engineering news
School of Engineering
WINTER 17
SANTA CLARA UNIVERSITY

DEAN'S MESSAGE

Connections. In our personal lives and our professional careers, connections are crucial to our sense of well-being and fulfillment, our development as human beings, and our contributions to society.

As engineering educators, we place a high value on providing opportunities for our students to connect their theoretical learning with hands-on experiences. At Santa Clara, we pride ourselves on our small class sizes and our ability to connect individually with our students. We also treasure a connection with our fellow Jesuit universities around the globe and are enriched by the experience of exchanges between students and faculty.

At the School of Engineering, we have enjoyed a longstanding connection with KEEN, a collaborative network of colleges and professors championing the entrepreneurial mindset in engineering undergraduate students by focusing on three Cs: curiosity, connections, and creating value.

In this edition of *Engineering News*, you will find many examples of how these three Cs come together through our student and faculty work. You'll read about the personal experiences that fueled curiosity and connections that have created great value, about a priest whose 6,000-mile journey brought about a connection with researchers at Santa Clara that will improve health and well-being in Argentina. And, we have an interview with Tim Healy, who has been teaching electrical engineering at Santa Clara University for 50 years and still strives every day to find new connections that enrich and enable student learning!

Happy reading!

Godfrey Mungal
Dean
School of Engineering

Big Win in a Small Package

Photo: Joanne Lee, SCU Photographer

The gleeful team celebrates their victory!

Santa Clara's rEvolve House took first place at California's inaugural Tiny House competition last October.

An interdisciplinary team of undergraduates researched, designed, and built the 238-sq-ft, solar-powered home, and their hard work over the past two years paid off. The team won all the measured contests outright, such as heating water and maintaining a constant comfort level. ("Close the door!") It also won big in the subjective categories.

While the home boasts many innovative features, what really wowed visitors and judges alike was rEvolve House's solar tracking system. This 40-ft diameter rotating ring was designed and built to the team's specifications by Colossun, a leader in solar energy management. The entire tiny house sits on a turntable programmed to slowly follow the sun, capturing as much energy as possible during daylight hours. A bonus: the tracking system created space for a huge outdoor deck, and an additional rooftop deck accessed by a sleek spiral staircase afforded even more getaway space.

Faculty project leader Tim Hight said, "This team of students was highly motivated and worked really well together. They were inspired by their client, Operation Freedom Paws, to design and build a house that is at once welcoming, elegant, efficient, and also practical. The team also overcame many obstacles, not the least of which was the loss of their mentor Papa Reites."

Learn more: **revolvehouse.com**

The rEvolve House took top honors in the main categories of Communication and Energy, as well as in six sub-categories: Best Daylighting, Best Integrated Lighting, Best Interior Design, Best Kitchen Design, Best Program, and Best Tour. rEvolve House is now installed at Operation Freedom Paws, a local nonprofit empowering military veterans' independence. More at **operationfreedompaws.org**

When Crazy Happens, Making It Work

As a young girl, Anna Harris '17 wanted to be an architect. Then she asked for Legos one Christmas and a civil engineer was born. "I realized I was more interested in knowing how buildings stayed up as opposed to design and aesthetics," she recalled. Jack Dinkelspiel '17 can relate. "I always liked building. I was always putting things together and taking them apart. My grandfather was a civil engineer, and I grew up hearing about things he designed and built."

So it's no surprise that these two structural engineering students found themselves as teammates working on SCU's winning entry in California's first-ever Tiny House competition. "I'd always really liked hands-on projects and learned the most having that kind of experience—not just technically, but also about how to be a team player," said Harris. For Dinkelspiel, the chance to work on a project outside the classroom was a draw. "A lot of extracurriculars are not engineering related. I wanted to apply what I was learning in class to something in the real world," he said.

Photo: Heidi Williams

Anna Harris and Jack Dinkelspiel show their school spirit in their clothing and their actions.

As is often the case with big, long-term projects such as this one, teammates came and went, and Anna found herself the civil team lead. Later, Jack became co-lead. "I did the management side, talking with electrical and mechanical leads, and Jack did research, calculations, and behind-the-scenes stuff. We both learned Revit, the 3D modeling software," she said.

After debating the benefits of using SIPs (structural insulated panels), the entire team visited the factory where theirs were made. And although the trailer-borne entries only had to follow recreational vehicle standards, the rEvolve students sought to meet California Building Codes. "We put seismic ties on our SIPs to make it as structurally sound as possible," said Harris.

Throughout design and construction, roadblocks, hurdles, and delays became the norm. The team learned to manage change, frustration, disappointment, and anxiety with a calm befitting a neurosurgeon. Their biggest issue was when Hanjin Shipping declared bankruptcy, leaving SCU's solar tracking system stranded on a dock in Spain, seriously jeopardizing the team's potential score. (It arrived in time and they ended up winning the energy contest!) Other maddening problems arose too, Dinkelspiel recalled. It turned out the trailer on which the home was built was not exactly square. "Also, the whole deck had to be redesigned a week before the competition," he said, demanding more problem solving on the fly. "Constructability changed compared to the way the plans were modeled."

"We'll Figure It Out"

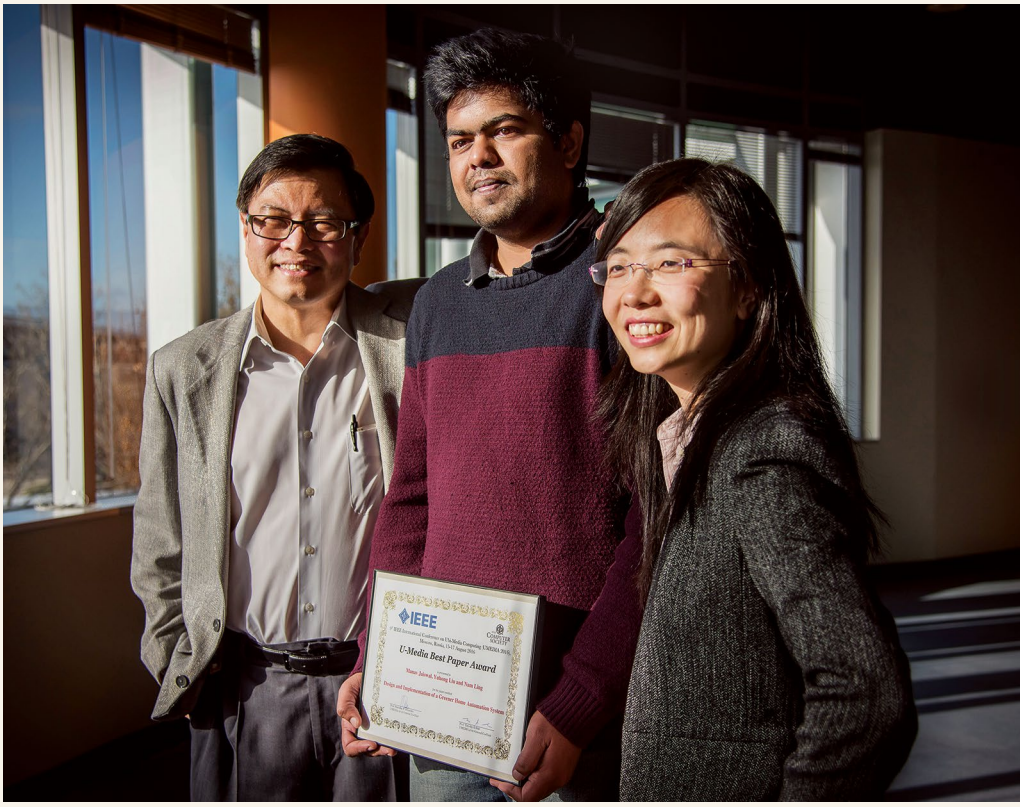
A day before judging was to begin, Harris calmly made more than 100 phone calls to building suppliers and home improvement stores before finding deck fascia in the color the team needed to present a polished product for the judges and viewing public. "A project like this helps you put things in perspective," she said. "If we don't get the fascia, we'll figure something out; we always do. Crazy things happen, you just have to make it work."

Summing up his two years, Dinkelspiel said, "We had to research a lot of things we hadn't taken classes for. Ninety percent of the things we didn't have in classes. There was a lot of trial and error, learning things outside our major—plumbing, electrical, mechanical—things we're not normally exposed to. When I first joined the team I felt I didn't have enough knowledge to be useful, but I've learned so much. I feel much more self-sufficient now."

"We were all so different on this team," Harris added. "Different personalities, different majors—it's pretty surprising how well we got along. But all of us were passionate about building a great house for Operation Freedom Paws. Yes, we were trying to win, but that was not the only motivator. We're so lucky SCU lets us do these projects and that Dean Mungal is especially supportive of providing students with hands-on experiences. We're lucky to have our crazy ideas—we made the whole house rotate!—taken seriously and supported."

BEST PRACTICES LEAD TO BEST PAPER

Photo: Joanne Lee, SCU Photographer



Living with unreliable electricity in his hometown in India was always frustrating for Manav Jaiswal. While studying the Internet of Things (IoT) as a Santa Clara computer engineering master's student, he wondered if he could create a system to not only save power but also change users' behavior. The result of this research won him and computer engineering advisors Nam Ling and Yuhong Liu the Best Paper Award for "Design and Implementation of a Greener Home Automation System" at the Ninth IEEE International Conference on Ubi-media Computing last year.

"The idea was inspired by a bachelor's project I did in India," Jaiswal said. "In my town, our power would be cut off for hours at a time. The technology of IoT was not there in 2013–14, but my family used batteries and inverters and relied on solar appliances when power was not available. I wanted to find a way to use less power so it would be available for future use."

With some SCU graduate courses under his belt, Jaiswal approached Dr. Ling. "I wanted to do something practical using the theory I'd learned in my classes. I planned to take independent study under Dr. Ling, but he advised me to instead write a thesis and spend two to three quarters working on the paper because my idea was good. I started the work under him and then met Dr. Liu and got to know her. She is proficient in computer security, and my project was lacking in that area, so I asked if she would be a reader and guide me in making the project more secure."

In a nutshell, their paper describes the design and implementation of an intelligent framework in IoT that can handle tasks of thermostat and humidity control similar to other products currently on the market for about $250, but can also do much more for less. "The major point is that the system should not be fancy," Jaiswal said. "It's cheap; it controls temperature, humidity, lighting, and air quality, all for about $110. It is also very small. Every node of my system is a small box that connects to wifi. It is easy to install and monitor on the web, with details shown in real time. Once it's up, it's done. Cheap and easy to install, but it's also important that users contribute from their side; this is not a one-way thing. If the engineering does something to enhance efficient use, the user should use the product efficiently, so it was important to have an effective user interface that would inspire a change in behavior," Jaiswal reports.

"When I started the project, I knew about 10 to 20 percent of what I should have known before starting. From start to finish it was a learning curve. But once I began, I had a sense of responsibility to learn new things to meet Dr. Ling's expectations," Jaiswal said. "I knew hardware and how to code but had to learn communications and databases. When we start a project, it's not just about the field we're confident in; it's about a whole range of areas, so many different fields. I'm good at hardware but needed to know user interface [UI]. I needed hardware, coding, database, communication, UI to have a complete product. Not just concentrating on one area, I needed a holistic approach to complete the project. I wasn't even hoping for Best Paper initially," he added. "Professor Ling told me to apply and get my thesis done and try to publish the paper. It was a great learning experience and I had some very great people helping me out."

FROM ARGENTINA TO SANTA CLARA: FINDING THE PATH TO SOCIAL JUSTICE

Fr. Guillermo Blason, a Jesuit priest from Argentina currently enrolled in the School of Engineering's graduate Frugal Innovation certificate program, jokes about the intersection of his calling and his lay education: "I liked to help people go to Heaven, so I studied aeronautic engineering," he quipped.

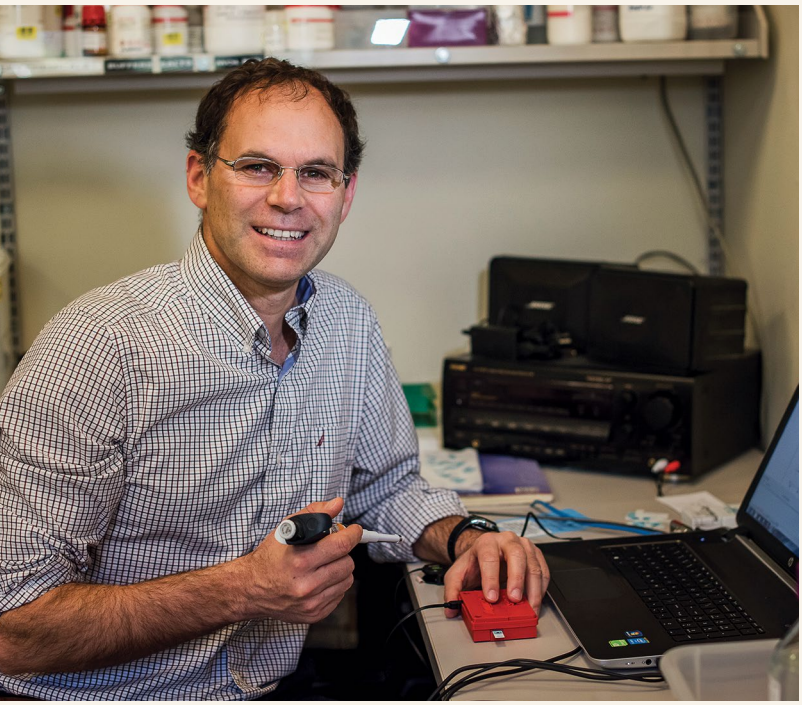


Photo: Joanne Lee, SCU Photographer

Blason in the Department of Bioengineering's Biological Micro/Nano Systems Lab.

In fact, engineering was his first choice for his career path. "I always liked the topic of engineering more than the particular field of aeronautic engineering. I like to create and develop new things. As a child I lived in the countryside; my relatives were farmers so I came in contact with a lot of technical and mechanical things."

Before receiving his engineering degree in 1999, Blason considered a religious life, but says he "did not have enough courage at that time to take that path." When he later learned that some Jesuits are involved in scientific work or in universities, he entered the Society of Jesus in 2000. "Becoming a Jesuit and going through the formation process—11 years of study and ministerial work—was a kind of parentheses in my life as an engineer. I was ordained as a Jesuit priest in 2009, received a master's degree in theology from Jesuit School of Theology of Santa Clara at Berkeley in 2011, and then was sent to Universidad Católica de Córdoba in Argentina where I was assigned to Campus Ministry and to teach in the School of Engineering. When I met again engineering, it was very nice, but I had a different kind of feeling of how to be an engineer now that I was a priest. I was enthusiastic to do social projects with my students," he said.

Working for the university's Social Responsibility Department, Blason was tasked with promoting social justice with students through careers, projects, and courses. He became involved with immersion experiences in Patagonia, where students brought solar installations to people living in the desert. In northern Argentina, he found wells contaminated with arsenic, so chemistry students developed a cheap, simple homemade filter. "The students were very enthusiastic to bring the solution," Fr. Blason said, but when they returned four or five months later, they discovered few families using them. The filters changed the water's taste, and residents also did not connect poisoned water with health problems such as cancer. "Working on these types of projects led me to think this could be my path. I talked with my superior about doing a more focused study on sustainable engineering, and I found Santa Clara's Frugal Innovation graduate certificate. Last quarter I have taken three courses and my advisor, electrical engineering professor Alex Zecevic, put me in contact with [bioengineering associate professor] Ashley Kim. I was invited to join her research group which is working on a portable electrochemical sensor for arsenic in water. They are expanding the scope of this project by testing not only contaminated water sources but also hair from the people in the affected area to study long-term exposure of the poisoning. This could be very important for the project in north Argentina, which is 500 miles away from Córdoba where testing would normally be done.

"Here at Santa Clara, I'm reading different articles, doing my part, and am very happy. I'll finish my studies by June and return to teach in the School of Engineering in Córdoba. I am very enthusiastic to go back with different ideas and start more projects like this one about arsenic. In Córdoba we had different opportunities to help communities but couldn't. Now I feel more confident to say, 'yeah, this is a good path to go.'"

Learn more about the Frugal Innovation Hub at **scu.edu/engineering/frugal**

Tim Healy—The Spark in Electrical Engineering for 50 Years

Tim Healy is a live wire. Ideas swarm in his brain like extra electrons in his outer valence band, and for five decades, he's brought that spark and connection to the SCU electrical engineering faculty. Respected, revered, and treasured by students and colleagues alike, with his impish smile, bright blue eyes, and inquisitive and thoughtful nature, Healy is the go-to guy for everything from deep discussions on the future of engineering to pedagogical advice or recipes for dinner. If he's not in the classroom, lab, or outside assisting students with an experiment, he's in his office with the door open—welcoming you to stop in for a chat. Dean Godfrey Mungal says, "While Tim Healy may be among the oldest of the faculty, he is among the youngest at heart, as demonstrated by his creation of the Latimer Energy Laboratory in 2012 and his enthusiastic adoption of active learning methods."

Recently, Heidi Williams, director of communications for the School of Engineering, interviewed Healy about his half century at SCU. Following is an excerpt. Read the entire interview at **scu.edu/engineering/healy**

Where did you grow up, what was your childhood like, and was anyone in your family an engineer?
I grew up in Bellingham, Washington; born during a lightning storm, I'm told—I don't recall it, myself. My parents were both lawyers, educated at the University of Washington. My uncle, who turned out to be something of a figurehead for me, wasn't an engineer exactly, he was a contractor, so he built buildings. I really had a lot of respect for him. And because of him—because of his contracting work—I started out at the University of Washington as a civil engineering student. The first day of class my father died... I kind of blew off the first year, and I more or less flunked out of the freshman year at the University of Washington.

So I got drafted into the Navy. Went in during the Korean War and the Navy sent me to electronics school. I spent nine months' wonderful duty on Treasure Island in San Francisco and they taught me all about electronics, and then I wandered around the Western Pacific on an aircraft carrier for 14 months and loved it. When I got out I decided to go back to school and study electrical engineering.

What was your outlook on engineering education when you first started teaching?
[Laughing] I don't think I had an outlook. That developed only later on. I just liked to teach. I think it's just a natural thing for me. I don't know why, but I enjoy teaching. I think I was just born to teach.

What gets you out of bed and excited to get into the classroom each morning?
I just like explaining stuff. And I love finding new ways to explain something. That is my science. That's my research. Discovering, seeking different ways to present something that I've maybe talked about for 40 years and all of a sudden found a new way to look at it, a new perspective; that's what I really love.

Today, after we're done here, I've got to work on a set of problems for a tutorial I've written for one of my classes. I can't wait to get started on it—it's a ball! When I find a new way of looking at things or when a new idea just pops into my head—a new way to look at something—I get charged up!

After 50 years of teaching, you are one of the most innovative educators I know; you hear something new—a new pedagogy, active learning or whatever, and you're the first one to want to try it. Have you always been that way? Where does that come from?

Photo: Joanne Lee, SCU Photographer

Professor Healy, doing what he loves best.

I have no idea. I am pretty comfortable with life. I can accept things pretty well. So, I don't fear things too much and it makes it easier then to poke around and try something new because it isn't too much of a threat…Every once in a while when I go to a bookstore I like to pick up a book that I don't want to read, or that doesn't hit me right. Just to read it and see what it does, see where it goes. I just take off on that. And I like doing that when I teach; I like to find another way to say something, or another way to do it, or a different perspective on it, an analogy or something like that that's fun.

What are your hopes for SCU Engineering in the next 50 years?
Well, I'm highly confident that we will continue the growth of the last fifty years. The Teacher-Scholar model will persist. I'm hopeful and optimistic that we will not lose our interest in teaching—that it will always be a paramount thing. That when we hire people, we will not hire people we don't think will be effective teachers. That's very important for me.

I'm greatly intrigued by this STEM idea. I just don't know where it's going to go. But we are living in an increasingly complex world. The marriage of biology and engineering which has been going on for some time is just going to get stronger and stronger and stronger. And those problems are going to be really difficult. They're going to be biological, they're going to be physical, electrical; they're going to be ethical. They're going to involve mechanics. And this idea of convergence that we've talked about on our campus—not that disciplines converge, not that physics and chemistry become one thing, but that people with physics expertise and with chemistry expertise and with engineering expertise converge together to create teams that are effective in facing real, complex problems—I think that's an exciting future. My guess is Santa Clara University will go in that direction. And to the extent that we do, I think that if we are able to bring our relatively unusual Jesuit viewpoint and our philosophy of living in the world effectively together with the idea of convergence, I think we can make a contribution that is, if not unique, perhaps unusual.

Anything else you would want to share?
It's been fun! It sure beats working for a living.

The Write Stuff

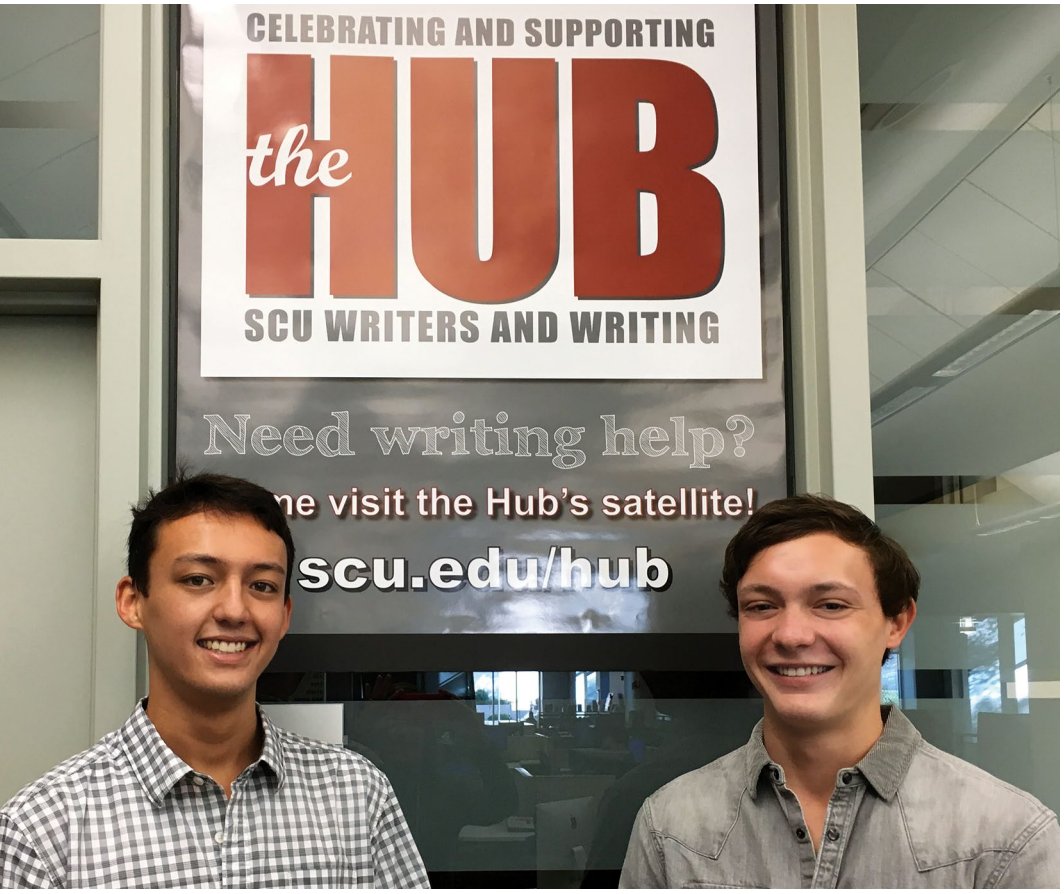


Photo: Heidi Williams

Wil Morrison and Bobby Bayer at The Hub.

Two engineering students walk into a … no, no, not a bar … they walk into a writing center, and—wait for it—they're the tutors! Hang on! Is this a joke?!

"The stereotype that engineers are not good communicators is patently false," claims Wil Morrison '17, the bioengineering student in the scenario above. "In the engineering work environment, you are only as smart and as helpful as your ability to communicate your ideas. Engineers have a fundamental need to communicate effectively, both to engineering peers and with other collaborators."

So Morrison and computer engineering senior Bobby Bayer tutor fellow Broncos in The HUB, Santa Clara's writing center, modeling and teaching better communication.

"We work with drop-in students on all sorts of assignments, not just technical writing and not just review or proofreading. We're really interested in the whole writing process, even brainstorming how to approach an assignment," said Bayer.

Honing these skills has proven helpful as they tackle their own senior design projects. Advised by industry mentors and bioengineering assistant professor Prashanth Asuri and biology associate professor James Grainger, Morrison has teamed up with two other bioengineers and one biology student to improve the strength of artificial corneas, work he started as an intern at Eyegenix in Hawaii last summer. "There is lots of communication going on—lots of back and forth between us here in Santa Clara and the team in Hawaii and lots of coordinating. Technical communication is important as we develop manufacturing techniques and conduct cellular-based studies on how to characterize biocompatibility to determine if the body will accept the transplant," he said.

For Bayer, communication lies at the heart of his capstone project. He and a teammate are creating a communication app with the goal of introducing it to nonverbal students at Hope Technology School in Palo Alto, a school that uses technology to bridge gaps between typically-learning and special needs children to provide an inclusive environment for all their students. "Right now, there are two options for nonverbal users: You can use an app or machine to type out words that the machine then speaks—it's flexible but takes a long time and is strenuous to hold a conversation this way. Or, you can use a device with preprogrammed buttons, which is quicker, but limits the user's voice. We're looking to combine these two current solutions by having both the keyboard and preset buttons. Our app learns how the user speaks. The app listens to conversations and learns the user's speech usage and patterns, so it can give personalized suggestions in the form of the preset buttons based on the user's unique style," he said. His team is advised by Yi Fang, assistant professor of computer engineering, who specializes in big data and machine learning.

"I didn't see myself as a tutor when I first came to SCU," said Bayer. "You have to weigh your priorities, but it's totally doable and it encourages me to allocate more time to literary things, like reading a book just for fun. Anything you read gives you more experience and makes you better at your job." Morrison agrees that reading is important. "It helps you develop tone and an ear, and good rhetorical skills. Working at The HUB has pushed us to become more concrete in our own writing skills so we can give advice that is helpful and meaningful."

DIVING INTO THE DEEP END

Meet Daniel Webber ’19, dynamo. He’s a freelance photographer and videographer specializing in sports and aerial photography whose work has appeared on television in an Emmy-nominated series, on The Weather Channel, and on The Nightly News with Lester Holt. He’s also seizing a great opportunity by taking a quarter off from his electrical engineering studies to intern as a hardware engineer at Apple. He thinks fast and talks fast—and when an idea strikes? “When I want to do something, I want to get to it, and I’ll do it,” he said.

So after his freshman year, it struck him that he wanted to try his hand at research. He applied to be a student researcher in UC San Diego’s Engineers for Exploration and was accepted in the 10-week summer program, charged with improving the range of an unmanned aerial system (UAS) platform used to track tagged animals with radio collars. “While the system has been deployed internationally, the detection range wasn’t suitable for researchers. I worked on the hardware to design new antennas that are built for the correct frequency. I was always interested in radio technology, but taking on this work was like diving into the deep end of the pool for me. I had taken no formal class in radio-related frequency or radio magnetics, but I’m always pushing the boundaries of what I know I can do. I had to learn how to build the system and then how to technically evaluate it.”

Working on his own with just weekly check-ins with the project principal investigators, Webber took the plunge. The result: He was able to benchmark several software defined radios (SDRs) to determine which was most sensitive, and he added a low noise amplifier to the platform, improving detection range while minimizing noise. His advisors encouraged him to write a paper. “I had never written a technical paper in my life, but I just figured this is the best time to do it so I’m going to try. At first I didn’t think what I had done was significant enough to write about, but my PIs were in strong disagreement. As I started writing about the work, I discovered it was novel enough.” Others agree. His paper was accepted to the IEEE Conference in Research in Networking and Systems. He also presented his research at the Council on Undergraduate Research NSF Poster Symposium in Washington, D.C., and gave a talk in January at the National Workshop for REU Research in Networking and Systems.

But applying his research in the field gratifies Webber most. “I got to meet the people from the San Diego Zoo conservation group who will be using this technology during their spring season deployment to the Cayman Islands. A big end goal for me is that I would not be researching just for research sake. This is actually going to someone who can use it, and that feels great. The whole experience was really fun. It showed me that grad school is definitely in the picture now. I’d love a mix between that and working in industry. SCU’s five-year combined BS/MS program is super interesting,” he said.

“Mostly, I just feel really fortunate that my non-career interests and my career came together this way. To do something you really like and also like what you love learning about is so cool!”

Photo: Courtesy of Daniel Webber.

Daniel Webber takes his system out for a test run.

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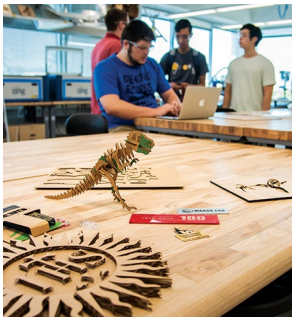
The Jesuit University in Silicon Valley

Photo: Joanne Lee, SCU Photographer



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FIRST PERSON: FIXING WHAT'S BROKEN

Photo: Courtesy of Allie Sibole '14

Allie Sibole '14, taking a break from her work in Switzerland.

Bioengineering alumna Allie Sibole '14 turned curiosity about her own injury into a passion for helping others. Here's her story.

I graduated in 2014 with a degree in bioengineering and a minor in mechanical engineering. While in school, I stayed busy by competing for the Santa Clara cross-country and track teams. Right before my sophomore year, I suffered a stress fracture in my femur. Although it healed without any complications, I sustained another stress fracture in the opposite leg two years later. My desire to understand my own injuries better, combined with classes in biomechanics and anatomy I was taking at Santa Clara, sparked my interest in orthopedic medical devices that prevent and treat injuries to bones and muscles.

Two weeks before my official graduation from Santa Clara, I started graduate school at the Johns Hopkins Center for Bioengineering Innovation and Design. The yearlong master's program gave me the opportunity to shadow doctors at the Johns Hopkins medical center, travel to Nepal to observe healthcare needs in low-resource settings, and work on numerous healthcare projects. One of these projects was a device to detect kidney damage during surgery, which is now being evaluated in two large medical centers, and another was an improved protective suit for healthcare workers treating Ebola patients, which is now in the process of being manufactured by DuPont.

After graduating from Johns Hopkins, I landed my dream job working in research and development for the world's number one orthopedics company. I am working as a product development engineer for DePuy Synthes, which is part of the medical devices division of Johnson & Johnson. In my role, I design and test implants and instruments that surgeons use to treat complex fractures. As part of my job, I've also gotten to meet with surgeons from all around the world and spend an extended time period working at my company's office in Switzerland. It's so rewarding knowing that my work will help patients regain their ability to walk and live pain-free lives.

One thing I've learned in my time in industry is that engineering is so much more than being able to set up calculations or make cool designs. It requires teamwork, dedication, and careful consideration of the human impact of engineering decisions. During my time at Santa Clara, I memorized formulas and built robots like any stereotypical engineering student, but I also got to analyze the ethics behind sustainable construction, learn about the challenges of designing for low-resource countries, and apply my skills over the summers in internships I found through career fairs and my professors. Engineering at Santa Clara was never about problem sets; it was about impact, and figuring out what kind of mark we wanted to leave on the world through our chosen field.

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