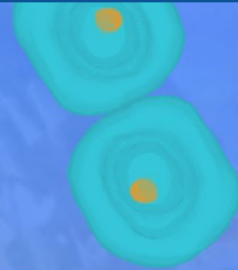


Stem Cell

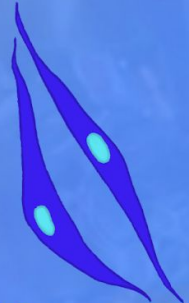


UC San Diego
Jacobs School of Engineering

Hematopoiesis



Myogenesis



BioEngineering Newsletter

Structural



Erythroid



Winter
2020

Introduction

Dear readers,

During the winter quarter, I had the fortunate opportunity to attend one of the Ph.D. recruitment events hosted by the Bioengineering department. Organized by our graduate coordinator Jan Lenington, this extravaganza invited students from all across the globe for a campus visit and interviews with faculty members. As I conversed with some of the attendees during the networking luncheon, I learned that they come from a wide spectrum of academic fields, research interests, cultures, and socioeconomic backgrounds. The inherent diversity in this body reinforces the notion that bioengineering is an interdisciplinary and collaborative field, consisting of scientists and engineers who use their expertise to revolutionize medical technology.

The winter issue of the Bioengineering Newsletter celebrates the diversity that is inherent to bioengineering through the lenses of both students and professors.

One of the key drivers that promote diversity in bioengineering is the Institute of Engineering in Medicine (IEM). This issue features its founder Professor Shu Chien and the current director Professor Andrew McCulloch, informing readers on the mission, history, organization structure, and programs of IEM. As an organized research unit, IEM also helps to bridge the gap between academia and industry with its Industry Advisory Board (IAB). For instance, with the help of IAB, the Bioengineering Industrial Relations Committee (BIRC) hosted the Bioengineering Career Fair in early February. Finally, as one of its diversity initiatives, IEM sponsors student organizations to volunteer in high schools and local events.

This issue also highlights some of our most distinguished professors and students in the department. Professor Bruce Wheeler shared his experience in directing the capstone senior design projects in Bioengineering; Assistant Professor Stephanie Fraley talked about her career path in becoming a professor; Ph.D. student Julian Kosacki articulated how his undergraduate major in chemical engineering informed him on his graduate study in bioengineering; MS-BS student Alyssa Chiang expressed her opinion on challenges pertinent to gender in science and engineering fields.

As you read through this newsletter, I hope that you will appreciate the diverse and multidisciplinary nature of bioengineering, and be inspired by the stories as told by current and future bioengineers.

Sincerely yours,

Chak Hang (Julian) Ho

Editor-in-Chief of the UCSD Bioengineering Newsletter (BEN)

BS Bioengineering (Biotechnology); BA Economics, 2020



The People of BEN

Every now and then, people are mesmerized by stories of novel drugs being synthesized, groundbreaking medical devices being invented, and pioneering research being published. Yet, the avant-gardes—bioengineers, scientists, students—behind the continuous revolution in medical technology are often overlooked. To most, bioengineering is a ray of white light. It certainly illuminates human society, but its very components—the assiduous engineers and the interactions across multiple academic disciplines that make innovations possible—are largely concealed from viewers. We at The UCSD Bioengineering Newsletter (BEN) strive to be a prism that refracts this singular white light into multiple colors, displaying not only the fruit of a research or the launch of a life-saving product, but also the motivations, aspirations, inspirations, hardships, and triumphs of current and future bioengineers.

By Chak Hang (Julian) Ho | Editor-in-Chief of BEN

Editor-in-Chief.....	Chak Hang (Julian) Ho
Deputy Editor-in-Chief.....	Ashwin Ganesh
Features.....	Chak Hang (Julian) Ho, Huy Le
Interviews.....	Yichen (Jenny) Xiang, Ashwin Ganesh, Nicholas Sada
Student Spotlight	Chak Hang (Julian) Ho
BMES representative.....	Kevin Yu
ISPE representative.....	Huy Le
UBIC representative.....	Alexandria Tran
BEGS representative.....	Hao Mu, Clara Posner, Ariel Wang
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The UCSD Bioengineering Newsletter (BEN) is a student run publication that covers the people, the research and the events that occur within the U.C. San Diego Bioengineering Department. For Winter 2020, we decide to celebrate the diversity in bioengineering through the lenses of both students and professors.

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Features



The Institute of Engineering in Medicine

New Leadership, New Initiatives

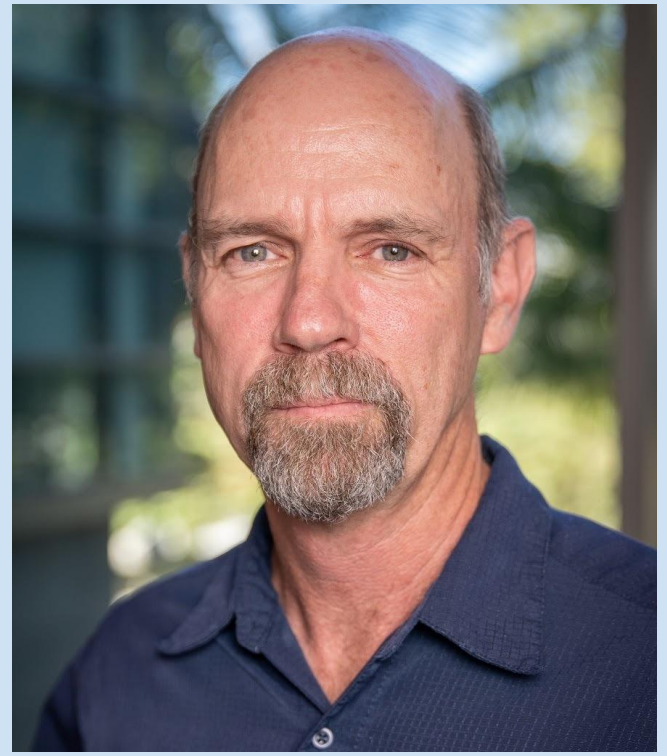
By Chak Hang (Julian) Ho | Editor-in-Chief

Intro: Following the retirement of Professor Shu Chien, Professor Andrew McCulloch has taken over as the new director of the Institute of Engineering in Medicine (IEM). In this interview, Professor McCulloch introduced us to the mission and history of IEM, described new initiatives that will promote new partnerships and innovations in biomedical technology, and discussed the value of modern education.

Q: What is the Institute of Engineering in Medicine (IEM)? What is its mission?

A: The Institute of Engineering in Medicine (IEM) is an organized research unit on campus that brings together faculty, research scientists, and students from different disciplines with a common scientific interest. In the case of IEM, our theme centers on the application of engineering approaches to solve biomedical problems, advance medical science, and improve the delivery of healthcare to patients.

There are currently 15 centers within IEM, running the gamut of technologies from nanomedicine and tissue engineering to multi-scale imaging and focusing on medical fields ranging from perinatal health to cancer. Under the umbrella of IEM, numerous engineers, basic health scientists, and clinicians collaborate to advance research at the interface between engineering and medicine. While some of our centers focus on specific health problems, others develop sophisticated technological solutions to various scientific and clinical problems.



The Whitaker Center for Biomedical Engineering is IEM's outreach center. This center bridges the gap between industry and academia via the Industrial Advisory Board (IAB), consisting of members from not only local but also national and international companies. These corporate representatives inform us on new biomedical technology, give us employers' expectations when hiring bioengineers, and propose potential partnerships with the university to promote new educational and research opportunities. The Whitaker Center also partners with student organizations such as the Biomedical Engineering Society (BMES) and Engineering World Health (EWH) to inspire the future generations of bioengineers to innovate in medical technology and serve the community.

One important program of IEM is Galvanizing Engineering in Medicine (GEM). GEM is a seed program that funds engineers to develop solutions to clinical problems, which sometimes lead to the formation of start-ups and clinical studies. One product that was born out of the GEM program is non-invasive ablation therapy, which is employed to treat patients at risk of sudden cardiac death ventricular fibrillation (VF). The conventional treatment for these diseases is an implantable cardioverter defibrillator (ICD), but false firings give patients a big shock that is distressing and can even lead to depression. An alternative to ICD is radiofrequency ablation to kill muscle triggering the abnormal heart rhythm. While current ablation therapy is too risky for VF, the new non-invasive technology funded by IEM could make ablation fast and safe enough to be used in VF as an alternative to ICD implantation.

Q: Can you tell me more about the history of IEM? When and why was it founded?

A: The Institute of Engineering in Medicine is a successor to the Whitaker Institute for Biomedical Engineering. Before 1994, the Bioengineering department was not yet established. The research groups that were interested in bioengineering were situated in various departments on campus. In an effort to bring together these groups, we formed an organized research unit called the Whitaker Institute for Biomedical Engineering.

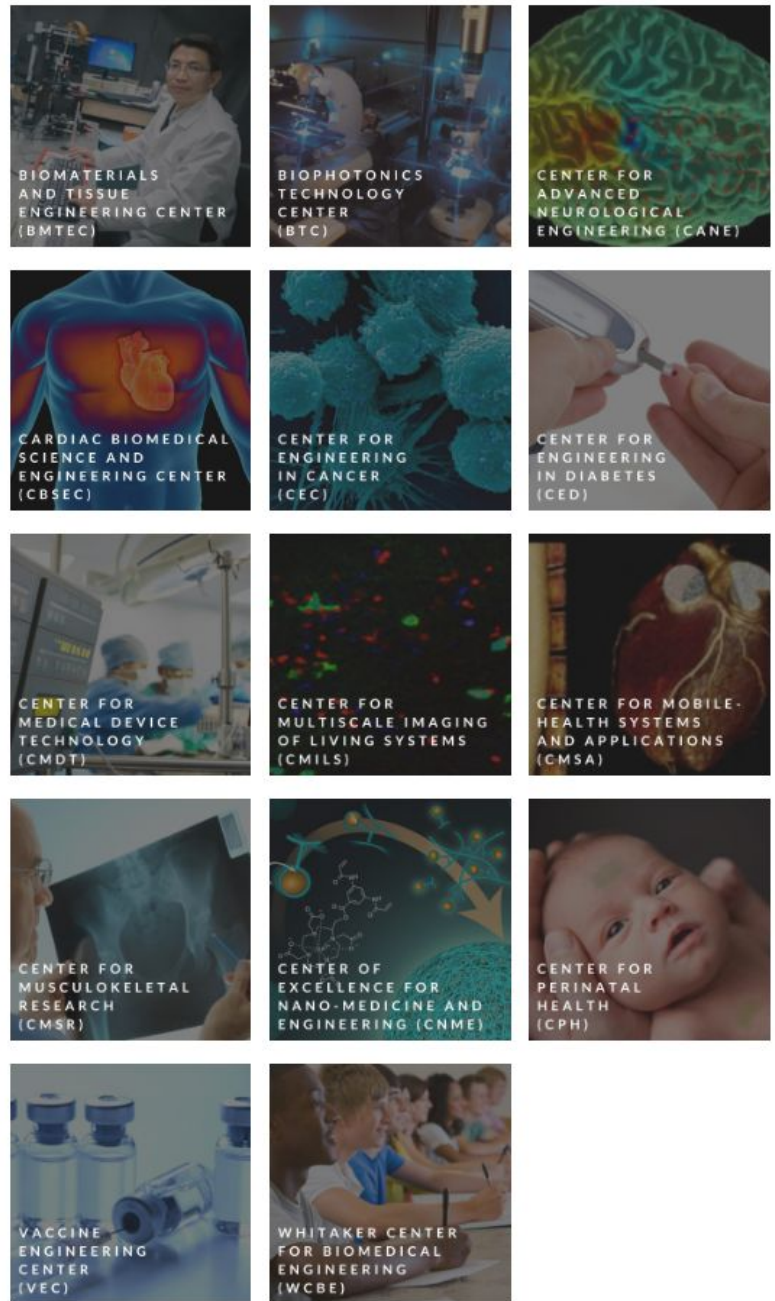


Figure 1: Research Centers under the Institute of Engineering in Medicine (IEM)*

*Figure courtesy of the Institute of Engineering in Medicine <https://iem.ucsd.edu/centers/index.html>

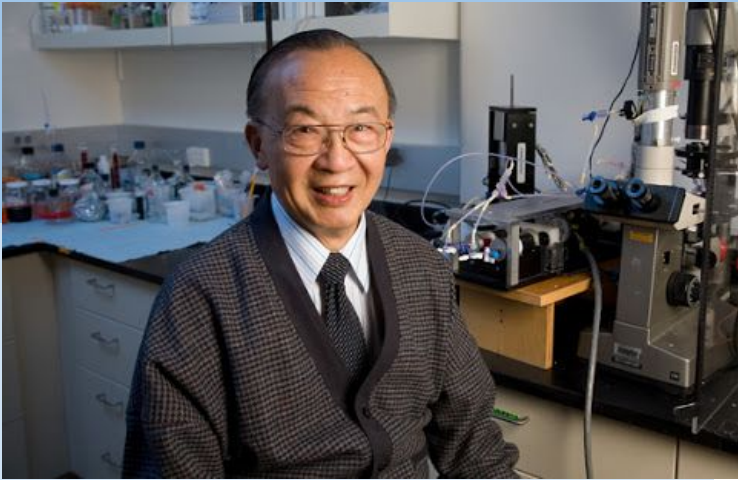


Figure 2: Professor Shu Chien, founder of the Institute of Engineering in Medicine (IEM)

At that time, our major theme was tissue engineering. Back then, the word tissue engineering--coined by Drs. Y.C. Fung and Richard Skalak--was brand new. Members of the institute were mainly basic-scientists. We had a strong medical school in basic science, a deep understanding in human physiology, and knowledge of the engineering principles that could be used to study cardiovascular, metabolic and musculoskeletal diseases.

In 1994, the institute received a development award from the Whitaker Foundation, which led to the establishment of the UC San Diego Bioengineering Department. Over time, the interest in bioengineering grew on campus; it grew beyond bioengineering to the point where every engineering department was doing interdisciplinary science and engineering research related to biomedical problems. This biomedical engineering research was often much more translational than we were doing when the Bioengineering department was

formed. Material scientists were developing biocompatible materials for surgery and tissue engineering; Mechanical engineers were creating devices such as vascular stents; Electrical engineers were designing new instrumentations and imaging techniques.

In response, Dr. Shu Chien founded a new institute to encompass the ever-increasing engineering applications to medicine--the Institute of Engineering in Medicine (IEM). The Whitaker Institute was rebranded as the Whitaker Center for Biomedical Engineering and serves as an outreach center for IEM.

As we broadened from the Whitaker Institute to IEM, one element that you notice is that there is much more translation. And that is one of the reasons that the GEM program was started--to promote translational research that is not only for gaining knowledge, but also for developing technologies with clinical applications.

Q: How does your experience as a professor in bioengineering inform you in serving as the director of the UC San Diego Institute of Engineering in Medicine?

A: I have been a professor in UC San Diego for nearly 33 years. After obtaining a PhD in Engineering Science at the University of Auckland, I came to San Diego. On the very first day, I walked into the medical school and met Professor Covell in Cardiology, who became my mentor. That was also when I started collaborating with Dr. Omens,

who was just completing his doctorate with Professor Y-C Fung and then moved to Dr. Covell's lab. As I advanced further in my career as a professor, I started collaborating with more cardiologists and basic and clinical scientists in the School of Medicine, School of Pharmacy, and the VA and University hospitals. The interdisciplinary culture of UC San Diego empowered me to expand the network that helps me to be director of IEM today.

I also served as the vice chair for Bioengineering from 2002 to 2005, under the leadership of Professor Shu Chien, and succeeded him after 2005.

"It is both an honor and a challenge to follow Professor Chien because he always has boundless energy, is widely known and respected, and has a phenomenal ability in encouraging people to pursue excellence."

With his retirement, and me taking over as the director of IEM, I hope that I can carry on his leadership in promoting the advancement of biomedical technology and science and inspiring current and future generations of bioengineers.

Q: Under your leadership, what initiatives are you planning to implement?

A: We have several initiatives we are actively pursuing. One of them is to expand the Galvanizing Engineering in Medicine (GEM)

program. The GEM program in its current form funds engineers to develop solutions to clinical problems but offers no means to test these solutions in a clinical setting. Our idea for Phase II of the GEM program would sponsor medical scientists to perform preclinical and clinical trials on the new engineered product, mainly in the UC San Diego medical center and the Altman Clinical and Translational Research Institute, to assess safety and efficacy.

We will also have a new outreach initiative known as GEMINI, or the Galvanizing Engineering in Medicine Inclusion Initiative. The goal of GEMINI is to encourage graduate and undergraduate students and post-doctoral researchers, to participate in outreach activities in schools and the San Diego community. For instance, three bioengineering student organizations--BMES, UBIC, and BEGS--represented UC San Diego in the San Diego Festival of Science and Engineering in early March; in this extravaganza, our delegates exposed local K through 12 students to diverse aspects of bioengineering such as tissue engineering and regenerative medicine. By serving our local community, IEM strives to promote diversity and inclusion bioengineering research and education.

Our third initiative involves assembling teams of students and faculty to develop tools that will improve patients' experience in the healthcare system, particularly those from underserved communities.

The biggest problem in healthcare isn't finding the right diagnosis or treatment, but ensuring that the patients have access to care, delivering the right treatment to patients and following up. For those of us who can drive, have a job, and are covered by health insurance, we often do not recognize the problem of accessibility as a major impediment to an effective healthcare system. Yet, for people who are uninsured, rely on public transportation, suffer from a disability, live in poorer communities, or do not speak English, simply getting to a clinic or hospital can be a major challenge.

With the advent of better information technology and the Internet, these patients can better take advantage of the healthcare system. The widespread use of cell phones in particular enables us to develop apps that can track patients; relatively simple technologies can also empower us to help with patient compliance to their medications, diet or exercise regimens. At UC San Diego, we have a hundreds of engineering students who are skilled at app programming and data sciences techniques like machine learning; with the help of the Qualcomm Institute and the new Halicioğlu Data Science Institute, we hope to develop data-driven technology that can improve patients' access to healthcare. I also believe that this will also be a great way for engineering students to learn about the lives of people dependent on the healthcare system. Recently for example, I connected our chapter of Engineering World Health with Dr. Saravia,

an expert on global health from the Anthropology department, who showed the students real-world examples of health projects working with indigenous communities in Chile. The enthusiastic and engaged response from the students was tremendous.

Finally, we wish to develop programs to help graduate students, post-doctoral researchers and new faculty in writing successful fellowship and grant proposals. Many of our faculty members have been on the panels that review these proposals; we can use that experience help first-time applicants to write more competitive proposals.



Figure 3: The official logo of the Institute of Engineering in Medicine (IEM)

Q: What is the value of education? According to the job-market signaling model proposed by Dr. Michael Spence, there exist two types of laborers--high skilled and low skilled, that are difficult to be distinguished by an employer. An applicant, though, can gesture that he/she belongs to the former group through higher education. The degree itself serves as an economic signal to the employer that the applicant is capable of carrying an assigned task. To what degree do you agree with this theory? Are there any intrinsic value of education aside from opening the doors to employment opportunities?

A: It is clearly true that higher education gives you access to high skill careers. But I tend to take the broader view of education. The value of education goes way beyond vocational training and Bioengineering itself is evidence of that. We have a lot of graduates going into careers that one would not have predicted an engineer would do--attorneys, school teachers, business consultants, sales people, writers. It is the ability to identify, analyze and solve problems, work in teams and communicate and lead effectively that are common.

In the university, we do not teach people how to do a job, and increasingly, we are not here to teach students knowledge either. What we are really doing here to teach students is lifelong learning, teamwork, critical thinking, problem solving, and analysis. With the Internet and machine learning, knowledge is at our

fingertips. But being able to discriminate high-quality from low-quality information, real news from fake news, promises that can produce a change from promises that are hollow, requires critical thinking skills that you learn in university.

“As a professor, I should not be trying to train this generation of bioengineers to do a particular job, because the job that they will do may not yet exist. ”

Bioengineering Career Fair 2020

Connecting Students with Industry

By Huy Le | Features Writer, ISPE rep.



This year was the second year of the Bioengineering Career Fair, a student-led career fair with support from the Bioengineering Department that aims to provide students with opportunities for networking, internships, and full-time positions. Since last year's event had 8 companies and well over 200 student attendees, the department was eager to expand the reach of this year's fair - with an emphasis on more companies and even more opportunities.

Organizing the Career Fair

The event was organized by the Bioengineering Industrial Relations Committee (BIRC), formed from representatives from each of the Bioengineering related organizations on campus - Tau Beta Pi (TBP), Biomedical Engineering Society (BMES), Bioengineering Graduate Society (BEGS), International Society of Pharmaceutical Engineering (ISPE), Undergraduate Bioinformatics Club (UBIC), and Engineering World Health (EWH) - along with the Industrial Relations Director, **Isgard Hueck**,

and the Executive Assistant to the Chairman, **Gabriela Moreira**. The mission statement is: "To develop sustainable and scalable industry connections for the UC San Diego Bioengineering students."

With these goals in mind, students and staff members in the Bioengineering administration met every week beginning in Fall Quarter to plan the fair's execution. Isgard and Gabriela were crucial in reaching out to companies for the career fair, and their vast networks allowed this year's career fair to host a diverse set of industries within bioengineering, from Seaspine's spinal technologies to Trial AI's innovation of clinical trials. The club representatives themselves collaborated to organize professional development workshops to ensure students' resumes and elevator pitches were polished before presenting themselves to industry professionals.

The Outcome

BIRC's dedication paid off on the day of the event. Over 20 companies and 250 students attended, with many praises given to the professional demeanor of the event and the event's ability to cater to niche fields within Bioengineering.

The distribution of participants affiliated with the University of California, San Diego is shown in Figure 2. While most attendees were undergraduate and graduate students, staff members from various departments also participated in the event.

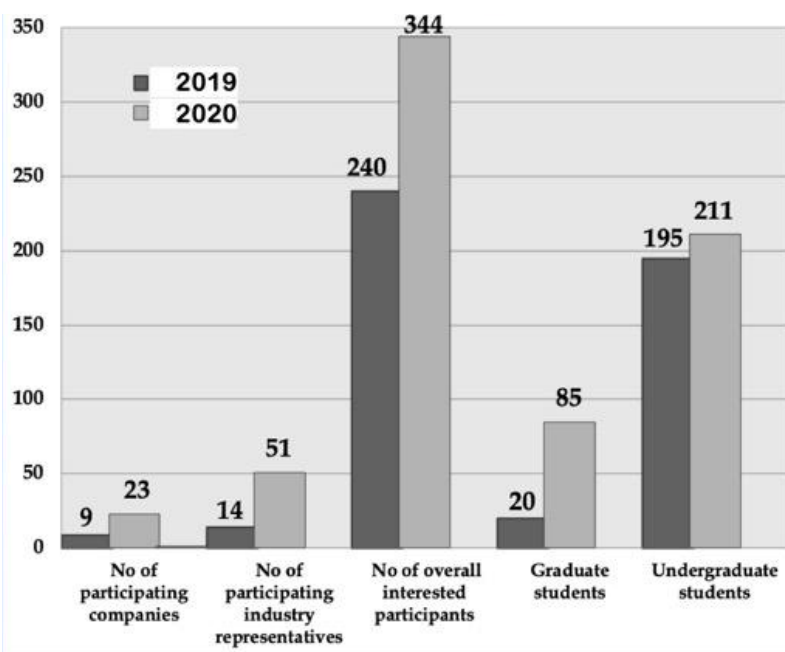
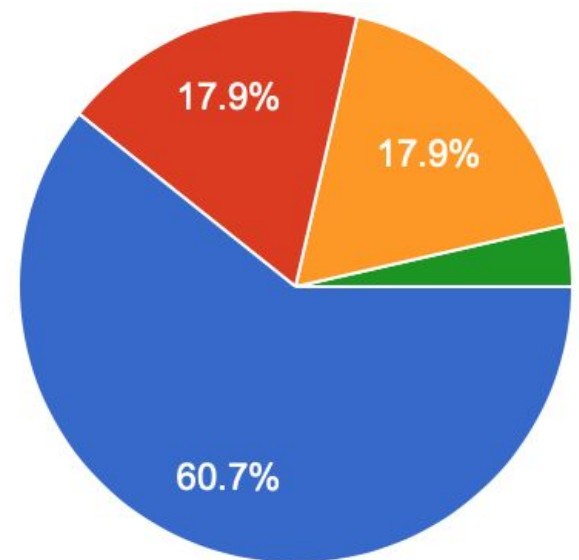


Figure 1: Bioengineering Career Fair Participation in 2019 and 2020

Compared to the first Bioengineering Career Fair in 2019, this year's extravaganza experienced an increase in attendance by undergraduate students, graduate students, and industry representatives, highlighting the increasing interaction between the academia and industry as facilitated by BIRC.



- Undergraduate Student
- Master's Student
- PhD Candidate
- UCSD staff - Computer Science & Engineering

Figure 2: Participant Distribution in the 2020 Bioengineering Career Fair

In a survey, we asked 67 participants to identify their main goals of attending the event. The result is shown in figure 3. Most students perceived the event as a valuable opportunity to network with representatives from different companies. Others were seeking either summer internship or full-time employment after graduation.

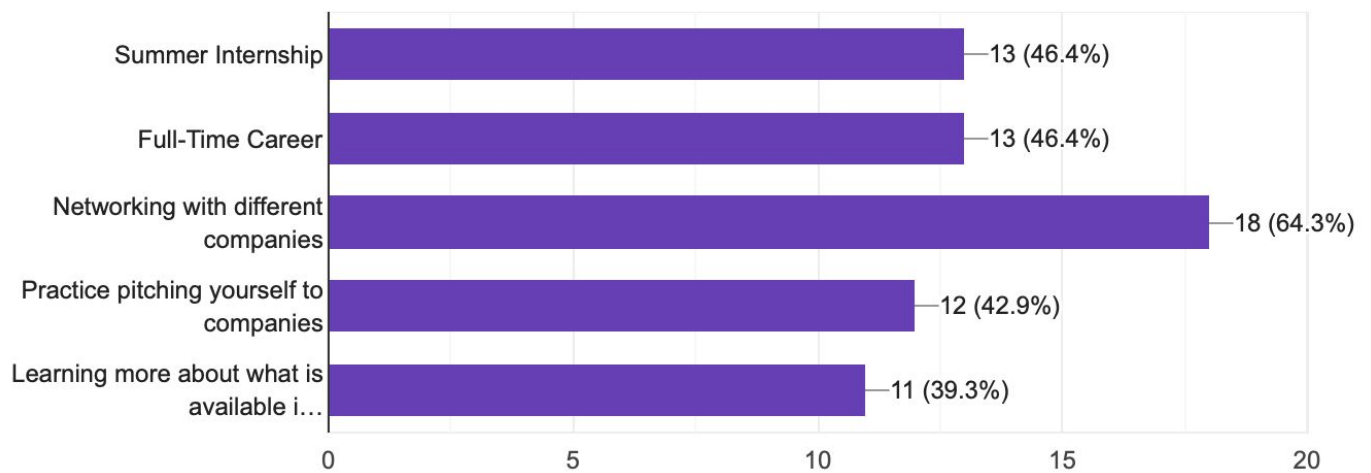


Figure 3: Students' goals of attending the Bioengineering Career Fair

Participants also provided valuable feedbacks after the career fair. Figure 4 shows some of their comments on the extravaganza.

- Good, I appreciate the career fair only targeted towards bioengineering students
- Really useful, thanks for organizing it!
- Great, important and rare opportunity for bioengineers.
- Great job!
- I think this is great that Bioengineering is doing a career fair for students, and I'd love to see more!

Figure 4: Participants' feedback on the Career Fair

All figures courtesy of Isgard Hueck, Industrial Relations Director

Interviews



Dr. Shu Chien

Beyond Bioengineering: Do Professors Ever Retire?

By Yichen (Jenny) Xiang | Chief Interview Writer

Q: When you were an undergrad what did you think you would do?

A: I went to Peking University for a year and half, then my family left Beijing in 1949, December, because of civil war. We went first to Shanghai and then to Taiwan. My father became the provost of the national Taiwan University, and later he became the president. While my whole family was there, I transferred to National Taiwan University. I graduated there after another 4 1/2 years of premed and medical school. After I graduated from medical school I had two choices. One is to become a medical practitioner, another is what I eventually chose—that is to become a professor and to do research as well as teaching. I was interested in both; I would love to see patients, but clinical medicine is a little bit too stereotypical: you have to do what's proven, you cannot experiment and try new things. I want to have a certain freedom to do new things and I love teaching, so I chose a profession that allows me to do both teaching and research. That is why I decided to pursue one of the basic science disciplines and I chose physiology. Afterwards I went to Columbia University and earned my PhD in physiology, then I stayed there and taught physiology for 30 years.

Q: Why did you come to UCSD?

After I taught in Columbia University for nearly 30 years, Dr. Fung and Dr. Zweifach from UCSD invited me to come here. Both of them were going to retire, and so they contacted me asking me to be their successor. I enjoy quantitative research, however physiology these days used



mainly qualitative approaches. I was not in bioengineering and I never went to engineering schools, so I took engineering courses and learned different theoretical and experimental engineering approaches. So Drs. Fung and Zweifach said what I did there was real bioengineering. That was how I came here in 1998, and shortly after that they both retired.

I only had two jobs in my life, one in Colombia and one here. It was hard to leave Columbia, I was happy there. The other thing is that my wife was a pediatrician, and she had a job in the NY city, and she had a clinic in East Harlem, a poor neighborhood. She wanted to serve the poor people, really wonderful. She did well there, to come here means that she had to give up her job. Worse yet, California does not

recognize the license in NY or any other state, so she had to retake her license exam when she was approaching 60. So I was hesitant to come. Finally she said let's give it a try, she came here and took the related courses. It's not only that she would forget what she learned in medical school more than thirty years ago, but also that many of the subjects and materials now she never learned at her time, e.g. molecular biology. So she took a 6-week review course, and she passed the California State medical board exam. It was truly amazing, she actually inspired many younger people to do the same.

After visiting UCSD three times we decided to give it a try, and we liked it. Now thinking back, I am very grateful that I made the choice. New York was a difficult place to live, not only the weather but also the rush hours. Here it is so much better. And the school [UCSD] has been on its steep trajectory, especially during the last 30 year it really has been vastly improved,

Q: What was your research about? And how did you enter the field of bioengineering?

A: My original research, my PhD thesis is about the pathophysiological effects of hemorrhage (blood loss) on our body, particularly the role of the sympathetic system. Because I was interested in both neurophysiology and cardiovascular physiology, I thought I could combine them. So I studied the role of the sympathetic neural system in our compensatory responses to hemorrhage. A few years after I received my degree, I realized

that the blood flow properties can have an influence on the bodily responses to hemorrhage and shock, and that sort of an engineering property, the flow properties of blood, was quite interesting to me. So I spent some time learning and starting to study blood rheology. In a few years we published three papers in a row in the Science magazine all in one issue. When I was young I didn't know how difficult it was; I tried and I made it. Now I don't try (chuckles). But anyway, I got three papers published there about blood rheology, which I didn't know anything about five years earlier. So this shows that you can always learn new things and get into a new field, and this is how my work started to get into engineering.

From there, in the 1980s, I was interested in molecular biology, as a foundation for research in physiology. At that time very few physiologists are interested in molecular biology because they didn't study it when they were students. I didn't study it in school either, because even the double helix was found only in the 1950s, when I was graduating. When we were students, we never learned it. Even for students in the 1960s-70s, these classes were never taught in physiology departments. I felt molecular biology is a new horizon which represents the future of physiology. I was a council member of the American Physiological Society in the 1980s, and I organized symposia and workshop on molecular biology for physiologists. I invited companies to set up tables at the national meetings so that people could get hands-on experience with molecular

biology techniques. I convinced them [the tech companies] that although these people don't do molecular biology now, if you let them learn, they will become your customers. So the industry people were very interested in providing everything. It is very hard for you to get into anything if you have no background at all. This workshop gave many physiologists the initial training; later on many of them developed into very outstanding researchers of molecular biology because of such training. Do you know Dr. Hu Shih, a Chinese philosopher? He has a famous saying that "scholarship is like the pyramid, it has to be broad and it has to be tall (deep)." It means that you need to have depth with true excellence.

So that gives you a general idea of the two major areas: systems-level diagnostics and then engineering mammalian cell factories for recombinant protein drugs.

Q: Why do you decide to retire?

A: I am 88, you know. Dr. Fung retired when he was 70. He had to, because those days people who hit 70 had to retire. But since a year after he retired, the law has been changed. Because there was a professor in Berkeley, he brought up a lawsuit saying that while he was 69, but he was not in any way less effective than his colleague next door at 55. So he asked why should he retire. He won the lawsuit. Once he won, then it is applied to everybody. People like us do not have to retire like Dr. Feng. That is why I can stay as a full-time faculty till I was 88. That was really a long time. Not many

people worked until 88. If you look at all the faculties here, you can find quite a few in their 70s, but very few in 80s. I am very grateful that even now I can still go over papers with my young colleagues and make suggestions in research. I couldn't ask for that, it's not in our control. Of course, we try to do the right thing, not to overeat or do other wrong things such as drinking too much, and we must try to keep our body in good shape; however, part of it is genetics, you cannot beat that. I think everything has its course, you cannot overstretch. So I finally decided to retire.

Q: What has changed in your academic and social life after retirement? Is this different than you expected?

A: I have less course assignments. Like BENG 1, I used to be responsible for it, now Dr. Sah is taking over, so I just attend the lecture and give some lectures, which I think is more enjoyable with less responsibilities. Last Wednesday for example, it so happened that my wife for some reason was not feeling well, just when I was going to class. So she called me and I turned back home. Actually we had to go to the emergency room because she was feeling very dizzy and her blood pressure shot up. The doctors didn't know why, but she recovered and they sent her home, so everything is fine now. But it would have been harder if I had not retired. As it happened, I just texted Dr. Sah and Dr. Peter Chen and went home.

I was also able to spend more time with my wife. We moved into a retirement home about a year a half ago, they have dining rooms and housekeepers, so she is free from all of the houseworks. They also have a place called care center. It is a place where people can live when they have health problems. When it is really a severe problem you have to go to the hospital, but the hospital doesn't keep you long these days. Even for a big operation, after three days they send people home. If we were at the previous home it would have been really hard. But here we can go to the care center in the same retirement apartment unit, and they have private rooms and nurses so we can stay there for several weeks without extra charge, when needed. We like it very much. There are also many UCSD personals and people of Chinese backgrounds, and we meet many new friends. So my wife no longer needs to make arrangement for socialization. They also offer classes, like Taiji, sitting yoga, singing, dancing, American Mahjong, and various kinds of lectures. You know, in every stage of life you have to try to do the right thing.

Q: Are you happier after retirement?

A: I am always happy, I mean, that is me. I am happy with what I have, even at difficult times, such as during the war. We were in a very difficult situation. we couldn't even have three meals in a day, but we lived through that. And I think a tough time makes a person stronger, and you appreciate everything because you went through the worst and everything after that is better. So now I am very satisfied,

always. I wouldn't say I am happier than before, but it is safe to say that I am as happy as before.

Q: What can bioengineers do after retirement? Could you ever stop doing research?

A: You can still help the field, help the young faculties and students. Because you have more experience in the field and in life, you can share it with the younger generation. I am sure I will stop research one day, but right now I can still do it. Sooner or later I will find it's too much for me, but not yet. I see it[research] not as a chore, but something very enjoyable.

Q: How does development in bioengineering facilitate the development of medication?

A: The one very important thing, as I mentioned, is the quantitative aspect and the temporal consideration of any kind of treatment. Use different treatments at different stages of the disease as it develops. Now there is a term called Precision Medicine, you have to do it precisely. Precision medicine really needs engineering, the old way of medicine wasn't precise. With engineering methods and consideration of individual differences, using genomic and other technologies to make the treatment more tailored to the individuals. I think it is a very important development.

And then there are several new ways of treatment that are made possible by new engineering approaches like nanoengineering, nanoparticles, biomaterials, and also the use of big data, robotic surgeries. Those are all made possible by bioengineering approaches that were not there thirty years ago. There is also a new direction of bioengineering, immunoengineering. Immunology is so important. When I was a medical student we had a little bit of knowledge about immunology and we didn't think it was applicable very much. But today we realized how important it is, a lot of the diseases are related to overeating and et cetera.

Q: How did the concept of Bioengineering change as computer science and human understanding in biology developed?

Bioengineering initially, I think, is more focused on technology for medical devices. We still have bioengineering development on sensors and the mechanical aspect of it. But at the same time bioengineering has also developed into a discipline, so we have new knowledge, new principles and new concepts that are at the interface of biomedical science and engineering science, to make it applicable, eventually to clinical medicine, not just a simple device focusing on one particular goal. It now has its own transient value, fundamental knowledge and applications.

Q: What do you think is the most important thing to learn in college for bioengineering students?

A: The most important thing is to learn how to learn. It's what we teach in the classroom and in the lab is limited, but if you can learn how to learn it's for your whole life. It's true for every discipline so you can learn on your own.

The other thing that's important is to learn to work with people, in a lab and in a group. Because no matter what you do later in life, you cannot be by yourself.

Dr. Bruce Wheeler

Insight into UCSD's Foremost Bioengineering Educator

By Nicholas Sada | Interview Writer



Q: Can you summarize your work and research at UCSD?

A: At UCSD I'm teaching, I don't have a research program. I had active research programs at Illinois and Florida but I left those behind when I came here. I'm primarily teaching undergraduates in the BioSystems major and Senior Design, where I see almost every student. Most of my research work can be summarized as Brain on a Chip – culturing neurons on top of microelectrode arrays. I've worked for a long time with a colleague, now at Irvine, who is expert in microbiology and neural culture; my contribution was the addition of electrical engineering techniques, including microlithography to control positioning of neurons and signal processing to analyze activity. At UCSD I'm primarily teaching in the BioSystems program: BENG 152, an instrumentation lab, BENG 135, a biosignals.

class, BENG 2, a first year Matlab class, BENG 125, the modeling class, usually shared with Dr. Hasty, and Senior Design

Q: Speaking of Senior Design, what has your experience been working with seniors and working on senior design in general?

A: It's been very rewarding. The students are very committed, working very hard out of a sense of pride, which makes teaching very easy. This has been a very good year despite the sudden end of in person activity; a lot of fun, lots of moving parts. There are 41 projects with 41 different faculty or industry people mentors. It's a complex organization but it works pretty well and student enthusiasm has been incredibly rewarding.

Q: How do you think the field of Bioengineering Education will develop in the future?

A: The big changes have happened over the last half century. Bioengineering was a small field dominated by the traditional departments – EE, ME, ChemE – and perhaps 20 Biomedical Engineering Departments. The great explosion took place in the 1990s, coincident with sequencing of the human genome and the growth in our understanding of molecular biology; also tremendous funding support from Whitaker Foundation including at UCSD in support of new departments and undergraduate degree programs. The explosion of computation and electronics led to

the reshaping of medical practice with devices -- imaging, physiological measurements, automated diagnostics. Parallel has been the biomolecular revolution for advanced diagnostics and therapeutics and highly sophisticated research tools.

I would expect there won't be a step change in the next 20 years but there will be a steady increase in the number of students who are much more interested in the biological side than the traditional engineering sides. The other change that's probably going to happen -- and it's already begun to happen -- is that the other engineering departments will develop Bioengineering minors or concentrations. For instance it is common to see students in mechanical doing biomedical projects. Almost US engineering departments include bioengineers on their faculty. Biomedical Engineering has become the field of the future because it's so big and important that everyone has noticed and wants to be involved. This is analogous to the dominance of military applications throughout engineering in the 60's and 70's.

Perhaps the biggest change has been the rapid inclusion of women in the field, making it easily the most diverse of the engineering disciplines.

Q: What do you think the next big thing will be in Bioengineering?

A: Ah ... what do I see in the crystal ball? Most obvious is already here -- the exploitation of CRISPR-Cas gene editing for all kinds of applications, from basic research, to

bio-pharmaceuticals, and disease treatment. That's a real step change in fundamental approach. The other change with more significant immediate impact involves delivery of mass and public health care, which requires not just political commitment, but also the resources of computation, the internet, and wireless technologies, making possible everything from national healthcare systems to telehealth in remote areas. These two -- biomolecular and information technology -- are clear winners in changing the face of bioengineering.

Q: Do you foresee any ethical problems that may arise within the field?

A: We have already encountered the ethical problem of editing the genome in utero. The issues are not easily "put back in Pandora's box", as there are all kinds of other applications -- perhaps editing in utero to crease the expected height of children. Law and enforcement vary so widely across the world that whatever ethical rules are proposed will be violated somewhere. This will be a growing area of concern.

There have always been ethical issues with the transition of a potential treatment to the treating of people through clinical trials. It's a difficult issue, but we have laws that, although tedious at times, are effective. I'm impressed at how far we've come in translating ethical concerns into our laws governing how medical

experimentation is done. That isn't to say all the problems have gone away -- they have to be addressed all the time -- it's just that we have a framework for addressing them.

Q: How do you think diversity can be encouraged within the field of Bioengineering?

A: Much has already been achieved. For instance, the UCSD Bioengineering Class of 2019 is 65/65 female/male, something not close to being achieved by other engineering disciplines. This is a significant contributor to how productive and fun Senior Design is. We are behind -- but improving -- in faculty hiring; bioengineering across the country is ahead of other engineering fields and steadily becoming more gender diverse. I note that for some time a slight majority of new MDs have been female, significantly restructuring the medical profession and quite noticeable among spokespeople during the COVID-19 crisis. Neither the US nor UCSD has done well in racial and ethnic diversity within Bioengineering, which is usually less diverse than other engineering fields. One of the hallmarks of all academia in the US is the abundance of faculty and students from other countries -- this is a continuing source of great strength. Overall, bioengineering has a record that is good for this decade, but steadily improving, with much greater impact coming in our students' generation.

Q: So going back to you, what made you decide to go into your field of study, with Brain on a Chip and everything?

A: A long time ago when I was looking at grad schools I read a book called Machinery of the Brain and said I would do something with technology that would be of use in neuroscience and that's essentially what I pursued for a career. I went to school in electrical engineering, did neuroscience projects, mostly signal processing and data recording and taught myself how to use electronic microfabrication technology. When I was at the University of Illinois I became interested in Brain on a Chip when I met my collaborator Dr. Brewer, now on faculty at UC Irvine but then at the Southern Illinois University School of Medicine; we worked together for 30 years including my first three years at UCSD. Our ideas began developing around 1990 when we were among the first to use microlithography both to control the growth of neurons in culture and to record in combination with microfabricated electrode arrays. We were among the very first to do brain slice / electrode array recording. We'd been doing this for 15 years before we put the name Brain on a Chip on it, just a little before organ on a chip became popular. We were doing neural engineering before anybody called it neural engineering. We didn't realize we were doing things that would soon become hot topics. I also had a project with binaural hearing aid signal processing, now the subject of various patents.

Q: It seems that sometimes students have difficulties transitioning from academia to industry, how do you think we could best bridge this gap?

A: There's several things that are going on. One is increased emphasis on internships and so the department – led by Isgard Hueck -- has greatly increased the number of internships as well as built up Bioengineering Industry Day. While a number of students want to go to med school or to PHD programs, a greater number want to go into industry, implying that we need realistic to communicate realistic expectations. Very important is to realize that industry expects its new employees to be technically trained, but they look for soft skills – teamwork and communication. Since bioengineering graduates are less likely than, for instance, CS majors, to be hired for their technical skills, soft skills are very often the difference makers – for the student and for the success of the company. A strong job market is very important – and we had an exceptional job market until a few weeks ago – everyone is trying to guess as to how we come out of this crisis. There has always been a tension between academics wanting to teach basics and industry wanting students to come pre-trained for exactly their product. We have responsibility not only for fundamentals but also for introductory experience in design and soft skills, it is not our job to teach students the product line of an individual company. Still, my experience at UCSD is that the match of expectations is pretty good.

Q: What steps could students take to better develop an area of interest?

A: The classic is to get into a lab for doing research. At UCSD more than at my other schools – Florida and Illinois – undergraduate students manage to get into labs. And not just the Bioengineering Department labs but also in the medical school and biology departments. Many are involved in campus activities – BMES for example – and out-of-class projects – the concrete canoe for Structural Engineers. More design projects for undergraduates would be a real plus. Internships are clearly important. UCSD is a big, active and diverse university providing many opportunities for the pro-active student.

Q: Any further comments?

A: I have a MOOC entitled “So You Want to Become a Biomedical Engineer” available from UCSD and EdX. It's in the form of a course but it really is just advice. It's free -- although you can pay if you want a certificate -- but the material is free. You can access it here: <https://www.edx.org/course/so-you-want-to-be-a-biomedical-engineer>

Dr. Stephanie Fraley

Education, Research, and Service

By Ashwin Ganesh | Interview Writer



Q: What do you do as a professor?

A: So all of us professors have 3 major jobs. The first is education. I am involved in teaching the fundamentals of bioengineering to undergrads and teaching the advanced elements to graduate students. The second is the research part. I mentor undergrads up to graduate students and teach them research fundamentals. My lab's research is in cancer metastasis and infectious disease. We are really trying to connect what happens in a patient and what happens in the lab. Our overall goal is to bridge this gap and connect lab data to patient data. The third part is service to the university. Since I got here I have worked on the new faculty hiring community. That committee looks through all the applications and

facilitates the process through which we hire. I am also on the graduate studies committee and this does a lot of things. It looks through the educational component of the graduate program and handles all day to day components of what goes into graduate education. There are lots of other self-governance that goes on in which faculty makes decisions that benefit students, faculty, and staff. At UCSD, professors are also encouraged to improve diversity. The way I have done this is by working with sociology professors to study the hiring practices at UCSD so we can promote the hiring practices.

Q: What's the focus of your research?

A: The big idea is that we study cancer and other diseases in a dish to help us understand those diseases. However, they are very context-dependent. We want to understand the information in our study and translate that into the patient. When you study a cell, you put it into different environments, where the cells change their metabolism and other processes. Cells are a product of their environment. We want to engineer cells to study these microenvironments for cancer and for infectious diseases. We also want to understand how this translates to humans. We want to develop technologies that can be used reliably in patients. We also wish to understand disease processes in humans. That is a systems medicine approach. We develop ways to take more information from the lab and apply that to humans.

Q: What Innovations can result from research into your field?

A: Innovations that have come out of my lab include diagnostic gene signatures to understand the profile of diseases and how to treat it. Also, we have developed molecular detection technologies that can be used to cheaply and quickly test patients for disease. That is a technology that has been licensed and was developed by a student in my lab who graduated. Hopefully, on the cancer side of things, we hope to move that forward so that we have therapeutic targets that we can use to stop metastasis. Metastasis is responsible for most cancer deaths.

Q: Where do you see the field of Bioengineering going in the future?

A: I think it is really exciting to think about how bioengineers can leverage the tech we develop and the biology we understand and facilitate the strategic integration of those two pieces of knowledge with data science approaches using machine learning and information theory. We are uniquely poised to understand the most effective uses of these technologies because we understand the biology and we can develop good ways to measure this biology that can measure the data that feeds these algorithms. A tool is only as good as its user. Bioengineers have a unique position in which they can develop and integrate these tools.

Q: All professors were students once. How did you decide your career path in college/university amid the many options available?

A: I was always interested in science and research and the why and how things work in the human body. I am a first-generation college student, so I didn't know all the options of how to get a career doing these things. My parents really encouraged me to go to a 4-year university, so I talked to people in my community about how to go into science. They encouraged me to go into engineering and I chose chemical engineering because chemistry is the basic building block of life. Bioengineering was new and my college didn't have a bioengineering track. I chose my local university because I got a scholarship and my parents couldn't afford for me to go to other schools. I loved this school but what I did not have was a lot of research programs. I reached out to bigger schools that had research opportunities and I didn't get any of those. Just so you know, we all fail before we succeed, and the point is to keep trying. I worked with professors in my college to develop an honors thesis research project. It was computational modeling of a bioreactor and I got it published in an undergrad research journal. I was able to present at a national research conference and in my local community at rotary clubs to raise money to go to these conferences. All these things added up. I am convinced that these efforts enabled me to then go to Johns Hopkins for graduate school. In grad school, I still wasn't sure if I wanted to be a

professor or a scientist in university or at a research institute. To figure it out, I did a couple of things. I knew a professor would have to write grants, so I tested these skills. I also went to the NSF GRFP (Graduate Research Fellowship Program), where I did an industry internship. This is a graduate research program over the summer. I did this while writing my thesis. And all of that helped me to understand that I enjoyed the academic research part of science.

Q: Do you see any ethical concerns as the field of Bioengineering develops?

A: Oh yes, we are at the forefront of exciting technology, biotechnology, that has the potential to change how everyone lives, diseases, societal class separations, food shortages, and basically, you name it. We are at the forefront of all those challenges that face humanity forever. We understand the technology behind these challenges and how to regulate them.

Q: As an educator, what do you think is the purpose of higher education? Is it merely an economic signal for employers to sort out highly-skilled laborers?

A: NO! Skilled laborers can be developed. An apprenticeship is a better way to develop skilled laborers. What higher education is meant for is to develop thinkers that can break big problems down into fundamental pieces and use this knowledge to come up with new solutions. So that is why as an undergrad you learn these concepts. For example, I teach mass transfer where students learn these concepts. Underlying everything out there is mass transfer. I love mass transfer.

Student Spotlight



Julian Kosacki

From Chemical Engineering to Bioengineering

By Chak Hang (Julian) Ho | Editor-in-Chief

Bio: Julian Kosacki attended Chaffey Community College before transferring to the University of California, Riverside where he obtained his bachelor's degree in chemical engineering with an emphasis in biochemical engineering. He then began his graduate studies at UC San Diego where he is currently pursuing a doctoral degree in bioengineering. He is currently working in Dr. Bernhard Palsson's lab where he investigates alkaline stress response pathways in E. coli.

Q: What is your research focus?

A: Specifically, my research aims to elucidate possible mechanisms that E. coli implements to survive in highly alkaline conditions, such as some parts of the gastrointestinal tract and the pancreatic duct. To do this, my labmates and I implement Adaptive Laboratory Evolution (ALE) which is used to track the adaptive and evolutionary changes in bacterial populations when exposed to a constant source of stress (such as high pH) over a long period of time. In the future, I hope to use the knowledge gleaned from these (and many other researchers') results to design my own synthetic pathways and semi-synthetic genomes.

Q: Who is your faculty advisor? How does he/she guide you in your research?

My faculty advisor, Dr. Bernhard Palsson, has established a laboratory where collaboration is key and advice freely given. Through his guidance and support, I have been expanding my knowledge base and tool set, learning things that I do not think I would have learned on my own. Because his lab has a wet lab along with a



dry lab component, I can continue to be primarily a wet lab scientist while honing my dry lab skills so as to incorporate them in my ongoing research.

Q: Why do you choose to pursue a PhD in Bioengineering?

Although I have always wanted to ultimately work outside of academia (so far), I still want to be involved in research and conduct research as a career. But to be competitive, I decided that it would be very helpful to have a doctorate degree. On the other hand, I love being in an academic setting such as UCSD everyday. I love being able to take classes and deepen my understanding of the field I am working in. I love being in an environment

where I can be taught the theory behind a technique and immediately turn around and use it in my research or pop into seminars, talks, conferences, etc, or conduct research that is interdisciplinary and gives me the opportunity to collaborate with others all while being surrounded by a host of like-minded people in the sense that we are all in the pursuit of higher knowledge. Knowing these things, I decided that pursuing my PhD in Bioengineering was the way to go for me.

Q: Bioengineering and Biology seem indistinguishable to many people. What do you think are the differences between the two fields? Why do you prefer the former to the latter in your graduate study?

A: The differences between the two, I think, are right there in the name. I think that biology in general is more focused on basic science questions and observations of the natural world as well as on figuring out the rules that govern it. Bioengineering is using those observations to bridge the gap between knowledge and function. Fundamental engineering principles such as thermodynamics, kinetics, and transport phenomena can be taken into account on a more rigorous level. Although there is a lot of overlap between the two disciplines, I think that the differences are enough to warrant a divide. Sometimes, I used to think to myself that I should have applied to biology programs but then I see just how much the engineering mindset brings to the table and I do not regret anything.

Q: How does your undergraduate major in chemical engineering inform you on your graduate study in Bioengineering?

A: Being trained with a background in engineering is obviously incredibly useful, and I will continue to use those principles forever. Although I appreciated the importance of chemical engineering, I was bored by its traditional career routes. I had chosen the biochemical concentration path in my curriculum. As I took upper division biology-based electives, I realized more and more that what I really wanted to do was apply my engineering background to living systems. One of the classes that cemented my desire to pursue bioengineering as a future career was my bioprocess engineering class my senior year. There, for the first time, I was introduced to the principles of working with cells from an engineering standpoint. That same quarter, I started applying to graduate school solely in bioengineering departments.

Q: Bioengineering is a field that encompasses a variety of topics, running the gamut from material science to electrical engineering. How do your summer internship experiences in Stanford University, Pennsylvania State University, and the University of Nebraska deepen your understanding of bioengineering?

A: Technically, I have always done “bioengineering” research although it was usually not through a bioengineering department or lab. There was always

something about learning from biology or having biological applications in my research that drew me. In Nebraska, I participated in an internship through the chemistry department where I learned about the existence of metabolites and how important metabolomics research can be. In the Kisailus lab at UCR, I basically did materials science research to help create a material that could mimic the material properties of the mantis shrimp club. At Penn State, I built, programmed, and tested a device to measure the properties of hydrogels that were being used to model epithelial mesenchymal transition in cystic fibrosis. At Stanford, I used synthetic biology tools such as CRISPR to interrogate membrane proteins and used statistical learning tools to find relationships between protein structure and function. Bioengineering can be a pretty diverse branch of engineering but each and every one of these research experiences helped me to narrow my focus more and more. Not everyone knows exactly what they want to do right away, and I am glad that I had the chance to dip my toe into a plethora of sub-disciplines in bioengineering before ultimately deciding on my current long-term focus.

Q: Diversity is a key component in all fields of science, especially with the dawn of globalization. Based on your experience, how can researchers benefit from a diverse working environment, with colleagues having different academic backgrounds, expertises, and nationalities?

A: As the son of low-income Argentinian immigrants in a Spanish-speaking household, I

have experienced what it is like to grow up in a multicultural environment. I am also a nontraditional student who restarted my college career at the age of 21- going to community college and then transferring back to the school that had originally dismissed me. Throughout my untraditional journey, I have met countless persons from diverse backgrounds who have all had something unique to bring to the table. Their personal struggles and insights borne from experience have allowed me to grow as a researcher. This has led me to strongly believe that fostering an environment in which diversity is allowed to not only exist but also flourish is key to the success of any discipline.

Q: How is the work-life balance of a PhD student? What do you do in your free time?

A: As a student it can be really hard to find a good work-life balance. I think it really depends not only on the department and lab one chooses, but also on that quarter's particular course load or TAships. Some quarters will be fine and dandy, and others will be hell; that's why it is important to practice good time-management techniques along with being extra aware of when you need to take a break and decompress. Building these habits have helped me juggle all of these responsibilities while still managing to have a personal life. When I do have time, I spend it with friends that I have made in the department and on campus. I also love to go out dancing, and you can catch me at the climbing gym on campus twice a week. I also love to read, and, when I can, I write and compose songs on my guitar.

Alyssa Chiang

And the MS-BS Program in Bioengineering

By Chak Hang (Julian) Ho | Editor-in-Chief

Bio: Alyssa Chiang attends University of California, San Diego, where she is currently working on her master's degree in bioengineering through the combined BS/MS program. Her bachelor's degree was completed last year in bioengineering with a focus in bioinformatics. Her current research combines synthetic biology with microfluidics technology to develop a biosensor for seawater toxins to quantitatively determine the safety of the water for Navy divers.

Q: What is your research focus?

A: My research focus pertains to combining synthetic biology and microfluidics to create biosensors that could be applied to solve various problems. The current problem I am working on is determining the safety of seawater for Navy divers who often face harsh conditions with harmful toxins. The solution that my labmates and I are working on consists of genetically engineering *E. coli* with promoters sensitive to the toxins of concern and inserting a green fluorescent protein behind so that we can use fluorescence to quantify toxin concentrations.

Q: Who is your faculty advisor? How does he/she guide you in your research?

A: My faculty advisor is Dr. Jeff Hasty. He is incredibly supportive in the lab's pursuits. He provides the flexibility for us to make decisions about the directions we want to take our work, and he gives helpful feedback along the way to provide guidance.



Q: Why did you choose to partake in the five-year BS/MS Program?

A: I chose to partake in the five-year BS/MS program because during my third year as an undergraduate student, I was standing at the crossroads. I was not 100% sure I wanted to do a Ph.D., nor did I know what area of bioengineering industry I wanted to pursue, or how much I even really enjoyed research. I was about 75% sure that I wanted to do a Ph.D., and that was not enough for me to apply to a program right away. Thus, I ultimately decided that an accelerated MS program would be a happy medium that would allow me to get a taste of graduate school, obtain more research experience, and buy more time before deciding on my next move.

Q: What are some features of the program that you find to be valuable to your career?

A: The best thing about the program is that it has allowed me to gain more research experience. Given that my involvement in research had begun later in my college career, this additional experience is invaluable. Furthermore, I have been able to take classes with people at a variety of stages in their lives, which has pushed me to consider different paths along my career. Ultimately, I feel like I am leaving the program with a much clearer sense of what's next.

Q: How does your undergraduate major in Bioinformatics help you during your graduate study in Bioengineering?

A: My undergraduate major in bioinformatics has been helpful in understanding where the field of bioengineering is headed. It has also helped me understand how seemingly vastly different components of the field could potentially come together to solve increasingly complex problems. I also cannot deny that the coding experience has been extremely helpful in the lab, since coding is increasingly becoming an expectation in our day and age and is a handy skill to have.

Q: Bioinformatics, a subject closely related to computer science, is traditionally a male-dominated field. Have you faced any challenges pertinent to gender?

A: Though I haven't experienced outright unfair treatment as a female in bioinformatics, I do believe there are often underlying challenges pertinent to gender that we face as women in a traditionally male-dominated field. This is often manifested

subtly, such as feeling like I am not being taken as seriously as my male peers; but for the most part, these challenges are not unique to the school setting and are challenges that many women still face daily.

Q: I know you are also the former president of the International Society for Pharmaceutical Engineering (ISPE). What did you learn from your leadership experience?

A: Serving as president of ISPE was one of the best experiences from my undergraduate experience. It taught me important lessons on managing people and fostering a team, not just a board of discrete members. I learned to delegate tasks out and make meetings as effective and concise as possible. I also learned that treating all members with respect and taking the time to show genuine appreciation goes a long way. These are lessons I will take with me into my career because I know I will be in countless settings in which I will be collaborating with others.

Q: Looking to the future, do you want to continue your research in academia or find jobs in industry? What are some pros and cons of both fields?

A: I intend to ultimately pursue a Ph.D. in bioengineering before heading into industry. I want to see the manifestations of my work in the complex problems the field faces. Research in academia is a rewarding path. It evolves in you a different kind of mindset that allows you to see how your work makes an upstream impact through its developing downstream impacts. This means that you are often at the “cutting-edge” and have the room to move in various directions with your research. Finding work in industry feels like a more immediate and apparent impact, but you run the risk of falling into a routine grind and feeling like a cog in the wheel. Either way, I think the most important thing, independent of the path of choice (note that academia and industry are not necessarily the only options), is to remember the bigger picture of why you are doing what you are doing.

Student Organization Events



Lab Expo 2020

Biomedical Engineering Society (BMES)

By Kevin Yu | BMES Representative



We often don't consider what it takes for busy professors and graduate students to take a bite out of their time, and bring their high-level expertise to the undergraduate level. At times it may seem like professors don't care about teaching their classes, and thus the critical student disregards the class as a whole — including the instructor and the expertise they're willing to share. Add onto that the prevalent issues of student anxiety, time constraints, and scheduling conflicts, and it becomes obvious why many students feel that research is another entire world — foreign, remote, and highly demanding.

The problem here is that education — especially at the collegiate level — is a two-way street. To learn what's happening on the cutting edge, there's no better substitute than talking directly with those who practice on that fringe. Learning is as much an art as it is a science: it's as collaborative as it is didactic. Yet, with all that's placed on a student's plate these days, the gap between an undergrad and a professor inevitably widens.

Enter Lab Expo, an annual symposium dedicated to bridging the gap between researchers and students. Focusing on bringing research directly to students, the event aims to emphasize the collaborative element missing from traditional lectures. Typically, the event consists of a keynote presentation, a networking lunch where students speak directly to UCSD researchers of various fields, and a poster session where students can openly interact with researchers and better understand the various projects occurring at the school.

At the keynote presentation, Kate Yoshida, a writer for the YouTube channel MinuteEarth, brought stellar insight into the topic of science communication. Like a mentor guiding her apprentice, she elaborated on the complexity of STEM topics. These topics are built upon a lifetime of education and experiences, so despite the enthusiasm of those already predisposed towards science, not everyone can understand them instantly. One must communicate science in a manner familiar to

the audience, with straightforward language and familiar metaphors to describe complex topics – again, like a mentor to an apprentice, rather than a lecturer to a student. She further mentioned that the framing of a topic can be as important to communication as the content itself – nobody wants to hear a lecture. But a story? That gets people invested, through narrative and information intertwined.

I had a chance to talk with Kate personally during the networking lunch session. Among the greater hum-drum of discussions floating in the air among other researchers, a nervous silence held the air at our table at first. Breaking the ice, an undergraduate fan sitting to my right asked about the workflow of MinuteEarth, followed up by a girl to my left recounting her work writing for a science journal and its similarities with writing for educational videos. As I listened in to their conversations, I found myself noting the way Kate conducted herself in conversation: an approachable demeanor coupled with distinct confidence in speaking her mind. She crafted a short parable out of her transition from a Ph.D. in zoology to her work on MinuteEarth – practicing what she preached – and eventually drew me into the conversation as an active participant rather than a passive listener.

Afterwards, lunch gave way to the main attraction of Lab Expo: the poster session with various researchers and even some student organisations. The sheer variety of presenters, as well as the subjects covered, threw me for a loop. Traditionally a STEM-focused event, this year's Lab Expo had made strides to expand past that

narrow lens, bringing in researchers from the departments of Anthropology and Sociology.

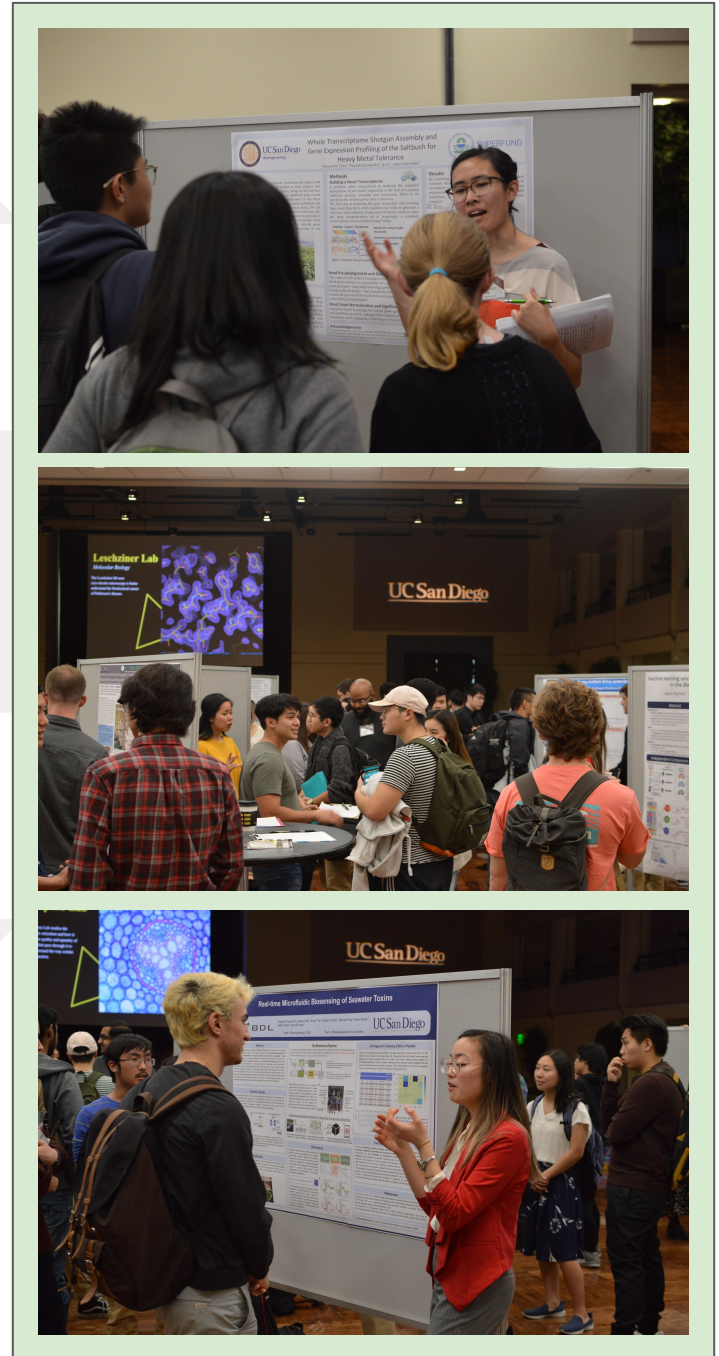
What truly impressed me though was the interdisciplinary nature of research presented. For instance, the Levy research group focused on the excavation and documentation of Roman-era structures in tide-prone areas. Photogrammetry and image processing – techniques originally developed for ecological and other STEM-related studies – were used to determine the age of these structures when traditional analysis of loose matter could not. Another group, the Triton Robosub student organization, impressed me with their autonomous underwater vehicle (AUV), as well as the team's integration of software, circuits, and mechanical engineering expertise to construct the robot. Without any one of those three, their AUV would've sputtered and crashed without question. But, as explained by the team, it more than held its own.



From this, it seems obvious that the efficacy of research or a project depends on interdisciplinary thinking. But to enable this, researchers need to be able to understand each others' work. Likewise, to integrate team members of different backgrounds on a single project, each member must be able to explain their expertise to others effectively. Thus, effective communication becomes as important to a researcher as the research itself!

This is what Lab Expo is about: bridging the gap between researcher and student and fostering the interdisciplinary collaboration that makes successful projects possible. No lone pair of hands can move a mountain, but with many pairs, such a task may become feasible. Through this year's Lab Expo, it seemed as if the nature of research itself formed the core of the event: interdisciplinary collaboration fostered through effective science communication, resulting in projects that impress and inspire.

As the day drew near to its end and my fellow BMES officers who organized the event gave their closing speeches, I found myself considering the same quandary that this article started out with. It's difficult to learn from a professor who doesn't seem to care about teaching, but oftentimes that isn't the case at all. Sometimes, it's the teaching itself, the communication, that has broken down. And I don't think one should be blamed for something like that. Instead, such a failing only leaves the door open for suggestions, collaboration, and improvement in the future.



Paint Night

Bioengineering Graduate Society (BEGS)

By Hao Mu, Clara Posner, Ariel Wang | BEGS Representatives



Graduate life can be immensely stressful. The Bioengineering Graduate Society's community development events are designed to combat this stress by providing a place for graduate students to relax and to build a supportive network with their fellow graduate students. One of our most popular events is our annual Paint Night. During Paint Night, students from all years gather together in the grad lounge to display their creativity on canvases. With the help of some food and wine in the company of good friends, many masterpieces have been created year after year.

This year's event took place in the Bioengineering Grad Lounge on February 20th. We had a record-breaking 35 participants! There were so many people that all 6 tables were occupied during the event. Everyone enjoyed not only the act of painting but also the camaraderie.

Community building is the most meaningful aspect of Paint Night. Every year, we are greeted

by new and old faces joining the event; many senior graduate students still come. It is a great opportunity to meet new people, especially for busy students like us. First-year students can talk to senior students and get mentorship advice, and senior students get to network with people from different research groups.

Paint Night gave everyone a break from the daily grind of graduate school. We all bonded over the struggle of following along with the master painter, Bob Ross. Starting the painting was the most challenging part. Each brush stroke injected the blank canvas with an intimidating, vibrant block of the color of yellow, orange, blue, or purple. Strokes of green and brown made the shape of the forest more apparent. After adding some happy little trees

and shrubs, the painting was complete. The painters examined their final masterpieces and felt a sense of accomplishment as we admired each other's beautiful paintings. Throughout the event, the stress of graduate school and other concerns melted away as painters focused intensely on the quick instructions of Bob Ross. At the end of the event, each painter walks away with a beautiful painting to display at home or even in the lab office!



See how many smiling faces we had? Students attend year after year for the engaging and welcoming atmosphere of the event, making Wine and Paint Night a staple event for our organization.

Acknowledgment



STAFF NOTE

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