THE CATALYST

New Beginnings for BIOE: Clark Hall

Inside the Mind of a Bioengineering Pioneer: Dr. Fischell

Research, Honors, Abroad: Busy BIOE's

University of Maryland's Undergraduate Bioengineering Research Journal

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THE CATALYST

The Catalyst is UMD's undergraduate bioengineering research journal. We are looking to publish a variety of related undergraduate research with our ninth issue coming this Summer 2018! If you are an undergraduate student working on research related to biomedical engineering and biotechnology, you are qualified to submit a research blurb. Contact us via email or submit your research abstract through the link provided below. Please check out our previous issues as well.

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IN THIS ISSUE

Dear Catalyst Readers,

Welcome to the eighth issue of The Catalyst! We are the University of Maryland's Undergraduate Research Journal. That may be a bit of a misnomer however -- this semester and in the past, we have had more to offer than just research articles. It is our aim to inform and connect bioengineering undergraduates on and connect them with any opportunity that will help them excel as students in our field. This includes to a great extent content related to research, however, we have also had pieces that provide information on relevant topics such as specific courses, professors and design competitions that our department has or will be participating in.

In this issue, we present to you the experiences of three undergraduate researchers: Nick Giroux, Maeesha Noshin and Linnea Warburton and interviews with professors Dr. Yang Tao and Dr. Gregg Duncan (the department's newest professor). The co-founders of Synapto, Dhruv Patel and Christopher Look, were interviewed regarding their experience in the DEBUT competition and future directions for their company. Our issue eight also offers a look at the medical device hackathon, MedHacks, from the point of view of BIOE participants, Hannah Horng, Sahana Rao, and Corinne Farley; an interview with Dr. Qijin Lu, from the FDA, providing insight into possible BIOE career paths and discussion of his current work; a piece on the new UMD student group, Engineering Word Health; an interview with student Jessica Yau in which she tells us about the Departmental Honors program. Last but not least we have some big ticket items: an interview with our department's namesake, Dr. Fischell, and a piece regarding some of his latest inventions. We also provide a timely look at the new home of Bioengineering at UMD, A. James Clark Hall.

I have been a member of The Catalyst since my very first semester here at the University of Maryland, and it has truly been a pleasure to watch and be part of this group's evolution and growth, ever adapting to better serve BIOE undergraduates. It has been my honor to serve as Editor in Chief this past semester. Many veteran members who helped our organization flourish graduated prior to this semester; however our new and returning members certainly stepped up to the plate. Please take a moment and flip to the back of the journal to check out the staff of hardworking editors and designers who put together this issue. Please enjoy issue eight, and stay tuned: I expect great things from our team in the future.

Sincerely,
Justin Sylvers
The Catalyst Editor-in-Chief

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Photo Source: "John T. Consoli/University of Maryland."

ENTREPRENEURSHIP

DR. ROBERT FISCHELL

Experiences of an Inventor and Entrepreneur

By Havisha Garimella, Staff Editor

Dr. Robert E. Fischell, a renowned inventor and entrepreneur with over 200 U.S. and international patents in the medical device space, recipient of the National Medal of Technology and Innovation from former President Barack Obama, and the namesake of the Fischell Department of Bioengineering at the University of Maryland, sat down for an interview to share his experiences as an accomplished engineer, inventor and serial entrepreneur.

Dr. Fischell earned his undergraduate degree in Mechanical Engineering in 1951 from Duke University before going on to earn his master's degree in Physics from the University of Maryland. Additionally, he was given an honorary doctorate in Engineering from University of Maryland in 1993 due to his significant contributions to the field. While getting his master's degree, he worked 40 hours a week in the United States Naval Ordnance Laboratory in White Oak, Maryland. Although he did finish the necessary coursework for a Ph.D, he never had the time to write his thesis because soon after working at the Naval Ordnance Laboratory, he went to work for the Emerson Research Laboratory and United States Air Force, where he developed the first black box used for recording jet aircraft flight logs in the event of a crash. After his three year stay at Emerson Research Laboratory, he began his role as Chief Engineer of the Space Department at the Johns Hopkins Applied Physics Laboratory where he developed 50 spacecrafts and worked on the first navigation satellites for the U.S. Navy over the course of 32 years.

Dr. Fischell recounts how a pure accident sparked his innovative idea for improving the life-saving pacemaker. After coming home one evening from working on satellites, he was reading the IEEE magazine, Spectrum, when he saw an advertisement for pacemaker batteries that were so "good" that they lasted two years, meaning the patient would need to get surgery every 24 months. He thought if a rechargeable nickel cadmium cell was used instead, then the batteries could last a lifetime, so long as recharging was done via magnetic induction through the skin once a week and the pacemaker would be half as thick and ¼ the diameter. He called up Dr. Kenneth Lewis at Johns Hopkins who worked with pacemakers and told him, "Put down on your calendar one week from today, I'll bring to you the circuitry and battery for a pacemaker that will be one quarter of the size and last the patient's lifetime." Being a Chief Engineer, he drew up his idea on the board, explained how it would work to a few scientists and engineers working under him, and asked them to build it. He filed for a patent and started St. Jude Medical, the second biggest pacemaker company in the world. Dr. Fischell explains, "the accident of seeing the advertisement changed my life. I had done 50 satellites that are enough for anybody. Not many people get to design 50 satellites in their lifetime and so I said, "well let's try medical devices."

"THE ACCIDENT OF SEEING THE ADVERTISEMENT CHANGED MY LIFE"

"SHEER DETERMINATION; THE HARDER I WORK, THE LUCKIER I GET."

Surprisingly, Dr. Fischell never envisioned himself becoming an entrepreneur; he thought he would work for Johns Hopkins for the rest of his life. His next innovation, after inventing the rechargeable pacemaker, was an automated heart defibrillator. Having done so well financially with the royalties from the pacemaker company, Johns Hopkins told him "no scientist at this laboratory was ever intended to make as much money as you are making from your royalties. So in the future we will give you only 10 percent, instead of 25 percent, of any future royalty." At that point, he decided the best option, emotionally and financially, was to leave. So after acquiring about 100 patents with Johns Hopkins, Dr. Fischell left and started development of his stent inventions, which was funded by Johnson and Johnson. The Cordis Corporation, a division of Johnson and Johnson, found out about Dr. Fischell's stent design and licensed his patents in order to make his stents. Today, more than 20 million people have Dr. Fischell's stent in their hearts. How does Dr. Fischell come up with so many novel ideas? He has said that it is his curse. "So the curse is when people show me that there's a problem in medicine, my mind sees the drawings of a solution." Although he is in his late 80s, Dr. Fischell keeps working to ensure the solutions he envision become a reality.

For a bioengineering undergraduate who is an aspiring entrepreneur, one may question how to generate ideas. Dr. Fischell advises, "As you go through life, one always encounters health problems. When an inventor sees a health problem he says, 'Oh that's an opportunity in work clothes. Let's invent a solution to that.' So if trained engineers would start thinking when they see a problem, to say not just, 'oh there's a problem', but rather to say, 'how can I use the great education I have in engineering at the University of Maryland to invent a solution for the benefit of mankind?' That is what I do."

Once you have an idea, Dr. Fischell suggests, "you write out the concept of it. Show it to a patent attorney and see if you can get a patent on it…You have to make sure that you're not inventing something that's already been invented...you have to design the device that will have commercial value, and then you have to find a way to fund this development…It's a matter of what I call sheer force in honoring this or total determination. OK, I'm going to make my idea work. I'm going to find the money and I'm going to do it. And that's not easy. It's never been easy, and with the best of ideas, even with the reputation of more than 200 patents, it's still hard for people to invest in what you do. But nothing ventured, nothing gained."

After getting investors and conducting necessary preclinical research, you may want to start clinical trials for the FDA approval process. While the process is long and intimidating, Dr. Fischell encourages that "it looks difficult and it is difficult but it just takes time, energy, and courage to win the game. But it can still be won. What is easily gained is easily lost. What is got without effort is worth what it costs."

"Do everything you can for the benefit of mankind. And so if that's your religion that you practice, you work at it instead of just lying in the sun."

With 15 companies and counting. Dr. Fischell's momentum has carried him forward to help save many lives.

"When I get an idea that can change human life, it's hard to say, 'oh you know what? I don't want to bother. I just want to go out and lie in the sun.' Yeah. I just don't do that. It's sort of because my religion is to help human beings. Humanitarianism is my religion. I really believe in its Tenets. Do everything you can for the benefit of mankind. And so if that's your religion that you practice, you work at it instead of just lying in the sun. So that's about what it is; it's your own determination that drives you. It's a challenge because most of the time it's hard. But then there come some times that are amazingly wonderful. I remember more than once this child or grandchild will be at an occasion and say, 'you saved my father's life' or 'my father had a heart attack but your device saved him.' You know what? That will make not only your day, it will make your year. And it's a chance to make some money so you can give more away."

For undergraduate bioengineering students at University of Maryland, Dr. Fischell hopes to inspire and leaves with these last words of advice, "there's still room to make big improvements in the future; that's what the students at Maryland should be doing." One mantra to always remember is, "Sheer determination; the harder I work, the luckier I get."

THREE BIOMEDICAL DEVICES

By Tima Mikdashi, Staff Editor

Dr. Robert Fischell

With 120 new emails in his inbox, 16 months from reaching the age of 90, and over 200 patents under his belt, Dr. Fischell, the founder of the University of Maryland's eponymous bioengineering department, doesn't plan on slowing down.

On October 19th, Dr. Fischell shared his expertise on the medical device industry with students by discussing three devices that he created: Neuropace, Angels Medical System, and eNeura. Despite each innovation's impressiveness, he claims that these inventions are nothing more than a strategy to "get a free dinner at the White House". Throughout the talk, Dr. Fischell highlighted some of the challenges that are associated with the design and creation of medical devices, from the extensive research and testing that goes into transforming an idea into a functioning product to the tedious process of getting FDA approval. However, Dr. Fischell continuously emphasized the importance of working on projects that will have a significant impact on the lives of others, whether that impact is preventing a heart attack or simply eliminating a day off from work. As engineers, we relish creating the cutting edge technologies that make these devices work, but it is only because these devices respond to a need, some complication, inconvenience or failure associated with the human condition, that they gain value.

Detect, Monitor, Reverse Epilepsies

Image Source: www.neuropace.com

Neuropace

Neuropace, is a system that serves to detect, monitor, and reverse epilepsies. The main technology behind this device is the RNS® System, an implantable neurostimulator connected to two electrodes. The neurostimulator is secured within the skull such that it isn't noticeable while the electrodes are placed in seizure onset areas. The system constantly monitors brain wave activity. As soon as an anomaly is detected, 15 milliamp electrical pulses respond through the electrodes, effectively reversing the seizure before it is even felt. It comes with a simple remote monitor that is used to wirelessly collect information from the neurostimulator which it then transfers to the Patient Data Management System (PDMS). A doctor can then log into the PDMS at any time to review accurate, ongoing information about seizure activity and treatment progress.

Preventing Migraines

eNeura

Dr. Fischell also discussed eNeura, a non-invasive portable device to treat and prevent migraines. Currently, migraines affect over 25 million Americans every year, and prescription drugs are often used to reduce the burden of migraines. Common drugs such as Triptan (Imitrex) and Ergotamine (Migergot) are known for their harmful side-effects that include nausea, dizziness and muscle weakness. eNeura offers an alternative that rids patients of these side-effects as well as their restrictions of use (pregnancies, existing medical conditions, etc). The device is used by placing it at the back of your head, as to cradle your skull then you simply press a treatment button. This treatment button creates an intense magnetic pulse onto the brain that induces mild electrical currents that depolarize neurons in the brain, thus interrupting abnormal hyperactivity that has been associated with migraines. Further research has indicated that this system successfully reduces the frequency and intensity of migraines that occur after the use of this device. The system is adaptable to each patient and has recently been approved both in the US and in Europe to be used an unlimited number of times a day. Due to its effectiveness and versatility, eNeura has allowed patients to cut down on the indirect costs associated with migraines such as taking time off from work. Furthermore, the eNeura device has reduced by more than 50% the frequency that migraine headaches occur and complete relief from pain has been achieved in about 50% of the patients when the magnetic pulsations treatment is used.

Image Source: www.eneura.com

AngelMed

90 second Heart Attack Detection

The second device discussed was the AngelMed Guardian® system, an implantable device that can detect the a heart attack within 90 seconds after it starts. Patients who have had a heart attack in the last six months and who are at risk for recurring attacks can request an implant of the AngelMed Guardian® system. This system continuously monitors heart activity, and once it detects a rapid shift in the ST-segment of the electrogram, it sends a signal to an implanted device that vibrates to alert the patient and causes an external device to make a warning sound to further warn the patient. The aforementioned ST-segment, corresponds to a flat, isoelectric section of the ECG, occurring after complete depolarization of the heart's ventricles. A shift of this segment may indicate a major cardiac events such as a myocardial infarction. The most significant benefit of this device lies in its ability to recognize and respond to heart attack symptoms which are often ignored or are unable in elderly patients, to even be detected. Ultimately, the goal of this device is to reduce the time-to-door from a manifestation of heart attack symptoms until treatment at a medical facility. While this device is still FDA pending, it has already been implemented in other countries.

Image Source: www.angel-med.com

PROFESSORS PERSPECTIVES

DR. DUNCAN

Interview conducted by Justin Sylvers, Editor-in-Chief

Describe your professional path and how you ended up here at the Fischell department.

My interest in medicine started from my family's careers with my mom being a nurse and my brother, a pharmacist. This really influenced my desire to pursue a career in health care, seeing how they enjoyed their careers and how rewarding it was. So I started to think about pursuing careers related to medicine; being a medical doctor, going into pharmacy like my brother, I volunteered for a summer in a physical therapy clinic. However, none of these really seemed to integrate the subjects I was interested in high school, math and science. I talked to my guidance counselor, who knew what classes I was doing well in, and she thought engineering made a lot of sense for me. So, I started looking into different engineering majors, and the one with medicine in the title was biomedical engineering, so that's the one I decided to dig into. But where I went to college at Florida State University, there was no biomedical engineering major. It was kind of a new thing at the time so it wasn't offered everywhere. So I studied chemical engineering where I was able to minor in BME.

At some point in time one of my professors at FSU, I was in a thermodynamics class, pulled me aside and said, "I think you should work in my lab this summer." It was completely out of the blue, and I had no interest in research. My idea at the time was to get a degree in chemical engineering and try to find a job in the pharmaceutical industry. So this really hadn't been on my radar but I told my professor that I would think about it. Later he followed up saying he found some funding and I could actually get paid to do this, so I took the job. I worked in the lab from sophomore year onward studying nanoparticles and how they behave in different solvents. This eventually turned into an undergraduate research thesis and I learned a lot about nanotechnology as a result. I started thinking about how this might relate to medicine. I looked into it and learned a lot about how nanoparticles were being used as a delivery vehicle for drugs and nucleic acids. So then I was like, "Perfect! I know about nanoparticles, now I can take this knowledge and use it to make medically related technology." This is how I came to the decision to go on for my PhD to pursue this further.
In looking for graduate schools, I wanted to see which ones had a strong biological component. I was still interested in sticking with chemical engineering since that is what all my training had been in, but I wanted to go to a school with a good medical program. That's why I ended up going to Johns Hopkins, because their chemical engineering department has a strong biology focus. There I worked with Michael Bevan, who is an expert in microparticle and nanoparticle systems. He had recently moved to Hopkins with the idea of working on more projects related to biology. The focus of my PhD work was understanding how nanoparticles interact with cells. How can you control their behavior so that they will accumulate on, a cancer cell for instance, versus on a healthy cell? It was a very fundamental project to understand nanoparticle-cell interactions, more of a colloid & surface science project with less of an application focus.

In order to do more application-focused work, I did my post doc at the Johns Hopkins school of medicine, at the Center for Nanomedicine directed by Justin Hanes. This is a large multi-investigator research center where we worked on how to design nanoscale systems for translational applications. From the offset of design, we would think about the key steps of translating an idea from the bench to a clinical product. The goal of the center is to improve upon already existing therapies. Safety was one aspect we considered, but also how do we make them more effective in general. My work focused on lung diseases where we were developing a new nanoparticle-based diagnostic test for cystic fibrosis (CF), an inherited lung disease. Another part of my work was developing a new inhaled gene therapy using a virus as a delivery tool. They've done about 25 inhaled gene therapy clinical trials, up to this point, for CF and none have been successful. Essentially if you can correct that genetic defect, you can potentially cure these patients. One aspect that we saw limiting their success was the viruses are actually very adhesive to mucus. The large amounts of mucus that accumulates in the lungs of these patients effectively prevents the therapy from working by trapping the viruses and never letting them reach the cells with the genetic defect. We were able to find a viral vector capable of bypassing the mucus barrier to deliver the corrective gene more broadly throughout the lung.

My biggest takeaway from that whole experience was to really think about ultimately how you're going to help somebody with the science that you do and not worry so much about how exciting the science is that you're doing. How does your work ultimately help patients in the long run? On several occasions, I would be really excited about some aspect of our work and my advisor's question to me would be, "What's the big picture here? Why does that matter? How will it help us achieve our goal of helping patients?"

From there, I was still in between taking the knowledge I had gained and pursuing a career in the pharmaceutical industry, or making my own space in academia. Staying in academia and having complete control over the work that I do really excited me, so I thought I should give it a shot. I applied for faculty position across the country, but Maryland was always an attractive option because of the area and all of the resources around, like the NIH, FDA, and NIST. Maryland was the first place that I interviewed, and it went extremely well. What really tipped the balance for me was the number of young talented faculty that were already here that were doing amazing work. It felt like the support level was really strong in the department, and there was a lot of energy. It seemed like a good fit for someone at my stage, trying to get a lab off the ground. Any questions I had, it seemed like they had already thought it through, which was a big selling point. So that's how I ended up here.

Tell me about your research interests? Speak about your past projects you undertook as a PhD, or even as an undergraduate, and then about the projects that you have planned for the NIBE lab.

The work in my group will build off of the work from my postdoc, focusing on pulmonary disease applications and how we can use nanotechnology to develop new treatments or new diagnostics that really change the way we analyze these patients. The motivation for me was being able to speak with clinicians being over at the school of medicine. We worked with clinicians that supported our projects to obtain patient samples to work with or giving us feedback on some of our projects. In talking with these folks about how they assess patients with these diseases, it became clear to me that the limited options for diagnosing or predicting patient outcomes was a major issue. For other diseases out there, like breast cancer for instance, you can run analyze panels of biomarkers to figure out what type of cancer someone has and if they're gonna be resistant to certain therapies. Despite all these advances, there really hasn't been this type of innovation for analyzing and treating patients with pulmonary diseases. This motivated me to do work in this area to create new diagnostics using nanoparticles as a tool. Mucus in these patients has properties that are very distinct from people without disease. An open question in the field is based on the properties of their mucus can we make predictions as to the severity of disease. That's really going to be a focus of my lab, to tease apart what's happening in the airway on a micro and nano scale, where a lot of the action is happening. All of the bacteria and viruses we inhale are nano and micro-scale entities. If we can understand what is going on in that environment on that level, we might have a better shot at preventing infection or understanding disease pathways.

There is a general class of pulmonary diseases called muco-obstructive lung diseases [that result in mucus with distinctive properties]. Cystic fibrosis, asthma, and chronic obstructive pulmonary disease (COPD) are in that category. I'm really interested in asthma, because I grew up with really severe asthma where not much has changed in terms of diagnostics and treatment. Therapies for asthma are generally limited to inhaled corticosteroids, which is a purely symptomatic treatment and does not tackle the root of the disease. It's a big challenge, but I'm hopeful using some different approaches we can make some headway towards improved diagnostic tools and treatment strategies.

What approaches do you plan on using in your lab?

My background is in interfacial science. This is really the study of properties at an interface or surface. There are some really interesting things that happen on the nanoscale that have importance in the lung-airway environment, which is essentially another surface that we haven't really interrogated from that perspective. The tools we use are advanced microscopy and nanoparticles to interrogate that surface. We do a lot of high-speed video microscopy to look at how nanoparticles behave on these surfaces, then based on these behaviors draw conclusions about the properties of that surface using principles from engineering and biophysics. For the case of viruses or bacteria, we will actually look directly at how they behave on these surfaces to see how these pathogens are able to get through mucus to reach the underlying epithelium. I plan on doing some work looking at respiratory viruses themselves, like the flu or cold viruses, exploring how they are able to get through mucus so easily, when a lot of the viruses used for inhaled gene therapy can not. What is so unique to these common viruses? If we can understand that, we could potentially prevent infections by the flu or cold viruses, which in asthma, can cause a cascade of issues that leads to worsening of their condition. The hope is to understand why these viruses are so capable of causing infection in the airway, and in patients with lung disease, why does it cause such an exacerbated response.

What can you say about the process of setting up and starting a lab?

I'm in a very unique position, because I'm not only moving to a new university, but into a new building as well. It's one thing to already have a system in place, but I'll basically be moving into this space and creating the system. This is exciting, getting to create a system that works for me, but you also want to do things as safely as possible. There has been a lot of coordinating with people to figure out what makes the most sense given our new setup. I've also been meeting a lot with vendors, trying to get the best prices on things. I like to haggle people, and I think that's a good quality to have as a new professor. If you want to start up a lab, be prepared to haggle people and be difficult. At the end of the day, you're spending a lot of money on this stuff, so you should give them as much trouble as you can to get the lowest prices possible. As a new PI, you've only got so many resources and you want to use them as effectively as you can. Finally, you have to be optimistic, because it's a big challenge. Hopefully you can convince other folks that the work you're doing is important enough that they'll help you with it. You have to go in with unbridled optimism, because other folks aren't going to come on board if you're a nervous wreck.

How do you plan to integrate interested undergraduates into your lab?

I've been actively recruiting undergraduates with 3 students joining so far. I always like to have undergraduates in the lab, which goes back to the optimism side of things. They come in with energy and optimism that people who have been in research for a long time do not often have. Undergrads get a lot out of the experience and it's always nice to see their progression as they are going along on their projects. I always like for undergraduates to have projects of their own, so they can take ownership and push forward. It's a really valuable experience for them, and it is nice to see how they take to the whole process. If it weren't for me having the same experience at their stage, I wouldn't be here giving this interview.

PROFESSORS PERSPECTIVES

DR. TAO

Interview conducted by Ajay Kurian (Assistant Editor-in -Chief of Design) and Rick Silcott (Staff Editor)

Can you tell us about your educational background?

My first position in academia was at the University of Arkansas. I heard about the position at Arkansas through some of my colleagues who were professors there. There were around 50 people who were interviewed and I ended up getting the position. I served as a faculty member there for 5 years before I came here [UMD] in 2000.

What led you to choose studying food engineering and biosystems?

My main focus was machine vision/computer vision, but this was able to be applied to many different areas. This type of technology was able to be applied to food engineering because there is a lot of manual labor involved. Typically there are thousands of employees working in food processing facilities, but machine vision is able to automate and make some of the food safety processes more efficient, more cost effective, and more productive. It is able to mitigate the effects of poor hygiene as well as provide a more uniform quality to the products. Machine vision is all related to robotics as well, and I currently have a project relating to that.

One of the most exciting things about my area, machine learning, is how applicable it is. You can use it in semiconductors, food processing, and more! We have another project going on that involves rehabilitation for stroke patients and computer and robotic vision plays a significant role.

Can you tell us a little bit more about this robotics project?

Currently, the project revolves around crab meat picking, like Maryland Blue crabs in the Chesapeake Bay. The robot has a camera that is able to guide an arm that picks all of the meat out of the crabs using a high speed water jet. The camera captures the image of the crab and gets data on its morphology, and the robotic arm cuts the crab based on that data. Even the crab project I mentioned earlier can be used in surgery as well; you know how surgery requires careful handling. You can utilize an algorithm to cut the crab at strategic positions to ensure no damage-similar to how a surgeon has to make incisions on a human body.

Can you elaborate on your role at AgriTech as VP/Director of Research?

That was my first job after my PhD from Penn State. It was an apple packing company and this is where I used my machine vision to lead the R&D group to create technology that was able to automate the process of sorting apples. I arrived in July of 1991 and by the end of the year, we had a prototype. This machine was widely successful within the entire industry; 50% of the United States was using my design to sort apples, so it was a big impact in that sense. Three years after that, I was promoted to a VP position. In 1995, when the company was at its peak, it was bought out by another company. I wasn't trained at Penn State to deal with this kind of thing like Maryland's engineering school does. I wasn't trained at Penn State to deal with this sort of thing. However, Maryland's engineering school definitely prepares students to adapt to such an environment.

The Clark School trains their students in entrepreneurship, but at the time, Penn State only trained their students to be very good designers, so I was inexperienced in the buying and selling of businesses and was shocked when I was told about it. However, what you learn is that this is all normal and part of business. I actually incorporate those experiences into my capstone class.

Do you incorporate this kind of knowledge into Capstone?

Yes. I let the students know that these kinds of company transitions are normal, and in most cases beneficial to you as an employee. You get better benefits, a 401K, better insurance, and better financial support—but when I was in the middle of AgriTech's transition, I did not know this at the time.

In industry, engineering and entrepreneurship have a good mix. In a company you do research and produce a product. You have a mission goal to achieve and you have to design and create a product that reflects that. That is why I teach capstone to bring those components into the curriculum. Look at Google automation and see how it is progressing over time. This sort of machine learning is prominent all over and over the years, research universities get a lot of research grants for topics such as that. You can update processes and have an important impact on a whole company or industry!

You talked a lot about the food-processing industry. Is that the type of research you conduct here on campus?

From time to time I am always tied down with the industry folks. When you do a project for the university you are always in contact with the stakeholders. Oftentimes, we have people in industry come to us and ask us to help them with their issues. For example, recently I was working on a strawberry cutting machine that would prevent workers from manually cutting every strawberry and I got a chance to fly over there and see the problem firsthand.

So would this be more consulting based work rather than what we think of as traditional research in a laboratory setting?

I do some consulting but the majority of my time is spent on my research projects. I did some consulting work before- some for the military. Unfortunately, I cannot talk in detail about that particular engagement.

What kind of advice could you provide for students who want to go into industry or academia?

I think that this department has a very good environment that provides inspiration for students. Our motto "Fearless Ideas" and the focus on entrepreneurship from the president to the deans of all the schools encourages students to achieve great success and save human lives. Unfortunately, the university does not have as much money as industry. Some of my students get paid higher than I do! Dr. Bob Fischell came to speak to senior capstone recently and one of the things he complained about was the FDA grant process. It is important to have experience in both industry and academic settings. Additionally ,internships help a lot and if you can get one it can be tremendously beneficial, particularly when you write grants for research funding because you know what is going in both sides (research and industry).

Photo Source: "John T. Consoli/University of Maryland."

CLARK HALL

The Future of the Bioengineering Department

By Michael Hildreth, Vice President of Marketing

In November 2017, the A. James Clark School of Engineering celebrated the long-awaited opening of the new home of the Fischell Department of Bioengineering (BIOE) , A. James Clark Hall. Located right behind the Jeong H. Kim Engineering Building, this newly constructed building will feature many new amenities for bioengineering students. To help unveil the main features that Clark Hall will offer YOU, my fellow bioengineers, I visited the new building with Dr. John Fisher, the Fischell Family Distinguished Professor and BIOE Chair, to learn more about the new and exciting things to expect from this extraordinary addition to the department.

Upon approaching the building from the outside, I realized just how large an addition it is to the University of Maryland campus. Clark Hall spans six floors and towers over most of campus, providing an expansive view from the upper floors from which you can see across Route 1 and towards Regents Garage. At the entrance there are yellow tinted doors that open up to an expansive hall, with ceilings that span two floors. To the left of the main entrance is an oversized replica of an expandable coronary stent, honoring the invention created by the bioengineering department's namesake, Dr. Robert E. Fischell. To the right, columns cascade down the Leidos Innovation Lab, where soon there will be workstations that Capstone teams from across the college can use throughout the year. Also on the first floor will be wet labs for BIOE 121, Introductory Laboratory for Bioengineers, and other educational purposes. Throughout the Leidos Innovation Lab hang banners of different Clark School academic teams and innovations produced in recent years. Near the stairs to the second floor, a conference room, as Dr. Fisher says, was set up as a small museum to honor the life of our college namesake, Mr. Jim Clark, and to recognize his contributions to the University of Maryland and the field of engineering. The space, and several of the items throughout the Clark Memorial hallway, were made possible by contributions from the Clark family and Lawrence C. and Melanie Franco Nussdorf.

On the second floor, classrooms and study spaces occupy many of the rooms. In speaking with Dr. Fisher, he explains how the new classrooms feature "tables that are set up in round circles for more discussion workspace." He also explains how different bioengineering clubs could possibly utilize workspaces on this floor for meetings, collaboration, or storage. Also taking residence in this new facility will be a Terrapin Works laboratory. Right next to this laboratory is the Overlook Conference Room, which looks out onto the first floor for all visitors to observe the Leidos Innovation Lab below. The conference room is named for T.K. "Patrick" and Marguerite Sung, two contributors to the building.

For the final part of my tour, Dr. Fisher brought me through the third through fifth floors. These floors all have a nearly identical floor plan featuring offices mixed with lab spaces. These new lab spaces constitute huge open areas for multiple lab groups to work in the same space. Dr. Fisher describes these labs as "continuous for students to work and collaborate" and create a more "dynamic and collaborative" space in which faculty can work as well. This will mark the first time all bioengineering faculty, staff, and laboratories will come together under one roof. In total, there will be 25 bioengineering labs spanning the third through fifth floors, as well as many study spaces for graduate students to work just outside the labs and collaborate.

Overall, Clark Hall is not only an impressive building, but it will also be the home of even more impressive research. Dr. Fisher sees this building as a step toward further solidifying the status of the department among the top-ranked institutions in the country. Clark Hall will not only be a center for research collaborations with students, faculty, nearby companies, and federal labs, but it will also serve as a stepping stone earn the University of Maryland greater recognition in the collegiate bioengineering world. Clark Hall, Dr. Fisher believes, will help to reinforce the areas in which the bioengineering department already excels and help further emphasize the department's many accomplishments.

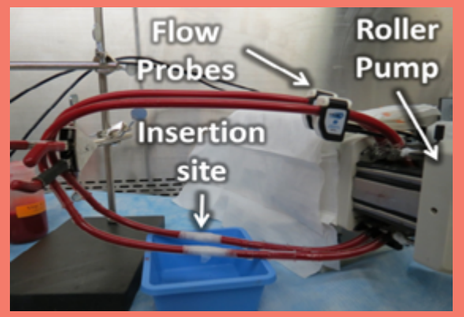
This new building prioritizes one major component: collaboration. Between the design of the classrooms and the research laboratories, Clark Hall's architecture was designed such that students, faculty, and staff could interact more easily, exchange ideas and foster innovation. With support from the Clark family, the State of Maryland, Dr. Fischell, and other donors, , Clark Hall will not only serve as a home for bioengineers to flock to, but it will also help distinguish the Fischell Department of Bioengineering as one of the nation's premier centers for human health research and innovation.

INSIDE THE FDA : Dr. Qijin Lu

Interview conducted by Maxwell Hakun, Staff Editor

Could you please briefly describe your career path from college to working at the FDA?

I got my Bachelor's degree in Polymer Science and a Master's degree in Biomedical Engineering from Sichuan University in China. After that, I worked for a cardiovascular device company for 6 years in China. After working in different phases of new product development, I felt I had much more to learn. So, I decided to come to the US for further education, and I eventually got my Ph.D. in Bioengineering from Clemson University. I then started my work at FDA as a Postdoc fellow through a research program managed by the Oak Ridge Institute for Science and Education (ORISE), and now I've been at the FDA for about 12 years.



What part of the FDA do you work in?

I am a biomedical engineering working in the FDA's Center for Devices and Radiological Health (CDRH) / Office of Science and Engineering Laboratories (OSEL). OSEL is the research arm of CDRH, which supports the assessment of a wide variety of medical devices, from simple devices like needles and catheters, to complex devices like MRI scanners and artificial heart systems. OSEL has four scientific divisions, each with several multi-disciplinary laboratories. In my case, I am a member of the Fluid Dynamics Laboratory Group within the Division of Applied Mechanics.

What, if anything, attracted you to the work that you currently do? If possible, what makes working at the FDA different than anywhere else? What inspires you in your work?

The prestigious reputation of the FDA as a world leading regulatory agency was originally what attracted me to work here. Even before coming to the US, I learned a lot about the FDA's important role in regulating food and medical products when I studied and worked in China. Since joining the FDA as a biomedical researcher and a technical reviewer of new devices from companies, I have acquired first-hand experience on how FDA functions to protect and promote public health as a science-based agency. My position at the FDA does offer several unique opportunities that are different from working in industry or academia, as my work may be characterized as performing "Regulatory Science". First, our research at the FDA is primarily focused on evaluating safety and effectiveness of medical devices, rather than developing a new medical device or discovering a new material. Second, the research results that we obtain tend to have a broad impact on a variety of medical devices from many companies, as opposed to specific implications for a single product or a single company. Third, through regulatory review of various submissions from many companies, we also have the opportunity to be exposed to different medical product ideas and technologies, including innovative technologies that are trying to reach the market. We take pride that our research findings have contributed to making new technologies available to patients in a more efficient manner. What most inspires me is knowing that our work here impacts so many people and that we are helping to ensure and improve the safety of medical devices for all patients.

Please give a quick summary of the current work that you are doing. What is your current role within the fluid dynamics lab?

Overall, the Fluid Dynamics Lab is interested in fluid flow and its interactions with medical devices in the human body. We currently have 12 full-time scientists with different areas of expertise. We also have many interns–from high school students to post-doctoral fellows–working in the lab, especially during the summer months. In some instances, our undergraduate interns also work part time in the fall and spring semesters. The research goal is to develop and validate assessment tools to assure the safety and effectiveness of various medical devices. The group works in multiple research areas such as in vitro blood damage assessment, computational fluid dynamics modeling, and bioaerosol transport.

As for myself, my work has been focused on the blood compatibility evaluation of medical devices and biomaterials. More specifically, we are working to develop meaningful, standardized, validated benchtop methods that can be used to evaluate thrombosis (blood clotting) risk of medical devices in a quicker and less expensive manner than traditional animal studies. The methods that we work on include some relatively simple static test methods, which can be used to evaluate the effects of materials on different blood components such as platelets, white blood cells, and blood plasma coagulation systems. We also study more complex dynamic blood test systems that can be used to evaluate thrombosis risks caused by non-physiological flow patterns around or through the medical devices.

What are some of you and your department's plans for the future? What is some of the work you are looking into starting in the future?

At the FDA, we not only need to investigate new approaches to improve the review efficiency for the products that are currently being submitted to the FDA, but we also need to be proactive in preparing assessment methods for evaluating future products with new or emerging technologies. Some new technologies that we are preparing for include nanomaterials, microfluidics, and additive manufacturing (3D printing). For my specific research area in blood compatibility, some new projects that we are looking into include: (1) Thrombosis test methods that have improved sensitivity to differentiate between biomaterials having mediocre and excellent blood compatibility; (2) device thrombosis evaluations through computational modeling; (3) benchtop methods to accurately predict the risk of thrombosis in long-term implants. While we can carefully prepare for some of our research projects, another one of our important tasks is to have the resources and expertise in place to quickly react to unforeseen public health issues that may suddenly arise.

What are some of your most recent accomplishments at the FDA? What are some of the highlights of how the fluid dynamics lab is working to improve life and health sciences?

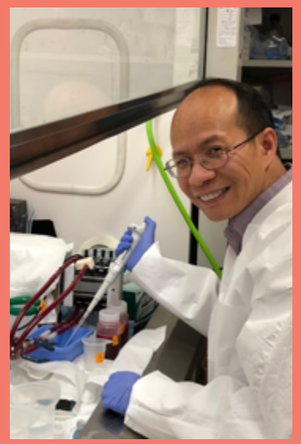
Some of our recent accomplishments include co-organizing a public workshop on thrombogenicity testing methods, in which hundreds of experts from academia, industry, and government came together to discuss the optimization of in-vitro and in-vivo thrombogenicity test methods. Also, the data obtained from our research has been used to guide the writing of the Hemocompatibility section in a recently published FDA/CDRH Biocompatibility Guidance Document that will help device companies. Our research results have also been used to support the revisions of several national and international thrombogenicity test standards. The research at FDA is also commonly published in high impact peer-reviewed journals. From the regulatory aspect, with the recognition of these new in-vitro test methods, we have noticed that companies are starting to use these methods to limit the necessity of using animal studies for short term blood contacting devices.

For the Fluid Dynamics Lab, one of our recent highlights is that we have published an FDA guidance Document entitled "Reporting of Computational Modeling Studies in Medical Device Submissions." This document provides a guideline to industry regarding how a computational modeling/simulation study and its outcomes can be used to support a regulatory submission to determine safety and effectiveness of a medical device.

What, if any, are some of the biggest challenges or obstacles you have faced in reaching your results?

The biggest challenge is competing time requirements for research and regulatory reviews. When companies send information about new devices that they have developed and want to market in the United States, FDA must review them by certain mandated due dates once they are received, so we need to work efficiently to complete the technical review on time and still make progress on our research projects. We often need to prioritize the regulatory tasks over research; thus, this can delay the progress of our research work when our regulatory workload is overwhelming. Also, as a federal agency, our annual budget is typically determined on a yearly basis, which sometimes makes it very difficult to plan long-term, impactful research projects. With the above challenges, we would love to have more student interns in the lab (paid or volunteers) to help expedite our research.

What, if any, advice do you have for students interested in either working at the FDA or within your field of work? How does the FDA go about hiring new employees (For example, NASA typically will only hire from within their pathway engineer program)?



As the field of biomedical engineering is multi-disciplined in nature, we would like our students to have as much hands-on experience as possible, and also have a very broad background from their studies and coursework. It is very important that the student is enthusiastic about the research and is self-motivated. It is very difficult to accomplish ambitious research tasks if you are not truly interested in the work that you do. There are different pathways for applying to the FDA. Many of my colleagues, including myself, got started by getting a temporary post- doctoral position with the FDA, or through an internship program. We do have some students who come in as Pathways engineers and later convert to a full-time position. There are always opportunities to get FDA positions through USAJobs.com. For University of Maryland students looking for internships, you may want to talk with your Engineering Career Services coordinators and be on the lookout for job/internship announcement postings, which will usually come out in the winter for summer positions.

Entrepreneurship and Innovation

Synapto

MedHacks

Engineering World Health

SYNAPTO

An Interview with Dhruv Patel and Christopher Look, Co-founders of Synapto
Conducted by Michael Dunkelberg, Staff Editor

Looking back at the DEBUT competition, what were some challenges/obstacles you faced? How did you overcome these obstacles? Of these challenges/obstacles, which took the most effort to overcome?

(Dhruv) Our project involves using a portable electroencephalogram to rapidly access Alzheimer's disease using machine learning and artificial intelligence algorithms. A large part of that is using real clinical data and extracting features from it in order to build these algorithms. We needed to obtain that clinical data, so I think one of the greatest challenges we had as a small undergraduate team was going out to researchers not just in the U.S., but worldwide, and saying "hey, we're doing this project, can we use data collaboration? Can we sign an agreement? Can we keep these patients confidential, but at the same time can we use them to build our algorithms?" Fortunately enough, we contacted the right people and we did get the data that we needed, and we were able to perform enough feasibility tests in order for the product to be shown to have potential in the market, and that's why we were given the 20 thousand dollar prize in the DEBUT. I definitely think that data collection was one of the most difficult parts, because if we hadn't contacted those researchers, I think the only other option to perform that clinical validation test would be to go out and gather data ourselves, which, with the whole FDA regulations and IRB approval thing, can take months, if not years to get. Going this route for an early feasibility test was definitely the best route to take, but it was certainly a challenge.

During the early stages of the project, did your team experience any changes in direction or objectives? What motivated this/these change(s)? Where did you all find inspiration for your new direction?

(Dhruv) We actually started the project in October of last year. We were originally interested in brain waves and diagnosing some sort of neurological disease, since at the time there were a lot of studies that were coming out reporting the effects of a lot of concussions in the NFL. These concussions were a really big deal at the time since they caused a really severe condition: encephalitis. So we thought, "let's use a portable EEG to rapidly access these concussions on the field as they happened." We started doing a little bit of research on that, found a few viable biomarkers, but by then, we also noted there were a lot of big players in the field, notably Brainscope, who had gotten a lot of big grants and had a product out specifically for this purpose with a patent. So, we thought, "Let's pivot into something else". My co-founder and I actually had family members who have been affected by Alzheimer's disease, so we thought let's tackle a problem of Alzheimer's diagnosis. From there we went on to perform lots of research and development to determine new biomarkers that can be viable and built these into our algorithms.

Can you tell us about the transition from Synapto the competition team to Synapto the company?

(Christopher) From really early on we knew we wanted to be involved in the venture side things because a lot of us had already been in research. Research is definitely great; you do a lot of fundamental work, which is fantastic, but we also wanted to be able to bring this device from research all the way into the market so that we can see the effect we have on patients. We always knew we wanted to do a venture, so we actually have been doing a venture even before we found out we won DEBUT, and I think even before we applied to DEBUT. In the transition from very early on when we were just doing research to the company was a slow realization that there is a big market for this and that we wanted to use our knowledge, not just of research, but of business, to bring this device to that market.

What changes do you anticipate will be made to move Synapto from a prototype to a clinical product?

(Dhruv) One of the first things that has to happen at this point is we need to go out ourselves and collect our own clinical data. That doesn't mean that we perform validation studies. That simply means that we take an existing piece of hardware that we already have or we borrow it from another company. The hardware must be portable, but it is not the novelty of our device. We will take this device and go out to collect basic clinical data, putting our headset on both patients that have Alzheimer's and patients that don't have Alzheimer's. We collect this data, which becomes proprietary data, and perform proprietary data analytics to generate an integrated, dynamic system of both software and hardware that can accurately and rapidly access Alzheimer's disease. Once we have that system, we are going to take it to a Class 2 FDA 510k regulatory pathway, which will be approved within 180 days, and once that's approved, we'll be able to market in the United States. From there, we move on to commercialization and reimbursement through public and private insurance companies.

Do you anticipate that you would have some sort of government contract in the future? Or is the grant more that they are invested in your research? Where do you see that sort of relationship moving?

(Christopher) We see it as more of the later. We see it more as the government investing in us. Grants, generally, don't come with equity, so it is essentially free money for a lot of research companies to give benefit to the world. We are hoping to take advantage of that so that we don't have to dilute our equity before we go into asking a lot of venture capitalists, which we might have to do someday, because grants are essentially free. However, they are also very slow sometimes.

Do you think you will sell your product as combined hardware and software? Or do you think you might sell hardware and software separately? Is that something possible in the future?

(Dhruv) We are still looking into a few options. Right now we are leaning more towards the hardware and software option as a combined, integrated system, just because having that portable EEG is not something that a lot of neurologist, geriatric, or primary care physician's offices have right now. Enabling that hardware to be sold along with the software makes this technology a lot more accessible for a much lower cost option. These portable electroencephalograms are only about $2,500 at the maximum for what we're buying them for, compared to what it takes for a high density electroencephalogram, which can cost up to $10,000 or $15,000. So I think it's a really, really great bargain.

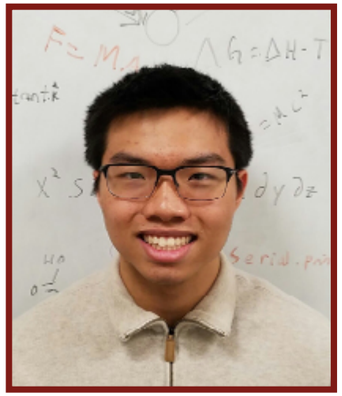
How do you see your project concept evolve into other neurological conditions? What avenues are you exploring with this technology?

(Dhruv) We are constantly, even right now, focusing on Alzheimer's disease, but we are constantly looking into new research and development into different EEG biomarkers. When we look into these EEG biomarkers we always like to look at how the brain is reacting or what the EEG biomarker tells us about the brain. So let's say we are looking into something that's called synchronization, which is basically an evaluation of the functional mode networks of the brain, so how neurons are communicating in different parts of the brain. We are noticing in Alzheimer's patients that certain regions in the brain are firing at the wrong times and thus not communicating in the right way. What we want to do for Alzheimer's patients is use that EEG biomarker and plug it into the algorithms. We can use that same model of analysis and mode of analysis for other neurological diseases. Let's say you had Schizophrenia, and you wanted to analyze their functional mode networks and see which parts of their brain are not communicating correctly or firing at either the wrong or right times. We can use that same system that we've already developed, and the machine learning algorithms that we've already developed, to produce a model that can accurately diagnose that disease as well.

Dhruv Patel, CEO

How would growth of this project affect your team moving forwards? In what ways has/would your group dynamic and/or composition change?

(Dhruv) Right now we have a team of about five engineers, including myself, and I think as the group moves on we are going to need a lot more people who know about the regulatory process. Very soon we are going to be applying for SBIR grants, which means that we are anticipating a clinical pilot study anywhere from June next year to next year in December. Going through that process for a couple undergraduates, it's scary. It's daunting. We don't know how to deal with the FDA. So we are really looking for regulatory personnel, in terms of market commercialization as well, and obviously a lot more software engineers, because that's where the core technology is.



Christopher Look, CTO

Do you think you would rely on some of your advisors here at Maryland? Or you might bring in professionals once your company is up and running to navigate that process?

(Dhruv) We are actually in the process of generating a board of advisors and working with partners in the field familiar with the FDA regulatory process. We are constantly looking for more experienced personnel, specifically in this field of EEG research, to do the same.

How would growth of this project affect your team moving forwards? In what ways has/would your group dynamic and/or composition change?

(Dhruv) Right now we have a team of about five engineers, including myself, and I think as the group moves on we are going to need a lot more people who know about the regulatory process. Very soon we are going to be applying for SBIR grants, which means that we are anticipating a clinical pilot study anywhere from June next year to next year in December. Going through that process for a couple undergraduates, it's scary. It's daunting. We don't know how to deal with the FDA. So we are really looking for regulatory personnel, in terms of market commercialization as well, and obviously a lot more software engineers, because that's where the core technology is.

Have you primarily fallen into topics you are familiar with? Are there some concepts or skill you have had to learn and become familiar with?

(Christopher) I think a lot of us have had to get better at Matlab. I have also been able to teach a lot of my team how machine learning works to a very high level. I have also had to learn a lot of more technical things, like Python plugins, to work with the EEG device that we have. A lot of it is just learning the space of EEG and Alzheimer's. We have had to learn a lot of EEG specific biomarkers, a lot of the terminology, and how it works like fast-forward transforms. On the whole, we've learned a lot of specific technical stuff in the machine learning space, the software space, and the Alzheimer's and EEG space.

Are you going to have some form of mentors or professionals that you work closely with as you start to develop this company and move more into commercial space?

(Christopher) We did all the research ourselves, we did all of the programming, and everything. But moving forward, we definitely need advisors in the business space, because connections are everything, especially in this area. We are going to get advisors for the FDA, and we are working with a company with a similar EEG headset, because the FDA process would be quite similar. We are also trying to get in touch with a lot of the people from the Robert E. Fischell Department of Bioengineering, since he does a lot of medical devices, as well as the department heads. We are trying to get a bunch of different mentors from a bunch of different areas because this project is multidisciplinary: computer science, bioengineering, and regulatory processes.

Do you think that you would use existing data from other teams or organizations that have mapped different diseases or would you try to build everything from the ground-up using your own algorithms?

(Dhruv) In terms of feasibility tests, you always want to start out using whatever is available and out there. For the data that we collected, we used what was already out there performed by other institutions for feasibility tests to know that this technology has a product viability in the market, and the science actually turns out to work. But once we're past that feasibility test, you would want to start building your own algorithms and building your own proprietary data analytics just because every institution, every group does their data collection in a slightly different way, which makes it kind of hard to integrate, and not all of them have the number of patients that you need. So, in order to build strong accuracy in a machine learning algorithm, you have to have a certain amount of patients that contribute to a certain amount of biomarkers, and not every institution is going to have that because their immediate goal is not our immediate goal.

You applied for an LLC, what can you tell me about that process and what advice do you have for people looking to take similar steps, like developing a company?

(Christopher) The LLC process is actually quite easy as all of it is online. Essentially, you apply online, you say who you are, and you say a little bit of what you do. It is not very long. You pay a couple hundred dollars and then in a couple weeks you receive a thing in the mail or in your email saying you have a registered LLC. In terms of starting a company, I think you have to know, very specifically, something called a business model canvas, where you have your value proposition and who you are partnering with. You want to be able to test all of these assumptions really quickly. They teach you a lot of these things in the business school. I am in the Entrepreneurship and Innovation Program, so I had to learn these things through the program. I think the biggest thing to know is whether people will want your product or not. Even for us, it is kind of tough. There is no treatment for Alzheimer's, so our value proposition is kind of shaky since we can tell you that you have Alzheimer's, but what is to be done after that? Our claim right now is that you can use the fact that you have Alzheimer's and then try out for novel clinical drugs. Since this is designed to be able to diagnose Alzheimer's in an earlier stage, you have a better chance of getting into those clinical drug trials. For an early stage, you just want to know whether people want your product by validating and testing all of your assumptions.

MEDHACKS

Interviews conducted by
Morgan Janes, Staff Editor

MedHacks is a hackathon hosted by the Johns Hopkins University in conjunction with the Major League Hacking organization. Medhacks is unique in that it's healthcare-centric, and the aim of all projects are to rectify or advance issues in healthcare. The 2017 hackathon was held from September 8-10, and was attended by over 700 hackers. At this year's hackathon there were three tracks for participants to choose to pursue: Access to Care, Medication Adherence, and Patient Safety and Quality. Each of these tracks were sponsored by a company or organization (CVS Pharmacy, Blue Cross Blue Shield, and the Armstrong Institute respectively), offering specialized rewards and incentives for teams in each track, in addition to the Major League Hacking prizes. On the first night of the hackathon, participants were encouraged to interact with others to form groups and choose a project. Once the groups were finalized, hacking officially began at 10pm. The next 36 hours were devoted to developing the projects, however, there were plenty of other activities to engage the hackers, such as recreational events, games, and an opportunity to network with some of the companies present at the hackathon.

How did you hear about MedHacks?

Sahana:
I'm part of an organization called AWC, which is Association for Women in Computing, and they sent out different events that are happening like Hackathons and this was one of the ones that they contacted us about. I was really interested in it because I'm really interested in biological-related applications to computer science so I thought it would be a really interesting opportunity.

What inspired you to attend and how did the event align with your career goals?

Hannah:
I knew how to code in MATLAB and a little in Python, so I thought it would be a great learning experience. I plan on going into biomedical imaging, and image processing requires a lot of computation so I thought I could learn something. I was also curious to see what other projects others were able to complete to address problems in the medical device community.

Corrine:
I am a bioengineering major and computer science minor, so this program was the perfect combination of my interests. I had been looking for some way to get practical experience in both technology and healthcare, and MedHacks provided exactly that. This was the first opportunity I had participated in that allowed me to write code for a project directly related to healthcare.

Is there a selection process or is anyone admitted as long as you apply within the time frame?

Corinne:
It was super easy to apply. There was an easy online form that asked me to answer some basic questions and submit my resume. I applied pretty early, so I didn't have any issues getting in.

Hannah:
Yes, the application didn't take me very long.

What was the atmosphere like?

Sahana:
We got there on Friday and then the hacking actually started at 10 pm, so they had a lot of time for us to meet other people and kind of gather ideas. So they had three main topics for us that we had to pick from - I think they were access to care, one was specifically about getting medical adherence, so people don't always take their medications and stuff like that, and then another one was actually being able to get to the doctor, so that's access to care, being able to go the doctor's office and stuff and how can we help with that, and then the third one was patient care quality, like what can we do to improve patient care. So my group tackled the third one. We had some time to actually come up with the ideas and then we actually formed into groups and they had us say like this is our group, so that kind of ensured that you're working on a project and you're not just hanging out there the whole weekend so you're actually getting something done which I thought was really nice to make sure that everyone is being productive that weekend. The hacking goes on until Sunday at 10 am and then we had presentations where we could all present our projects. On Saturday during the day they had a lot of breaks and stuff, they had a gym time, they would have meals and snacks and stuff like that too.

Hannah:
It's kind of hard to describe—everyone was super tired and hopped up on caffeine but still having fun! No matter what hour of the day it was, there were always a couple people either hanging out or working on a project and talking. Everyone was connecting over their shared interests, both hacking and non-hacking related, and that made the atmosphere really warm and welcoming.

What did you build and why? Did you work individually or as a team?

Corinne:
I worked on a team of five bioengineering and computer science majors from all over the country. We decided to build a communication portal between nurses and patients to help patients feel heard in a busy hospital setting. In our ideal design, we wanted the portal to be expanded to give patients updates on their care. Our project was meant to keep patients from feeling isolated and forgotten about when hospital staff are attending to other people.

Hannah:
I worked on a team to design QuRe, a QR code that could be scanned by emergency responders to rapidly identify key patient information, such as age, pre-existing conditions, and drug allergies. The QR code could be scanned and translated into patient information using an Android app.

How did you decide on a final idea for your project?

Corinne:
One of my team members had experience as an emergency room volunteer, and she described the frustration of patients who have gone long periods of time without seeing a doctor or nurse. We came up with many other ideas during our initial brainstorming session, but this one resonated with us the most. We thought it was both important and feasible.

Hannah:
We struggled for a long time to decide on what we needed to do—our team was mostly composed of people with little to no programming experience, so we had to think of something that was feasible with our team makeup. We brainstormed for a couple hours and debated about the feasibility of each idea until someone proposed the QR code.

MEDHACKS

Was your project successful? Do you think you will try to expand upon it in the future?

Sahana:
It was mostly successful, we got everything that we wanted done. So we were able to have a map-based web page and then we had a form for paramedics to fill out and put in all the information about the patients and then that would directly put it into the map so you could see exactly how far that ambulance was. The only thing that we couldn't really do was include a tracker in an ambulance that has the location on the map move as the ambulances moves. We didn't have the tracker, but that would be an interesting feature that we could add to it.

Corinne:
We managed to build a basic prototype for our idea, but we weren't able to implement all the features we wanted. We connected an online form for patients to an interactive website for nurses that required login information and could be filtered by patient names, but we could not connect this website to official patient care information due to time and resource constraints. I have no plans of continuing the project in the future, but I still enjoyed working on it and learned a lot.

What is one new thing that you learned?

Corinne:

The most significant thing I learned was Javascript. I am now able to make basic webpages with some styling and interactive elements.

Sahana:

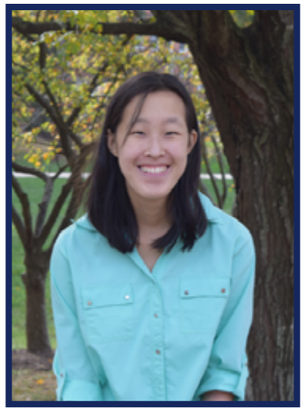
I was doing a lot of the software side of it as one of the only CS people on our team, so I learned how to use the Javascript Maps API, so I learned how to implement Google Maps into a web page.

Hannah:

I learned a lot about how to pitch ideas to investors and what they look for in a good pitch. I attended a workshop on it prior to presenting and found the information presented to be very helpful. Judges and investors look for teams that have both an understanding of the need addressed by their product and a long-term vision about

Sahana Rao
Computer Science

Corinne Farley
Bioengineering and Computer Science



Hannah Horng
Bioengineering

What surprised you the most?

Sahana:

I think it was really exciting to see all the projects and stuff that people built and it was amazing to see how much people could do in one weekend.

Corinne:

I was surprised by how invested I got in the project. Going in, I wasn't sure whether I would find a project I enjoyed or a team to work with. I ended up finding both, and I stayed up all night excitedly finishing the features I wanted to add. Even though I knew we probably wouldn't turn it into an actual product, I was still eager to create the best something cool.

Hannah:

I was most surprised by how much I was able to bond with my teammates. I'd never been to a hackathon before, and I wasn't sure if a team would be willing to take me since I didn't have that much coding experience. Even as we worked on the project, we learned a lot about each other and had a great time doing it.

How did people without a programming background contribute?

Hannah:
What I mostly contributed was some knowledge of how the product would fit into a clinical setting, and I also helped to pitch the product. I also worked on some of the graphic design of the QR codes themselves to make them more visually appealing. My teammates that also didn't have programming experience helped pool in a lot of ideas to improve the product and presentation and learned more about how to code.

Corinne:
People with a programming background did most of the technical work while the others primarily helped with brainstorming, writing patient surveys, and creating videos to advertise our project. Those with more programming experience did all the back end development. I focused on the website's layout and linking the surveys to the portal.

Do you have any advice for students who might want to attend next year?

Corinne:
I would say go for it, even if you're not sure how you'll contribute. It was a great way to pick up new skills quickly and work with people from different backgrounds. Like I mentioned before, I ended up being way more invested in the project and contributing a lot more than I expected. At the very least, seeing the winning projects is inspiring. It is definitely a worthwhile experience.

Sahana:
I think just be open to having new ideas and building something and working together.

Hannah:
Before you go into the hackathon, think of some potential products you might want to pitch! There is a good chance that someone's going to be interested and want to help make that product a reality.

Engineering World Health

An Interview with Salma Gohrab (Co-President of EWH)
Conducted by Subhashini Arumugam, Vice President of Finance

Can you tell me a little bit about yourself and your background?
My name is Salma, and I am a currently a sophomore, and was studying chemical engineering until I recently switched to mechanical engineering and computer science. I realized working in the chemical engineering field was not what I would like to do for my life's work. I enjoy medical devices and the impact it would give to people around the world, and the whole goal of EWH is to develop low cost medical devices for people around the world.

Can you describe what EWH is and what they do?
Engineering World Health is an international organization and we just established a chapter of it at the University of Maryland. There are three main aspects to EWH: Innovation, Repair and Provide. The "innovation" aspect is basically about the International Competition, where you submit a prototype for a device that is low cost and can be used in developing countries. In the proposal you describe what is the need for the device - be it an epidemic or lack of clean water - you explain the need for it and how the device could be implemented and used. Right now we're actually in the process of trying to collectively come up with an idea for the design competition. Hopefully by the end of the semester, so that we can spend next semester just developing a prototype.

The "repair" aspect is basically partnering with local hospitals and companies, and taking their devices and fixing them. There's a sizable number of devices that are donated, but they don't necessarily work as well as they should so our goal is to repair these devices. We have Kit Days, where we teach everyone how to use Kits, which are a simulation for medical devices since most people don't have prior experience with medical devices. And based on that, we would use those days to give the knowledge to the members to teach them how to fix the devices. However, we haven't decided how to organize the devices yet.
The last component is "provide," so we're looking to have service events, such as education outreach events by going to local high schools, middle schools, or even elementary schools, just to teach them about medicals devices and teach them about the kits. So having that as an outreach event is definitely something we're looking forward to and a future goal.

Engineering World Health Chapter at UMD seeks to tackle global and local health issues.

Can you tell me more about your design competition?
The Design competition deadline is in mid-May, and this is when we have to have our proposals and prototypes submitted by. The prototypes are intended to satisfy the "proof of performance" criteria. After submitting the proposals, the top three proposals are announced by Engineering World Health a month later. Those three proposals are recognized and receive some monetary prize. Something that was beneficial for us was reviewing the past proposals that were successful.

So when you say educational outreach, do you plan on including the high schoolers you're reaching out to in your service events and having them be a part of the club?
Right now, since most of the design competition is limited to a smaller number of people, it would mostly be to teach them how to use these kits. Personally, I had never used an Arduino kit until I came to college, so I think exposing them to that in case they have an interest would be beneficial. For me going into college, I didn't know a lot about medical devices, and if I had [more exposure] it would have changed my course.

What kinds of issues are you mainly focused on for your design competition?
The process we have been going through to narrow down ideas has been to first have all the members brainstorm all the different problems afflicting developing countries. We then write solutions and find more specific problems. From there we had a discussion and narrowed down to three problems, and we researched it outside and discussed the topics, and finally narrowed down to one. So right now we have narrowed it down to providing energy access for medical devices. Seventy to eighty percent of devices don't have energy access, and have power outages eighteen times a month, which is a pretty significant number and a significant problem. We're trying to find a constant and reliable energy source for medical devices that surgeons can rely on at low cost. We are currently trying focus and develop the ideas so by the end of the semester we can submit a proposal. The proposal is all we have to submit at the competition, but sometimes you can develop a prototype to take. Sometimes a proposal may sound great, but you have to consider how easy it is to use in these developing countries.

Why did you decide to start EWH on campus, what made it different?
I had wanted to join EWB my freshman year but didn't have the time. I just felt that EWH better aligned with my goals, and the idea of applying the engineering principles I learned in school to solving problems. The reason I decided to start EWH was because of the research I did with my Gemstone team, and I found that medical devices were something I was very passionate about, so I thought that there was a need for it for people more interested in biomedical engineering. We also like to emphasize the fact that we are inclusive, and even though engineering is in the name it is not a requirement. When writing the proposal, we definitely will be needing the skills of humanities majors or business people. We are pretty similar to BMES and have hosted an event with them, but that thing that distinguishes EWH is the people provides for, which is developing countries. Our devices have to be feasible and easy to use so the "Provide" aspect is the major characteristic that defines EWH.

What kinds of activities would you guys want to conduct and how do you see the general structure of the club?
Everything has been running pretty fast, and we're looking to have kit days more in the beginning of the semester. This provides a way for members to understand how to use medical devices so they could later use their knowledge to repair them the propose new ones for development. How I imagine it would be is that we would have them once every week for the first weeks in the semester. We also definitely want to have more service events to do later in the semester.

Can you describe the process of starting a club?
When Tima (EWH Co-President) came up to me, we first had to make sure the club didn't already exist. After that, the process was going through the SORC and getting 25 people as members. Then we had to submit a constitution, which is basically a guideline for how the club is going to run and how we will have officer positions. Afterwards we'd be recognized as a club by UMD, allowing us to participate in the first look fair, and get certain benefits from the First Look Fair. Afterwards we had to be recognized by Engineering World Health, and pay membership dues. From there we could get certain benefits such as reduced price kits or reduced admission fees. Then we again had to go through SORC and develop a budget to be approved so we could send the dues to EWH.

How do you plan on integrating people from different majors and backgrounds?
In the beginning there was a bit of a learning curve. At first we tried to have general body discussions which didn't really work because no one was really inclined to speak. So since then, we have divided the members up into smaller groups to discuss specific topics, and then they would share their ideas during the general body discussion. We haven't really split people up by major since medical devices is such an eclectic field so that they can glean other experiences from other people and get to know other people.

ENGINEERING WORLD HEALTH
at UMD

Study Abroad

Madrid, Spain

By Maryam Ghaderi, Staff Editor

Interview with Kellie Holovac (K) and Mairead Fahy(M) about their study abroad experience in Madrid, Spain!

What kinds of engineering classes did you take?

M: I took three bioengineering classes. Biomaterials, and instrumentation class, and biomedical devices. Biomedical devices was my favorite class, most of the students were about to graduate so I was able to learn a lot from them and form relationships with them. I really liked biomaterials which was a major required course, and specifically a class I needed to take that people take here take and don't like.

K: I took four different bioengineering electives. One class was on medical imaging, and I learned to analyze different medical images like MRIs. I took a biomaterials class, and one class that was biological systems which was an overview of different biological systems. In that class, we studied proteins a lot with software called Pymol which was used to study proteins in different conformations. The last class I took was a nanotechnology class with an overview of different nanoparticles and how they can applied to different biomedical devices

What do you wish you had known before you started your program?

M: Take classes that will contribute to your major so you're not behind at all because of study abroad. So even though it might not be appealing, try to keep on track with your major.

K: That classes are harder than I was expecting. My assumption of classes being easier abroad was debunked. In Spain the difficulty is pass/fail classes, they don't have an A/B/C grading system, but it is harder to do well in classes because of this grading system (not a lot of partial credit is given). The advice I have is to plan it in your schedule earlier on as soon as possible because you want to save certain classes to take abroad. Also to do a lot of research on where you're going so you can understand the culture and not stick out as a tourist.

In what ways did the curriculum differ UMD's from your program at UMD?

M: Spain's curriculum is very regimented for students who take 4 years of classes. There is less flexibility in choosing classes. All students take same classes all the time. There is not a lot of homework involved, mostly just exams and keeping up with material. M: I haven't taken Spanish since high school. In my education, Spanish didn't play a role cause my classes were in English, but walking around a lot of my Spanish came back to me which was pretty cool. This was nice because I wouldn't have felt comfortable if I couldn't communicate at all with the people around me.

K:The classes were two hours long and had a break in between. Everything was taught from a powerpoint. There was no homework, but there were a few midterms that were pretty hard because you didn't have homework to help you practice. I don't speak Spanish, but all classes are taught in English. But being able to speak French helped me pick up on what people were saying. I learned a bit of Spanish as I was living there.

What kinds of resource and opportunities are available for students who want to study abroad?

K: You can go for a year (requires extra planning) or semester but there are also also summer and winter and spring break programs. There are three different types of study abroad programs at UMD: exchange (most immersive), Maryland in programs (led by Maryland faculty), and other approved or affiliate programs (outside program that has an affiliation with UMD for study abroad). There are programs in Australia and Hong Kong and Copenhagen specifically for BioEs.

How do you feel your study abroad experience enriched your undergraduate career?

M: Studying abroad looks good professionally. Besides that , my cultural competency increased through the traveling I did. I saw different ways of life, and how different people value different things. I had a lot of conversations about how different cultures handle recycling. I had some roommates from France, and I was surprised that Europe is viewed as more environmentally friendly but I couldn't find a recycling bin in many areas, but instead Europeans are very focused on turning off the lights and energy conversion. I learned about how different cultures approach different prob-

K: I got to take classes that weren't offered at MD. Like the medical imaging class. I was able to put myself out there, and get out of my comfort zone because everything was different and you're an outsider. Being able to adapt to changes.

What tips do you have for integrating into a foreign society?

M: Try to speak language as much as possible even if you feel dumb cause everyone appreciates it. I felt pretty accomplished speaking Spanish, and it added to satisfaction in terms of my personal experience. Even if it's uncomfortable at first, try it!

What can you say about student life and extracurricular involvement in the country where you studied abroad?

M: I didn't participate in any, preferring to instead travel a lot, but I know that some are available available. Extracurriculars are more available here cause bigger school.

K: They don't have many extracurriculars. There was no club fair. The closest thing to the extracurriculars we have here would be students organizing some sports on their own but it wasn't university organized. There were some students doing research outside of school too.

A Mitochondrial Paradigm for the Study of Aging

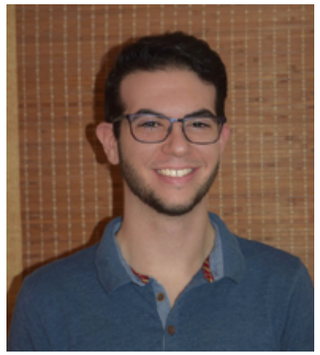
By Nick Giroux, Guest Contributor

I am currently a senior bioengineering student on the Biotechnology and Therapeutics Engineering track. I have worked in the Lab of Genetics and Genomics at the National Institute on Aging since the summer of 2016, initially as an intern and now as an IRTA fellow.

My research group, headed by Dr. Jun Ding, is interested in identifying new molecular biomarkers for metabolic and aging-related diseases. Our group has published several software applications used to investigate the mitochondrial genome and its role in progressive courses of disease, including Alzheimer's. I have been involved in validating these programs and am currently using them to better understand the mitochondrial etiology of Alzheimer's disease. My work is entirely computational, so I have had the opportunity to learn several new programming languages including R, Perl, and Python as well as key statistical concepts used in GWAS.

The mitochondrial genome is encompassed in a circular molecule of approximately 16.6-kb of DNA; each cell has a tissue-dependent number of these molecules, known as the copy number. Variation in copy number between cells has recently been recognized as a valuable indirect measure of metabolic output. For example, a 50% decrease in mitochondrial DNA copy number has been observed in Alzheimer's brain tissue – an indication of significant mitochondrial dysfunction. Sequence variation in the mitochondrial DNA may affect oxidative phosphorylation - ultimately leading to increased oxidative damage and eventual apoptosis - due to mutations in electron transport chain proteins. Several other layers of regulation remain unidentified or uncharacterized in the mitochondrial etiology of Alzheimer's.

My first project involved the validation of a software utility for copy number estimation, fastMitoCalc, against a cohort of whole-exome sequenced samples. In order to reliably and consistently estimate copy number, the sample DNA must be sequenced with even and preferably high coverage. Whole-exome sequencing (WES), though less expensive and far more accessible than whole-genome sequencing, produces patterns of high and low coverage across the mitochondrial genome. This is due to preferential enrichment of exonic baits during sequencing. By exploiting the inefficiencies of the capture kit and selecting for reads in the low-coverage areas, I was able to increase the reliability of this method to estimate copy number in WES samples. Ultimately, this technique can replace expensive whole-genome sequencing required for clinical identification of mitochondrial dysfunction.The computational requirements for storage and processing time are also significantly reduced.



As a fellow, I inherited a project investigating the association of mitochondrial sequence variation, copy number, and heteroplasmic load with Alzheimer's disease. Although nuclear loci have been identified which contribute to risk of Alzheimer's disease – known as the amyloid-ß and tau paradigm – no causative mutations have been found. Using 10,000 samples from the Alzheimer's Disease Sequencing Project (ADSP) I work to impute unobserved mitochondrial variants using haplogroup classification , and with that information I can then determine which factors are deterministic for Alzheimer's disease.

This field of work can be broadly categorized as computational biology, and the investigation of personal genomics is part of a movement towards omics in modern medicine. From this wealth of data, statistical models may dictate targets for continued research. Unlike more traditional modes of genetic analysis, this computational strategy is mostly unbiased and will point to biomarkers in potentially unexpected places. The mitochondrial genome is one of these unexpected places: until recently, mitochondrial epigenetics were believed not to exist; however, omics research points to mitochondrial methylation patterns associated with neurodegenerative disease states. Thus, the mitochondrial paradigm of medicine has grown in recent years with the possibility of new therapeutic targets for next-generation drugs in the future.

Using 3D Modeling Software to Improve Access to Dental Care

By Linnea Warburton, Guest Contributor

This summer, I flew 4,900 miles from the state of Maryland to Córdoba, Argentina where I was an intern in the biomedical engineering department at the University of Córdoba. As an intern, I worked on an independent project to improve access to dental care. In both the United States and Argentina, many people living in remote areas or challenging socioeconomic conditions find it difficult to regularly visit a dentist. This is a serious issue especially for children, because early diagnosis can be crucial to preventing long-term oral health issues. In many other health areas, "telemedicine", the use of technology to deliver health care from a distance, has allowed doctors to identify health concerns in remote patients and recommend further action. Previous research has shown that mobile "tele-dentistry" is also a viable type of telemedicine. These studies demonstrate that 2D digital images taken by a smartphone camera of children's teeth can be used by dentists to accurately identify oral health concerns. A proper diagnosis in dentistry however requires 3D information so that the dentist can visualize the problematic areas. Usually dentists will make stone or plaster molds of the patient's teeth, or use 3D laser scanners are used to create a 3D model. But without the physical presence of the patient, none of these common techniques can be used.

Hypothesis and Models

My hypothesis was that 3D models of patient's teeth could be created from 2D digital images taken by a smartphone camera. These 3D models would give the dentists more information to work with and make it easier for them to diagnose oral health problems. I decided to use a smartphone camera rather than a digital camera because patients in remote areas may not have access to expensive digital cameras. It is far more likely that someone in the area will have a phone that can take and send pictures.

To make the 3D models, I used a software called Agisoft Photoscan. While Agisoft Photoscan is most commonly used for making 3D models of landscapes, this powerful software can create detailed 3D models of small objects as well. I worked closely with the dental school at the University of Córdoba, and was able to take photographs of several patients during their regularly scheduled dentist appointments. I then used these 2D photographs to make the 3D models in Agisoft Photoscan. The 3D models that I created allowed a full view of the gums, teeth and tongue of the patients [See Image 1-2]. The dentists can rotate and zoom in on the 3D model to get a better look at certain parts of the mouth.

Now that I have completed several 3D models, the next step for my project is to test to accuracy of the 3D modeling software by comparing the 3D models to plaster models or laser scans. Additionally, I hope to create 3D models of patients with diagnosable dental diseases rather than patients with healthy teeth. These new 3D models will allow me to test whether dentists can accurately diagnose oral health problems using my models.

3D modeling has applications in many different types of medicine, not just in dentistry. The same process that I used could be used to model everything from wounds to skin cancer. With 3D models, patients who otherwise would not get care can receive accurate diagnosis and health information from remote doctors and dentists. I was lucky to have the opportunity to travel to Argentina this summer and research a topic that affects both Argentina and the United States. Patients in remote areas or difficult socioeconomic conditions around the world do not have the resources to attend regular doctor's or dentist's appointment. With the use of new technology however, we can overcome these challenges and promote equal access to medical care.

"3D modeling has applications in many different types of medicine, not just in dentistry. The same process that I used could be used to model everything from wounds to skin cancer"

3D Printing Scaffolds For Cartilage Repair

By Maeesha Noshin, Guest Contributor

My name is Maeesha Noshin, and for the past six months I have worked in the Fisher Lab with Ph.D. candidate Ting Guo on 3D printing polymer scaffolds for therapeutic use in damaged human cartilage tissue. My primary responsibilities included culturing human mesenchymal stem cells and analyzing their attachment to these plastic scaffolds. There is a pressing demand for a lasting solution to cartilage defects in humans, which is one of the reasons why I was drawn into research involving the engineering of biomaterials and regenerative tissue.

This semester, I had the opportunity to be trained to use of EnvisionTEC's 3D-Bioplotter® system. The 3D-Bioplotter is an extrusion-based 3D printer that is capable of printing with various materials through easy adjustments in printer speeds and pressure. 3D printing scaffolds with new polymers is not for the faint of heart. The task requires an in-depth understanding of material behavior under varying temperatures and speeds of printing. Bioprinting often involves constant observation and maintenance of the printed structures as layers are extruded.

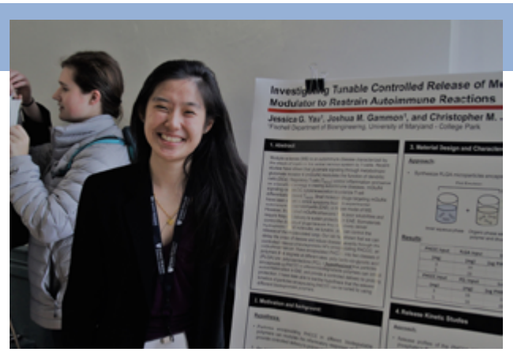
My first experience with printing began with me learning how to print under high-temperature settings on the 3D-Bioplotter. Printing at high temperatures is recommended for plastic polymers which are ideal materials for mimicking cartilage. The lengthiest task during the high temperature printing process is waiting for plastic to melt. This waiting period is followed by attempts of purging the material from the printing needle. If the material is not dispensed or dispensed too slow, you often have to wait a longer period of time to reach an ideal flow of extrusion. Once the ideal flow is achieved, printing can begin.

My time in the lab has led me to believe that the dedication of a scientist is not truly tested when things go right, but rather when they go wrong. Having worked with Ting on 3D printing multiple times, she shared her experiences of failures and success. These experiences helped her improve in conducting her studies though and I had the chance to learn from her wisdom. When Ting and I first printed together, we were able to collect about thirty uniform rectangular cuboid scaffolds. I was very excited to see how easy it was to print but little did I know that I still had a lot to learn as more printing days approached. For instance, one week we planned to use cylindrical scaffolds for a particular study. The polymer material was the same as what we had been printing with previously. This time, it was up to me to observe the print on my own. After the first layer began extruding, I saw that the material was curling up and forming a ball around the needle without actually sticking to the printing platform. I had to stop printing and clean the needle several times but it was very hard to produce even one layer of the scaffold. Later, Ting came to my aid and used forceps to hold the starting end of the extrusion down to force the layer to stick to the platform. We repeated this technique multiple time and by the end of the day, we had almost half a dozen cylindrical scaffolds; most of the initial prints appeared to be heavily deformed. Having had my first experience printing a different shape, I felt slightly disheartened by the yield of scaffolds but Ting assured me that it could have been worse. There have been situations where no scaffolds were retrieved by printing but for our cylindrical prints, we adjusted the technique and our next printing day for them was a success. The key is to avoid becoming frustrated, and use a difficult printing day to ensure better printing in the future.

When it comes to research, successes are often few and far in between, but beautiful things can arise from those few successes. Learn from your mistakes and of those of your peers and share what you have learned with others. This is how science and engineering advances. Whether it involves printing scaffolds or growing cells, Rome wasn't built in a day, and neither is cartilage.

DEPARTMENTAL HONORS

By Aviva Borison, Staff Editor



Through the Undergraduate Departmental Honors program, the Fischell Department of Bioengineering offers students the opportunity to work closely with a faculty mentor on an independent research project. This intensive program involves thesis-driven research and guidance in professional development. Jessica Yau, a senior bioengineering major, was interviewed about her experience in the program.

Q: Before participating in Departmental Honors (DH) did you have any research experience? In what fields? What kinds of lab skills did you come in with?

A: In high school I started my first research experience at the National Cancer Institute. I worked on a project with Parkinson's disease, so I came in with a lot of biology related skills like PCR (Polymerase Chain Reactions), Western Blotting, and bacterial cultures. I missed the engineering side of bioengineering, though, so in college I joined the Jewell Lab, which studies biomaterials and immuno-engineering. I did that freshman year Spring semester. Then, sophomore year I heard about the Bioengineering Honors Program from a fellow member in lab and decided to join. I also did a little bit of research at the Food and Drug Administration (FDA) studying biomaterials. We tested whether blood would clot with certain biomaterials used for cardiac devices.

Q: What made you interested in continuing your research through DH? Why did you choose the structure of the DH program?

A: I wanted to be more intensive with my research and it provides you the opportunity to really work hard on a single research project, collect all the data for it, and at the end present a thesis of some sort. I also want to go to grad school, so I thought this would be helpful. The program involves honors classes that present opportunities to develop writing skills; for example, we had to write a proposal for the NSF (National Science Foundation) grant. They also teach you presentation skills. We attended seminars, about five per semester, which were helpful because we got to see other fields of research and other professors' work. There are many valuable skills and experiences to gain in this program.

Q: Since you are almost done with the program, were your expectations met and what do you feel you gained from the experience?

A: The main thing was doing a lot of research, getting a lot of data, and presenting your thesis. So that is what I expected. And there were little tidbits in between, like the seminars, the practice writing, and the practice presentations. Other than the r

esearch and presentation skills, I also learned how to talk to faculty, to network, and do collaborations. Those are different skills I didn't realize you had to gain to build your professional network.

Q: Did you form relationships with other participants?

A: Our cohort did bond even though we didn't see each other often, just because we were a small group. We all went to the Biomedical Engineering Society conference, and get to see each other at seminars and around the Kim building.

Q: How do you think your experience compares with what you would have done if you had continued researching more informally?

A: This program drives you more to do the research, where if you had more flexibility you might not want to push as hard because you have other courses and classwork. This sort of gives you that motivation to drive forward with your research.

Q: Is the DH program tailored for people who want to do PhDs? Are there other career paths DH students choose to pursue and are the skills gained in DH transferable to a variety of careers?

A: The program is tailored towards people who want to get a PhD because it is research intensive – I actually want to get an MD-PhD – but I do think it could be transferable to industry or to MDs. I think learning how to execute a research project, to communicate your project, and having those lab skills will always be good skills to have. I think anybody who wants to go into industry, medical school, or any other career path would benefit.

Q: Do you have any advice to underclassmen about DH? Would you recommend they participate?

A: I really recommend participating in DH. I had a lot of fun, and got very close with the professor I was working with. My advice is to keep pushing your research. If you keep pushing you'll see results, you can get published, and you can go to conferences. My other advice is to find an upperclassman who you can talk to freely about research because that helped me a lot.

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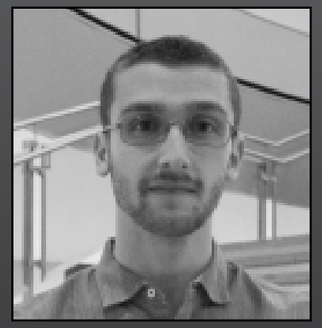

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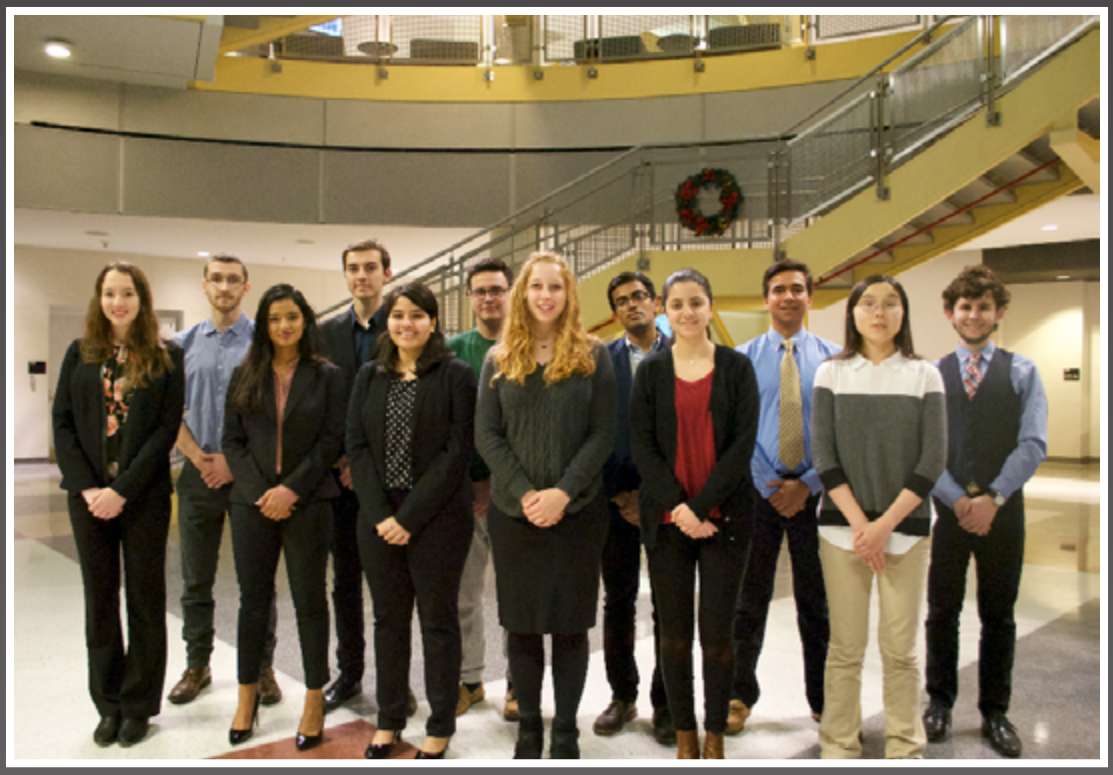

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