suggests that LIN-5 is required for EMS spindle positioning and is in the SRC pathway, but not in the Wnt pathway. My data suggest that LET-99 and Gα may not be required for spindle positioning and previously published EMS phenotypes may be secondary defects due to earlier division abnormalities. Whether there is asymmetry in the cortical localization pattern of LIN-5 in EMS is unclear, as any enrichment observed could be coming from neighboring cells, not EMS itself. To address this, I am using the CRISPR/Cas9 system to generate a transgenic worm strain expressing Dendra::LIN-5.

Dendra can be photo-converted from green to red in a defined region of a cell. I will photo-convert the fusion protein specifically in the EMS blastomere and observe its

cortical localization in WT and mutant backgrounds. These and other experiments will enable me to further elucidate the molecular mechanisms that position the EMS spindle.

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Rudolf Grimm, Ph.D., Development Manager, Worldwide Proteomics Market & Metabolomics

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Palo Alto, CA 94304
(650) 485-4327
www.agilent.com

Agilent delivers critical tools and technologies that sense, measure and interpret the physical and biological world. Our innovative solutions enable a wide range of customers in communications, electronics, life sciences and chemical analysis to make technological advancements that drive productivity and improve the way people live and work.

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 the physical and biological properties of substances and products.

Our seven key product categories include microarrays; microfluidics; gas chromatography; liquid chromatography; mass spectrometry; software and informatics products; and related consumables, reagents and services.

AgraQuest, Inc. (now a Bayer company)

Contact:
Magalie Guilhabert, Ph.D., Scientist

1540 Drew Ave.
Davis, CA 95616
(530) 750-0150
www.agraquest.com

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

Contacts:
Bruce Kerwin, Ph.D, Scientific Director; Protein Pharmaceutics
One Amgen Center Drive
Thousand Oaks, CA 91320-1799
(805) 447-1000

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.

Contact:
Jack D. Newman, Ph.D., Co-founder & V.P. Research
Joel Cherry, Ph.D., President of Research and Development

5980 Horton St., Suite 450
Emeryville, CA 94608
(510) 450-0761
www.amyrisbiotech.com

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.

Bayer HealthCare Pharmaceuticals, Inc.

Contact:
Rick Harkins, Ph.D., Principal Scientist; Novel Technologies, Protein Therapeutics Research
Ben Lindenmuth, Ph.D., Biochemical Engineer

2600 Hilltop Drive
Richmond, CA 94804
(510) 669-4066
http://www.bayerhealthcare.com

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.

Our aim is to discover and manufacture innovative products that will improve human and animal health worldwide. Our products enhance well-being and quality of life by diagnosing, preventing and treating disease.

BioMarin Pharmaceutical, Inc.

Contact:
Eric Fouts, Ph.D., Associate Director; Manufacturing Sciences

105 Digital Drive
Novato, CA 94949
(415) 506.6700
http://www.biomarinpharm.com/

BioMarin develops and commercializes innovative biopharmaceuticals for serious diseases and medical conditions, focusing on product candidates that:

- Address currently unmet medical needs
- Suggest a clear-cut development profile
- Provide an opportunity to be first-to-market

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.

Contact:
Laure Escoubet-Lozach, Ph.D., Senior Scientist, Epigenetics – Oncology Research
***Aaron Nguyen, Ph.D**., Senior Scientist

4550 Towne Center Court
San Diego, CA 92121
(858) 795-4759

1500 Owen St., Suite 600
San Francisco, CA
(908) 673-9000
www.celgene.com

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.

At Celgene, we seek to deliver truly innovative and life-changing drugs for our patients. Our mission as a company is to build a major global biopharmaceutical corporation while focusing on the discovery, the development, and the commercialization of products for the treatment of cancer and other severe, immune, inflammatory conditions.

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.

As committed as we are to clinical accomplishment, we are equally committed to patient support, which is a guiding principle at Celgene. We believe all who can benefit from our discoveries should have the opportunity to do so. Celgene puts patients first with industry-leading programs that provide information, support and access to our innovative therapies.

***DEB Graduate**

Cytokinetics, Inc.

Contact:
Adam Kennedy, Ph.D., Scientist II

280 East Grand Avenue
S. San Francisco, CA 94080
(650) 624-3000
www.cytokinetics.com

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)

Contact:
Colin Mitchinson, Ph.D., Director; Biomass Applications

925 Page Mill Road
Palo Alto, CA 94304
(650) 846-5853
www.genencor.com

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

Reaching diverse industries
Genencor discovers, develops, manufactures, and delivers eco-friendly, efficient enzyme product solutions for the agri processing, cleaning and textiles, food and feed, consumer, and industrial markets. We also develop innovative advancements for the biofuels, biodefense, and biosafety industries.

A technology leader
We are a recognized leader in protein and pathway engineering. No other biotechnology company offers the breadth of skills and experience that we do to deliver total solutions to a broad array of markets.

A catalyst for change
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.

Contacts:
Benjamin Lin, PhD, Senior Research Associate, Pharmacodynamic Biomarkers (DEB Graduate)
Melody Trexler Schmidt, Ph.D., Scientist (DEB Graduate)

1 DNA Way
South San Francisco, CA 94080-4990
(650) 225-1000
www.gene.com

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.

Development Pipeline:
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.

Contact:
Pam Marrone, Ph.D., CEO and Founder, Board of Directors

2121 Second Street, Suite 107B
Davis, CA 95618
(530) 750-2800
www.marronebioinnovations.com/index.php

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 – Woodland and Davis Campuses

Contact:
Timothy Conner, Ph.D., Woodland & Davis Chemistry Lead

37437 State Highway 16
Woodland, CA 95965
(530) 668-8268
www.monsanto.com

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 became a research and development unit within Monsanto Technology. In 2011, the team became a part of Monsanto Chemistry Technology leveraging its plant biological sciences expertise for agricultural innovations. The Woodland and Davis Chemistry Technology teams are focused on delivering novel technology approaches through Biologicals for broad agricultural utility. A key area of the Biologicals focus is the BioDirect platform. To advance BioDirect discovery and Biologicals research into product development and agricultural products, the Chemistry Technology teams work across disciplines and use a variety of tools from biotechnology, molecular biology, biochemistry, genomics, formulations and analytical chemistry. Using these tools, the team is focused on developing BioDirect opportunities for protecting yield by controlling crop pests and improving other crop agricultural characteristics.

Monsanto provides a wide array of integrated solutions and is developing new technology platforms to help meet 21st century challenges to food production through meeting the needs of growers, commercial customers, and consumers in sustainable systems.

Novartis AG (formerly Chiron Corporation)

Contacts:
John Donnelly, Ph.D., Senior Director

4560 Horton Street
Emeryville, CA 94608-2916
(510) 655-8730

Matthew Coleman, Ph.D., Scientist, Manufacturing Technology
***Michael Plesha, Ph.D**., Biopharmaceutical Production Manager,
2010 Cessna Drive
Vacaville, CA 95688
(707) 453-2200
www.novartis.com/

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

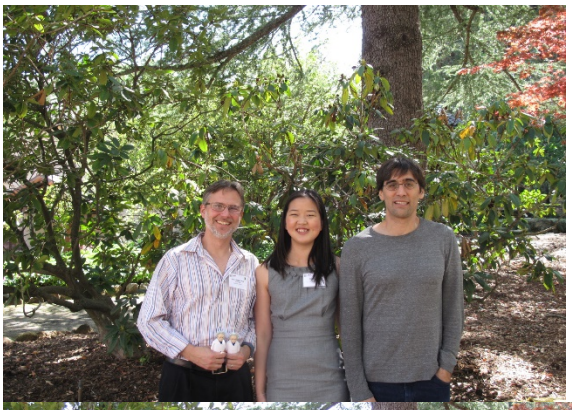
The company has become a pioneer in the discovery, development and value creation of novel biological markers for the clinical diagnostics marketplace: ***Biomarkers***. The company believes there is a large unmet need in both the discovery of potentially important biomarkers and the eventual use of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

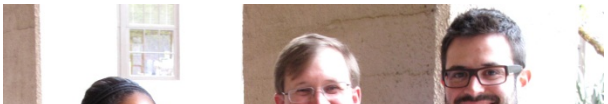
Tethys Bioscience has built expertise, created significant intellectual property, and is executing its business plan around three key areas: ***Biomarker Discovery, Clinical Validation and ValueCreation***. Tethys is focused upon introducing products that yield significant savings to the health care 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 2014 - 2015	
Johnathon Anderson	Integrative Genetics & Genomics
Casey Boosalis	Molecular, Cellular & Integrative Physiology
Allison Hoch	Biomedical Engineering
Nicole Nozzi	Chemistry
Christian Siltanen	Biomedical Engineering
Anna Marie Tuazon	Biochem, Mol. & Cellular Developmental Biology
Biotech Fellows 2014 - 2015	
Doug Gettel	Chemical Engineering
Rosanna Kwok	Entomology
Sam Westreich	Integrative Genetics & Genomics
Keith Dunaway	Integrative Genetics & Genomics
Graduate Students/Post-docs	
Karan Agrawal	DEB, Pharmacology and Toxicology
Nicholas Aguirre	DEB, Neurobiology, Physiology & Behavior
Salem Alkanaimsh	PostDoc, Chemical Engineering & Materials Science
Brittany Anderson	DEB, Chemistry
Liz Anthony	DEB, Chemical Engineering
Brian Avanzino	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
Doug Banda	DEB, Chemistry
Andrew Burch	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
Michael Burnside	DEB, Chemistry
Austin Carroll	DEB, Chemistry
Anna Case	DEB, Chemistry
Christopher Chapman	DEB, Biomedical Engineering
Krishna Choudhary	DEB, Biomedical Engineering
Nicole Coggins	DEB, Molecular, Cellular & Integrative Physiology
Adam Contreras	DEB, Department of Entomology
Jasmine Corbin	DEB, Chemical Engineering & Materials Science
Ryan Dowdy	DEB, Food Science & Technology
Marjannie Eloi Akintunde	DEB, Immunology
Samantha Feng	DEB, Pharmacology and Toxicology
Michael Fong	DEB, Biomedical Engineering
Anupama Ganesh	DEB, Immunology
Pui Yan Ho	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
Julia Jennings	DEB, Chemistry
Kalimuthu Karuppanan	PostDoc, Chemical Engineering & Materials Science

Ozge Kurtulus	DEB, Chemical Engineering
Malgorzata Liro	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
Chandrima Majumdar	DEB, Chemistry
Amelia Manlove	DEB, Chemistry
Jordan McEwen	DEB, Chemistry
Debika Mitra	DEB, Biomedical Engineering
Angela Monterrubio	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
David Silberstein	DEB, Chemical Engineering
Scott Strobel	DEB, Biological & Agricultural Engineering
Sara Sukenik	Biomedical Engineering
Alireza Tafazzol	DEB, Biomedical Engineering
Brandon Tautges	PostDoc, Chemistry
Denise Trans	DEB, Pharmacology and Toxicology
Ellie Yin	DEB, Food Science Technology
Abigail Yu	DEB, Integrative Genetics & Genomics
Benjamin Yuen	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
UC Davis Faculty	
Sharon Aviran	DEB, Biomedical Engineering and Genome Center
Joanna Chiu	DEB, Entomology and Nematology
Sheila David	DEB, Chemistry
Annaliese Franz	DEB, Chemistry
Kent Leach	DEB, Biomedical Engineering
Karen McDonald	DEB, Chemical Engineering & Materials Science
Atul Parikh	DEB, Chemical Enginnering & Materials Science
Alexander Revzin	DEB, Biomedical Engineering
Alan Rose	DEB, Molecular and Cellular Biology
Erkin Seker	DEB, Electrical & Computer Engineering

Industry	
David Barber	Terminal Systems Manager, San Francisco
Timothy Conner	Monsanto
Jeannie Giacchino, MD, PhD	Bavarian Nordic, Inc.
Louise McGinnis	HDR Architecture, Inc.
Christopher Murriel	OncoMed
Gian Oddone	Agrinos, Inc.
Mylavarapu Venkatramesh	Agrinos, Inc.
Alice Yam	Sutro Biopharma
Guests	
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 2015

Karan Agrawal	Pharmacology & Toxicology
Nicholas Aguirre	Neurobiology, Physiology and Behavior
Hannah Aizad	Molecular, Cellular & Integrative Physiology
Leif Anderson	Biomedical Engineering
Lisa Anderson	Chemistry
Brittany Anderson	Chemistry
Johnathon Anderson	Integrative Genetics & Genomics
Liz Anthony	Chemical Engineering
Brian Avanzino	Biochemistry, Molecular, Cellular & Developmental Biology
Mina Azimi	Biochemistry, Molecular, Cellular & Developmental Biology
Douglas Banda	Chemistry
Roberto Barrozo	Immunology
Kristen Beck	Biochemistry, Molecular, Cellular & Developmental Biology
Katherine Beglinger	Biochemistry, Molecular, Cellular & Developmental Biology
Christopher Beitel	Integrative Genetics & Genomics
Zachary Bendiks	Microbiology
Geoffrey Benn	Plant Biology
Anastasia Berg	Biochemistry, Molecular, Cellular & Developmental Biology
Akhila Bettadapur	Biochemistry, Molecular, Cellular & Developmental Biology
Marta Bjornson	Horticulture and Agronomy
Matthew Blain-Hartung	Biochemistry, Molecular, Cellular & Developmental Biology
Giselle Blanco	Biochemistry, Molecular, Cellular & Developmental Biology
Stephen Bolus	Plant Pathology
Casey Boosalis	Molecular, Cellular & Integrative Physiology
Brandon Brown	Pharmacology & Toxicology
Andrew Burch	Biochemistry, Molecular, Cellular & Developmental Biology
Michael Burnside	Chemistry
Timothy Butterfield	Plant Biology
Daniel Caddell	Plant Biology
Austin Carroll	Chemistry
Anna Case	Chemistry
Patricia Castillo	Immunology
Elenor Castillo	Plant Biology
Stephanie Cevallos	Biochemistry, Molecular, Cellular & Developmental Biology
Nicole Chaffee	Chemistry
Pauline JoJo Chang	Electrical & Computer Engineering
Christopher Chapman	Biomedical Engineering
Arnold Chen	Biomedical Engineering
Sum Ying (Annie) Chiu	Biochemistry, Molecular, Cellular & Developmental Biology
Krishna Choudhary	Biomedical Engineering

Dong hee Chung	Chemistry
Elizabeth Clark	Biochemistry, Molecular, Cellular & Developmental Biology
Nicole Coggins	Molecular, Cellular & Integrative Physiology
Joshua Cohen	Food Science
Adam Contreras	Biochemistry, Molecular, Cellular & Developmental Biology
Caitlin Cooper	Animal Biology
Jasmine Corbin	Chemical Engineering
Ailsa Dalgliesh	Molecular, Cellular & Integrative Physiology
Amanda Dang	Material Science and Engineering
Destiny Davis	Plant Biology
Nicole De Jesus	Biomedical Engineering
Kevin De Leon	Molecular, Cellular & Integrative Physiology
Raquel de Mello e Pinho	Animal Biology
Derek Decker	Biophysics
Elieke Demmer	Nutritional Biology
Shuchi Desai	Microbiology
Alison Deshong	Biochemistry, Molecular, Cellular & Developmental Biology
Nithin Dhananjayan	Biophysics
Ryan Dowdy	Food Science
Cintia Helena Duarte Sagawa	Plant Biology
Keith Dunaway	Integrative Genetics & Genomics
James (Mitch) Elmore	Plant Biology
Marjannie Eloi-Akintunde	Immunology
Maher Elsheikh	Medical Microbiology and Immunology
Kenneth Eum (DECEASED 6/2014)	Molecular, Cellular & Integrative Physiology
Qingwen Fan	Food Science
Samantha (Chun) Feng	Pharmacology & Toxicology
Kateryna Feoktistova	Biochemistry, Molecular, Cellular & Developmental Biology
Jonathan Flynn	Biochemistry, Molecular, Cellular & Developmental Biology
Zachary Fogassy	Microbiology
Michael Fong	Biomedical engineering
Erin Fong	Electrical & Computer Engineering
Greg Foster	Biomedical Engineering
Elizabeth Fox	Immunology
Amanda Fox	Immunology
Jenna Gallegos	Plant Biology
Iniyan Ganesan	Plant Biology
Anupama Ganesh	Immunology
Douglas Gettel	Chemical engineering
Donald Gibson	Integrative Genetics & Genomics
Hyrum Gillespie	Integrative Genetics & Genomics

Aiza Cathe Go	Biochemistry, Molecular, Cellular & Developmental Biology
Ben Golomb	Food Science
Hossein Gouran	Plant Biology
Alex Gulevich	Biochemistry, Molecular, Cellular & Developmental Biology
Pasha Hadidi	Biomedical Engineering
Jenna Harvestine	Biomedical Engineering
Dustin Heeney	Microbiology
Amanda Hildebrand	Biological Systems Engineering
Briana Hill	Chemistry
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
Allison Hsia	Biomedical Engineering
Jonathan Hughes	Microbiology
Vicki Hwang	Integrative Genetics & Genomics
Hyun Tae Hwang	Pharmacology & Toxicology
Melissa Ishii	Biomedical Engineering
Mittal Jasoliya	Integrative Genetics & Genomics
Julia Jennings	Chemistry
Roger Jesinghaus	Chemistry
Rogelio Jimenez Espinoza	Chemical Engineering
Liequn "Leah" Jin	Biostatistics
Stefanos Kalomoiris	Biochemistry, Molecular, Cellular & Developmental Biology
Sercan Karav	Food Science & Technology
Prema Karunanithi	Biochemistry, Molecular, Cellular & Developmental Biology
Rachel Kerwin	Plant Biology
Brenna Kiniry	Microbiology
Sophie Kiss	Pharmacology & Toxicology
Angelica Kowalchuk	Integrative Genetics & Genomics
James Kurniawan	Chemical Engineering
Özge Kurtuluş	Chemical Engineering
Timothy Kwa	Biomedical Engineering
Rosanna Kwok	Entomology
Diana Lac	Pharmacology & Toxicology
Vu Lam	Biochemistry, Molecular, Cellular & Developmental Biology
Jennifer Lee	Biomedical Engineering
Linda Lee	Molecular, Cellular & Integrative Physiology
Mark Lemos	Plant Biology
Ingrid Leth	Chemical Engineering
Daniel Lewis	Integrative Genetics & Genomics
Zachery Lewis	Microbiology

Ying Li	Entomology
Malgorzata Liro	Biochemistry, Molecular, Cellular & Developmental Biology
Furong (Frank) Liu	Plant Pathology
Alan Lombard	Biochemistry, Molecular, Cellular & Developmental Biology
Simon Lopez	Integrative Genetics & Genomics
Michelle Lozada-Contreras	Chemical Engineering
Rita Luu	Microbiology
Regina MacBarb	Biomedical Engineering
Nicholas Mahoney DECEASED 2014	Biochemistry, Molecular, Cellular & Developmental Biology
Chandrima Majumdar	Chemistry
Jordan Mancuso	Materials Science and Engineering
Amelia Manlove	Chemistry
Kevin Martin	Chemistry
Alice Martinic	Nutritional Biology
Lauren Matelski	Immunology
Jordan McEwen	Chemistry
Shane McInally	Microbiology
Lucas McKinnon	Plant Biology
Amory Meltzer	Integrative Genetics & Genomics
Beatriz Merchel Piovesan Pereira	Microbiology
David Merriam	Microbiology
Emily Mills Ko	Immunology
Debika Mitra	Biomedical Engineering
Angela Monterrubio	Biochemistry, Molecular, Cellular & Developmental Biology
Jared Moore	Chemistry
Lucas Moore	Chemistry
Jessica Moore	Chemistry
Charles Mordaunt	Biochemistry, Molecular, Cellular & Developmental Biology
Alexi Morris	Chemistry
Akshata Mudinoor	Chemical Engineering
Sucheta Mukherjee	Pharmacology & Toxicology
Andrew Murley	Biochemistry, Molecular, Cellular & Developmental Biology
Meghan Murphy	Biomedical Engineering
Bernadette Nera	Biochemistry, Molecular, Cellular & Developmental Biology
Tin Ngo	Biochemistry, Molecular, Cellular & Developmental Biology
Alice Ngo	Chemistry
Alan Nguyen	Immunology
Chuong Nguyen	Pharmacology & Toxicology
Jared Nigg	Microbiology
Jennifer Nill	Chemical Engineering
Nicole Nozzi	Chemistry

Neal Oliver	Chemistry
Nadia Ono	Biochemistry, Molecular, Cellular & Developmental Biology
Mattie O'Sullivan	Biochemistry, Molecular, Cellular & Developmental Biology
Gulustan Ozturk	Food Science & Technology
Mario Parks	Immunology
Dipali Patel	Biomedical Engineering
Mira Patel	Chemical Engineering
Kyle Pelot	Plant Biology
Maria Peralta	Chemistry
Trisha Pfluger	Biochemistry, Molecular, Cellular & Developmental Biology
Jonathan Pham	Microbiology
Adam Poe	Biochemistry and Molecular Biology
Marc Pollack	Microbiology
Ali Rahimian Mashadi	Comparative Pathology
Anita Rajamani	Biomedical Engineering
Sonia Reveco	Integrative Genetics & Genomics
Juan Reyes	Integrative Genetics & Genomics
Gabriel Rodriguez	Chemistry
JohnPatrick (Patrick) Rogers	Chemistry
Shailise Ross	Chemistry
Jordan Sayre	Microbiology
Guy Shani	Microbiology
Esther Shin	Pharmacology & Toxicology
Megan Showalter	Biochemistry, Molecular, Cellular & Developmental Biology
Natasha Shroff	Integrative Genetics & Genomics
David Silberstein	Chemical Engineering
Christian Siltanen	Biomedical engineering
Priyashiela Singh	Soils & Biogeochemistry
Chelsea Snyder	Pharmacology & Toxicology
Julie Soderlind	Material Science and Engineering
Jennie Sotelo	Nutritional Biology
Breanne Sparta	Biochemistry, Molecular, Cellular & Developmental Biology
Allison Stevens	Nutritional Biology
Jessica Stolfi	Immunology
Scott Strobel	Biological Systems Engineering
Linda Su	Biochemistry, Molecular, Cellular & Developmental Biology
Anandkumar (Anand) Surendrarao (Rao)	Plant Biology
Alireza Tafazzol	Biomedical Engineering
Ruensern Tan	Biochemistry, Molecular, Cellular & Developmental Biology
Tang Tang	Chemistry
Srinivas Tapa	Biomedical Engineering
Brandon Tautges	Chemistry

Justin Thomas	Chemistry
Nicholas Thomas	Integrative Genetics & Genomics
George (Kenneth) Todd	Molecular, Cellular & Integrative Physiology
Elyse Towns	Chemistry
Denise Trans	Pharmacology & Toxicology
Adama Traore	Electrical & Computer Engineering
Kim Truong	Pharmacology & Toxicology
Tiffany Tu	Chemical Engineering
Anna Marie Tuazon	Biochemistry, Molecular, Cellular & Developmental Biology
John Uhrig	Microbiology
Troy Vaden	Chemistry
Rachel Anne Valenzuela	Chemistry
Kacey VanderVorst	Biochemistry and Molecular Medicine
Erica Vonasek	Biological Systems Engineering
Gordon Walker	Biochemistry, Molecular, Cellular & Developmental Biology
Gregory Walker	Microbiology
Katherine Walker (nee Byrne)	Biomedical Engineering
Eric Walters	Microbiology
Kening (Connie) Wang	Biomedical Engineering
Kaitlin "Kay" Watt	Integrative Genetics & Genomics
Mariana Weber	Microbiology
Toni West	Biochemistry, Molecular, Cellular & Developmental Biology
Donnelly West	Integrative Genetics & Genomics
Samuel Westreich	Integrative Genetics & Genomics
Damion Whitfield	Microbiology
Priscilla Williams	Biomedical Engineering
John Williamson	Chemistry
Kelsey Wood	Integrative Genetics & Genomics
Natasha Worden	Plant Biology
Zong Wu	Biochemistry, Molecular, Cellular & Developmental Biology
Le Yee	Biomedical Engineering
Xiaochen (Ellie) Yin	Food Science & technology
Fei Yian Yoong	Plant Biology
Abigail Yu	Integrative Genetics & Genomics
Annabelle Yu	Microbiology
Garrick Yuen	Biochemistry, Molecular, Cellular & Developmental Biology
Benjamin Yuen	Biochemistry, Molecular, Cellular & Developmental Biology
Wade Zeno	Chemical Engineering
Xinjun Zhang	Evolutionary Anthropology
Yuxuan (Eric) Zheng	Chemistry
Steve Zicari	Biological Systems Engineering

Venkatesh Akella	Electrical & Computer Engineering
John Albeck	Molecular & Cellular Biology
Rajeevan Amirtharajah	Electrical & Computer Engineering
Paul Ashwood	UCD MIND Institute
Kyriacos Athanasiou	Biomedical Engineering
Shota Atsumi	Chemistry
Matthew Augustine	Chemistry
Sharon Aviran	Biomedical Engineering
Alan Balch	Chemistry
Enoch Baldwin	Molecular and Cellular Biology Chemistry
Abdul Barakat	Mechanical & Aeronautical Engineering
Daniela Barile	Food Science & Technology/Forensics
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, Vet Med
Peter Beal	Chemistry
Laurel Beckett	Department of Public Health Sciences/Biostatistics
Craig Benham	Biomedical Engineering / Genome Center
Alan Bennett	Vegetable Crops (Plant Science)
Don Bers	Pharmacology
Charles L. Bevins	Microbiology & Immunology
Linda Bisson	Viticulture & Enology
Christiansen Blaine	UC Davis Health System Department of Orthopaedic Surgery
Caroline Bledsoe	Soils and Biogeochemistry
David Block	Viticulture & Enology/Chemical Engineering & Materials Science
Eduardo Blumwald	Plant Sciences
Sue Bodine	Neurobiology, Physiology and Behavior (NPB)
Laura Borodinsky	Physiology & Membrane Biology, UCDMC
Alexander Borowsky	Pathology
Richard Bostock	Plant Pathology
Kent Bradford	Vegetable Crops
Siobhan Brady	Plant Biology
Nadean Brown	Cell Biology and Human Anatomy, School of Medicine
Christine Bruhn	Food Science & Technology
Alan Buckpitt	VM: Molecular Biosciences
Sean Burgess	Molecular & Cellular Biology

Judy Callis	Molecular and Cellular Biology
Christopher Calvert	Animal Science
Kermit Carraway	Biochemistry and Molecular Medicine
Luis Carvajal-Carmona	Genetics & Biochemistry, Molecular, Cellular and Developmental biology
Hongwu Chen	Biochemistry & Molecular Medicine
Xi Chen	Chemistry
Xinbin Chen	Comparative Oncology; UCD Cancer Center
Holland Cheng	Molecular & Cellular Biology
Simon Cherry	Biomedical Engineering
Nipavan Chiamvimonvat	Internal Medicine; Division of Cardiovascular Medicine
Joanne Chiu	Entomology
Gitta Coaker	Plant Pathology
Luca Comai	Plant Biology
Douglas Cook	Plant Pathology
Gino Cortopassi	Molecular Biosciences
Stephen Cramer	Applied Science
Beate Crossley	California Animal Health and Food Safety Laboratory System
Abhaya Dandekar	Pomology/Plant Sciences
Satya Dandekar	MED: Medical Microbiology & Immunology
Sheila David	Chemistry
Cristina Davis	Mechanical and Aeronautical Engineering
Scott Dawson	Microbiology
Katayoon (Katy) Dehesh	Plant Biology
Wenbin Deng	Cell Biology and Human Anatomy (School of Medicine)
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	Molecular and Cellular Biology
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
Angie Gelli	Pharmacology, SOM
Damian Genetos	Anatomy, Physiology and Cell Biology
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
Stacey Harmer	Plant Biology
Richart W. Harper	Division of Pulmonary/Critical Care Medicine
Dennis Hartigan-O'Connor	Medical Microbiology and Immunology
Dominik Haudenschild	Orthopaedic Research Labs
Volkmar Heinrich	Biomedical Engineering
Paul Henderson	Internal Medicine: Division of Hematology and Oncology
Wolf-Dietrich Heyer	Microbiology
James Hildreth	Molecular & Cellular Biology
David Horsley	Mechanical & Aerospace Engineering
Krassi Hristova	Land Air Water Resources
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
Rick 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/Genome Center & Bioinformatics Program
Ian Korf	Molecular & Cellular Biology/Genome Center & Bioinformatics Program
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	Molecular & Cellular Biology
Carlito Lebrilla	Chemistry
Pamela Lein	Molecular Biosciences
Noelle L'Etoile	Center for Neuroscience & Dept. of Psychiatry and 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 C Luhmann, Jr.	Electrical & Computer Engineering
Elizabeth Maga	Animal Science
Maria Marco	Food Science & Technology
Laura Marcu	Biomedical Engineering
Verónica Martínez Cerdeño	Department of Pathology and Laboratory Medicine
Karen McDonald	Chemical Engineering & Material Sciences
Steffen mcdonald	Vegetable Crops & Weed Science
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	Food Science & Technology

Maria Mudryj	Medical Microbiology & Immunology
William J. Murphy	Dept. 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
Nitin Nitin	Dept. Food Science & Technology & Dept. of Agricultural Engineering
Stephen Noctor	Neuroscience
Jan Nolta	UCDHS: Hematology & Oncology, Department of Med
Jodi Nunnari	Molecular and Cellular Biology
Martha O'Donnell	Physiology and Membrane Biology; Schl of Med
David Ogrydziak	Food Science & Technology
Tingrui Pan	Biomedical Engineering
Rebecca Parales	Microbiology
Atul Parikh	Applied Science
Anthony Passerini	Dept. of Biomedical Engineering
Timothy Patten	Chemistry
Randen Patterson	Department of Physiology and Membrane Biology
Niels Pedersen	Department of Medicine and Epidemiology
Isaac Pessah	Molecular Biosciences
Ronald Phillips	Chemical Engineering & Material Science
Kent Pinkerton	Pediatrics, School of Medicine
David Pleasure	Neurology and Pediatrics
Ann Powell	Plant Sciences
Jerry Powell	Hemat & Oncol: Med
Robert Powell	Chemical Engineering & Material Science
Martin Privalsky	Microbiology
Jinyi Qi	Biomedical Engineering
Subhadip Raychaudhuri	Biomedical Engineering
David Reid	Food Science & Technology
Michael Reid	Environmental Horticulture
Alexander Revzin	Biomedical Engineering
Robert Rice	Environmental Toxicology
Subhash Risbud	Chemical Engineering & Material Science
William Ristenpart	Chemical Engineering & Materials Science & Dept. of Food Science & Technology
David Rocke	Applied Sciences/MED: Biostatistics
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	MED: Pharmacology/Genome Center
Erkin Seker	Electrical & Computer Engineering
Barbara Shacklett	Med Microbiology & Immunology: School of Med
Jared Shaw	Chemistry
Kazuhiro Shiozaki	Microbiology
Justin Siegel	Biochem & Molecular Med
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	Molecular & Cellular Biology
Francene Steinberg	Dept. of Nutrition
Ioannis Steriopoulos	Plant Pathology
Pieter Stroeve	Chemical Engineering & Material Science
Gang Sun	Textiles & Clothing
Ilias Tagkopoulos	Computer Science
Cheemeng Tan	Biomedical Engineering
Dean Tantillo	Chemistry
Alice Tarantal	Pediatrics, School of Medicine, CA National Primate Center
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 & Clinical Immunology, GBSF
Alison Van Eenennaam	Animal Science
Marta Van Loan	Nutrition
Jean VanderGheynst	Biological Systems Engineering
John Voss	Biochemistry and Molecular Medicine
Bart Weimer	Vet Med: Population Health & Reproduction
Robert H. Weiss	Internal Medicine: Division of Nephrology, School of Medicine
Valerie Williamson	Nematology
Barry Wilson	Animal Science & Environmental Toxicology
David Wilson	Molecular & Cellular Biology

Matthew J. Wood	Environmental Toxicology
Reen Wu	MED: Pulmonary / Critical Care Medicine
Stefan Wuertz	Civil & Environmental Engineering
Heike Wulff	Pharmacology
Kevin Xiang	Pharmacology
Lifeng Xu	Microbiology
Soichiro Yamada	Biomedical Engineering
Yin Yeh	Applied Science
Tilahun Yilma	VM: Pathology, Microbiology & Immunology
John Yoder	Plant Sciences
Yohei Yokobayashi	Biomedical Engineering
Glenn Young	Food Science & Technology
Aiming Yu	Biochemistry & Molecular Medicine
Philipp Zerbe	Plant Biology
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.

In Memoriam Nicholas Mahoney

It is with great sadness and a heavy heart that we say goodbye to **Nicholas Mahoney**. Nick passed away December 6, 2014 from a fatal heart attack. He was an excellent graduate student, researcher, athlete, musician and friend. His enthusiasm for learning new things was truly inspiring as well as his passion for the outdoors and his family.

Nick earned a bachelor's degree in economics at Northeastern University in Maine and graduated from the University of Southern Maine Law School. After practicing law for fifteen years in Portland, Maine, he gained admittance into UC Davis' Biochemistry, Molecular, Cellular and Developmental Biology (BMCDB) graduate group in Professor Chris Fraser's lab. The Biotechnology Program was very pleased when Nick joined our Designated Emphasis in Biotechnology (DEB) family in 2013, as he brought with him his love of learning and philanthropy. Nick was a judge for the 2014 Teen Biotech Challenge science competition that included high school teens throughout Northern California and also volunteered during the Awards Banquet. Nick continued to volunteer for other outreach endeavors such as our Biotech Event at Picnic Day where he ran experiments with the general public, in particular kids. Needless to say he was a hit!

The Biotechnology Program extends its deepest sympathies to Nick's wife, Cydney and two boys, Sean and Rhys. Nick has forever touched our hearts and we are the better for knowing him.

Goodbye Nick, you will truly be missed!

Those we Love remain with us,
for Love itself lives on.
Cherished memories never fade,
because a loved one is gone.
Those we Love can never be,
more than a thought apart.
For as long as there is a memory,
they'll live on in our heart.
~Author Unknown