Twenty Fifth Annual

Biotechnology Training Retreat

Saturday,
March 5, 2016

Christian Brothers Retreat & Conference Center
Napa, CA

Twenty Fifth Annual Biotechnology Training Retreat

Co-sponsored by:

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

UC Davis Designated Emphasis in Biotechnology Graduate Program (DEB)

UC Davis Biotechnology Program

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2016 Welcome

On behalf of the UC Davis Biotechnology Program, the executive committees of the Designated Emphasis in Biotechnology (DEB) and the NIH T32 Training Program in Biomolecular Technology, we thank you for helping us celebrate our silver anniversary! It is hard to believe that this is our 25th anniversary of the Biotechnology Training Retreat and I have attended 20 of them. This annual event honors our **2015-16 Fellows and their preceptors**, as well as **our industry affiliates**. In addition, our other DEB students are showcasing their research in the poster session. We have a new website to showcase our Fellows. Check it out: http://www.NIHT32.ucdavis.edu. The DEB graduate program continues to be a model program for the 21st century and keeps growing. We currently have over 225 students from 29 graduate programs and over 200 graduates. More information can be found at deb.ucdavis.edu.

Many thanks go out to our Biotechnology Program team. The logistics of this retreat have been expertly overseen by **Jacki Balderama,** our Event Manager; **Marianne Hunter**, Assistant Director of Administration; **Jacqueline Phillips,** our Program Associate, and our Associate Director, **Dr. Denneal Jamison-McClung.** In addition, we are grateful to Professors **Luis Carvajal-Carmona** and **Joanna Chiu** for chairing the sessions today**. Great teams are critical to great programs.**

It is a pleasure to introduce our current Biotechnology Fellows. The **NIH Fellows** include: **Karan Agrawal,** Pharmacology & Toxicology (preceptor is John Newman); **Jasmin Corbin,** Chemical Engineering (preceptor is Karen McDonald); **Rosanna Kwok**, Entomology (preceptor is Joanna Chiu); **Nicole Nozzi,** (preceptor is Shota Atsumi); **Anna Marie Tuazon,** Biochemistry, Molecular, Cellular & Developmental Biology (preceptor is Luis Carvajal-Carmona) and **Sana Vaziri,** Computer Science (preceptor is Sharon Aviran). Our four **Biotechnology Fellows** (industry and campus fellowships) include: **Joshua Cohen**, Food Science (preceptor is Daniela Barile); **Daniel Lewis**, Integrative Genetics and Genomics (preceptor is Cheemeng Tan); **Debika Mitra**, Biomedical Engineering (preceptor is Kent Leach) and **Sam Westreich,** Integrative Genetics & Genomics (preceptors are Ian Korf and David Mills).

We will be selecting our **2016-17 NIH Fellows** in May. Nomination forms are on the web at www.NIHT32.ucdavis.edu. The application deadline is **Friday, April 22, 2016.** 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 Biotech Training Grant. We are submitting a 5 year competitive renewal this May. Our new leadership team includes: Prof. J.

Kent Leach as director and Profs. Joanna Chiu and Luis Carvajal-Carmona as co-directors. Please welcome the new team as well as thank our current directors (Profs. Hammock and McDonald) for their dedicated service.

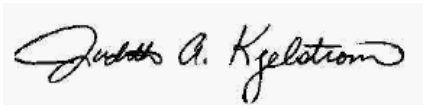
In regard to DEB internships, we placed over 25 students in 2015/2016. They include the following companies and national labs: 1) **Allergan**: Angeliki Palampro; 2) **Allied Minds** (VC firm): Garrett Yuen; 3) **AstRoNA**: Marc Pollack; 4) **Aquilo Capital Management,** SF and **ViVita Technologies**: Jennifer Lee; 5) **Army Corp of Engineers**: Jessica Moore; 6) **Bayer HealthCare:** Wade Zeno; 7) **BioRad**: Vickie Hwang; 8) **California Family Health Council** (clinical trials): Esther Shin Patchin; 9) **Celgene S.F.**: Brian Avanzino; 10) **Genentech**: Brandon Brown, Marjannie Eloi-Akintunde; Elyse Towns; 11) **General Automation Lab Technologies** in QB3: Rita Luu; 12) **Glaxosmithkline**: John Patrick Rogers; 13) **Hampton Creek**: Scott Strobel; 14) **IBM**, Almaden Research Center: Kristen Beck; 15) **Juno**: Christopher Chapman; 16) **LLNL**: Amanda Dang; 17) **Los Rios Community College district**: American River College: Geoff Benn; 18) **Monsanto** in Woodland**:** Marta Bjornsen; 19) **Novozymes:** Silvia Hilt; 20) **Oculeve**: Nithin Dhananjayan; 21) **Stem Cell Partners**: Johnathon Anderson; 22) UC Davis **Chancellor's Office**: Erica Vonacek; 23) UC Davis **Corporate Relations:** Kristen Beck, Elizabeth Fox; 24) UC Davis **Innovation Access**: Aiza Cathe Go, Nadia Ono. We would like to thank all of our industry, government and campus affiliates for their support of our training program. With the rapid growth of the DEB, we are going to need even more training sites in the near future.

A number of our students graduated in 2015 with their PhD's in one of 29 disciplines along with a Designated Emphasis in Biotechnology. Our graduates have found positions in both academia and industry. Please see our **2015 Biotech Times** (link is on our Biotech Program home page) for more information on our students and activities. We hope our graduates stay connected and even present a Biotech Seminar in the Future! We had a number of our graduates return this past year (or will speak this spring) to present an MCB 294 seminar: **Zane Starkewolfe** (UC Davis Venture Catalyst); **Rena Goodman Mizrahi** (Gia Gen); **Kseniya Zakharyevich** (Bayer HealthCare); **Kristen Beck** (IBM); **Kevin Holden** (REG Life Sciences), and **Victor Haroldsen** (UC Davis Corporate Relations). Our alumni continue to pay it forward.

With a heavy heart, I must tell you that we lost another one of our stellar DEB students this winter. **Aiza Cathe Go** had just completed her technology transfer internship at Innovation Access last summer and was finishing her dissertation. She was a member of the BMCDB graduate program and Dr. Alexander "Sandy" Borowsky was her major professor. She was such a positive woman and we all miss her very much. Please see our *In Memoriam* at the back of the book.

Thank you for coming to our silver anniversary retreat. Listen to the great presentations, view the posters, make new friends, and enjoy the delicious food and beautiful scenery. We value all of you…..you are all part of our Biotech Family!

With warmest wishes,



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

Dr. Judy Kjelstrom (Director Biotechnology Program) & Prof. Karen McDonald (Co-Director of the training grant)

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

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Karen McDonald, Co-Director

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Marianne Hunter; Assistant Director, Administration
Jacki Balderama; Event Manager
Jacqueline Phillips; Program Associate
Kelly Meade; Budget Analyst

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UC Davis Twenty Fifth Annual Biotechnology Training Retreat
March 5, 2016
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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, PhD** Co-Director, NIH Training Grant in Biomolecular Technology
8:45 – 12:00 pm	**Morning Session** **Joanna Chiu, PhD** Co-Director on Renewal; NIH Training Grant in Biomolecular Technology
8:45 – 10:20 am	**Presentations** 8:45 am Rosanna Kwok ..... *Mentor: Joanna Chiu* 9:10 am Jasmine Corbin..... *Mentor: Karen McDonald* 9:35 am Karan Agrawal..... *Mentor: John Newman* 10:00 am **Juan Pedro Sanchez, PhD** ... . ***Monsanto Company (DEB Graduate)***
10:20 – 10:45 am	**Break / Poster Viewing**
10:45 – 12:00 pm	**Presentations** 10:45 am Nicole Nozzi ..... *Mentor: Shota Atsumi* 11:10 am Anna Marie Tuazon ..... *Mentor: Luis Carvajal-Carmona* 11:35 am Denneal Jamison-McClung, PhD ..... *Bioethics Question (Handout)*

Afternoon Schedule

12:00 – 1:00 pm	**Lunch / Poster Viewing**
1:00 – 1:20 pm	**Photo Taking for NIH/Biotech Fellows**
1:20 – 5:30 pm	**Afternoon Session Chair** **Luis Carvajal-Carmona** Co-Director on Renewal; NIH Training Grant in Biomolecular Technology
1:20 – 3:05 pm	**Presentations** 1:20 pm Denneal ..... *Bioethics Question (Discussion)* Jamison-McClung, PhD ..... *Mentor: Sharon Aviran* 1:40pm Sana Vaziri ..... ***OncoMed Pharmaceuticals*** 2:05 pm **René Meisner, DVM** ..... *Mentor: Cheemeng Tan* 2:25 pm Daniel Lewis ..... ***Sutro Biopharma, Inc.*** 2:50 pm **Elenor Castillo, PhD** .... ***(DEB Graduate)***
3:05 - 3:20 pm	**Short Break (15 min)**
3:20 – 4:50 pm	**Presentations** 3:20 pm Debika Mitra ..... *Mentor: J. Kent Leach* 3:45 pm **Sabina Gude** ..... ***Novozymes, Inc.*** 4:05 pm Sam Westreich ..... *Mentor: Ian Korf* 4:30 pm **Sara Gaucher, PhD** ..... ***Amyris, Inc.*** 4:40 pm Joshua Cohen ..... *Mentor: Daniela Barile* 5:05 pm **Kristin Bernick, PhD** ..... ***Agilent Technologies***
5:20 pm	**Closing Remarks** Karen McDonald, PhD Co-Director, NIH Training Grant in Biomolecular Technology

5:40 pm – Bus departs Napa

For social media, use #BiotechRetreat

2016 Poster Titles

A. **"A Cross-Comparison of Methylome Landscape Features Between Different Human Pluripotent Cell Lines and Tissues"**
Keith Dunaway*, Sarita Goorha, Lauren Matelski*, Pam Lein, Larry Reiter, and Janine LaSalle
[1]Department of Medical Microbiology and Immunology & Genome Center, University of California, Davis

B. **"Uncovering the Mechanism of Trogocytosis in *Entamoeba histolytica*"**
Shea E. Feeney* and Katherine S. Ralston
Department of Microbiology and Molecular Genetics, University of California, Davis

C. **"Context-Dependent Inversion of Dose-Response in Synthetic Biological Networks"**
Daniel Lewis*, Michael Chavez, Cheemeng Tan
Department of Biomedical Engineering, University of California, Davis

D. **"Epigenetic Regulation of *FOXP3* in Regulatory T Cells and in Autism Spectrum Disorder"**
Charles E. Mordaunt* and Janine M. LaSalle
Department of Medical Microbiology, Genome Center, and MIND Institute, University of California, Davis

E. **"Determining the Ligand Coordination Sphere and Functionality of the ZN^{2+} Linchpin Motif of the DNA Repair Glycosylase Mutyh"**
Nicole Nuñez*[1], Steve Bertolani[1], Satheesan Babu[2], Anisha N. Rajavel[1], Jen Spear[1], Justin Siegel[1], Carmay Lim[2], Sheila S. David[1]
[1]Department of Chemistry, University of California, Davis
[2]Department of Biomedical Sciences, Academia Sinica, Taipei, Taiwan 11529

F. **"Metabolic Profiling of Human Naïve and Primed Embryonic Stem Cells Reveals Distinct Differences in Metabolism"**
Megan Showalter*[1,2], Henrik Sperber[3,4], Julie Mathieu[3,4], Hannele Ruohola-Baker[3,4], Oliver Fiehn[1,2]
[1]UC Davis Genome Center, Davis, CA
[2]NIH West Coast Metabolomics Center, Davis, CA
[3]Department of Biochemistry University of Washington, Seattle, WA
[4]Institute for Stem Cell and Regenerative Medicine University of Washington, Seattle, WA

G. **"*Agrobacterium* Mediated Transient Expression of Biodefense Agent in *Nicotiana benthamiana* Plants"**
Salem Alkanaimsh[1], Kalimuthu Karuppanan[1], Somen Nandi[2], Raymond Rodriguez[2], and Karen A. McDonald[1]
[1]Department of Chemical Engineering and Materials Science, University of California, Davis
[2]Department of Molecular and Cellular Biology, University of California, Davis

H. **"Investigation into the Broad Substrate Specificity of the DNA Glycosylase hNEIL1"**
Brittany Anderson*, Jongchan Yeo, Jonathan Ashby, Sheila David
Department of Chemistry, University of California, Davis

I. **"Introns Versus Promoters: Who's Doing All The Work?"**
Jenna Gallegos* and Alan Rose
Department of Molecular and Cellular Biology, University of California, Davis

J. **"Extracellular Matrix-Coated Composite Scaffolds Promote Mesenchymal Stem Cell Persistence"**
Jenna N. Harvestine*, Nina L. Vollmer, Steve S. Ho*, Chris A. Zikry, Mark A. Lee, J. Kent Leach
Department of Biomedical Engineering, University of California, Davis

K. **"Downstream Processing and *N*-Glycosylation Monitoring of Plant-Made Recombinant Anthrax Toxin Receptor FC Fusion Protein**"
Kalimuthu Karuppanan[1], John K. Muchena[2], Sifti Dhuhra-Gill[1], My L. Phu[3], Carlito Lebrilla[2], Abhaya M. Dandekar[3], Somen Nandi[4], Raymond Rodriguez[4], and Karen 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

L. **"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

M. **"Production and Evaluation of an Antiviral Peptide Against Human Metapneumovirus in Tobacco by Transient Transformation**"
Márquez-Escobar Verónica Araceli*[1], Tirado Mendoza Rocío[2], Noyola-Cherpitel Daniel Ernesto[3], Gutiérrez-Ortega Abel[4] and Alpuche-Solís Ángel Gabriel [1]
[1]Molecular Biology Division, Instituto Potosino de Investigación Científica y Tecnológica; [2]School of Medicine, Universidad Nacional Autónoma de México; [3]School of Medicine, Universidad Autónoma de San Luis Potosí; [4]Unidad de Biotecnología Médica y Farmacéutica, CIATEJ. San Luis Potosi S.L.P, México, 78216

N. **"Influence of Extent of Cross-Linking on the Physical Properties of Spray-Dried Alginate Microcapsules for the Protection of Crop-Enhancing Bacteria**"
Scott Strobel*, Herbert Scher, Nitin Nitin, Tina Jeoh, Salem Alkanaimsh[1], Andres Guerrero[2], Carlito Lebrilla[2], and Karen A. McDonald[1]
Department of Biological & Agricultural Engineering, University of California, Davis

O. **"Analysis of Single Cells in Embryonic Basal Ganglia Via Genetic Labeling and Single-Cell Transcriptomics"**

Linda Su-Feher*[1], Shanni Silberberg[2], John L. Rubenstein[2], and Alex S. Nord[1]
[1]Department of Neurobiology, Physiology, and Behavior, University of California, Davis
[2]Nina Ireland Laboratory of Developmental Neurobiology, Department of Psychiatry, University of California at San Francisco

P. **"Modeling Monoclonal Antibody Production in *Nicotiana benthamiana* Plant Cell Suspension Culture"**

Sara Sukenik*[1] and Karen McDonald[2]
[1]Department of Biomedical Engineering, University of California, Davis
[2]Department of Chemical Engineering and Materials Science, University of California, Davis

Q. **"Structures of an Editing Enzyme Bound to Duplex RNA Reveal Base-Flipping Mechanism and Basis for Site Selectivity"**

Justin M. Thomas[1*+], Melissa M. Mathews[1+], Yuxuan Zhang[1+], Kiet Tran[1+], Kelly J. Phelps[1+], Anna I. Scott[2], Cody Palumbo[1+], Peter A. Beal[1+], Andrew J. Fisher[2]
[1]Department of Chemistry, University of California, Davis
[2]Department of Molecular Biology, University of California, Davis
[+]These authors contributed equally to this work

R. **"Airborne Disease Transmission via Expiratory Aerosols"**

Sima Asadi* and William D. Ristenpart
Department of Chemical Engineering & Material Science, University of California, Davis

***DEB Graduate Student**

2016 Presentation Titles

1. **"Uncovering the Epigenetic Regulation of the Circadian Clock"**
   Rosanna Kwok*, Elizabeth C. Chan, Christine A. Tabuloc, and Joanna C. Chiu
   Department of Entomology, University of California, Davis

2. **"Semicontinuous Bioreactor Production of a Recombinant Therapeutic Protein in Metabolically Regulated Transgenic Rice Cell Cultures"**
   Jasmine Corbin*[1], Bryce I. Hashimoto[1], Sara C. Sukenik[1], Kalimuthu Karuppanan[1], Zachary R. Kyser[1], Raymond Rodriguez[2], Somen Nandi[2], and Karen A. McDonald[1]
   [1]Department of Chemical Engineering and Materials Science, University of California, Davis
   [2]Department of Molecular and Cellular Biology, University of California, Davis

3. **"Inflammatory Mediator Profiling in Sweat: A Potential Non-Invasive Diagnostic for Inflammatory Skin Diseases"**
   Karan Agrawal*[1,3], Lauren Hassoun[2], Manisha Notay[2], Negar Foolad[2], Raja K. Sivamani[2],
   John W. Newman[1,3,4]
   [1]Departments of Nutrition, University of California, Davis
   [2]Department of Dermatology, University of California, Davis
   [3]NIH West Coast Metabolomics Center, Davis, California
   [4]USDA-ARS Western Human Nutrition Research Center, Davis, California

4. **"Current Growth Platforms within Monsanto"**
   Juan Pedro Sanchez, PhD
   Monsanto, Woodland, 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. **"One in Ten Hispanic Breast Cancer Cases Carry *BRCA1*, *BRCA2*, or *PALB2* Mutations: Results from a Population-Based Study in South America"**
   Anna Marie Tuazon* and Luis Carvajal-Carmona
   Department of Biochemistry and Molecular Medicine, University of California, Davis

7. **"To Edit, or Not to Edit? That is the Question" - Ethics Discussion**
   Denneal Jamison-McClung, PhD
   Associate Director, Biotechnology Program, University of California, Davis

8. **"Data-Driven RNA Secondary Structure Predictions"**
   Sana Vaziri*[1], Sharon Aviran[2]
   [1]Department of Computer Science, University of California, Davis
   [2]Department of Biomedical Engineering, University of California, Davis

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

10. **"Context-Dependent Inversion of Dose-Response in Synthetic Biological Networks"**
Daniel Lewis*, Michael Chavez, Cheemeng Tan
Department of Biomedical Engineering, University of California, Davis

11. **"Production of Site-Specific Antibody Drug Conjugates using Optimized Non- Natural Amino Acids in a Cell-Free Protein Expression System"**
Elenor Castillo*, Erik S. Zimmerman, Tyler H. Heibeck, Mary Rose Madlansacay, Cuong Tran, Gang Yin, Alexander R. Steiner, Trevor J. Hallam, Christoper D. Thanos, and Aaron K. Sato
Sutro Biopharma, Inc., South San Francisco, CA

12. **"Collagen Cosslinks Detected Via Non-Destructive Fluorescence Spectroscopy Affect Mesenchymal Stem Cell Differentition"**
Activity of an HCV NS5A Anchor Peptide Derivative"
Debika Mitra[1]*, Hussain Fatakdawala[1], Michael Nguyen-Truong[1], Amy Creecy[2,3], Jeffry Nyman[2,3], Laura Marcu[1], J. Kent Leach[1,4]
[1]Department of Biomedical Engineering, University of California, Davis
[2]Department of Orthopaedic Surgery and Rehabilitation and Vanderbilt Center for Bone Biology, Vanderbilt University Medical Center, Nashville, TN
[3]Department of Veterans Affairs, Tennessee Valley Healthcare System, Nashville, TN
[4]Department of Orthopaedic Surgery, School of Medicine, University of California, Davis, Sacramento, CA

13. **"Enzyme Variant Selection Using *in vitro* Compartmentalization"**
Sabina Gude* and Robert Blazej
Novozymes, Inc., San Francisco, CA 94158

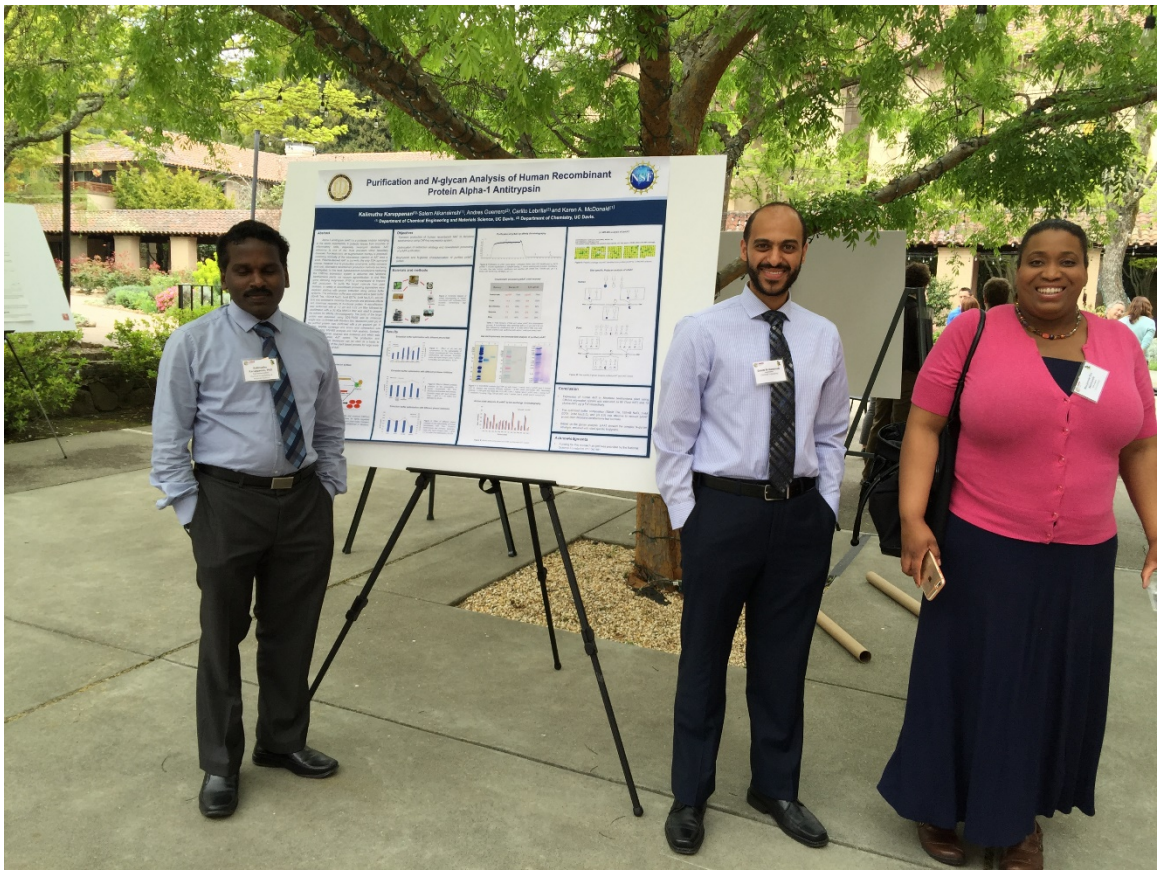
14. **"Metatranscriptomics: Monitoring Gut Microbiome Activity in Response to Diet"**
Sam Westreich*[1], Ian Kort[1,2], David A. Mills[3,4], Danielle G. Lemay[1,4]
[1]Genome and Biomedical Sciences Facility, University of California, Davis
[2]Department of Molecular and Cellular Biology, University of California, Davis, CA
[3]Department of Food Science and Technology, University of California, Davis, CA
[4]Foods for Health Institute, Unfiversity of California, Davis, CA

15. **"Synthetic Biology for Renewable Chemicals Manufacture"**
Sara P. Gaucher
Amyris Inc., Emeryville, California

16. **"Immobilization of a Recombinant N-Glycosidase for Isolation of Bioactive Glycans From Dairy Processing Co-Products"**
Joshua Cohen*, Sercan Kara, Juliana MLN de Moura Bell, and Daniela Barile
Department of Food Science and Technology, University of California, Davis

17. **"Agilent Research Labs: Enabling Breakthrough Science and Technology"**
Kristin Bernick
Agilent Laboratories, Agilent Technologies, Santa Clara, California

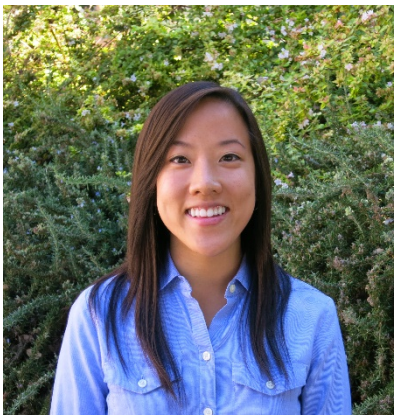
***DEB Graduate Student**



Oral Presentation Abstracts

NIH FELLOW: Rosanna Kwok

UNCOVERING THE EPIGENETIC REGULATION OF THE CIRCADIAN CLOCK



Presenter:	Rosanna S. Kwok*
Authors:	**Rosanna S. Kwok**, Elizabeth C. Chan, Christine A. Tabuloc, and Joanna C. Chiu
Affiliations:	Department of Entomology, University of California, Davis
Preceptor:	Joanna C. Chiu

Circadian clocks enable organisms to anticipate daily changes in the environment and coordinate temporal rhythms in physiology and behavior with the 24-hour day-night cycle. Proper timekeeping is essential to organismal health, and mutations in circadian gene expression and circadian disruption are associated with human health problems including cancer, metabolic diseases, and mental health disorders. Robust cycling of circadian gene expression is regulated by events such as transcription factor binding, RNA polymerase II (RNAPII) recruitment and elongation, and post-transcriptional modifications. Despite the growing understanding of events that occur at clock-controlled promoters, there still lacks a comprehensive understanding of the temporal changes in epigenetic landscape required to facilitate rhythmic transcriptional activity in the animal clock. Given the importance of epigenetic state in the regulation of transcriptional activity, 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 *Drosophila* as an animal model. We have previously characterized the role of an evolutionarily conserved epigenetic regulator, the SWI/SNF (Brahma) chromatin-remodeling complex, in regulating the circadian clock. By dissecting its catalytic vs. non-catalytic activities, we propose a model in which the non-catalytic activity of BRM functions to recruit repressive factors to limit the transcriptional output during the active phase of circadian transcription, while the primary function of the ATP-dependent catalytic activity is to prevent over-recruitment of negative regulators by increasing nucleosome density. We have since expanded our investigations to identify a network of regulators that interact with BRM to facilitate circadian transcription.

***DEB Graduate Student**

NIH FELLOW: Jasmine Corbin

SEMICONTINUOUS BIOREACTOR PRODUCTION OF A RECOMBINANT THERAPEUTIC PROTEIN IN METABOLICALLY REGULATED TRANSGENIC RICE CELL CULTURES

Presenter:	Jasmine M. Corbin*
Authors:	**Jasmine M. Corbin[1*]**, Bryce I. Hashimoto[1], Sara C. Sukenik[1], Kalimuthu Karuppanan[1], Zachary R. Kyser[1], Raymond L. Rodriguez[2], Somen Nandi[2], and Karen A. McDonald[1]
Affiliations:	[1]Department of Chemical Engineering and Materials Science, University of California, Davis [2]Department of Molecular and Cellular Biology, University of California, Davis
Preceptor:	Karen McDonald

Plant cell suspension cultures present a promising alternative to traditional bioreactor-based systems for the production of recombinant therapeutic proteins. Here we demonstrate the use of a transgenic rice cell suspension culture for efficient, semicontinuous production of butyrylcholinesterase (BChE), a complex and highly glycosylated human enzyme that can function as a bioscavenger against organophosphorus nerve agents. In this platform, the target protein is expressed under the control of a metabolically regulated promoter and tagged with a secretion signal peptide that enables secretion out of the cell.

After design of the gene construct and transformation of the cells, over 300 cell lines from independent transformation events were screened at increasing scale for high growth rate and BChE expression. After selection of a single cell line, the culture was scaled up to a 5L lab scale bioreactor to determine growth, BChE production, and sugar consumption kinetics under controlled conditions of temperature, agitation, and dissolved oxygen. These data were then used to determine an efficient operational strategy to enhance biomass growth and volumetric BChE productivity through multiple cycles of growth and expression.

***DEB Graduate Student**

NIH FELLOW: Karan Agrawal

INFLAMMATORY MEDIATOR PROFILING IN SWEAT: A POTENTIAL NONINVASIVE DIAGNOSTIC FOR INFLAMMATORY SKIN DISEASES

Presenter:	Karan Agrawal*
Authors:	**Karan Agrawal*** [1,3], Lauren Hassoun[2], Manisha Notay[2], Negar Foolad[2], Raja K. Sivamani[2], John W. Newman[1,3,4]
Affiliations	[1]Departments of Nutrition, University of California, Davis [2]Department of Dermatology, University of California, Davis [3]NIH West Coast Metabolomics Center, Davis, California [4]USDA-ARS Western Human Nutrition Research Center, Davis, California
Preceptor:	John Newman

Sweat is a complex biological fluid with potential diagnostic value for the investigation of skin disorders. Previous efforts in sweat testing focused on analysis of small molecules and ions for forensic and diagnostic testing, but with advances in analytical and sweat collection techniques, there has been recent interest in conducting metabolomic analyses of sweat to establish biomarkers for and understand mechanisms of skin inflammation and repair. Our study aims to characterize the lipid mediator profile in sweat and identify differences in these profiles between subjects with and without atopic dermatitis.

Using the Macroduct® collection device, originally developed for cystic fibrosis diagnostic testing of sweat chloride in neonates, sweat (40-100 µL) was collected from subjects with and without atopic dermatitis (n = 10 per group), and profiled over 100 lipid mediators including oxylipins, endocannabinoids and ceramides/sphingoid bases using liquid chromatography-tandem mass spectrometry.

A total of 37 lipid mediators including 25 oxylipins, 6 endocannabinoids and 6 ceramides/ sphingoid bases were detected in the sweat. Increases in concentrations of linoleate-derived triols, arachidonate-derived epoxides, and C30-C40 [NS] ceramides were observed in the sweat of subjects with atopic dermatitis ($p < 0.05$, one-tailed Student's t-test). Separation of the subject groups was possible using partial least squares-discriminant analysis with separation primarily due to increased concentrations of [NS]-type ceramides in the sweat of subjects with atopic dermatitis.

Our current findings demonstrate the presence of lipid mediators in sweat, and suggest differences in the lipid mediator profile between subjects with and without atopic dermatitis. Sweat mediator profiling therefore may provide a non-invasive assessment of atopic dermatitis pathogenesis and mechanistic progression, and aid in novel target elucidation and assessment of therapeutic efficacy.

***DEB Graduate Student**

COMPANY AFFILIATE: Monsanto Company

CURRENT GROWTH PLATFORMS WITHIN MONSANTO

Presenter:	Juan Pedro Sanchez, PhD*
Authors:	**Juan Pedro Sanchez PhD**
Affiliations:	Monsanto Company Woodland, CA

During this talk, I will describe the current growth platforms that exist within Monsanto and how these have emerged from previous technologies used over the past 20 years or so and how these represent the next inflection point for Ag Biotech companies such as Monsanto. First, I will talk about BioDirect, the project that we are pursuing in our Woodland, CA campus. A brief history of this project will be presented, along with the current RNAi applications for this project. Then, the BioAg alliance, a collaboration with Novozymes, will be introduced. This alliance aims at identifying beneficial microbes that can enhance nutrient uptake, root growth, drought tolerance, etc. This will be followed by a brief description of Climate Corporation, and how Monsanto has invested in climate prediction, integrated farming systems and data science in Agriculture. Lastly, I will talk about the interactions between the DEB program and Monsanto.

*DEB Graduate

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: Anna Marie Tuazon

ONE IN TEN HISPANIC BREAST CANCER CASES CARRY *BRCA1*, *BRCA2*, OR *PALB2* MUTATIONS: RESULTS FROM A POPULATION-BASED STUDY IN SOUTH AMERICA

Presenter:	Anna Marie Tuazon*
Authors:	**Anna Marie Tuazon*** and Luis Carvajal-Carmona
Affiliations	Department of Biochemistry and Molecular Medicine, University of California, Davis
Preceptor:	Luis Carvajal-Carmona

Breast cancer is the leading cause of cancer incidence and mortality among Hispanic women. While strides have been made in understanding Hispanic breast cancer genetics, most studies have been limited to screening familial cases for few highly penetrant genes. We aimed to assess the mutation prevalence in three breast cancer genes (*BRCA1*, *BRCA2* and *PALB2*) in unselected Hispanic breast cancer cases. Six hundred and forty-six unselected cases with invasive breast cancer, recruited through a multi-center study in Colombia, were screened for *BRCA1/2* and *PALB2* mutations using genotyping and Illumina sequencing. Analyses focused on mutation prevalence and clinical characteristics of the mutation carriers. We identified 67 cases with a pathogenic or likely-pathogenic mutation in *BRCA1* (n=42), *BRCA2* (n=18), and *PALB2* (n=7). Eighty-eight percent of these mutations were founder mutations. The average age of diagnosis among mutation carriers was 46y, with *BRCA1* carriers having a significant younger age of onset (41y) than that of *BRCA2* (53y, P=0.001) or *PALB2* (51y, P=0.049). Family history of cancer was reported in 41%, 28%, and 43% of the *BRCA1*, *BRCA2* and *PALB2* carriers, respectively. Remarkably, we found that 10.4% of the cohort, regardless of family history of cancer, carried a pathogenic mutation. The high mutation prevalence in this cohort, and the lack of family history in >60% of the mutation carriers, suggests that population-based genetic analysis can identify most Hispanic carriers who would otherwise be ineligible for testing. Additionally, among the high-prevalence of founder mutations was the *BRCA1* p.Gln111Asnfs mutation, which was found in 32 breast cancer cases. This particular mutation has been reported previously in other parts of the world. To determine whether the mutation originates from a single, unique haplotype, genome-wide SNP data, generated for carriers from Colombia, Spain, Portugal, Brazil, Chile, and Angola, were subjected to

haplotype analysis. Significantly, mutation carriers from these diverse countries share a common core haplotype, likely to have originated from Spain. This story illustrates trans-continental immigration of an important breast cancer-associated *BRCA1* mutation, highlighting the significance of studying diverse populations.

***DEB Graduate Student**

Bioethics Discussion

Written and Presented by

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

ETHICS QUESTION

TO EDIT, OR NOT TO EDIT?
THAT IS THE QUESTION….

TO EDIT, OR NOT TO EDIT? THAT IS THE QUESTION

Genome editing via CRISPR-Cas9 has been a game-changer for genetic engineering, allowing scientists to produce:

- "virally cleansed" pigs for potential use in human xenotransplantation
- polled (aka hornless) dairy cattle *(UC Davis Prof. Alison Van Eenennaam working with Recombinetics)*
- Oxitec's mutant mosquitos for suppression of vector populations which spread tropical diseases, such as Zika virus and dengue fever
- human cell lines with corrected disease mutations (e.g. beta-thalassemia)

…just to name a few applications in the literature and popular press.

Rewriting the genetic code in many cell types, tissues and living systems has become much easier. Though the scientific community is currently opposed to human germ line editing due to off-target effects (need for refinement of the technology), the potential to develop and deploy gene editing as a therapeutic tool, or for "designer" humans, no longer seems far-fetched or straight from Hollywood (e.g. Gattaca, X-men). Coupled with the advent of personal genomics, direct to consumer genetic testing and HMOs' interest in building customer genome databases for precision medicine, issues of genetic privacy and the specter of World War II era eugenics have many people concerned.

In the world of agricultural biotechnology, genome editing also brings up a number of sticky regulatory questions. If genetically engineered crops are genome edited, but do not contain transgenes, should they be subject to the same regulatory scrutiny as first generation "GMOs"? When should regulatory review be triggered? When a particular number of changed nucleotides is reached? *(keeping in mind that mutation bred crops are not currently subject to regulatory review in the majority of countries)*

Discussion questions:

1. Which stakeholders in society should be involved in setting the regulatory parameters around genome editing technologies? Only scientists who understand the technologies? Patients and families who will benefit? Clinicians? Educators? General public? Policy makers? Insurance companies? Clergy?
2. In the case of Oxitec's mosquitos, which may be released into the environment to stop a global health crisis, who (national entities) should decide to whether this living (though for a short time) technology is deployed?
3. There is currently an IP war raging over the CRISPR-Cas9 genome editing technology. Should powerful, useful molecular technologies developed via federally funded research programs be patented by one or a few individuals?
4. Are you concerned about genetic privacy? What are the pros and cons of knowing your genomic variants given the current state of precision medicine and potential future of therapeutic genome editing?
5. Genome editing for the masses and creating "designer babies" is not currently possible, but it is worth discussing societal implications for human diversity if the

technology becomes widely accessible. How do we mitigate the potential for aggravating divisions between societies' "haves" and "have nots" via human genetic engineering?

6. For plant breeders, who regularly use radiation and chemical mutagens to increase trait variation in breeding populations of crops (not subject to regulation), genome editing offers a more precise mechanism for introducing desirable traits. What types of crops or food animals should be subject to regulatory review? Only those with transgenes? Those that have been mutation bred? Those that have been genome edited? How do we truly define a "GMO" in this technology space?

Peer Review, Purview or Purloin? by Dr. Martina Newell-McGloughlin

Prof Jean Luc Borg is one of very few molecular biologists working in a particular field. Dr. Borg receives a paper to review, about a protein called existencin, which he and a graduate student in his laboratory are researching. The article was submitted by Dr. Paul Murky to *Protein Connections*, a medium-impact journal, and the editor asked Dr. Borg and two other experts in the field to review the paper. The article suggests a new interaction between existencin and the protein PS3 and provides evidence for the fact that both proteins are necessary for the full survival-promoting function of existencin in a cell. The article also demonstrates, though, that if there is too much existencin inside cells they cease to exist.

But the paper is fraught with problems: poor controls, inconsistent data in figures, and alternative explanations are not considered and claims are overstated. Dr. Borg gives the paper to his graduate student Marge Innovera, who gives it a detailed critique and recommends significant revisions. Ms. Innovera has never reviewed an article before, and Dr. Borg thinks that doing so would be a good educational experience for her. Ms. Innovera notes the finding about too much existencin being toxic to cells, a problem she has had working with the protein, and discusses it with Dr. Borg. Both agree that they should lower the dosage of existencin in her experiments; the cells actually survive for a week, longer than her experience before, and then they die.

Dr. Borg submits Ms. Innovera's and his own comments about the research to the editor, suggesting that the paper be accepted only after a few more experiments are performed to validate some of the conclusions. One of the other reviewers has comments similar to Dr. Borg's, and the editor asks Dr. Murky, the author, to make the revisions before he will accept the paper.

But in the next few weeks the interaction between PS3 and existencin that is discussed in the paper remains in Dr. Borg's mind. PS3 was not a line of inquiry that Dr. Borg and Ms. Innovera were following in their research. They were focusing on other stimulatory proteins, but unsuccessfully. Dr. Borg suggests to Ms. Innovera that she add a compound to the cell culture system that stimulates the cell to produce its own PS3, a method that is somewhat different from what was in the paper by Dr. Murky that is under review. The enhancement method works. The cells live for a month.

Ms. Innovera and Dr. Borg draft a paper based on the results, which includes appropriate controls. *Science*, a prestigious journal, accepts the paper. Several months later, *Protein Connections* publishes a revised paper from the laboratory of Dr. Murky. But after Dr. Murky sees the article in *Science* he suspects that Dr. Borg, who was an anonymous peer reviewer on the paper, might have taken some of the ideas for the *Science* article from his paper under review. Dr. Murky knows that Dr. Borg hadn't been working on PS3 because it was hard to purify, and deduces that he used material in the unpublished manuscript to stimulate PS3 activity (he ground it up and added it to the media!!).

What is responsible peer review?

1. What types of conflict of interest might arise when someone is asked to review a paper or grant application?
2. Is it ever appropriate for a peer reviewer to give a paper to a graduate student for review? If so, how should the reviewer do so?
3. Is it appropriate for a peer reviewer to use ideas from an article under review to stop unfruitful research in the reviewer's laboratory?
4. Is it ever appropriate for a reviewer to use ideas from a paper under review, even if the reviewer's method to achieve a result is different from that used in the paper under review? If so, how should the reviewer proceed?
5. What are some of the challenges in the current peer-review process, in which the peer reviewer is anonymous but the author is known to the reviewer?
6. What recourse is there for Dr. Murky if he suspects that his ideas were plagiarized?

Additional thoughts…

1. How can one separate oneself from the content of a paper or grant application under review?
2. What are some ways in which the process of peer review might be improved? Pre-publications?

NIH FELLOW: Sana Vaziri

DATA-DRIVEN RNA SECONDARY STRUCTURE PREDICTIONS

Presenter:	Sana Vaziri*
Authors:	**Sana Vaziri*[1]**, Sharon Aviran[2]
Affiliations	[1]Department of Computer Science, University of California, Davis [2]Department of Biomedical Engineering, University of California, Davis
Preceptor:	Sharon Aviran

RNA is at the heart of many significant questions in molecular and systems biology, including gene regulation and protein synthesis. Its diverse functionalities are rooted in its ability to fold into a variety of structures. Despite its importance, predicting secondary RNA structure from sequence alone remains a challenging combinatorial problem. High throughput approaches to structure analysis have recently emerged, which couple chemical modification strategies with DNA sequencing, to obtain nucleotide-level measurements on RNA structure in a massively parallel fashion. This data can be incorporated into computational prediction methods, yielding considerable improvements over pre-data results, albeit with significant remaining errors. We are interested in statistically sound integration of chemical modification measurements from distinct probes as a way of improving structure prediction accuracy. We have implemented a recently outlined principled probabilistic framework for data-directed secondary structure prediction[1]. Appealing properties of such framework include ease of adaptability to a variety of probes and the potential to account for complex interpretations of structural information. This is joint work with Fei Deng, Mirko Ledda.

References

1. Eddy 2014, Computational analysis of conserved RNA secondary structure in transcriptome and genomes. Annual Rev Biophys 43: 433-456

***DEB Graduate Student**

COMPANY AFFILIATE: OncoMed Pharmaceuticals, Inc.

THERAPEUTIC APPROACHES TOWARDS TARGETING CANCER STEM CELLS AND IMMUNE REGULATORY CELLS

Presenter:	René Meisner, PhD
Authors:	**René Meisner**, Christopher L. Murriel, 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 seven anti-cancer stem cell 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), ipafricept (FZD9-Fc, OMP-54F28) and anti-RSPO3 antibody (OMP-131R10), each target key cancer stem cell signaling pathways, including Notch and Wnt.

OncoMed has expanded its research and development platform to include targeting immune modulating targets. This year OncoMed will file investigation new drug (IND) applications for two therapeutic proteins that either unblock or activate the immune system and thus target cancer cells. OncoMed has formed strategic alliances with Celgene Corporation, Bayer Pharma AG and GlaxoSmithKline (GSK).

NIH FELLOW: Daniel Lewis

CONTEXT-DEPENDENT INVERSION OF DOSE-RESPONSE IN SYNTHETIC BIOLOGICAL NETWORKS

Presenter:	Daniel Lewis*
Authors:	**Daniel Lewis***, Michael Chavez, Cheemeng Tan
Affiliations	Department of Biomedical Engineering, University of California, Davis
Preceptor:	Cheemeng Tan

Synthetic biological networks are traditionally engineered following the classical paradigm of engineering, where the dose-response relationship is static. However, living systems are known to exhibit context-dependent responses to biological inputs, when the presence of an environmental signal alters the dynamic behavior of a biological network. Here, we exploit these bio-inspired mechanisms to engineer a synthetic transcriptional network with a flexible structure that can produce context-dependent inversion of dose-response. The network allows a biological system to invert its response to an environmental signal between induction and repression. Specifically, the network has a novel architecture that is composed of a functional antagonism modulating an incoherent feedforward loop. Using mathematical modeling, we identify and validate key design principles of the network that control the dose-response inversion. We also demonstrate how our genetic network can measure the ratio of two diffusible molecular signals instead of absolute concentrations. Finally, we reveal the tradeoffs of the network with respect to expression noise. This work represents a new frontier in the design of synthetic biological systems, moving from a fixed-topology to a flexible-topology paradigm. Furthermore, our findings have implications for the mechanisms of natural occurrences of context-dependent signaling, and apply to a broader understanding of quantitative relationships within the dynamic interactome of cells.

***DEB Graduate Student**

COMPANY AFFILIATE: Sutro Biopharma, Inc.

Production of Site-Specific Antibody Drug Conjugates using Optimized Non-Natural Amino Acids in a Cell-Free Protein Expression System.

Presenter:	Elenor Castillo, PhD*
Authors:	**Elenor Castillo**, Erik S. Zimmerman, Tyler H. Heibeck, Mary Rose Madlansacay, Cuong Tran, Gang Yin, Alice Y. Yam, Alexander R. Steiner, Trevor J. Hallam, Chrostopher d. Thanos, and Aaron K. Sato
Affiliations:	Sutro Biopharma, Inc. South San Francisco, CA

Antibody drug conjugates (ADCs) are a targeted chemotherapeutic currently at the cutting edge of oncology medicine. These hybrid molecules consist of a tumor antigen-specific antibody coupled to a chemotherapeutic small molecule. Through targeted delivery of potent cytotoxins, ADCs exhibit improved therapeutic index and enhanced efficacy relative to traditional chemotherapies and monoclonal antibody therapies. The currently FDA-approved ADCs, Kadcyla (Immunogen/Roche) and Adcetris (Seattle Genetics) are produced by conjugation to surface-exposed lysines, or partial disulfide reduction and conjugation to free cysteines, respectively. These stochastic modes of conjugation lead to heterogeneous drug products with varied numbers of drugs conjugated across several possible sites. As a consequence, the field has limited understanding of the relationships between the site and extent of drug loading and ADC attributes such as efficacy, safety, pharmacokinetics, and immunogenicity. A robust platform for rapid production of ADCs with defined and uniform sites of drug conjugation would enable such studies. We have established a cell-free protein expression system for production of antibody drug conjugates through site-specific incorporation of the optimized non-natural amino acid, para-azidomethyl-L-phenylalanine (pAMF). By using our cell-free protein synthesis platform to directly screen a library of aaRS variants, we have discovered a novel variant of the *Methanococcus jannaschii* tyrosyl tRNA synthetase (TyrRS), with a high activity and specificity toward pAMF. We demonstrate that site-specific incorporation of pAMF facilitates near complete conjugation of a DBCO-PEG-monomethyl auristatin (DBCO-PEG-MMAF) drug to the tumor-specific, Her2-binding IgG Trastuzumab using strain-promoted azide-alkyne cycloaddition (SPAAC) copper-free click chemistry. The resultant ADCs proved highly potent in *in vitro* cell cytotoxicity assays.

***DEB Graduate**

BIOTECH FELLOW: Debika Mitra

COLLAGEN CROSSLINKS DETECTED VIA NON-DESTRUCTIVE FLUORESCENCE SPECTROSCOPY AFFECT MESENCHYMAL STEM CELL DIFFERENTIATION

Presenter: Debika Mitra*

Authors: **Debika Mitra*[1]***, Hussain Fatakdawala[1], Michael Nguyen-Truong[1], Amy Creecy[2,3], Jeffry Nyman[2,3], Laura Marcu[1], J. Kent Leach[1,4]

Affiliations: [1]Department of Biomedical Engineering, University of California, Davis
[2]Department of Orthopaedic Surgery and Rehabilitation and Vanderbilt Center for Bone Biology, Vanderbilt University Medical Center, Nashville, TN
[3]Department of Veterans Affairs, Tennessee Valley Healthcare System, Nashville, TN
[4]Department of Orthopaedic Surgery, School of Medicine, University of California, Davis, Sacramento

Preceptor: Ian Korf

The extracellular matrix (ECM) serves as the instruction manual for cellular response to the microenvironment. Type 1 collagen, the main structural component of the ECM, undergoes two types of crosslinks in the body: lysyl oxidase-induced enzymatic crosslinks and hyperglycemia-mediated non-enzymatic crosslinks. While enzymatic crosslinks are necessary for tissue maturity, non-enzymatic crosslinks such as pentosidine (PENT), which are formed in diabetic patients, can have deleterious effects on cellular interactions with the ECM, impairing bone formation and repair. However, the effect of PENT on progenitor cells including mesenchymal stem cells (MSCs) is largely unknown. Current techniques for studying PENT are destructive, laborious, and frequently employ oversimplified collagen films. Therefore, there is a need for a more biomimetic model system as well as a non-destructive method of evaluating crosslink formation. We addressed these challenges by exposing cell-secreted decellularized matrices (DMs) to ribose and then using Time-Resolved Fluorescence Spectroscopy (TRFS) to detect the accumulation of PENT. Ribose treatment resulted in a blue shift in peak fluorescence emission and a significant decrease

in average lifetime compared to control DMs. We confirmed that changes in observed fluorescence were due to PENT accumulation using high performance liquid chromatography, thus validating the use of TRFS as an alternative method of PENT detection. We characterized MSC response to PENT seeded on these non-enzymatically crosslinked DMs. Early markers of osteogenic differentiation were unexpectedly increased in MSCs cultured on ribose DMs at both 7 and 14 days. These data demonstrate the efficacy of non-destructive fluorescence spectroscopy to examine the formation of non-enzymatic collagen crosslinks within biomimetic culture platforms, providing a model system to explore the contributions of PENT towards diabetic bone healing and other collagen crosslink-related diseases. In contrast with non-enzymatic crosslinks, which are considered detrimental to bone formation, enzymatic crosslinks are beneficial for tissue maturation. To explore the role of these enzymatic crosslinks on osteogenic differentiation of MSCs, we are currently culturing MSCs seeded on 3D polymeric scaffolds under flow perfusion. We are also using TRFS to detect enzymatic crosslink formation and correlate the same with HPLC measurements. Bone constructs cultured under perfusion may have enhanced functional properties and provide insight into the importance of inducing enzymatic crosslinks in tissue engineered constructs.

***DEB Graduate Student**

COMPANY AFFILIATE: Novozymes, Inc.

ENZYME VARIANT SELECTION USING *in vitro* COMPARTMENTALIZATION

Presenter:	Sabina Gude
Authors:	**Sabina Gude** and Robert Blazej
Affiliations:	Novozymes, Inc. San Francisco, CA

Screening DNA libraries for variants that encode preferred enzyme activities is often carried out by transforming the library into a microbial expression host. Transformants are then grown on plates followed by colony picking into microtiter plates for outgrowth, protein expression, and activity testing. Robotic systems are capable of automating many of these steps, enabling up to 10^5 variants to be screened in weeks or months. When library size increases to millions or billions of variants, screening time becomes intractably long and costly. *in vitro* compartmentalization (IVC) provides an alternate means to screen vast DNA libraries without the need for host transformation, plating, picking, outgrowth, microtiter plates, or robotic systems. In the IVC process, reactions are partitioned into femtoliter droplets in a water-in-oil emulsion. Single DNA molecules are distributed along with a cell-free protein expression reaction mixture into the droplets. Each droplet maintains genotype and phenotype within a single compartment, ensuring co-localization of the *in vitro*-expressed protein and the encoding DNA template. Once reaction conditions are optimized, individual DNA molecules can be selectively-recovered based on the activity of the enzyme they encode. The droplets are stable over a wide range of temperatures and pH and can be used to screen up to 10^{10} variants in just one milliliter. Novozymes has developed IVC methods to perform massively-parallel screening of highly-diverse cellulase libraries. A novel self-selection method is employed that selectively recovers improved cellulase variants without the need for sorting using flow cytometry or microfluidics.

Novozymes is a biotech company with a strong focus on enzyme production. We are committed to changing the very foundations of our industrial system for the better by using industrial biotechnology. As the world leader in bioinnovation we believe that by using industrial biotechnology we can re-engineer thousands of everyday products to deliver enhanced sustainability performance, introducing energy cost savings, and decreased raw material costs for our customers.

BIOTECH FELLOW: Sam Westreich

METATRANSCRIPTOMICS: MONITORING GUT MICROBIOME ACTIVITY IN RESPONSE TO DIET

Presenter: Samuel Westreich*

Authors: **Samuel Westreich[1]***, Ian Korf[1,2], David A. Mills[3,4], Danielle G. Lemay[1,4]

Affiliations: [1]Genome Center, University of California, Davis
[2]Department of Molecular and Cellular Biology
[3]Department of Food Science and Technology
[4]Foods for Health Institute, University of California, Davis

Preceptor: Ian Korf

The study of the gut microbiome—the collection of microflora within the intestinal tract—is growing in popularity as associations are found between diet and nutrition, gut activity, and host health and disease. Shifts in diet or nutritional intake may not cause microbiome population changes, but may instead influence the activity of the existing community. Metatranscriptomics, the study of microbial activity based on RNA-seq data, offers detailed data on the gene expression of all microbes within the sampled community. Unfortunately, current approaches for processing raw metatranscriptome data rely either on restricted databases, a fully in-house analysis server, or use metagenome-based approaches that have not been fully evaluated for use in processing metatranscriptomic datasets. We have created a new bioinformatics pipeline, SAMSA (Simple Analysis of Metatranscriptome Sequence Annotations), designed specifically for metatranscriptome analysis, with options for either in-house or external server-based computational processing. Designed for use by researchers with relatively little bioinformatics experience, SAMSA offers a breakdown of metatranscriptome activity by organism or transcript function, and is fully open source. We have also determined a series of "best practices" for metatranscriptome preprocessing and sequencing for the most accurate analysis results. We demonstrate that SAMSA offers analysis of both the organism activity and transcript-level expression within a metatranscriptome, as well as identifying significant expression changes between control and experimental populations. We hope that SAMSA will shed new light on expression changes within the gut microbiome, providing a deeper understanding of how this community reacts to dietary modulation.

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***DEB Graduate Student**

COMPANY AFFILIATE: Amyris, Inc.

SYNTHETIC BIOLOGY FOR RENEWABLE CHEMICALS MANUFACTURE

Presenter:	Sara P. Gaucher PhD
Authors:	**Sara P. Gaucher**
Affiliations:	Amyris, Inc. Emeryville, CA 94608

Amyris uses an advanced synthetic biology platform to create organisms that efficiently convert plant sugars into a wide array of ingredient chemicals. Our products replace chemicals sourced unsustainably (e.g. from petroleum, from threatened animals/plants) or that are difficult/expensive to access through traditional chemistry. Starting with an engineered yeast that produces an antimalarial previously purified from plants, our technology has been proven effective from the lab to the commercial marketplace. Amyris today produces polymer additives, solvents, fragrance and food ingredients, cosmetic emollients, and fuels at our fermentation plant in Brazil. Amyris was recently awarded a grant from DARPA to create new tools and technologies that will significantly reduce the time and cost of bringing new molecules to market. We envision that industrializing synthetic biology to produce renewable materials and fuels will potentially transform and disrupt markets much like biotech did for the pharmaceutical industry.

BIOTECH FELLOW: Joshua Cohen

IMMOBILIZATION OF A RECOMBINANT N-GLYCOSIDASE FOR ISOLATION OF BIOACTIVE GLYCANS FROM DAIRY PROCESSING CO-PRODUCTS

Presenter:	Joshua Cohen*, PhD
Authors:	**Joshua Cohen**, Sercan Karav, Juliana MLN de Moura Bell, and Daniela Barile
Affiliations:	Department of Food Science and Technology, University of California, Davis
Preceptor:	Daniela Barile

Complex glycans called oligosaccharides in human milk have been demonstrated to have a variety of health effects in developing infants, including prebiotic, immunomodulatory, and anti-pathogenic roles. We are attempting to isolate milk glycans from dairy co-products in a multifaceted attempt to reclaim economic value from these currently underutilized waste streams and improve nutrition for infants worldwide. We have successfully developed several methods for pilot scale isolation of bovine milk oligosaccharides at pilot scale using fermentation, nanofiltration, and enzymatic treatment. However, in order to capture an oligosaccharide pool that more closely resemble those found in human milk, we have utilized a recombinant enzyme Endo BI-1 cloned from a commensal gut bacterium (*Bifidobacterium longum* subsp. *infantis*) whose primary function is to cleave N-linked glycans from glycoproteins. Isolation and use of this enzyme is limited to small scales, and in order to examine the biological functionality of the glycans released from bovine whey glycoproteins using Endo BI-1, the scale of enzymatic release must be increased. We will use this enzyme in combination with a variety of immobilization resins and further filtration optimization to optimize and scale glycan release and overall process dynamics. Examining various kinetic parameters and overall glycan release with cutting-edge mass spectrometry and chromatographic methods will inform developments. We hope to scale immobilization and subsequent glycan release to recover sufficient quantities of these released N-glycans to further foster collaboration with labs to investigate the *in vitro* and *in vivo* mechanisms of bioactivity.

***DEB Graduate Student**

COMPANY AFFILIATE: Agilent Technologies

AGILENT RESEARCH LABS: ENABLING BREAKTHROUGH SCIENCE AND TECHNOLOGY

Presenter: Kristin Bernick, PhD

Authors: **Kristen Bernick**

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Agilent Technologies has strengths in life sciences, diagnostics, and applied chemical markets, focusing specifically in the areas of Food, Environmental and Forensics, Pharmaceutical, Diagnostics, Chemical and Energy, and Research. To provide innovative products and solutions in all of these areas, Agilent has a strong R&D organization. One facet of R&D at Agilent is Agilent Research Laboratories, a central research lab. The charter of Agilent Labs is to help power Agilent's growth through innovation and breakthrough science and technology. This involves developing next generation technologies that go beyond the current products and platforms. An example technology that originated as a research project in Agilent Labs and is now a successful component of Agilent's product portfolio is Oligo in situ Hybridization (ISH). By harnessing Agilent's strength in DNA library synthesis, we are able to design and generate ISH probes to any region of interest. Our technology provides precise targeting, increased resolution, and true customization. In Agilent Labs, we have explored DNA and RNA mammalian FISH and CISH in both tissue culture cells and FFPE tissue sections. In addition, by probing the bacterial chromosome, we have demonstrated microbial FISH with higher specificity than traditionally used 16s ribosomal RNA ISH. This is a prime example of a mature research project in which we fully explored the power of our new technology, ultimately culminating in transfer to product R&D and commercialization.

Poster Abstracts

A. A CROSS-COMPARISON OF METHYLOME LANDSCAPE FEATURES BETWEEN DIFFERENT HUMAN PLURIPOTENT CELL LINES AND TISSUES

Keith Dunaway*, Sarita Goorha, Lauren Matelski*, Pam Lein, Larry Reiter, and Janine LaSalle
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Early embryonic stages of pluripotency are currently being modeled for epigenomic studies using a variety of cell lines. For the analysis of DNA methylomes, however, very few of these cell lines accurately reflect the DNA methylation levels found in preimplantation embryos. Whole genome bisulfite sequencing (WGBS) approaches reveal the presence of large partially methylated domains (PMDs) covering 30-40% of the genome in oocytes, preimplantation embryos, and placenta. Human and mouse embryonic stem cells (ESCs) show abnormally high levels of DNA methylation compared to the inner cell mass (ICM), unless cultured in serum-free two kinase inhibitors (2i) media. Furthermore, Lister et al. (2011) found that induced pluripotent stem cells (iPSCs) lose PMDs upon transformation to pluripotency. We found that Dental Pulp Stem Cells (DPSCs), cell lines derived from stem cells recovered from baby teeth and cultured in serum-containing media, have PMDs and therefore mimic the ICM and preimplantation methylome more closely than most iPSCs and ESCs. In our analysis, we compare pluripotent cell lines DPSCs, iPSCs, hESCs, and EPI-NCSCs to primary early life human tissues MII oocytes, zygotes, 2-cell, 8-cell, and ICM from human embryos as well as human SH-SY5Y, IMR90, LUHMES cell lines in order to determine which cell lines most closely match the methylation patterns of the human tissues they are reportedly modeling. These analyses are expected to inform future experiments on which cell types should be used in assaying early life epigenetic states.

***DEB Graduate Student**

B. UNCOVERING THE MECHANISM OF TROGOCYTOSIS IN *ENTAMOEBA HISTOLYTICA*

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Entamoeba histolytica is a eukaryotic pathogen that is the causative agent of amoebiasis—responsible for 50 million cases of diarrheal infections and 100,000 deaths per year. *E. histolytica* is invasive and causes profound tissue damage. Killing of human cells by amoebae is likely to drive tissue damage. Amoebae kill human cells by nibbling off human cell bites via trogocytosis, whereas dead cells are ingested whole via phagocytosis. There is an emerging theme that trogocytosis might represent a vital form of cell-cell exchange that is exploited by microbes, but the underlying mechanism is unknown. Although trogocytosis may share some mechanistic components with phagocytosis, I propose that there is also signaling unique to trogocytosis. I am using two approaches, a forward genetic screen and transcriptomics analysis, to identify genes uniquely involved in trogocytosis. For the former approach, I will separately isolate trogocytosis and phagocytosis mutants, in order to define genes that are unique to each process. In preliminary efforts, I have developed a way to isolate and quantify ingestion mutants. These studies will help to define the trogocytosis mechanism—relevant to amoebiasis and broadly relevant to eukaryotic biology.

***DEB Graduate Student**

C. CONTEXT-DEPENDENT INVERSION OF DOSE-RESPONSE IN SYNTHETIC BIOLOGICAL NETWORKS

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Synthetic biological networks are traditionally engineered following the classical paradigm of engineering, where the dose-response relationship is static. However, living systems are known to exhibit context-dependent responses to biological inputs, when the presence of an environmental signal alters the dynamic behavior of a biological network. Here, we exploit these bio-inspired mechanisms to engineer a synthetic transcriptional network with a flexible structure that can produce context-dependent inversion of dose-response. The network allows a biological system to invert its response to an environmental signal between induction and repression. Specifically, the network has a novel architecture that is composed of a functional antagonism modulating an incoherent feedforward loop. Using mathematical modeling, we identify and validate key design principles of the network that control the dose-response inversion. We also demonstrate how our genetic network can measure the ratio of two diffusible molecular signals instead of absolute concentrations. Finally, we reveal the tradeoffs of the network with respect to expression noise. This work represents a new frontier in the design of synthetic biological systems, moving from a fixed-topology to a flexible-topology paradigm. Furthermore, our findings have implications for the mechanisms of natural occurrences of context-dependent signaling, and apply to a broader understanding of quantitative relationships within the dynamic interactome of cells.

***DEB Graduate Student**

D. EPIGENETIC REGULATION OF *FOXP3* IN REGULATORY T CELLS AND IN AUTISM SPECTRUM DISORDER

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Autism spectrum disorder (ASD) affects 1 in 68 children in the United States and is associated with dysregulation of both the nervous and immune systems. Immune dysfunction occurs in a subset of ASD patients and includes increases in proinflammatory cytokines, self-reactive antibodies, and altered adaptive immune cell function. Epigenetic differences have also been observed in ASD patients, including in DNA methylation. Risk for ASD is thought to be promoted by a combination of genetic and environmental factors, which may include polybrominated diphenyl ethers (PBDEs). Previously, exposure of peripheral blood mononuclear cells (PBMCs) from ASD patients but not typically developing (TD) controls to the PBDE, BDE-49, resulted in increases in proinflammatory cytokines. Regulatory T cells (Tregs), which are necessary for immune tolerance, have been found in lower levels in ASD patients and may be involved in ASD immune dysregulation. The Treg lineage is specified by expression of the transcription factor *FOXP3* and demethylation at the Treg-specific demethylated region (TSDR) at *FOXP3*. However, it is unclear how *FOXP3* expression and TSDR demethylation interact and if this regulation is disrupted in ASD. Additionally, it has been difficult to study human Tregs, due to their low abundance and resistance to *in vitro* manipulation. The purpose of this project was to develop a human cell line model to investigate *FOXP3* regulation and to determine if TSDR methylation is altered in ASD. Jurkat T cells and umbilical cord blood Tregs were analyzed for DNA methylation at the TSDR and expression of *FOXP3*. To investigate TSDR methylation in ASD, PBMC samples were obtained from either ASD patients or TD controls, exposed to BDE-49, and TSDR methylation was assessed. Both Jurkat T cells and cord blood Tregs were found to be suitable models to study FOXP3 regulation, with different applications. TSDR methylation decreased in PBMCs from some TD subjects but not ASD subjects after treatment with BDE-49. This suggests an increase in the Treg population with BDE-49 exposure in some control subjects and a deficiency in immune regulation in ASD subjects.

***DEB Graduate Student**

E. DETERMINING THE LIGAND COORDINATION SPHERE AND FUNCTIONALITY OF THE ZN^{2+} LINCHPIN MOTIF OF THE DNA REPAIR GLYCOSYLASE MUTYH

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The base excision repair glycosylase MUTYH and its homologues are responsible for the removal of adenine (A) when base paired opposite a common product of oxidative DNA damage, 8-oxo-7,8-dihydroguanine (OG). Inheritance of biallelic mutations within the MUTYH gene can result in particular type of colon cancer known as MUTYH-associated polyposis (MAP). Many of these cancer-associated variants have amino acids changes that occur at positions surrounding the enzyme's metal cofactor binding sites. One of these cofactors found in all MUTYH homologues is a $[4Fe\text{-}4S]^{2+}$ cluster coordinated to four Cys residues located in the N-terminal catalytic domain. Recently, our lab also discovered that there is a second metal binding site in mammalian MUTYH homologues: three additional highly conserved Cys residues that coordinate to Zn^{2+} in the interdomain connector (IDC) region. The IDC region serves as the docking site for many DNA and cell regulator proteins such as the Rad9-Rad1-Hus1 binding complex. Therefore it is pertinent to understand the function of these metal cofactors and how these metal binding sites influence overall DNA repair. We utilized bioinformatics and a massive sequence alignment to in search of a possible fourth ligand for the Zn^{2+} and to provide insight into its evolutional significance. Also, with the aid of computational modeling we have generated a homology based structure optimizing cofactor binding within MUTYH in order to view spatial possibilities for a fourth ligand. Lastly, we also explored possible functionalities of the newly discovered Zn^{2+} binding site by assessing the enzyme's affinity for Zn^{2+}, probing its possible structural role via circular dichroism, and evaluating how oxidative stress can influence Zn^{2+} binding.

DEB Graduate Student

F. METABOLOMIC PROFILING OF HUMAN NAÏVE AND PRIMED EMBRYONIC STEM CELLS REVEALS DISTINCT DIFFERENCES IN METABOLISM

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INTRODUCTION: Mouse embryonic stem cells (mESCs) have been long known to exist as two stable pluripotent cell states known as naïve and primed mESC. Recently, the naïve state was also derived from human embryonic stem cells (hESCs). Naïve ESC are characterized by expression of Oct4 driven by a different enhancer than primed hESC, X chromosome inactivation (in females), increase in DNA methylation and deposit of H3K27me3 histone modifications(Gafni, O., 2013). Understanding these two ESC states has important implications for our understanding of human development, regenerative medicine and cancer. While investigations into other "omics" have been reported, the work presented here offers a novel exploration in the primary, secondary and lipid metabolism of these cells, showing dramatic differences between the two pluripotent states.

METHODS: Both naive and primed hESC were harvested and extracted for GC-TOFMS, HILIC-QTOFMS and RPLC-QTOFMS analysis. For GC-TOF, samples were submitted to derivatization and analyzed using Leco Pegasus IV, deconvoluted using ChromaTOF (Leco) and identifications performed by BinBase (Fiehn, O., 2008). HILIC-QTOFMS and RPLC-QTOFMS samples were analyzed using Agilent 6550 QTOFMS, ESI (+) mode for HILIC and both ESI(+) & ESI(-) for RPLC. Raw data was processed using MSDial for peak finding and identifications made using mz/RT in house library and Lipidbast (Kind,T., 2013). Statistical analysis was performed and submitted using R (R Development Core Team, 2011) to DeviumWeb (v 0.3.2)(Grapov, D., 2014) for creation of multivariate classification model (O-PLS-DA). Robust model performance statistics generated by Monte Carlo cross validation.

CONCLUSIONS: Human and mouse ESC show significant differences in central metabolism including both glycolysis and TCA intermediates. This work cautions the interpretation of recent publications using mouse ESC to make conclusions regarding pluripotency regulation in human ESC based upon mouse ESC. Lipidomic signatures provide a robust method for classification of pluripotency and could provide insights into how lipid species are regulated during differentiation in vitro. GC-TOFMS results illustrate significant changes in nucleotides, sugars and fatty acids between naïve and primed ESC. Interestingly, dramatic changes were observed between two naïve human ESC lines sharing similar pluripotency states. This finding provides new results on the subtle differences between hESC lines and has not been previously reported.

***DEB Graduate Student**

G. *AGROBACTERIUM* MEDIATED TRANSIENT EXPRESSION OF BIODEFENSE AGENT IN *NICOTIANA BENTHAMIANA* PLANTS

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Organophosphates (OP) are highly toxic inhibitors of the acetylcholine-hydrolyzing enzymes. The resulting accumulation of acetylcholine can lead to respiratory collapse and death. Current therapies are based on elevating the serum levels of OP bioscavengers. The most advanced candidate so far is human butyrylcholinesterase (hBChE). It is a 340 kDa blood protein made in the liver, which is capable of hydrolyzing different choline based esters. The major limitation of this therapy is high cost, with plasma-derived hBChE costing more than $10,000/treatment. Limitations like cost and availability necessitate an alternative expression platform capable of large scale, low-cost production of a fully active and efficacious recombinant hBChE. The development of an effective rhBChE is a pressing national security concern in terms of protecting the nation's warfighters and civilian population from the threat of attack with OP agents. We describe the use of viral amplicon-based gene expression system based on *Tobacco mosaic virus* (TMV) to express a functional rhBChE in *Nicotiana benthamiana* plants using transient agroinfiltration method. A viral gene silencing suppresser (P19) was used to improve the production of the target molecule. In this work, upstream bioprocessing was optimized by varying P19 concentration (OD_{600}). The production was monitored at different post infiltration time points using whole plants and harvested leave tissue as a production platform. At each time point, Production level was monitored using SDS-PAGE, western blot and an enzymatic assay (Ellman assay). The optimized bioprocessing approach can be used in a commercial scale production for the therapeutic applications.

H. INVESTIGATION INTO THE BROAD SUBSTRATE SPECIFICITY OF THE DNA GLYCOSYLASE hNEIL1

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The DNA repair enzyme, hNEIL1, prevents deleterious consequences of DNA damage by removing a broad array of oxidized bases. Two forms of hNEIL1 are generated by A→ I editing of its pre-mRNA, resulting in a change of an amino acid at position 242 (Lys→Arg). These two enzyme isoforms have been shown to have distinct preferences in lesion processing including with the thymine oxidation product thymine glycol and the heavily oxidized guanines, spirimino- and guanidino-hydantoins (Sp and Gh). hNEIL1 has been found to excise these lesions in a variety of contexts - recently, it was discovered the NEIL1 and related proteins were capable of excising the hydantoins from G-quadruplexes (G4) under certain conditions. This work aims to look at both binding and kinetic studies to determine the efficacy of both forms of hNEIL to process Tg related lesions, hydroxyuracil and uracil glycol. In addition, binding and kinetic studies will be conducted to determine the ability of hNEIL1's isoforms to target and remove heavily oxidized guanine lesions from G4 DNA.

***DEB Graduate Student**

I. INTRONS VERSUS PROMOTERS: WHO'S DOING ALL THE WORK?

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When generating transgenic plants, it is essential to ensure the gene of interest is expressed at a desirable level; however, the sequences that control gene expression are poorly defined. Many plant genes lack conserved promoter sequences, and some genes with fully intact promoters are not detectably expressed without an intron. For this reason, introns are often included in transgenes used in industrial applications. Certain introns can increase mRNA accumulation several orders of magnitude through the largely undefined mechanism of intron-mediated enhancement (IME). To investigate IME, we use *TRP1:GUS* fusions in transgenic Arabidopsis. We previously demonstrated that the first intron from the ubiquitin gene *UBQ10* increases mRNA production from *TRP1:GUS* more than 10-fold when located near the 5' end of the *TRP1* gene, but not when more than 1kb downstream of the major transcription start site (TSS). To determine the 5' limit of intron location for IME, we tested the ability of the *UBQ10* intron to stimulate expression at 6 additional positions around the TSS. The intron strongly increased expression from all transcribed positions but had no effect from either location upstream of the TSS. We used 5'-RACE to map the TSS in each case and found that moving the intron into the 5'-UTR altered TSS location. This suggests that the intron may be directing transcript initiation. To test this hypothesis, we deleted 300bp of the *TRP1* promoter including all known TSS's from constructs that contained the *UBQ10* intron. Remarkably, expression of the reporter gene was not noticeably diminished by this promoter deletion unless the intron was also removed. Instead, transcription began just upstream of the deleted region, a conserved distance from the intron. The ability of introns to drive expression independent of promoters and alter TSS selection provides clues to the mechanism of IME that should be considered when using introns as a tool to maximize gene expression.

***DEB Graduate Student**

J. EXTRACELLULAR MATRIX-COATED COMPOSITE SCAFFOLDS PROMOTE MESENCHYMAL STEM CELL PERSISTENCE

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Composite scaffolds comprised of degradable polymers and bioceramics address many of the shortcomings of polymer scaffolds used in tissue engineering by providing increased strength and improved handling. However, such substrates have limited capacity to present instructive cues to associated cells and upon implantation many of the cells will perish. We recently demonstrated that a cell-secreted extracellular matrix (ECM) produced by mesenchymal stem cells (MSCs) can induce or sustain the osteoblastic phenotype of MSCs. Furthermore, the ECM promoted the survival of transplanted cells *in vivo*, leading to improved bone formation. MSCs were cultured for two weeks in media which supports matrix deposition, after which the decellularized matrix was used to coat macroporous composite scaffolds fabricated with bioactive glass (BG) and poly-lactide-co-glycolide (PLG). The objective of this study was to examine the cellular response of naïve MSCs to the transferred ECM in a 3-dimensional environment. *In vitro* studies showed the presence of ECM resulted in increased metabolic activity and decreased caspase activity, while simultaneously stimulating secretion of pro-angiogenic factors. *In vivo* bioluminescence imaging revealed MSCs seeded on ECM-coated scaffolds had improved survival and proliferation over the course of three weeks. At week three, signal from scaffolds coated with 100 µg of ECM was more than nine times greater than uncoated scaffolds. This work demonstrates the beneficial impact of ECM-coated composite scaffolds on MSC survival and regenerative capacity.

***DEB Graduate Student**

K. DOWNSTREAM PROCESSING AND *N*-GLYCOSYLATION MONITORING OF PLANT-MADE RECOMBINANT ANTHRAX TOXIN RECEPTOR FC FUSION PROTEIN

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Molecular farming of tobacco plants provides a viable option over 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. The current work is focused on production, purification and *N*-linked glycosylation monitoring of recombinant anthrax toxin receptor Fc fusion protein (CMG2-Fc), transiently expressed in *Nicotiana benthamiana* plants. This chimeric fusion protein, designed to protect against the deadly anthrax toxins, is composed of the von Willebrand factor A (VWA) domain of human capillary morphogenesis 2 (CMG2), an effective anthrax toxin receptor, and the Fc region of human immunoglobulin G (IgG). Fc-fusion proteins have been intensely investigated for their effectiveness to control a range of pathologies, with several remarkable recent successes coming to market. These promising outcomes have stimulated the development of novel approaches to improve their efficacy and safety, however the influence of bioprocessing conditions on the glycosylation of the Fc-fusion protein is being investigated to improve drug efficacy. In this work *Agrobacterium tumefaciens* harboring the CMG2-Fc gene under the control of the constitutive CaMV 35S promoter system is delivered into *Nicotiana benthamiana* plants via vacuum agroinfiltration method. A viral RNA gene silencing suppressor (P19) is co-expressed to improve CMG2-Fc protein production. Purification of target protein molecule from the leafy biomass starts with liquid nitrogen extraction using Tris buffer saline (pH 8) followed by sequential filtration steps. A microfiltration step was performed with 1.2 μm and 0.22 μm filter followed by ultrafiltration with a 30 kDa MWCO filter to prepare the extract for Protein A affinity chromatography. The purity and quantity of the target protein was assessed using SDS-PAGE, western blot, ELISA and MS/MS. Site specific glycoform analyses were performed using UPLC system coupled to a triple quadrupole mass spectrometer at each step in the purification process to determine how downstream bioprocessing operations impact *N*-glycosylation.

***DEB Graduate Student**

L. 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 Gα, GPR, and LIN-5 (Gα/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 Gα/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/Mes-1 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 and LET-99 are required for EMS spindle positioning and is in the SRC/MES pathway, but not in the Wnt pathway. My data suggest that 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.

***DEB Graduate Student**

M. PRODUCTION AND EVALUATION OF AN ANTIVIRAL PEPTIDE AGAINST HUMAN METAPNEUMOVIRUS IN TOBACCO BY TRANSIENT TRANSFORMATION

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Human metapneumovirus (hMPV) is one of the responsible viruses of respiratory infections. Production of a safe, efficient and low cost drug against this virus is the current challenge since there is no commercially available treatment or vaccine for hMPV infections. Plant-made pharmaceuticals provide a safe system for the production of recombinant proteins that can be used as antivirals or vaccines due to the lack of contamination by microbial toxins, it is a cheaper system due to the elimination of expensive bioreactors used by bacteria and also it can produce complex proteins with post-translational modifications. Previously, it was demonstrated that the entry of hMPV to the host cell can be inhibit by an exogenous peptide analogous to F protein from the same virus. We designed a synthetic gene expressing this analogous peptide and named it as HRA2pl. A model of the secondary structure of HRA2pl showed in the C-terminal two alpha-helix structures (coil-coiled), this configuration could enhance its stability and function. The HRA2pl peptide was produced in tobacco plants using transient transformation. The gene expression was monitored by RT-PCR postinfiltration, the highest levels of were reached on day 10. Also on day 10, SDS-PAGE and Western blot showed that the peptide expression showed the highest levels with the expected size (10.2kDa). The functionality was evaluated in the total soluble protein extract in HEp-2 cell line; the cytotoxicity assay revealed that TSP was no toxicity to the cells in neither of the concentration tested. hMPV infection produces a cytopatic effect in HEp-2 cell line, so we used this characteristic to evaluate in vitro functionality. The inhibition rates of the cytopatic effect were 41.8 and 98.7 % at the concentration of 9.43 and 94.3 µg/ml, respectively. This suggests that HRA2pl peptide can be produced in plants with good functionality and could be used as prophylactic therapy against hMPV

N. INFLUENCE OF EXTENT OF CROSS-LINKING ON THE PHYSICAL PROPERTIES OF SPRAY-DRIED ALGINATE MICROCAPSULES FOR THE PROTECTION OF CROP-ENHANCING BACTERIA

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Encapsulation in dry cross-linked alginate microcapsules (CLAMs) has numerous applications in food and agricultural biotechnology, including preserving the activity of enzymes, bioactive compounds, and plant-beneficial microbes. Encapsulating crop-enhancing bacteria may increase their shelf-life or confer protection from incompatible ingredients in agricultural formulations. Furthermore, in dry encapsulated form, these materials are more easily handled, stored, and transported. Previously, we developed a novel, scalable, and cost-effective method to produce dry CLAMs by spray-drying, effectively consolidating a series of unit operations into a single step. In this study, we investigate how extensively the spray-dried alginate matrix is cross-linked and explore the implications of cross-linking on the physical properties of CLAMs. We developed a method to assess the cross-linking in CLAMs by quantifying the ratio of soluble/insoluble alginate when CLAMs are suspended in water. Modulating the concentration of calcium phosphate (0.05 to 0.5%) in the spray-drying inlet suspension enabled the production of CLAMs with varying degrees of cross-linking. We then explored how the extent of cross-linking within CLAMs influences their physical properties, including particle size, appearance, and the release of encapsulated cargo in aqueous environments. CLAM diameter generally increased with increasing calcium content. While CLAMs prepared with lower levels of calcium appear bowl-shaped, the morphology of CLAMs with higher calcium content was more irregular and spherical. Ongoing research efforts explore the diffusion of water-soluble compounds through the cross-linked alginate matrix and the survival of microencapsulated plant-beneficial bacteria.

***DEB Graduate Student**

O. ANALYSIS OF SINGLE CELLS IN EMBRYONIC BASAL GANGLIA VIA GENETIC LABELING AND SINGLE-CELL TRANSCRIPTOMICS

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Complex genomic signaling pathways define the specification, differentiation, and maturation pathways of cells during brain development. Inhibitory interneurons arise in the embryonic basal ganglia (BG) and migrate to populate the cortex during early development. Genes enriched during interneuron development are associated with neurological and neurodevelopmental disorders including schizophrenia and autism, but little is known about how dysfunctions in interneuron lineage specification affect patterning and function of the mature brain. Existing methods to classify cell types rely on phenotypic characterization, gene expression profiling, or the expression of key gene markers. Transcriptional enhancers, non-coding DNA elements, drive tightly regulated gene expression patterns and can be used as markers that label cell types with more specificity than gene markers alone. Using a combination of single-cell RNA-sequencing and genetic enhancer labeling, we profiled the transcriptomes of individual cells in the embryonic BG in order to build a cellular atlas of interneuron development. We dissected the BG of transgenic mice containing enhancer-reporter constructs at embryonic day 11.5 and performed single-cell RNA-sequencing. We analyzed the gene expression profiles of single cells and were able to assign cell classes from heterogeneous cell populations based on known neural markers, such as GABAergic interneurons and progenitors expressing *Nkx2-1* and *Dlx2*. We found that enhancer-labeled cells clustered into intermediate developmental stages within the GABAergic interneuron class. These results suggest that single-cell RNA-sequencing can be used to detect and characterize enhancer-labeled cells *in vivo*, enabling us to study cell populations of interest that have not been captured with previously defined markers. By building an atlas of interneuron lineage specification during early development using enhancer labeling, we hope to examine functional changes in interneuron specification in pathogenic brain development as well as develop new cellular markers for future studies of interneuron development.

***DEB Graduate Student**

P. MODELING MONOCLONAL ANTIBODY PRODUCTION IN *NICOTIANA BENTHAMIANA* PLANT CELL SUSPENSION CULTURE

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Technologies that enable rapid, large-scale production of novel protein therapeutics or vaccines will be invaluable in future infectious disease outbreaks. We are developing a novel bioreactor-based production process for ZMapp, an experimental cocktail of monoclonal antibodies used to treat Ebola. Our system uses genetically engineered *Agrobacterium tumefaciens* to mediate transient protein expression in *Nicotiana benthamiana* plant cells. Plant cells are being explored as an alternative to mammalian expression systems because they can also produce complex proteins, but provide enhanced safety and efficacy in certain cases. A key advantage of our system is that *Agrobacterium* constructs could be produced for use in a manufacturing process more rapidly than a transgenic plant or animal cell line. We have developed a mathematical model for this new process which uses differential equations to describe the growth of plant cells, transformation by *Agrobacterium*, and antibody production. Sensitivity analysis has been performed using the model to determine which parameters in the process are most critical to experimentally optimize. The model will be further refined as additional experimental data is obtained to elucidate underlying molecular mechanisms of key process steps. By improving our understanding of the process, this model could reduce the time and cost of development for novel proteins produced using our system.

***DEB Graduate Student**

Q. STRUCTURES OF AN EDITING ENZYME BOUND TO DUPLEX RNA REVEAL BASE-FLIPPING MECHANISM AND BASIS FOR SITE SELECTIVITY

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ADARs (adenosine deaminases acting on RNA) are editing enzymes that convert adenosine (A) to inosine (I) in duplex RNA, a modification reaction with wide-ranging consequences on RNA function. Our understanding of the ADAR reaction mechanism, origin of editing site selectivity and effect of mutations is limited by the lack of high-resolution structural data for complexes of ADARs bound to substrate RNAs. Here we describe the crystal structure of the deaminase domain of human ADAR2 bound to RNA duplexes bearing a mimic of the deamination reaction intermediate. These structures, together with structure-guided mutagenesis and RNA-modification experiments, explain the basis for ADAR deaminase domain's dsRNA specificity, its base-flipping mechanism, and nearest neighbor preferences. In addition, an ADAR2-specific RNA-binding loop was identified near the enzyme active site rationalizing differences in selectivity observed between different ADARs. Finally, our results provide a structural framework for understanding the effects of ADAR mutations associated with human disease.

***DEB Graduate Student**

R. AIRBORNE DISEASE TRANSMISSION VIA EXPIRATORY AEROSOLS

Sima Asadi* and William D. Ristenpart
Department of Chemical Engineering & Material Science, University of California, Davis

The size distribution of pathogen-laden expiratory aerosols has high impact on the transmission of diseases such as influenza, SARS, and Tuberculosis. Human expiratory activities including breathing, coughing, sneezing, and talking aerosolize significant number of droplets from respiratory tract. In the first part of this study, aerodynamic particle sizer (APS) was used to measure aerodynamic diameter of expiratory droplets resulted from different expiratory activities in the range of $0.5 - 20\ \mu m$ and the results revealed that talking can produce as much aerosols as coughing. Moreover, surprisingly, we found that uttering some phonemes can aerosolize more droplets than the others. Besides, loudness was also found to be one of the most important parameters affecting droplet production during talking. As an archetypical phoneme, the results obtained for phoneme \Λ\ demonstrated that the number of produced aerosols increases by increasing the loudness. In the second part of our work, an experimental set up was developed to perform transmission experiments on guinea pigs, using Interferometric Mie Imaging (IMI) technique to measure size distribution of aerosols without affecting pathogen viability. The purpose of transmission experiments is to investigate the effect of parameters such as airflow speed, temperature, and humidity on disease transmission and also to develop a comprehensive disease transmission model. To examine the applicability of IMI method, water droplets were produced using an ultrasonic humidifier (instead of actual guinea pigs) and the size distribution of droplets was obtained.

***DEB Graduate Student**

Company Affiliates

*Company Affiliates ** Support Biotech Training at UC Davis*

- **Agilent Technologies**
- **Amgen, Inc.**
- **Amyris, Inc.**
- **Bayer Crop Science (was AgraQuest)**
- **Bayer HealthCare Pharmaceuticals, Inc.**
- **BioMarin Pharmaceutical, Inc.**
- **Celgene Corp.**
- **Cytokinetics**
- **Genencor (A Danisco Division)**
- **Genentech, Inc.****
- **Igenica**
- **Marrone Bio Innovations, Inc.**
- **Monsanto, Calgene Campus****
- **Novartis AG**
- **Novozymes, Inc.****
- **Nunhems**
- **OncoMed Pharmaceuticals, Inc.**
- **Sutro Biopharma, Inc.**
- **Tethys Bioscience, Inc.**

****These Biotechnology companies have donated at least $20,000 per year for a Biotechnology fellowship, have offered an internship site for our DEB graduate students, and have presented at the annual Biotechnology Training Retreat. Company representatives also serve as advisors for training grants and other education programs.

The success of our biotech fellows depends on the continued support of our affiliates. The Biotechnology Program would like to thank them for their committed sponsorship.

Agilent Technologies

Contacts:
Jim Hollenhorst, Ph.D., Sr. Director of Technology
Rudolf Grimm, Ph.D., Development Manager, Worldwide Proteomics Market & Metabolomics

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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.

Amgen, Inc.

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

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

Amyris, Inc.

Contact:
Joel Cherry, Ph.D., President of Research and Development

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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 Crop Science (was AgraQuest, Inc.)

Contact:
Magalie Guilhabert-Goya, Ph.D., Director, Biologics

www.cropscience.bayer.us

At Bayer, we take our values to heart and live them out every day. From respect for people and nature; integrity, openness and honesty; and sustainability of our actions; to a passion for our stakeholders and a will to succeed, these core principles guide every action and decision we make.

Bayer works hard to deliver results for customers, partners and communities, and we believe we have a responsibility to do right by the environment, our country, and the people who live in it. By using environmentally sound practices, caring for our communities, investing in education and providing responsible, quality products and services for society, while maintaining a culture of honesty, we demonstrate our values in everything we do.

Our employees are committed to a philosophy called LIFE - Leadership, Integrity, Flexibility and Efficiency – and we work every day to deliver on the Bayer mission: Science For A Better Life.

Bayer HealthCare Pharmaceuticals, Inc.

Contacts:
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Ben Lindenmuth, Ph.D., Biochemical Engineer

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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., VP, Novato Manufacturing

105 Digital Drive
Novato, CA 94949
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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.

Contacts:
Laure Escoubet-Lozach, Ph.D., Associate Director, Head of Epigenetic Drug Discovery
***Aaron Nguyen, Ph.D**., Principal Scientist

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(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:
Darren Hwee, Ph.D., Group Leader

280 East Grand Avenue
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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:
Kathleen Clarkson, Ph.D., Sr. Staff Scientist

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, Ph.D., Senior Researcher, Oncology Biomarker Div. (DEB Graduate)
Melody Trexler Schmidt, Ph.D., Sr. 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

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Davis, CA 95618
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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:
Matthew Coleman, Ph.D., Scientist, Manufacturing Technology

4560 Horton Street
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(510) 655-8730

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.

Novozymes, Inc.

Contact:
Debbie Yaver, Ph.D., Director

1445 Drew Ave.
Davis, CA 95616
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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., Executive Vice President and Chief Scientific Officer

800 Chesapeake Drive
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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.

5858 Horton Street, Suite 550
Emeryville, CA 94608
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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

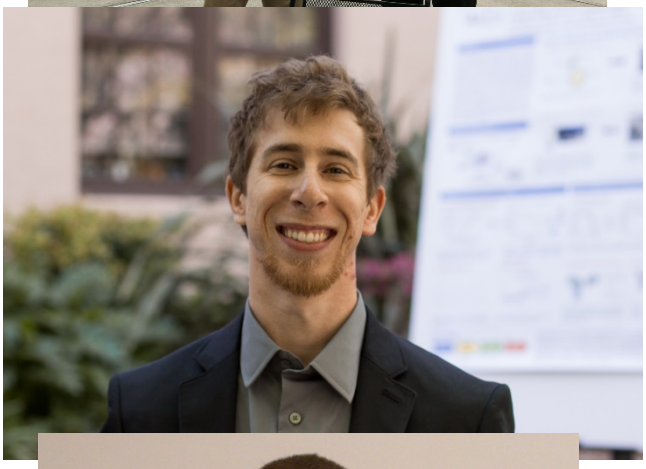
The company has become a pioneer in the discovery, development and value creation of novel biological markers for the clinical diagnostics marketplace: ***Biomarkers***. The company believes there is a large unmet need in both the discovery of potentially important biomarkers and the eventual use of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

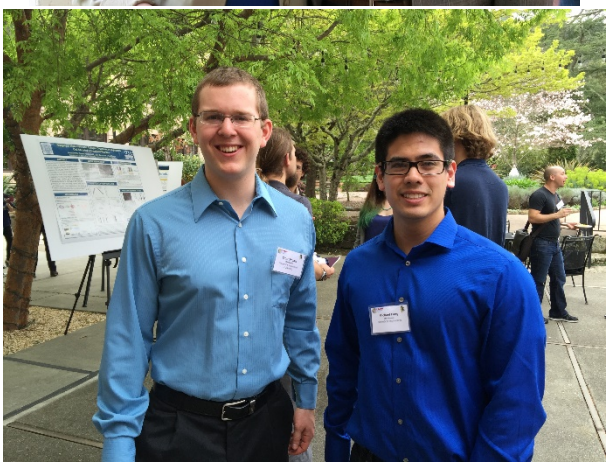
Tethys Bioscience has built expertise, created significant intellectual property, and is executing its business plan around three key areas: ***Biomarker Discovery, Clinical Validation and ValueCreation***. Tethys is focused upon introducing products that yield significant savings to the health care 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 2015 - 2016	
Karan Agrawal	Pharmacology & Toxicology
Jasmine Corbin	Chemical Engineering
Rosanna Kwok	Entomology
Nicole Nozzi	Chemistry
Anna Marie Tuazon	Biochemistry, Molecular & Cellular Developmental Biology
Sana Vaziri	Computer Science
Biotech Fellows 2015 - 2016	
Joshua Cohen	Food Science
Daniel Lewis	Integrative Genetics & Genomics
Debika Mitra	Biomedical Engineering
Sam Westreich	Integrative Genetics & Genomics
Graduate Students/Post-docs	
Brittany Anderson	DEB, Chemistry
Salem Alkanaimsh	Chemical Engineering & Materials Science
Sima Asadi	DEB, Chemical Engineering & Materials Science
Jonathan Ashby	DEB, Chemistry
Doug Banda	DEB, Chemistry
Allison Belliveau	DEB, Chemical Engineering & Materials Science
Akhila Bettadapur	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
Michael Burnside	DEB, Chemistry
Austin Carroll	DEB, Chemistry
Annie Chiu	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
Krishna Choudhary	DEB, Biomedical Engineering
Nicole Coggins	DEB, Molecular, Cellular & Integrative Physiology
Lisa Cohen	DEB, Molecular, Cellular & Integrative Physiology
Adam Contreras	DEB, Entomology
Shuchi Desai	DEB, Microbiology
Ryan Dowdy	DEB, Food Science & Technology
Cintia Helena Duarte Sagawa	DEB, Plant Sciences
Sifti Duhara-Gill	Chemical Engineering & Materials Science
Keith Dunaway	DEB, Genetics
Elizabeth Edmiston (Fox)	DEB, Internal Medicine
Ameen Eetemadi	DEB, Computer Science
Maher Elsheikh	DEB, Medical Microbiology and Immunology

Shea Feeney	DEB, Biochemistry, Molecular, Cell, and Developmental Biology
Sukriti Gakhar	DEB, Chemical Engineering & Materials Science
Jenna Gallegos	DEB, Plant Biology
Jisoo Han	DEB, Biochemistry, Molecular, Cell, and Developmental Biology
Jenna Harvestine	DEB, Biomedical Engineering
Luiz Carlos Irber Junior	DEB, Computer Science
Kalimuthu Karuppanan	Chemical Engineering & Materials Science
Kori Lay	DEB, Chemistry
Mirko Ledda	DEB, Integrative Genetics & Genomics
Jonathan Li	DEB, Animal Science
Malgorzata Liro	DEB, Biochemistry, Molecular, Cell, and Developmental Biology
Yulong Liu	DEB, Biochemistry, Molecular, Cell, and Developmental Biology
Simon Jesse Lopez	DEB, Genome Center
Kantharakorn Macharoen	Chemical Engineering & Materials Science
Veronica Marquez Escobar	Chemical Engineering & Materials Science
Morgan Matson	Chemistry
Leanna Monteleone	DEB, Chemistry
Angela Monterrubio	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
Charles Mordaunt	DEB, Medical Microbiology and Immunology
Akshata Mudinoor	DEB, Biological Systems Engineering
Nicole Nunez	DEB, Chemistry
Neal Oliver	DEB, Chemistry
SeHee Park	DEB, Chemistry
Rebecka Sepela	DEB, Biochemistry, Molecular, Cellular, & Developmental Biology
Megan Showalter	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
David Silberstein	DEB, Chemical Engineering
Scott Strobel	DEB, Biological & Agricultural Engineering
Linda Su Feher	DEB, Biochemistry, Molecular, Cellular & Developmental Biology
Sara Sukenik	DEB, Biomedical Engineering
Justin Thomas	DEB, Chemistry
Yaxin Wang	DEB, Plant Biology
Jacklyn Whitehead	DEB, Biomedical Engineering
Toni Wiegers	Animal Science
Mary Xiong	Chemical Engineering & Materials Science
Phoebe Yam	DEB, Internal Medicine
Britt Yazel	DEB, Neuroscience
Wade Zeno	DEB, Chemical Engineering

Yuxuan (Eric) Zheng	DEB, Chemistry
UC Davis Faculty	
Sharon Aviran	DEB, Biomedical Engineering & Genome Center
Daniela Barile	DEB, Food Science & Technology
C. Titus Brown	DEB, UC Davis Genome Center
Luis Carvajal Carmona	DEB, Biochemistry & Molecular Medicine
Joanna Chiu	DEB, Entomology
Abhaya Dandekar	DEB, Plant Biology
Danielle Lemay	DEB, Genome Center
Karen McDonald	DEB, Chemical Engineering & Materials Science
Alex Nord	DEB, Center for Neuroscience
Katherine Ralston	DEB, Microbiology & Molecular Genetics
William Ristenpart	DEB, Chemical Engineering & Materials Science
Allen Rose	DEB, Molecular and Cellular Biology
Cheemeng Tan	DEB, Biomedical Engineering
Industry	
Kristin Bernick, PhD	Agilent Technologies
Elenor Castillo, PhD	Sutro Biopharma, Inc.
Sara Gaucher, PhD	Amyris, Inc.
Sabina Gude	Novozymes, Inc.
Juan Pedro Sanchez, PhD	Monsanto Company
Abigail Yu, PhD	Sutro Biopharma, Inc.
René Meisner, DVM, DACVP, DABT	OncoMed Pharmaceuticals
Guests	
Yin Wu	Speq, Inc.
Biotechnology Program	
Jacki 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

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
  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
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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 NIH Training Program website: www.niht32.ucdavis.edu/

NIH Training Grant Faculty

Director: Bruce Hammock	
Co-Director: Karen McDonald	
Athanasiou, Kyriacos	Biomedical Engineering
Atsumi, Shota	Chemistry
Aviran, Sharon	Biomedical Engineering
Barile, Daniela	Food Science & Technology
Beal, Peter	Chemistry
Block, David	Viticulture and Enology
Brown, Titus	Population Health and Reproduction: Vet Med
Carvajal-Carmona, Luis	Biochemistry and Molecular Medicine, SOM and Genome Center
Chiu, Joanna	Entomology
David, Sheila	Chemistry
Dennis, Megan	M.I.N.D. Institute; Biochemistry and Molecular Medicine Genome Center
Facciotti, Marc	Biomedical Engineering
Faller, Roland	Chemical Engineering and Materials Science
Fiehn, Oliver	West Coast Metabolomics Center, Molecular & Cellular Biology; Genome Center
Franz, Annaliese	Chemistry
German, J. Bruce	Food Science & Technology
Goldman, Mark	Neuroscience
Griffiths, Leigh	Medicine and Epidemiology: Vet Med
Hammock, Bruce	Entomology and Nematology, UC Davis Comprehensive Cancer Center
Hell, Johannes	Pharmacology
Henderson, Paul	SOM; Hematology & Oncology
Hormozdiari, Fereydoun	Med: Biochemistry & Molecular Medicine
Horsley, David	Mechanical and Aerospace Engineering
Koehl, Patrice	Computer Science
Korf, Ian	Molecular & Cellular Biology; Bioinformatics, Genome Center
Kuhl, Tonya L.	Chemical Engineering and Materials Science, Biomedical Engineering
Lam, Kit S.	MED: Internal Medicine-Hematology/Oncology
LaSalle, Janine	MED: Microbiology & Immunology
Leach, Kent	Biomedical Engineering and Orthopaedic Surgery
Lebrilla, Carlito	Biochemistry, Molecular Medicine, Chemistry
Lein, Pam	Molecular Biosciences: Vet Med; Pharmacology and Toxicology
Lewin, Harris	Evolution and Ecology

Lewis, Jamal	Biomedical Engineering
Longo, Marjorie	Chemical Engineering & Materials Science
Marco, Maria	Food Science & Technology
McDonald, Karen	Chem Engineering and Materials Science
McPherson, John	UC Davis Comprehensive Cancer Center
Medrano, Juan	Animal Science
Michelmore, Richard	Plant Sciences, MCB, MED: Med Microbiology & Immunology
Mills, David	Viticulture & Enology
Newman, John	Nutrition
Nolta, Jan	SOM: Hematology & Oncology, Internal Medicine
Nord, Alex	Center for Neuroscience
Pan, Tingrui	Biomedical Engineering
Panitch, Alyssa	Biomedical Engineering
Parikh, Atul	Biomedical Engineering
Quon, Gerald	Molecular & Cellular Biology
Rauen, Katherine	UCDHS: Genomic Medicine; Pediatrics
Revzin, Alex	Biomedical Engineering
Ristenpart, William	Chemical Engineering & Materials Science, Food Science & Technology
Rocke, David	Biomedical Engineering
Segal, David	Biochemistry and Molecular Medicine, Pharmacology, MIND Institute
Seker, Erkin	Assistant Professor, Electrical & Computer Engineering
Shaw, Jared	Assistant Professor, Dept. of Chemistry
Siegel, Justin	Biochemistry, Chemistry, and the Genome Center
Silva, Eduardo	Biomedical Engineering
Simon, Scott I.	Biomedical Engineering
Tagkopoulos, Ilias	Computer Science
Tan, Cheemeng	Biomedical Engineering
Weimer, Bart	Vet Med: Population Health & Reproduction
Yu, Aiming	PK/PD Bioanalytical Core Facility
Zerbe, Philipp	Plant Biology

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 (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. **DEB 263 (previously 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 (www.novozymes.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 February 2016

Karan Agrawal	Pharmacology & Toxicology
Nicholas Aguirre	Neurobiology, Physiology and Behavior
Hannah Aizad Ledford	Molecular, Cellular & Integrative Physiology
Riley Allen	Biomedical Engineering
Leif Anderson	Biomedical Engineering
Brittany Anderson	Chemistry
Liz Anthony	Chemical Engineering
Sima Asadi	Chemical Engineering
Brian Avanzino	Biochemistry, Molecular, Cellular & Developmental Biology
Mina Azimi	Biochemistry, Molecular, Cellular & Developmental Biology
Krithi Bala	Genetics
Douglas Banda	Chemistry
Kristen Beck	Biochemistry, Molecular, Cellular & Developmental Biology
Katherine Beglinger	Biochemistry, Molecular, Cellular & Developmental Biology
Allison Belliveau	Chemical Engineering and Materials Science
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
Amirhossain Bolandparvaz	Biomedical Engineering
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
Elenor Castillo	Plant Biology
Stephanie Cevallos	Biochemistry, Molecular, Cellular & Developmental Biology
Christopher Chapman	Biomedical Engineering
Sum Ying (Annie) Chiu	Biochemistry, Molecular, Cellular & Developmental Biology
Krishna Choudhary	Biomedical Engineering
Nicole Coggins	Molecular, Cellular & Integrative Physiology
Joshua Cohen	Food Science
Lisa Cohen	Molecular, Cellular and Integrative Physiology

Adam Contreras	Biochemistry, Molecular, Cellular & Developmental Biology
Jasmine Corbin	Chemical Engineering
Ailsa Dalgliesh	Molecular, Cellular & Integrative Physiology
Amanda Dang	Material Science and Engineering
Rachel Danielson	Soils & Biogeochemistry
Destiny Davis	Plant Biology
Kevin De Leon	Molecular, Cellular & Integrative Physiology
Raquel de Mello e Pinho	Animal Biology
Shuchi Desai	Microbiology
Nithin Dhananjayan	Biophysics
Forrest Ryan Dowdy	Food Science
Cintia Helena Duarte Sagawa	Plant Biology
Keith Dunaway	Integrative Genetics & Genomics
Elizabeth Edmiston (nee Fox)	Immunology
Ameen Eetemadi	Computer Science
Nicholas Ellinwood	Environmental Toxicology
Maher Elsheikh	Medical Microbiology and Immunology
Shea Feeney	Biochemistry, Molecular, Cellular & Developmental Biology
Samantha (Chun) Feng	Pharmacology & Toxicology
Jonathan Flynn	Biochemistry, Molecular, Cellular & Developmental Biology
Zachary Fogassy	Microbiology
Michael Fong	Biomedical engineering
Amanda Fox	Immunology
Sukriti Gakhar	Materials Science and Engineering
Jenna Gallegos	Plant Biology
Anupama Ganesh	Immunology
Douglas Gettel	Chemical engineering
Donald Gibson	Integrative Genetics & Genomics
Hyrum Gillespie	Integrative Genetics & Genomics
Alex Gulevich	Biochemistry, Molecular, Cellular & Developmental Biology
Jisoo Han	Biochemistry, Molecular, Cellular & Developmental Biology
Jenna Harvestine	Biomedical Engineering
Dustin Heeney	Microbiology
Shawn Higdon	Plant Sciences
Briana Hill	Chemistry
Silvia Hilt	Biochemistry, Molecular, Cellular & Developmental Biology
Pui Yan Ho	Biochemistry, Molecular, Cellular & Developmental Biology
Gena Hoffman	Plant Biology
Kayla Horton	Pharmacology and Toxicology
Allison Hsia	Biomedical Engineering
Kuei-Pin Huang	Molecular, Cellular and Integrative Physiology

Jonathan Hughes	Microbiology
Hyun Tae Hwang	Pharmacology & Toxicology
Mittal Jasoliya	Integrative Genetics & Genomics
Julia Jennings	Chemistry
Rogelio Jimenez Espinoza	Chemical Engineering
Stefanos Kalomoiris	Biochemistry, Molecular, Cellular & Developmental Biology
Sercan Karav	Food Science & Technology
Prema Karunanithi	Biochemistry, Molecular, Cellular & Developmental Biology
Ryan Kawakita	Biological Systems Engineering
Brenna Kiniry	Microbiology
Sophie Kiss	Pharmacology & Toxicology
Angelica Kowalchuk	Integrative Genetics & Genomics
James Kurniawan	Chemical Engineering
Rosanna Kwok	Entomology
Vu Lam	Biochemistry, Molecular, Cellular & Developmental Biology
Kori Lay	Chemistry
Mirko Ledda	Integrative Genetics and Genomics
Linda Lee	Molecular, Cellular & Integrative Physiology
Mark Lemos	Plant Biology
Daniel Lewis	Integrative Genetics & Genomics
Johnathon Li	Animal Biology
Ying Li	Entomology
Malgorzata Liro	Biochemistry, Molecular, Cellular & Developmental Biology
Yulong Liu	Biochemistry, Molecular, Cellular & Developmental Biology
Furong (Frank) Liu	Plant Pathology
Simon Lopez	Integrative Genetics & Genomics
Shan Lu	Molecular, Cellular & Integrative Physiology
Rita Luu	Microbiology
Kantharakorn Macharoen	Chemical Engineering
Chandrima Majumdar	Chemistry
Maika Malig	Biochemistry and Molecular Medicine
Jordan Mancuso	Materials Science and Engineering
Amelia Manlove	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
Debika Mitra	Biomedical Engineering

Susan Moenga	Plant Biology
Leanna Monteleone	Chemistry
Angela Monterrubio	Biochemistry, Molecular, Cellular & Developmental Biology
Jessica Moore	Chemistry
Charles Mordaunt	Biochemistry, Molecular, Cellular & Developmental Biology
Akshata Mudinoor	Biological Systems Engineering
Bernadette Nera	Biochemistry, Molecular, Cellular & Developmental Biology
Livingstone Nganga	Plant Biology
Tin Ngo	Biochemistry, Molecular, Cellular & Developmental Biology
Alan Nguyen	Immunology
Chuong Nguyen	Pharmacology & Toxicology
Jared Nigg	Microbiology
Jennifer Nill	Chemical Engineering
Glyn Noguchi	Biochemistry, Molecular, Cellular & Developmental Biology
Nicole Nozzi	Chemistry
Nicole Nuñez (Chaffee)	Chemistry
Neal Oliver	Chemistry
Gulustan Ozturk	Food Science & Technology
SeHee Park	Chemsitry
Mario Parks	Immunology
Kyle Pelot	Plant Biology
Maria Peralta (del Refugio)	Chemistry
Laura Perilla	Plant Pathology
Adam Poe	Biochemistry, Molecular, Cellular & Developmental Biology
Özge Polat (Kurtuluş)	Chemical Engineering
Marc Pollack	Microbiology
Pengzhan Qian	Chemistry
Ali Rahimian Mashadi	Comparative Pathology
Anita Rajamani	Biomedical Engineering
Sonia Reveco	Integrative Genetics & Genomics
Juan Reyes	Integrative Genetics & Genomics
Shailise Ross	Chemistry
Jordan Sayre	Microbiology
Rebecka Sepela	iochemistry, Molecular, Cellular & Developmental Biology
Shanaya Shah	Biochemistry, Molecular, Cellular & Developmental Biology
Guy Shani	Microbiology
Megan Showalter	Biochemistry, Molecular, Cellular & Developmental Biology
Natasha Shroff	Integrative Genetics & Genomics
David Silberstein	Chemical Engineering
Christian Siltanen	Biomedical engineering
Julie Soderlind	Material Science and Engineering
Jennie Sotelo	Nutritional Biology
Breanne Sparta	Biochemistry, Molecular, Cellular & Developmental Biology

Allison Stevens	Nutritional Biology
Jessica Stolfi	Immunology
Robert Stolz	Integrative Genetics & Genomics
Scott Strobel	Biological Systems Engineering
Linda Su-Feher	Biochemistry, Molecular, Cellular & Developmental Biology
Sara Sukenik	Biomedical Engineering
Anandkumar (Anand) Surendrarao (Rao)	Plant Biology
James Ta	Biophysics
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
Denise Trans	Pharmacology & Toxicology
Kim Truong	Pharmacology & Toxicology
Anna Marie Tuazon	Biochemistry, Molecular, Cellular & Developmental Biology
Troy Vaden	Chemistry
Rachel Anne Valenzuela	Chemistry
Kacey VanderVorst	Biochemistry and Molecular Medicine
Sana Vaziri	Computer Science
Erica Vonasek	Biological Systems Engineering
Gordon Walker	Biochemistry, Molecular, Cellular & Developmental Biology
Gregory Walker	Microbiology
Eric Walters	Microbiology
Kening (Connie) Wang	Biomedical Engineering
Yaxin Wang	Plant Biology
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
Jacklyn Whitehead	Biomedical Engineering
Damion Whitfield	Microbiology
Priscilla Williams	Biomedical Engineering
Kelsey Wood	Integrative Genetics & Genomics
Natasha Worden	Plant Biology
Zong Wu	Biochemistry, Molecular, Cellular & Developmental Biology
Elyse Wudeck	Molecular, Cellular and Integrative Physiology
Yongao Xiong	Materials Science and Engineering

Phoebe Yam	Integrative Genetics & Genomics
Britt Yazel	Neurosciences
Le Yee (Huwe)	Biomedical Engineering
Xiaochen (Ellie) Yin	Food Science & technology
Fei Yian Yoong	Plant Biology
Cody Yothers	Chemistry
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

DEB Faculty Trainers as of February 2016

Venkatesh Akella	Electrical & Computer Engineering
John Albeck	Molecular & Cellular Biology
Rajeevan Amirtharajah	Electrical & Computer Enginering
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
Titus Brown	Population health and reproduction: Vet Med

Christine Bruhn	Food Science & Technology
Alan Buckpitt	VM: Molecuar 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
Clare Casteel	Plant Pathology
Chao-Yin Chen	Pharmacology
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)
Megan Dennis	Biochemistry & Molecular 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
Mark Goldman	Neurobiology, Physiology and Behavior; Ophthalmology and Vision Science
Tom Gradziel	Pomology
Jeffrey Gregg	MED: Pathology
Leigh Griffiths	Medicine and Epidemiology
Andrew Groover	Plant Biology
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
Johannes Hell	Pharmacology
Paul Henderson	Internal Medicine: Divison of Hematology and Oncology
Wolf-Dietrich Heyer	Microbiology
Fereydoun Hormozdiari	Biochemistry and Molecular Medicine
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
Dietmar Kueltz	Animal Science
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
Jamal Lewis	Biomedical Engineering
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
John McPherson	Biochemistry and Molecular Medicine
Claude Meares	Chemistry
Juan Medrano	Animal Science
Richard Michelmore	Plant Sciences
Lee Miller	Neurobiology, Physiology and Behavior
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
Alex Nord	Neurobiology, Physiology and Behavior and Psychiatry
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
Alyssa Panitch	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
Gerald Quon	Molecular and Cellular Biology
Katherine Ralston	Microbiology & Molecular Genetics
Katherine Rauen	MED: Pediatrics
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
Lesilee Rose	Molecular & 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 Şeker	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
Carolyn Slupsky	Food Science & Technology

Jay Solnick	MED: Infectious & Immunological Diseases
Athena Soulika	UC Davis School of Medicine, Dermatology
Daniel Starr	Molecular & Cellular Biology
Francene Steinberg	Dept. of Nutrition
Ioannis Steriopoulos	Plant Pathology
Pieter Stroeve	Chemical Engineering & Material Science
Alexei Stuchebrukhov	Chemistry
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
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
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 220 students enrolled, so we need more Academic-Industry Partnerships.

In Memoriam Aiza Cathe Go

It is with great sadness that we share the tragic news that one of our DEB graduate students, Aiza Cathe Go, has passed away. Aiza was part of the Biochemistry, Molecular, Cellular & Developmental Biology graduate group and her mentor was Prof. Sandy Borowsky. In this time of sorrow, we offer condolences to Aiza's son, husband, and entire family.

Prior to Aiza's passing, her sister had set up a GoFundMe web page to help offset severe medical complications which led to brain surgeries and other procedures. If you would like to help with the medical expenses, please visit the following site: https://www.gofundme.com/wbjzpsfg

Aiza's research was on characterizing Warburg phenotype in the pre-cancer DCIS MINO model and she was getting ready to graduate with her PhD in Biochemistry, Molecular, Cellular & Developmental Biology and a Designated Emphasis (DEB) in Biotechnology. She had completed her final DEB requirement last September, which was her internship. Aiza applied for and was accepted for an internship at UC Davis' Innovation Access where she focused on intellectual property and patents. After her internship, she went on filing fees to complete her dissertation so she could graduate in December.

The Biotechnology Program will forever be grateful to Aiza for the volunteering efforts she provided for several of our outreach activities. Some of these events included our annual Biotech Picnic Day Event, the Teen Biotech Challenges, and campus tours for high school students.

Goodbye Aiza, the world has suffered a terrible loss with your passing.