

# BIOENGINEERING BULLETIN

UNIVERSITY of CALIFORNIA, BERKELEY  
DEPARTMENT OF BIOENGINEERING

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## BioE by the numbers

Fall 2010

410 undergraduates  
16 Masters students  
164 Ph.D. students  
19 core faculty  
13 joint faculty  
3 emeritus faculty  
4 lecturers



1457 Freshmen applied for Fall 2010 admission to BioE.



In 2009-2010 we granted 118 bachelor's degrees - with an average time to degree of just 8 semesters!

Over one third of our current doctoral students have received extramural fellowships, including 36 from the NSF.

## Putting the engineering in genetics

It's a common joke that if you ask ten synthetic biologists to define their field, you'll get ten different answers. Most can agree, however, that Synthetic Biology is the design and construction of new biological systems not seen in nature.

Two of our newest faculty add a uniquely Berkeley flavor to their research, with a focus on technologies that bring standardization to the fledgling field.

Synthetic biology is already famous for assembling genetic devices from libraries of parts. However, design and assembly are often done with old-school by-hand methods.

"We're putting the engineering into genetic engineering," said Chris Anderson, Assistant Professor, "making it more of a rational process,

akin to a mature field like electrical engineering. We need to get to that level of predictability."



Anderson and Dueber



Anderson, who joined the department in 2007, has spent six years - not an unreasonable length of time - working with Adam Arkin on creating tumor-killing bacteria. This promising treatment option has graduated to animal trials, but Anderson now wants to speed up the process.

"It shouldn't take six years to make what we're making,"

he said, "we are only scratching the surface because it's really hard, slow, and expensive - we never get to create the level of complexity that we can design."

Anderson is a pioneer in adding automation to synthetic biology research, looking to speed up the process and lower costs.

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## BioEHS Academics helping students make the grades

At a time when many university students are asking, "what am I getting from my university?," our BioE students are asking, "what can I give?"

For BioEHS Academics instructors, the answer is a whole lot of help for their fellow students.

Begun in 2008 as a tutoring program of the Bioengineering Honor Society (BioEHS), BioEHS Academics runs study groups for multiple science and engineering courses. The weekly meetings, plus extra mid-term and final review sessions, are open to all students from any major, making this a unique service from a departmental organization.

These aren't simply casual study groups. Each weekly session for each course is led by a student instructor who has taken the class and

received at least an A-. Instructors go through rigorous student-led training and run each session equipped with worksheets and practice problems.

Over 100 students attend one of their study sessions each week, making BioEHS Academics the largest student-run tutoring service on campus. Feedback has been overwhelmingly positive.

"BioEHS hopes to provide students with quality tutoring services, as well as an opportunity to gain and develop teaching skills," said Student Coordinator Zhuchen Xu.

In Spring 2011 BioEHS is offering eleven study groups for nine different classes: Chem 3A, Chem 3B, EE100, BioE104, Physics 8A, Physics 8B, Physics 7A, Physics 7B, and Math 54.





BioE Lecturer Terry Johnson received the 2010 Golden Apple Teaching Award. This honor is given independently by Berkeley students.



The Bioengineering Department launched a new undergraduate concentration in Synthetic Biology in Fall 2010, giving undergrads a solid foundation for careers in this expanding new field.



BioE is recruiting for THREE new faculty positions. Learn more at [bioeng.berkeley.edu/career/bioefaculty.php](http://bioeng.berkeley.edu/career/bioefaculty.php)



Student surveys show that almost 90% of BioE undergraduates do research outside of class by their senior year.

Approximately 35% of Berkeley undergrads receive Pell Grants (low income federal student aid). That's more than all Ivy Leagues + Stanford combined.

# Chair Chat

The 2010-11 academic year has been one of intense creative thinking and exciting new actions, aiming to strengthen the translation of our bioengineering work at Berkeley to practical applications in important societal matters such as cost-effective healthcare and bioenergy.

One of the new ideas now well underway is the creation of an innovative masters degree which emphasizes Translational Medicine, joint with UCSF. Our thinking about this was stimulated and accelerated by the enthusiasm of Andy Grove, who has become a strong supporter of the program. We have created a new curriculum and recruited sixteen top-notch students (from over 85 applications received on a very short timetable), who arrived on campus in July.



We will continue to refine our approach to masters degree education in the next year or two, and beyond, but we firmly believe that this is a productive and exciting educational innovation in bioengineering.

In a similar vein, this month we are announcing the formal establishment of the Synthetic Biology Institute, with multi-year support from the first industrial member, Agilent. Department faculty hiring is also in high gear, with three open positions to fill this year.

We are actively shaping the future face of Berkeley Bioengineering. As always, we appreciate and count on the moral and material support from all of our friends.

*Matthew Tirrell*

## News Briefs

### BioE Excels in NRC Rankings

The UC Berkeley - UCSF Graduate Program in Bioengineering did outstandingly well in the 2010 National Research Council ranking of US graduate programs. The survey did not assign a single rank to any program, but rather placed programs within a range in their discipline by two different methods. Our Ph.D. program placed well within the top ten, between #2 and #8 by Regression, and between #1 and #6 by Survey. When sorted by either method, our program places third among bioengineering programs nationwide. Go BioE!

### Lee Receives Ho-Am Prize

In April 2010 Professor Luke Lee was awarded the 2010 Ho-Am Prize in Engineering. Lee was recognized for his seminal contributions to bionanoscience, and was described as "a leading scientist, inventor, and pacesetter in the field of bionanophotonics and microfluidic quantitative cell biology." The Ho-Am Prize is widely known as the "Korean Nobel Prize".



### Herr's Big Year

Assistant Professor Amy Herr has been chosen to receive a 2010 Eli Lilly and Company Young Investigator Award in Analytical Chemistry. Earlier in 2010 Herr also received the NIH Director's New Innovator Award, and was named a Sloan Research Fellow.

### Mofrad CAREER Award and New Book

Assistant Professor Mohammad Mofrad received a 2010 National Science Foundation Faculty Early Career Development (CAREER) Program award. CAREER awards are given to young researchers in science and engineering who have also translated their work into significant education activities. In 2010 Mofrad also published his third co-edited book, *Computational Modeling in Biomechanics*.



# “Never stop asking questions”

We interviewed BioE alumnus David Mun,  
Chemical Process Engineer at Life Technologies

David Mun received his B.S. in Bioengineering in May 2002 and went on to obtain a Masters in Mechanical Engineering at Berkeley and an MBA at UC Davis. He is now a chemical process engineer at Life Technologies (formerly Applied Biosystems).

## Tell us about your job now - what do you do?

My group is very project focused, meaning we're divided up to pursue different projects: supporting the transfer of a new product from R&D to Manufacturing, introducing process improvements to existing products, and troubleshooting persistent problem areas.

I am now at a stage in my career where I'm transitioning from participating in projects to leading projects of increasing scope and complexity. Currently I support two major projects -- one for our Foster City, CA facility and one at our Woburn, MA facility. This means a lot of travel back and forth as well as a lot of time management on my part to get things done promptly and to the satisfaction of my customers.



## How did you get where you are now?

A lot of trial and error. I am still learning to this day. I have mentored summer interns every summer at Life Technologies, and two concepts I try to impart to them is that you should never stop learning, and that I'd rather them make a decision and take a course of action than become stuck in "analysis paralysis". I also have an amazing group and boss to support me, and for that I am very grateful.

## What do you like best about the work you do?

Life Technologies is a very dynamic environment. The nice thing about being a project-based department is that I am able to observe and evaluate practices at different facilities. I am also able to help facilitate best practice transfer between sites to improve productivity and not have to "re-invent the wheel" every time a similar problem pops up at different facilities in the company. I enjoy being able to bring fresh eyes and an outside perspective. I believe that manufacturing should be central to a company's success and that we should do everything to ensure it runs most efficiently.

## Why have you stayed in biotech?

As a bioengineer I've always sought to put my education to good use. The Biotechnology/Life Sciences field is a good fit because I am able to use my passion for biology and apply it with the logical rigor of an engineering background. It is interesting in that the field is continuing to grow, and at the end of the day it's really satisfying to hear how our customers use our products to change the world or to raise the standard of living.

## How did your bioengineering education prepare you for the work you do?

It taught me how to learn. One of the harsh realities of working in the corporate world is that what's learned in school is only a fraction of the skills you need to thrive. But having the theoretical background from a great program really solidified my fundamental knowledge and allowed me to springboard from that point.

## What did you learn the hard way?

To really let go of the small stuff. In reality there is not enough time in the day to accomplish everything, and working over 10 hours a day plus weekends will only get you burned out faster. By strategically managing my time and prioritizing my responsibilities I have become a more effective and more productive person.

## You've come back several times to give career advice to students. What great tips do you have for them?

1. Never stop asking questions.
2. Find a mentor who will guide you throughout your career.
3. Coming out of college we do not expect you to know everything, but we do expect high performance and the potential to thrive at our company.
4. I'd rather hire a student who had a life outside of school than one who only focused on school.
5. I Google all prospective hires.
6. If you're a junior or senior, mentor the freshmen and sophomores. If you're an alumni, volunteer to speak at panels or mentor current students.

## What is your dream job?

To move into senior management at a successful Biotechnology/Life Sciences company and provide high-potential students entering the workforce with advancement opportunities. Most importantly to be happy in my work and achieve a great work-life balance.

## Did you know?



In 2009 - 2010 BioE had a higher percentage of women undergraduates than any other engineering department at 35.5%! And over 33% female graduate students!

Need help at work? Hire a student! Contact the BioE department for help with recruiting graduating students, summer interns, or 6-month Co-Op interns.



Worried about the UC budget cuts? You're not alone. Find the latest news on funding at Budget Central: [newscenter.berkeley.edu/budget](http://newscenter.berkeley.edu/budget)



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Want to be our next alumni profile?  
Drop us a line!

**Go Bears!**

# Synthetic Biology...

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"We're after that dirt-cheap dna-writing technology," he said.

One area his lab is pursuing tackles both data management and automation, areas Anderson feels are of huge importance for synthetic biology impact. Their software platform, Clotho, ([www.clothocad.org](http://www.clothocad.org)) handles data management, automation, design and data sharing with a very rigorously-defined data model for describing everything that exists in the field, from sequences to parts to sample plates.

On top of this core, developers can create 'apps' to use the data for everything from visualizations to data analysis, sequence comparison, and even to control an automated experiment process. Apps can be repeated a thousand times and strung together to create whole experimental workflows.

Assistant Professor **John Dueber** is working on a different front to improve efficiency, which he describes as "making cells more desirable for production of useful molecules, including biofuels." Dueber was hired in 2010 as part of a

joint search with the Energy Biosciences Institute.

Dueber is continuing research to build synthetic protein scaffolds, which will locate key enzymes near each other in a metabolic pathway, to increase the pathway's efficiency. When the engineered cells are producing chemicals, for example, metabolites must be handed from enzyme to enzyme in the pathway as steps in the production process. The scaffold co-localizes the enzymes as well as providing control over their relative quantities recruited to achieve optimal flux through the pathway.

Dueber and his lab were surprised to see just how well this strategy has worked to improve efficiency, and are now working to add further levels of control and generalize the principles to more pathways.

Both young professors feel that Berkeley is an exciting place to be doing their work.

"I like the focus on applications here," said Anderson, "people are doing very grounded projects with impact. Also, Berkeley has more people doing synthetic biology than anywhere else."

"It's a great community," agreed Dueber. "Berkeley has the right balance of aggressiveness in research and a laid-back, supportive personality."



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We started an interest group on @Cal ([alum.berkeley.edu](http://alum.berkeley.edu)): "Cal Bioengineers". Join us!



On @Cal you can also update your contact info, and get a free lifetime email address.

