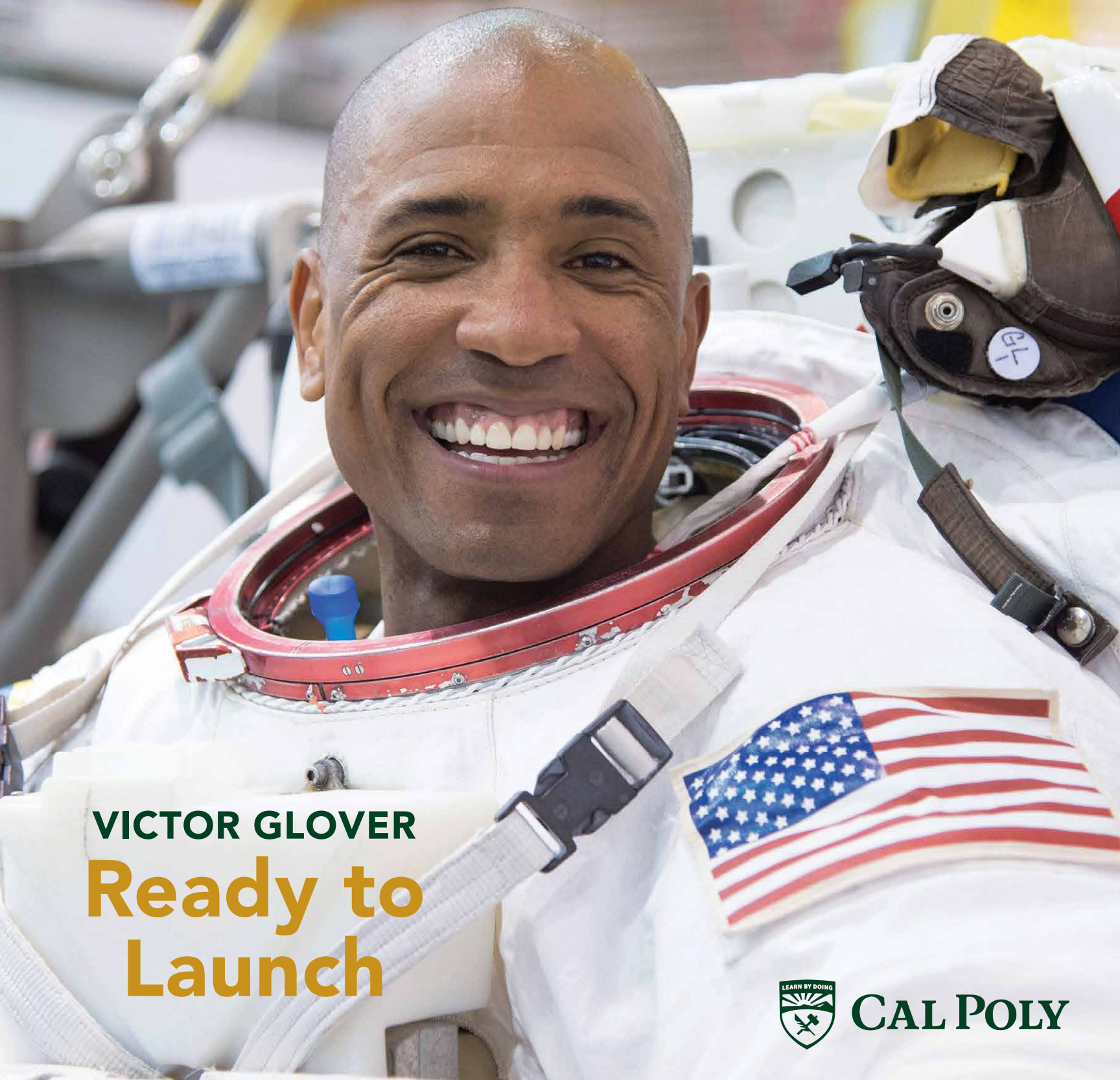


Engineering

ADVANTAGE



VICTOR GLOVER
**Ready to
Launch**



CAL POLY

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NASA Astronaut Victor Glover (General Engineering, '99) is set to launch aboard SpaceX's Dragon spacecraft for a half-year residency at the International Space Station. (Photo: NASA)

Back Cover Photo by Joe Johnston/Cal Poly



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THIS PAGE

Civil engineering students, from left, Derek Fromm, Lauren Tigue, Eleni Korogianos and Mason Breipohl paddled their concrete canoe to first place at the American Society of Civil Engineers Southwest Regional.



FROM THE DESK OF DEAN AMY S. FLEISCHER

Cal Poly Engineers are Doers

We don't sit back and wait for the world to change. Instead, we are out changing the world. We understand that engineering is a hands-on creative field and that engineering innovations are at the heart of every advancement in our technologically driven world. Cal Poly is the place where engineers become innovators.

We recognize that engineering is changing, and we intend to lead the way forward. Engineers today must be not only technically sound, but must also be comfortable working in an ever-changing, interdisciplinary, entrepreneurial, digital and global environment. With our Learn by Doing heritage, Cal Poly engineers are uniquely situated to respond to the need for innovative, systems-level approaches.

Now, Cal Poly and the College of Engineering are reaching for the next level, for exciting outcomes and for groundbreaking solutions with the Power of Doing: The Campaign for Learn by Doing. This universitywide and comprehensive campaign will allow our students to dream, design and create as we increase hands-on opportunities; multiply our impact through an inclusive and equitable college atmosphere; and expand Learn by Doing opportunities for students earlier in their time at Cal Poly through the Summer Undergraduate Research Program.



As you read through this special Power of Doing issue, keep an eye out for The Power of Doing: The Campaign for Learn by Doing logo (shown at left) to learn more about campaign priorities and how you can help.

Join Dean Fleischer on social media:

Instagram: [dramyfleischer](#)

Twitter: [@amyfleischer](#)

LinkedIn: [Amy Fleischer](#)

AMY S. FLEISCHER | DEAN, COLLEGE OF ENGINEERING

OPPOSITE: Biomedical engineering students Tessa Gunnin and Gabby Graham prepare cells for examination under a microscope.

THE POWER OF
DOING

The Campaign for
Learn by Doing

**EMPOWERING
STUDENTS**

**EMPOWERING
EXCELLENCE**

**EMPOWERING
INNOVATION**

THIS IS OUR
RESPONSIBILITY.
THIS IS OUR POWER.

LEARN BY DOING WAS BORN HERE

AND WILL THRIVE HERE, ALWAYS.



Join us and do something powerful for innovation, excellence and our students.

[GIVING.CALPOLY.EDU](https://giving.calpoly.edu)



INTRODUCING BOB CROCKETT

ASSOCIATE DEAN FOR
INNOVATION INFRASTRUCTURE

Facing the Future with Innovation

AS ASSOCIATE DEAN FOR INNOVATION infrastructure, Robert “Bob” Crockett is providing dynamic leadership in scholarly work, graduate programs, industry partnerships, facilities, space management and entrepreneurial pursuits for Cal Poly Engineering.

True to his innovative character, Crockett created the title and expressed his desire to use it as a service position, becoming a resource provider to continue enabling environments where bright people can do relevant, interesting work.

“I’m absolutely thrilled to be in this position,” he said. “My real joy is building something that allows others to do amazing things.”

The newly created position comes at a time when today’s college deans shift the focus from concentrating on the everyday happenings of the college to a more outward approach.

“The big picture is that a dean’s role has really evolved over the last 10 years,” said Crockett, who started in his new position in January, following Amy S. Fleischer’s appointment as dean in summer 2018. “A modern

**“My real joy
is building
something that
allows others
to do amazing
things.”**

dean spends more time away to build relationships out where our graduates are.”

As Dean Fleischer meets with donors, alumni and industry leaders, Crockett focuses on providing the infrastructure for innovative opportunities; facilitating new opportunities for research and graduate programs; partnering with industry; and making sure there is enough space for the ever-evolving opportunities within the college.

“Mine is very much a support role,” he said. “The one common theme in everything I do is making sure I can find the right resources for people within the college to do what they need to do.”

Becoming an associate dean was a natural progression of Crockett’s academic accomplishments since joining Cal Poly in 2003. Twice he has provided outstanding leadership as chair of the Biomedical Engineering Department, and he has served as program director for General Engineering. He has been a solid advocate for increasing resources and reducing barriers within the college, building corporate partnerships and building infrastructure.

Crockett and his wife, Amie, have one daughter, Clover, 11, and have called San Luis Obispo home since 2000. ■

INTRODUCING ERIC MEHIEL

ASSOCIATE DEAN OF DIVERSITY
AND STUDENT SUCCESS

Focused on Helping Students Thrive

IF YOU SPEND A LITTLE TIME WITH ERIC MEHIEL, IT WON'T take long to realize what motivates him. He is passionate about students, diversity and inclusivity, and impact — all things that fit perfectly into his new role in the dean's office.

As associate dean of Diversity and Student Success for the College of Engineering, Mehiel provides leadership in the areas of increasing diversity, promoting inclusivity and supporting undergraduate programs, student success and accreditation.

The title itself is telling, but what truly sets Mehiel comfortably into the role is his experience in each area.

"I've always been focused on student success and removing roadblocks to graduation," Mehiel said. "I am going to use this platform to effect change and reach out in a way that is genuine and sincere."

Mehiel brings extensive industry, academic and administrative experience to the dean's office. Prior to arriving at Cal Poly, he worked as a systems engineer at Boeing before starting as a faculty member in the Aerospace Department in 2004.

As department chair for six years, Mehiel secured meaningful funding to elevate the department's applications in autonomous flight offerings, led efforts to add an astronautics concentration, implemented curriculum changes that resulted in increased graduation rates, and led the department's ABET accreditation efforts, which he will continue collegewide.

As associate dean, Mehiel will build diversity and inclusivity while working closely with universitywide initiatives. Within the college, he will shape the college's Diversity and Inclusion Speaker Series to highlight why diversity and inclusivity is important within the university and in industry, track and eliminate achievement gaps, and build American Society for Engineering Education (ASEE) diversity recognition.

"This is the time to collect information and baseline data on where we are, then define some initiatives that will get us to where we need to be," Mehiel said. "These issues have always been important to me, but I didn't have this kind of platform to make a difference. Now I do."

Mehiel lives in Los Osos with his wife, Kristin, and their son and daughter. ■

**"I've always
been focused on
student success
and removing
roadblocks to
graduation."**



THE POWER OF
DOING

The Campaign for
Learn by Doing



Giving for Impact

CAL POLY KICKS OFF THE POWER
OF DOING: THE CAMPAIGN FOR
LEARN BY DOING

Around the world on any given day, Cal Poly engineers are putting the power of doing to work. With their reputation for being curious problem solvers, creative thinkers and, above all, hands-on doers, engineering graduates have made an extraordinary impact on science and society, in industry, and in service to humanity. Sidney Collin is one of those graduates.

Even before she participated in Cal Poly's June 2019 commence-

ment, Collin was making life better for people with Parkinson's disease.

"My ambition is to be able to create technology to help people," said Collin, who completed her biomedical engineering studies in March.

Her business, De Oro Devices, produces the Gaitway, a device that uses sound and visual cues to interrupt "freezing of gait" — a symptom that causes sudden immobility in patients with Parkinson's,

a progressive nervous system disorder that affects movement. The Gaitway represents the life-changing potential of Cal Poly's Learn by Doing ethos. But the ability to keep pace with the innovation needed to make the world a better place requires investment.

In May, the College of Engineering joined Cal Poly in kicking off a \$700,000,000 comprehensive campaign to empower students, empower excellence and empower innovation.

As part of that campaign, the College of Engineering is pursuing three major goals to impact future engineers:

- Build the Center for Creative Engineering: A Place for Doing.

Our students thrive on collaboration; it's at the core of their approach and their delight in how they manage and solve problems. The Center for Creative Engineering will create a welcoming environment that inspires diverse student teams to dream, design and create — harnessing next-generation opportunity through the lens of their Learn by Doing heritage.

- Multiply our impact through an inclusive and equitable college atmosphere. Our students do amazing things. Yet we have barely begun to tap the potential of wide segments of the student population. That's why we've made it our mission to provide more opportunities for women and historically underserved young people to know the joys and rewards of an engineering career. The world, and the world of engineering, needs their perspective and talent.

- We commit to expanding Learn by Doing opportunities for

students earlier in their time at Cal Poly while strengthening our ties with industry. The Summer Undergraduate Research Program allows students, primarily in their first or second year, to stay on campus over the summer and work on real-world, industry-sponsored research projects alongside mentoring faculty members. This high-impact program imprints students with critical-thinking skills and increases retention. Today, the program has many more qualified applicants than it has space for. It's time to change that equation.

NASA Astronaut Victor Glover (General Engineering, '99) was a keynote speaker during the Evening of Green & Gold in May, when Cal Poly President Jeffrey D. Armstrong kicked off the campaign. He was joined on stage by Lacey Davis, an aeronautical engineering student and pilot for the Cal Poly Prototype Vehicles Laboratory's solar powered car, who discussed a similar future: Glover is going to space; Davis plans to.

"As an engineer, I am most passionate about gaining hands-on experiences," Davis said. "As a future astronaut, I am most passionate about working on an interdisciplinary team to gain fresh perspectives. I have found the tools for both my passions at Cal Poly."

Students like Davis will do what needs to be done to meet the world's challenges and step up to its opportunities. The Power of Doing: The Campaign for Learn by Doing will help them do it. ■



LEFTHAND PAGE: Sidney Collin works with Korean War veteran Jack Brill on a device created for those who experience sudden immobility due to Parkinson's.

THIS PAGE: NASA Astronaut Victor Glover shares the Evening of Green & Gold stage with aerospace engineering student Lacey Davis, who someday hopes to reach the moon. Collin, Davis and Glover have all benefited from Cal Poly's Learn by Doing ethos.

SURP is Soaring

ONLY TWO YEARS OLD, THE SUMMER UNDERGRADUATE RESEARCH PROGRAM IS ALREADY MAKING A BIG IMPACT

Measuring the incredibly small amount of thrust needed to propel a CubeSat through space has turbo-charged the undergraduate education of two College of Engineering sophomores.

Working last summer on a project sponsored by the Summer Undergraduate Research Program (SURP), aerospace engineering students Alec Bluhm and Blaine Francis designed, built and calibrated a device that characterizes the energy produced by a CubeSat micro-thruster called a pocket rocket. For Bluhm, measuring thrust described as “about a milli-Newton or equal to the weight of a postage stamp” proved both challenging and enlightening.

“SURP opened up a lot of things for me that I wouldn’t have learned in class,” he said. “The project really got me to think about my skills as a problem solver. And it got me to realize I do

have to improve my problem-solving skills, and I do need to constantly work to improve myself as an engineer. But in the end, I really enjoyed the process.”

The SURP process awards participating undergraduates a CENG Summer Research Grant of \$3,000 to work with a faculty mentor for at least 20 hours a week for eight weeks on a collaborative research project that develops critical thinking and entrepreneurial skills.

Dean Amy S. Fleischer said the program, which had 320 students apply and 65 projects approved in 2019, offers undergraduates real access to serious research, the very reason the program has become a campaign priority.

“SURP is so much more than a research opportunity,” Fleischer said.





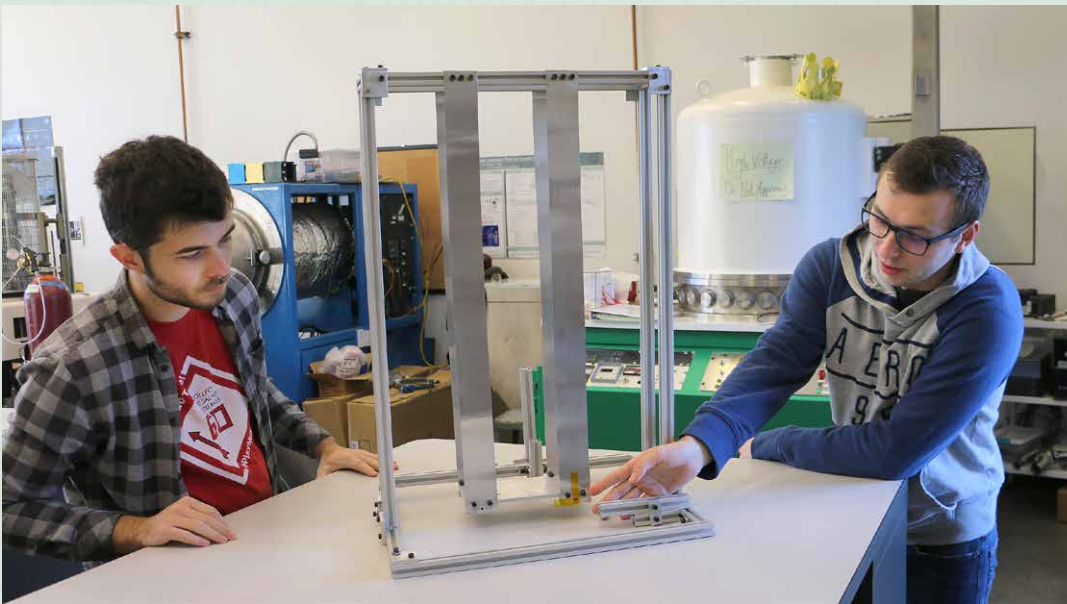
Computer science student Austin Quick works on a computer-generated lift simulation of a jet aircraft wing during his Summer Undergraduate Research Project. Quick's team won first place for posters during the 2018 SURP Symposium.

RIGHT: Computer science student Ishaan Jain explains his project, “Intelligent Aerodynamic Platform for Real-World Machine Learning,” during the 2018 Summer Undergraduate Research Symposium.



“Through the Summer Undergraduate Research Program, I was able to pursue cutting-edge research interests without fear of failure while working with a team of talented students from across majors. I can’t imagine something that would better prepare me for industry.”

— SEBASTIAN SEIBERT VON FOCK, Computer Science undergraduate



ABOVE: Aerospace engineering students Blaine Francis and Alec Bluhm demonstrate their SURP project, which involved measuring the thrust of CubeSat micro-thrusters called “pocket rockets.”



ABOVE: Environmental engineering student Darin Son explains her SURP project about groundwater flow biodegradation to Mechanical Engineering Department Chair Jim Widmann.

“Not only are students working hand-in-hand with faculty to create new knowledge, the mentoring aspects improve retention and progress to degree completion. The impact from this opportunity can actually change the course of their life. That’s amazing.”

Aerospace engineering Professor Amelia Greig, the faculty mentor for the pocket rocket project, agrees.

“It’s one of the few opportunities on campus for students to get involved in research at an in-depth level earlier on in their academic lives,” she said. “It’s great because they don’t have to wait for their senior year or graduate school to get involved in research. Cal Poly already has strong teaching and great extracurricular experiences in terms of clubs for undergraduates, so SURP is a nice way to get into a nice research program as well.”

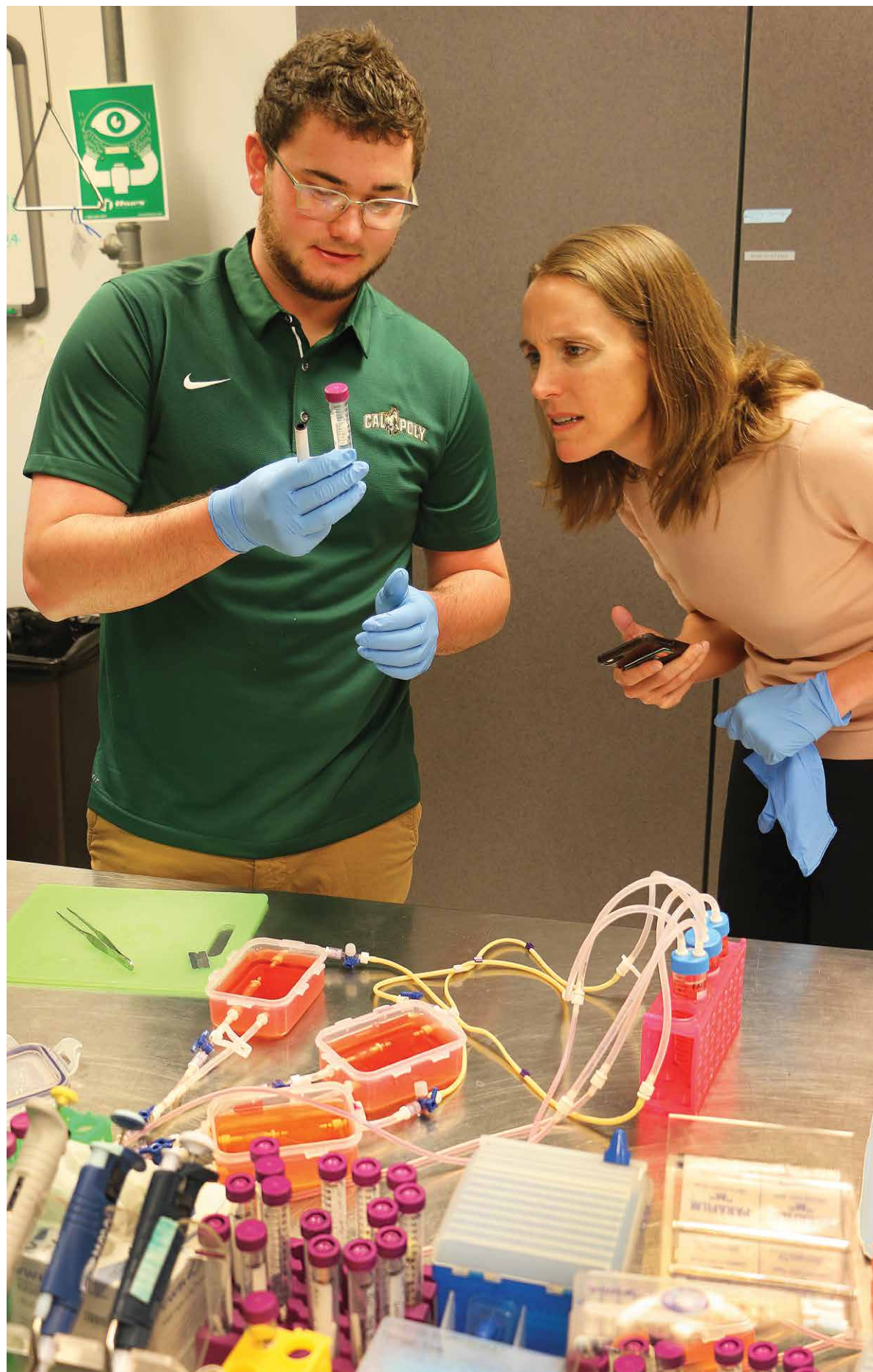
Computer science student Sebastian Seibert von Fock, who was on the winning team for best poster at the 2018 Summer Undergraduate Research Program Symposium, said the program was the highlight of his sophomore year.

“Through SURP, I was able to pursue cutting-edge research interests without fear of failure while working with a team of talented students from across majors,” he said. “I can’t imagine something that would better prepare me for industry.”

Bluhm, who claimed filling the 20-hours per week quota was easy because the project was so engrossing, said the program has already opened doors with industry.

“When I went to the career fair in the fall, just having it on my resume attracted a lot of contacts for me,” he said. “It’s already been very helpful.” ■

RIGHT: Biomedical engineering student Ben Dennis works with Professor Kristen Cardinal on a SURP project that involved growing cells in blood vessels.





Examining Life's Lessons

MAHVISH SYED WEARS A HIJAB SO HER TEEN SONS UNDERSTAND THEIR ROOTS

HAVING REHEARSED HER presentation until 2 a.m. the previous night, and again when she woke up at 7, Mahvish Syed, a 38-year-old biomedical engineering graduate student, walks out of her class relieved, having just given her peers an hourlong PowerPoint on drug-induced liver injury.

"I froze at the beginning, but I bounced back," she says, walking near Campus Market. "Now I can get on with my life."

Yet there's no time to celebrate — or stop — because she has to get to a nearby lab, where she will transition to her role as a teaching assistant, helping students inspect mouse kidney cells under a microscope. And, if that wasn't enough responsibility, Syed is also a researcher and a mother of two boys, aged 17 and 14.

"The one thing that has worked for me is planners," she said. "The more responsibility that was put on my shoulders, the more I planned."

With everything going on, she usually doesn't even remember she's wearing a hijab, a veil that symbolizes her faith and culture. But her hectic schedule is partly why she started wearing it to begin with. "I absolutely needed my kids to know who they are and where they come from."

Born and raised in Pakistan, Syed met her husband, Syed Shakir, through an arranged marriage.

"It was not a forced marriage," she said. "I did get a chance to meet him and speak to him. And my father was, like, 'Are you happy?'"

The arrangement was similar to a date set-up, she said — and she had veto power.

"That's just the culture there," she said. "Over

here people probably can't even imagine it. It's just the norm in Pakistan."

Shakir initially came to the United States to study electrical engineering. Syed followed in 2001, the same year their first child was born. Living in Texas, thousands of miles from home, Syed had a typical American lifestyle.

"I was a full-time mom," she said. "I loved being a homemaker."

But eventually, she became restless and wanted to do more.

"As my younger one was getting older, I started to get frustrated with not doing anything," she said. "And I think my biggest agitation was picking up the same thing and putting it in the same spot three times a day."

With Shakir's encouragement, she returned to school — the same day their youngest started school. Knowing she would have less time with the kids, who were born Americans, she began donning a hijab.

Wearing a hijab was not required when she lived in Pakistan, she said. But she wanted her boys to learn moral values advocated by Islam — not the negative stereotypes. Her husband supported those values, too, but he worried about the hijab.

"I had some hesitation because I thought this would put her on the spot, and she would have to explain a lot of things," Shakir said from their Atascadero home.

Despite his concerns, Syed believed the hijab would remind her sons of their roots and create understanding.

"I don't want them to see Muslim women as

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PRECEDING

PAGE: Biomedical engineering graduate student Mahvish Syed examines a slide with mouse kidney cells.

VIDEO:

To see a video of Syed and her family, visit: <https://engineering.calpoly.edu/life-lesson>.



ABOVE AND FOLLOWING PAGE: A teaching assistant with the Biomedical Engineering Department, Syed helps students Carolyn Teng and Nick Medjo.

weird or awkward or even different," she said.

At the same time, the boys know that they have advantages their parents didn't.

"They've told me a lot about how grateful I should be that I was born and raised in the U.S.A.," said Suleyman, their youngest. "Places like Pakistan and India are not as fortunate as us. Sometimes you have to boil water just to brush your teeth."

The family moved to California for Shakir's work, and Syed transferred to Cal Poly after attending Cuesta College. Last year, Syed earned her bachelor's degree, summa cum laude, then immediately began her graduate studies in biomedical engineering.

With Syed studying full time, working as an assistant and conducting stem cell research, Shakir has picked up household chores and parenting duties to support her.

"I realized a couple of days into Cal Poly that I had to step up," Shakir said.

At night, the mother and her sons study together at the dining room table, sometimes sharing their work.

"Sometimes she'll tell me how a muscle works or exactly how a neuron will fire in the brain," Suleyman said.

While few women wear a hijab on campus, being a student with teenage boys sets her apart more than anything, she said. People do occasionally ask about the hijab, though they've always been respectful.

And Syed, who has an inviting smile and gentle demeanor, is happy to discuss it.

"I feel that if there's anyone in the world they can talk to, it should be me," she said. "It's making me a better person, and that's the whole point." ■





The first recipient of the IME Department's Industry Advisory Board Scholarship created by alumnus Dave Hampton, manufacturing engineering student Steven Hoover works on a waterjet cutter in the lab.

Creating a Culture of Giving Back

INDUSTRIAL ENGINEERING ALUMNUS DAVE HAMPTON CONTINUES TO SERVE CAL POLY AFTER RETIREMENT

AS SCHOLARSHIP BASEBALL PLAYER FOR CAL POLY IN THE EARLY 1980s, Dave Hampton recognizes a good pitch. Hampton, a 1986 industrial engineering graduate and longtime supporter of both the College of Engineering and Mustang baseball, pitched, developed and awarded two new student scholarships to benefit students in need in the Industrial and Manufacturing Engineering (IME) Department.

The first scholarship was created following Hampton's 10-year tenure as chair of the department's Industrial Advisory Board (IAB).

"As a board, we discussed with the faculty what ways we could better engage and give back to the department," Hampton said. "We landed on a perpetual IAB scholarship that can be awarded each year. It is a great way to demonstrate our commitment to the department in a way the students will notice and foster a culture of giving back. And we have structured it to where we can continue donating and potentially increase the payouts down the road."

Steven Hoover, a manufacturing engineering senior and ex-U.S. Marine, received the first IAB Scholarship in August 2018.

The second scholarship created by Hampton came during his last year at Frito Lay Inc., where he led Frito Lay's Go To Market organization for 32 years.

"When I announced my retirement last fall, I wanted to find a way to celebrate the work done in lieu of traditional retirement gifts," he said. "Frito Lay, along with donations from my peers, funded a scholarship that will be delivered to IME students annually for at least the next five years."

Financial support is not the only way Hampton and members of the IAB support the success of students. The board created a faculty and IAB partnership by creating a course taught entirely by IAB members.

"As IAB members, we have an opportunity to balance fundamental learning with evolving industry needs," Hampton said. "By teaching this course we can expose students to multiple industries."

The IAB Facilitated Value Chain Course (IME 460) is taught each spring quarter and meets once per week for three hours. The specific learning objectives of the course are for the students to comprehend and explain key steps of the value chain and note how different companies from different industries execute their value chains.

"For a long time, giving back has been a focus for me, and I would like to see it become an even bigger part of the culture," Hampton said. ■

"For a long time, giving back has been a focus for me, and I would like to see it become an even a bigger part of the culture."

DAVE HAMPTON,
Industrial Engineering, '86



Chasing Disasters

CIVIL ENGINEERING
PROFESSOR ROBB MOSS
HAS TRAVELED THE WORLD
ANALYZING EARTHQUAKES

WHEN ROBB MOSS ARRIVED IN THE AFTERMATH of a 2001 earthquake in India, buildings had been reduced to massive mounds of rubble, cars were overturned on fractured highways, and covered corpses lay in the open.

As an engineer, though, he wasn't invited to provide relief to the afflicted; he was there to analyze geotechnical properties (soil and foundation conditions) in an effort to save future lives.

"You can't help the people that are dead," he said. "You can't necessarily help the people living that have been heavily impacted. You're there to collect the data to prepare for the next one."

A professor in the Civil and Environmental Engineering Department, Moss frequently trails tragedy, having been to disasters in nine different countries, including Turkey, Japan, Nepal and Chile.

"I work on a lot of things that have to do with what I call, 'hellfire and brimstone,'" he said. "Landslides, debris flows, earthquakes, tsunamis. I work on hazards."

While much discussion of earthquake damage centers around building design, Moss is particularly expert at analyzing how ground shaking during an earthquake influences structures.

"Everything that we build interacts with the dirt," he said. "Dirt is not an engineered material. We build steel, we build concrete ... but everything has to interface with a non-engineered material that is the ground."

Moss grew up in Montana, which isn't especially known for earthquakes.

"It wasn't like I was a kid, and the ground opened up and swallowed my dog," he said. "I don't have one of those origin stories."

RIGHT: Cal Poly civil engineering Professor Robb Moss surveyed the extensive damage to Kathmandu, Nepal, after an earthquake in 2015.





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LEARN BY DOING: LAND

BELOW: Civil engineering Professor Robb Moss examines ground cracking due to cyclic failure of clay soil after the 2015 earthquake in Nepal, India.

“I work on a lot of things that have to do with what I call, ‘hellfire and brimstone.’ Landslides, debris flows, earthquakes, tsunamis. I work on hazards.”





ABOVE: Moss advises civil engineering graduate student Yingyi Xu as she prepares a sand sample for subsequent liquefaction testing.

He did find earthquakes interesting, though, and earthquake engineering didn't really exist until the 1960s, representing fertile ground for discovery.

"The fact that there's so much to do and learn, and that it has a pretty deep impact on society, makes it a very rewarding field," he said.

After studying at North Carolina State, Utah State and then UC Berkeley, he became a specialist in geotechnical earthquake engineering. The amount of damage inflicted by an earthquake depends on how buildings are constructed and the type of soil around and underneath them. Different soils react to earthquakes in different ways, the most problematic soils requiring the most advanced seismic designs.

Since the most earthquake-proof designs are expensive, building or rebuilding entails knowing what degree of earthquake-proofing is needed.

"Schools and hospitals — top of the line," Moss said. "And then you ratchet it down from there."

Some countries, like Haiti, he said, simply aren't willing to change the way they build. In those cases, Moss said, he declines to visit the aftermaths.

"For some places it seems like a lost cause," he said.

California, by comparison, has reacted aggressively to earthquake disaster. After a 6.6 San Simeon earthquake hit San Luis Obispo County in 2003, two women were tragically killed when a building collapsed on them in Paso Robles. That resulted in a potential bellwether lawsuit that

forced others to shore up their buildings ahead of what was required by government code.

"It completely changed all of California, downtown SLO included," Moss said.

Days after the San Simeon temblor, a 6.6 quake struck Iran, where the city of Bam was built primarily of unreinforced masonry. While an astonishing 23,000 people were killed, little was done to prevent future carnage there.

"They're going to rebuild the same way," Moss said.

Moss is currently on sabbatical, performing research and writing, offering presentations and sharing information with Chile as a Fulbright specialist. He recently returned to campus to assist two graduate students he advises.

One of them, Yingyi Xu, was in the Advanced Geotechnical Engineering Lab, performing cyclic simple shear testing on Monterey sand.

"Just having theoretical knowledge is not enough to truly understand a topic,

which was why I chose Cal Poly for its hands-on learning experience," Xu said. "Since I can't casually observe earthquake aftermaths myself, having his input gives me a better picture on how the knowledge I gain in class being implemented in the real world."

Moss will continue his real-world work, but he also has to consider the impact on his family — so his wife helps decide when to chase disasters.

"When there's a reconnaissance trip, the event happens, we wait for one-and-a-half to two weeks until the rescues are done, and we get in for a couple of weeks," he said. "And then pretty much anywhere from a month to two months afterward, your life is consumed by analyzing data, writing up reports, and disseminating information and lessons learned to the broader community." ■

"The fact that there's so much to do and learn, and that it has a pretty deep impact on society, makes it a very rewarding field."

Beneath the Surface

FROM GREENLAND TO AVILA BEACH, MECHANICAL ENGINEERING STUDENT EJ RAINVILLE IS NOW FULLY IMMERSED IN OCEAN STUDIES

WHEN MOST PEOPLE look at kelp, they see clumps of seaweed at the surface of the ocean. But EJ Rainville has explored beyond the surface – and found another world.

“When you see it from the bottom, it’s incredible,” he said. “It looks like a forest. It looks like trees everywhere, and there are fish swimming in and out.”

Ever since he began studying at Cal Poly, the mechanical engineering student has become immersed in the ocean and how it works, assisting with oceanic research in Massachusetts, the Arctic and Avila Beach and earning academic accolades.

“I grew up in Evergreen, which is a small town in the foothills of Colorado about an hour outside

of Denver,” he said. “And it’s pretty far from any ocean.”

Once at Cal Poly, he was drawn to the ocean, taking up surfing, diving and spearfishing. He also wanted to get involved in research, so he reached out to physics Professor Ryan Walter, who studies physical oceanography.

“I sent him an email, asking if he needed help crunching numbers or whatever I could help with,” Rainville said.

Eventually, he wound up helping Walter perform ocean measurements.

“Locally, we are investigating how hydrodynamics influence local ecological habitats,” Walter said. “We are also looking at how a particular type of underwater wave in the ocean is affected by kelp forests.”

For that, Rainville has helped with analysis of

RIGHT: Mechanical engineering student EJ Rainville, pictured near the Cal Poly Pier in Avila Beach, is working on a study of ocean waves and kelp forests off the Central Coast.



“The icebergs in the water are very beautiful, and ice floating on the surface has a really incredible look and feel to it. The weather is harsh in these areas, and there are constant storms.”

— EJ RAINVILLE, on the waters off Greenland



ABOVE: Rainville, pictured off the coast of Greenland, worked for a summer measuring ocean temperatures on the Overturning in the Subpolar North Atlantic Program.



ABOVE: Rainville said looming icebergs outside a porthole window are among the spectacular sights in the North Atlantic.

ocean currents and internal waves in underwater kelp forests and with diving activities related to setting up underwater instruments. An oceanic paper he presented about their research won the Outstanding Student Paper Award at the American Geophysical Union’s meeting in New Orleans in 2017. The summer before, he was a student fellow at the Woods Hole Oceanographic Institution in Massachusetts, studying heat fluxes at the air-sea interface. While there, he learned that Woods Hole, which operates the research vessel Neil Armstrong, needed help working with the Overturning in the Subpolar North Atlantic Program (OSNAP), a project spearheaded by more than 20 scientists from around the world.

“I worked from 2 a.m. to 10 a.m. every day,” Rainville said. “It’s kind of weird getting up at 1 in the morning and going to bed at 5 p.m. But it was really nice seeing the sun rise in the morning.”

Rainville’s experience measuring ocean temperatures in Avila Beach helped him aboard the 238-foot vessel, which provided key data on the impact of climate change by monitoring the ocean’s movements across the Arctic and North Atlantic Ocean.

While the North Atlantic has been called the engineer that drives the global oceanic circulation, the area is also known for both spectacular sights and rugged conditions.

“The icebergs in the water are very beautiful,

and ice floating on the surface has a really incredible look and feel to it," he said. "The weather is harsh in these areas, and there are constant storms."

Rainville returned to San Luis Obispo County with a different perspective.

"This whole area is relatively understudied," said Rainville, who performs outreach at the Cal Poly Pier in Avila Beach.

In addition to helping physics Professor Walter measure local waters, he also helps analyze data collected from a project studying internal waves in the southern portion of Monterey Bay.

While the OSNAP program is looking at the bigger picture of climate change, local studies focus on understanding what other factors might impact temperature and salinity.

"It can tell us where some species might live or how

waters move through the ocean," Rainville said.

In California and other parts of the Pacific Coast, he said, those beautiful kelp forests – a vital source of food and shelter for many organisms – are diminishing.

"They've lost a lot of kelp, which is causing habitat destruction," he said. "Fish are leaving, and we're having different changes in the atmosphere."

Kelp forests tend to thrive on colder water, he said, so diminished forests could be a sign of warming water.

Sitting in a coffee shop with a view of the ocean and Avila Pier, Rainville looks out the window just like the other patrons enjoying the sight. But the full picture, he knows, is still a mystery.

When he sees the ocean, he considers how we know more about outer space than the oceans on our planet.

"I think about how much is unknown and how difficult it is to study," he said. ■

BELOW: Taking the temperature of the ocean at various depths is part of the job for Rainville, who is currently working in the waters and kelp forests off the Central Coast.



New Era in Space Ready to Launch



General engineering alumnus Victor Glover trained for more than two years in preparation for the first manned flight of the SpaceX Crew Dragon spacecraft to the International Space Station.

CAL POLY ENGINEERING PROVIDED ASTRONAUT VICTOR GLOVER THE TOOLS FOR SPACE TRAVEL

DURING THE ONGOING PREPARATIONS for his six-month space odyssey, Victor Glover learned how to insert an IV, give himself a flu shot, and suture a wound.

“As someone whose had stitches several times, it was cool to see how they tie knots,” said Glover (General Engineering, ‘99).

Medical training doesn’t appear on Glover’s resume, but when his team of NASA astronauts heads to space, he will serve as the chief medical officer. After all, if there’s a medical need 200 miles from the nearest planet, someone close has to address it.

“There’s no on-call doctor getting ready to launch on a rocket,” he said.

Of course, being a jack-of-all-trades has been an instrumental part of his background since college.

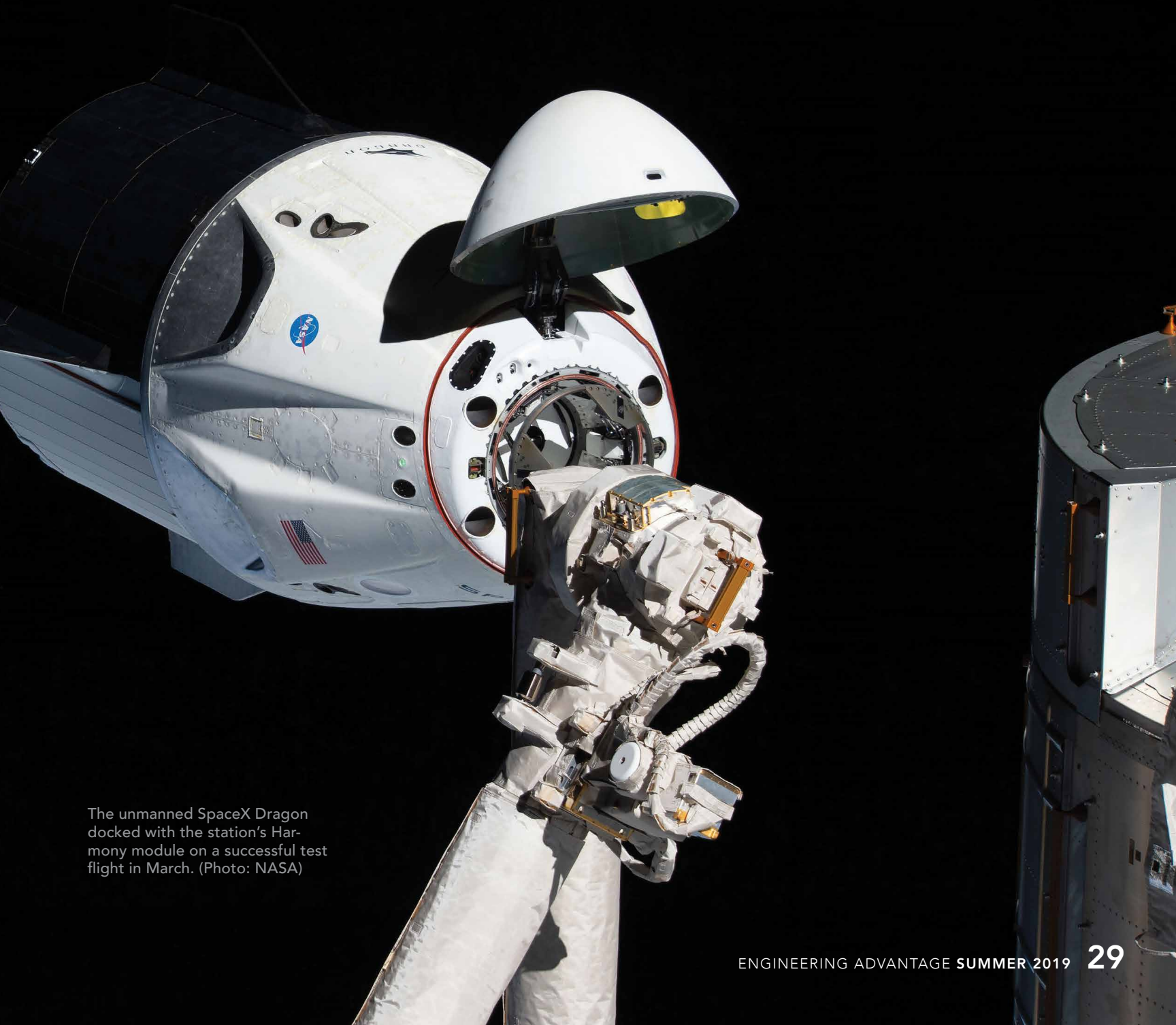
“Engineering is a great way to learn lots of different things,” he said. “It’s not any one class — it’s the big picture, learning to analyze and synthesize. It’s a great analytical tool bag.”

Glover is among an elite group of astronauts leading a resurgence in American space exploration. The Pomona native is set to launch aboard SpaceX’s Dragon spacecraft for a half-year residency at the International Space Station. Since astronauts have not flown to space from U.S. soil since 2011, the renewed efforts — aboard private craft for the first time — have generated a buzz that’s likely to afford Glover international celebrity status as liftoff nears.

The charismatic Glover did see himself as some sort of action star growing up. But space shuttle pilot was just one of the dream jobs he had in mind.

“I wanted to be a stunt man,” he said. “A policeman, like my father. A race car driver.”

“Engineering is a great way to learn lots of different things. It’s not any one class — it’s the big picture, learning to analyze and synthesize. It’s a great analytical tool bag.”



The unmanned SpaceX Dragon docked with the station's Harmony module on a successful test flight in March. (Photo: NASA)

LEARN BY DOING: SPACE

In high school, Glover excelled in academics and sports. But it was the barking orders of a high school football coach — “Keep your feet moving!” — that helped him as an African American student at Cal Poly.

Glover said he identifies with underrepresented students who feel isolated.

“I felt those same things — I had those same struggles,” he said. “But at the end of the day, I kept my feet moving.”

While academics were important, he said, so too was his social life.

“I met my wife there and many of my friends that I stay in touch with,” said Glover, a member of the College of Engineering’s Advancement Advisory Board.

He also credits his two years on the Cal Poly Wrestling Team with providing him with career skills.

“My first day of wrestling practice was one of the toughest days of my life,” he said.

One of his teammates was future MMA legend Chuck Liddell.

“Chuck was probably the toughest person I’d met up to that point,” he said. “He was calm and deliberate. I remember thinking, ‘That makes him seem even more intense.’”

After graduating from Cal Poly, Glover joined the Navy and attended flight school, eventually learning to fly F/A-18 fighter jets.

“I flew airplanes off of a carrier into combat in Iraq,” said Glover, a Navy commander.

After earning more degrees, Glover was one of eight people chosen out of 6,100 as NASA’s 21st astronaut class in 2013. He completed astronaut candidate training two years later, and he was chosen for Crew-1, which will be the Dragon’s first long-duration operational mission to the space station.

Until then, his Learn by Doing continues at NASA’s Johnson Space Center in Houston.

There was a time, he remembers, when he would look to the moon and think, “I want to go there.” But now when he looks up, his mind conjures a to-do list.

“It’s different now,” he said. “I look up there now with context and purpose.”

Astronaut training entails rigorous physical and psycho-

logical exercises while emphasizing the importance of teamwork. NASA also connects families with psychiatric experts, knowing the impact it will have on them.

Glover, who has four daughters, said he has spent considerable time preparing his family for his departure.

“I told my kids when they watched ‘The Right Stuff’ that there would be risk,” he said.

But he also told them how important his work would be.

Glover is one of several Cal Poly graduates who are playing a key role in space exploration. Tory Bruno (Mechanical Engineering, ’85) is the CEO of United Launch Alliance, which will launch NASA astronauts to space aboard a Boeing spacecraft.

“I promise you, there are way more than Tory Bruno and I,” said Glover, who regularly runs into Mustang alumni at NASA. “Whenever I see people in Cal Poly gear, I always make a point to stop and introduce myself.”

But, as Bruno acknowledged during a visit to campus last fall, Glover stands out.

“He’s going to space!” Bruno said. ■



CAL POLY

College of Engineering



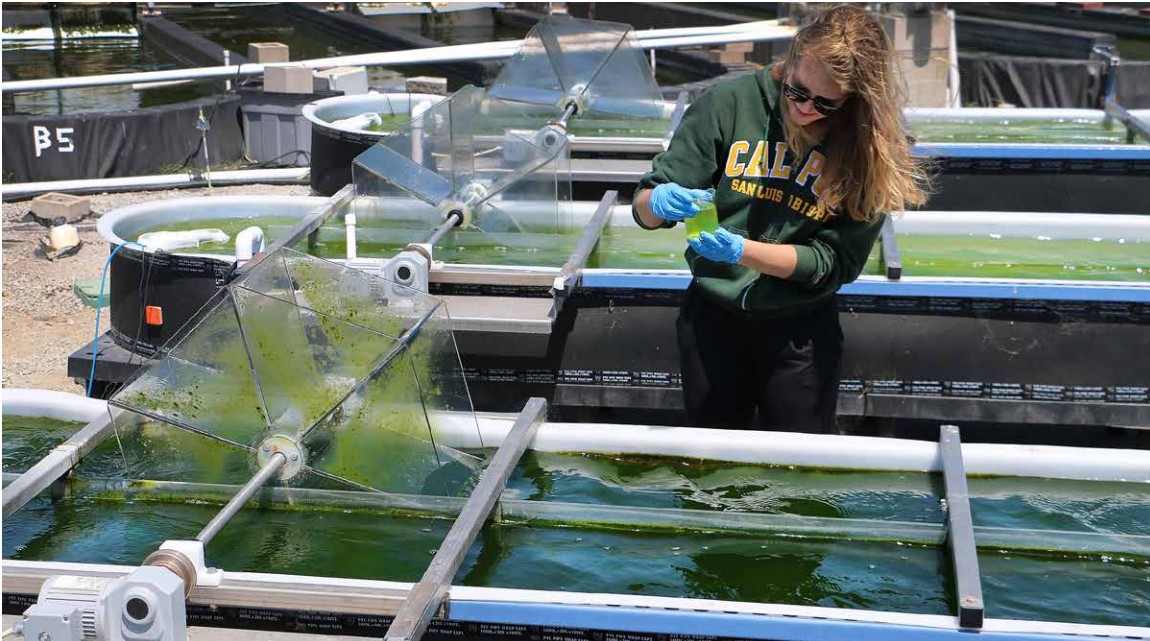
LEFT: After speaking in the Advanced Technology Laboratory on "The Future of Space," Victor Glover strikes a pose with engineering students.

BELOW: Glover, who has been training for more than two years, saw his future in space become clearer when the crewless SpaceX Crew Dragon spacecraft successfully docked with the International Space Station in March. (Photos: NASA)

"It's different now. I look up (at space) now with context and purpose."



LEARN BY DOING: PARTNERSHIP



ABOVE: Environmental engineering student Madeline Ross takes algae samples from one of the growing ponds at the Cal Poly Water Treatment Lab in San Luis Obispo.

Going Green

ALGAE FUELS MULTIDISCIPLINARY RESEARCH PROJECTS

THESE DAYS ON CAMPUS, THERE'S ALREADY A GREEN NEW DEAL. TEAMING WITH students from the colleges of Agriculture, Business, and Science and Mathematics, dozens of engineering students are involved in at least three large research projects involving a simple microscopic plant that boasts some wondrous properties and seems to flourish wherever water and sunlight meet — algae.

“Algae is amazingly good at photosynthesis and carbon capture,” environmental engineering Professor Tryg Lundquist said. “Water treatment, biofuels and feed stock are all active areas of algae study right now. Plus it’s really easy to grow. That makes it a perfect subject for research.”

Cal Poly research engineer Ruth Spierling said research involves more than 100 students working in three on-campus algae labs nicknamed the “Phycopolis,” plus the Cal Poly Water Treatment Lab located at the San Luis Obispo Water Resource Recovery Facility south of town. Many of the students are enrolled in ENVE 405: Environmental Engineering Research and make up the Water Environment Training Team.

“We have students from every department in the College of Engineering and many other departments on campus: Agriculture, Biochemistry, BioResource and Agricultural Engineering and Business. They all play a part in the research,” Spierling said. “The projects are multifaceted. There’s a biology part, an engineering part that occurs out at the field station, and then there’s a fermentation part in which we take the algal biomass and ferment it into alcohol for biofuel.”

Lundquist said a project funded by the U.S. Department of Energy is the primary focus of his research. “You could call it the ‘Algae Improvement Project’ because we’re working to improve algae strains the same way food crops have been improved over hundreds of years,” he said. “We’re just starting to learn how to improve algae so it is better for biofuels, or animal feed, or any kind of molecules that algae make that are unique and have some economic value.”

A second algae-centered study that Lundquist calls the “Nitrogen Management Project” involves growing



ABOVE: Environmental engineering student Antoine Andrianoelison and biology student Carly Lesne draw test samples of different strains of algae.



the plant in wastewater ponds at the Cal Poly Dairy. “Algae are microscopic plants that like things like nitrogen and phosphorous — fertilizer — and carbon dioxide and sunlight. In water, nitrogen is a pollutant. So if you can grow algae, the algae assimilates the nitrogen into its cells.”

A third algae-related research project focuses on algae cell biofuel production and involves students from Cal Poly’s Biological Sciences, Food Science, Physics and Electrical Engineering departments.

“We’re using pulsed electric fields to try to open algae cells to release lipids, or fats, for biofuel applications,” said electrical engineering Professor Dean Arakaki, who is leading the Boeing-sponsored project along with biological sciences Professor Elena Keeling and physics Professor Jonathan Fernsler. “We’re just at the very beginning of the research, but it’s exciting for the students to work on developing a renewable energy source based on algae because it’s so inexpensive to culture and so abundant. I mean, it’s everywhere.” ■

Pumping Air



WHEN AMERICANS FLOCKED TO GYMS TO PUMP IRON BACK IN THE 1970s, DENNIS KEISER CHALLENGED THEM TO TRY SOMETHING DIFFERENT

FITNESS IN THE 1970S CONJURES IMAGES OF hulking weightlifters clanking huge stacks of iron at Muscle Beach, where a future action star and governor bulked up for a docudrama chronicling his sixth straight Mr. Olympia crown.

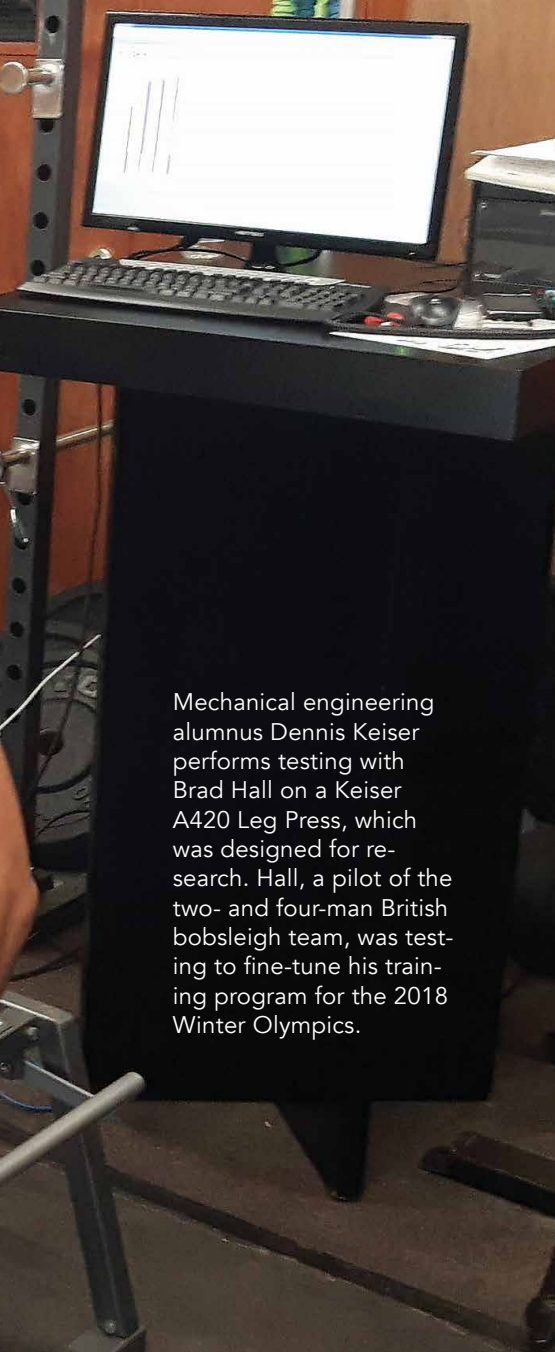
The 1977 movie “Pumping Iron” not only catapulted Arnold Schwarzenegger’s celebrity, it also bulked up the fitness industry, as new gyms across the country quickly filled with wanna-be body builders hoisting barbells.

As the trend exploded, Cal Poly engineering alumnus Dennis Keiser’s idea for fitness — introduced as a patent application the same year as “Pumping Iron’s” release — struck a different pose.

“I looked at the human being and said, ‘How can I make this human being perform better?’” he recalled. “That started with the question: Why are we using iron?”

Decades later, Keiser Corp. still addresses that question — with support from every major professional sport.

“That has been a 40-year challenge,” Keiser said.



Mechanical engineering alumnus Dennis Keiser performs testing with Brad Hall on a Keiser A420 Leg Press, which was designed for research. Hall, a pilot of the two- and four-man British bobsleigh team, was testing to fine-tune his training program for the 2018 Winter Olympics.



Dennis Keiser, center, discusses testing with employees Matt Austin (Mechanical Engineering, '08), left, and Daniel Schletewitz (Mechanical Engineering, '17).

“We make the muscle work at 100 percent all the way through the range of motion at functional speed, not the slow speed you have to use to lift iron.”

— DENNIS KEISER, Mechanical Engineering, '69

Keiser grew up on a farm in California's Central Valley, where he learned to weld at age 9. After earning his mechanical engineering degree in 1969, Keiser went to work in the fitness equipment industry before starting his own business, which he and his brother Randy (Mechanical Engineering, '73) incorporated as equal shareholders in 1977.

But, even as pumping iron became ingrained in fitness culture, Dennis Keiser questioned the approach.

Having used pneumatic (operated by air) and hydraulic (operated by liquid) equipment on the farm — and having already patented a hydraulic exercise machine — Keiser figured out how to make the first air-powered variable resistance exercise machines for building strength and power.

“We make the muscle work at 100 percent all the way through

the range of motion at functional speed, not the slow speed you have to use to lift iron,” he explained.

That maximizes exercise effectiveness and reduces the risk of injury, he said.

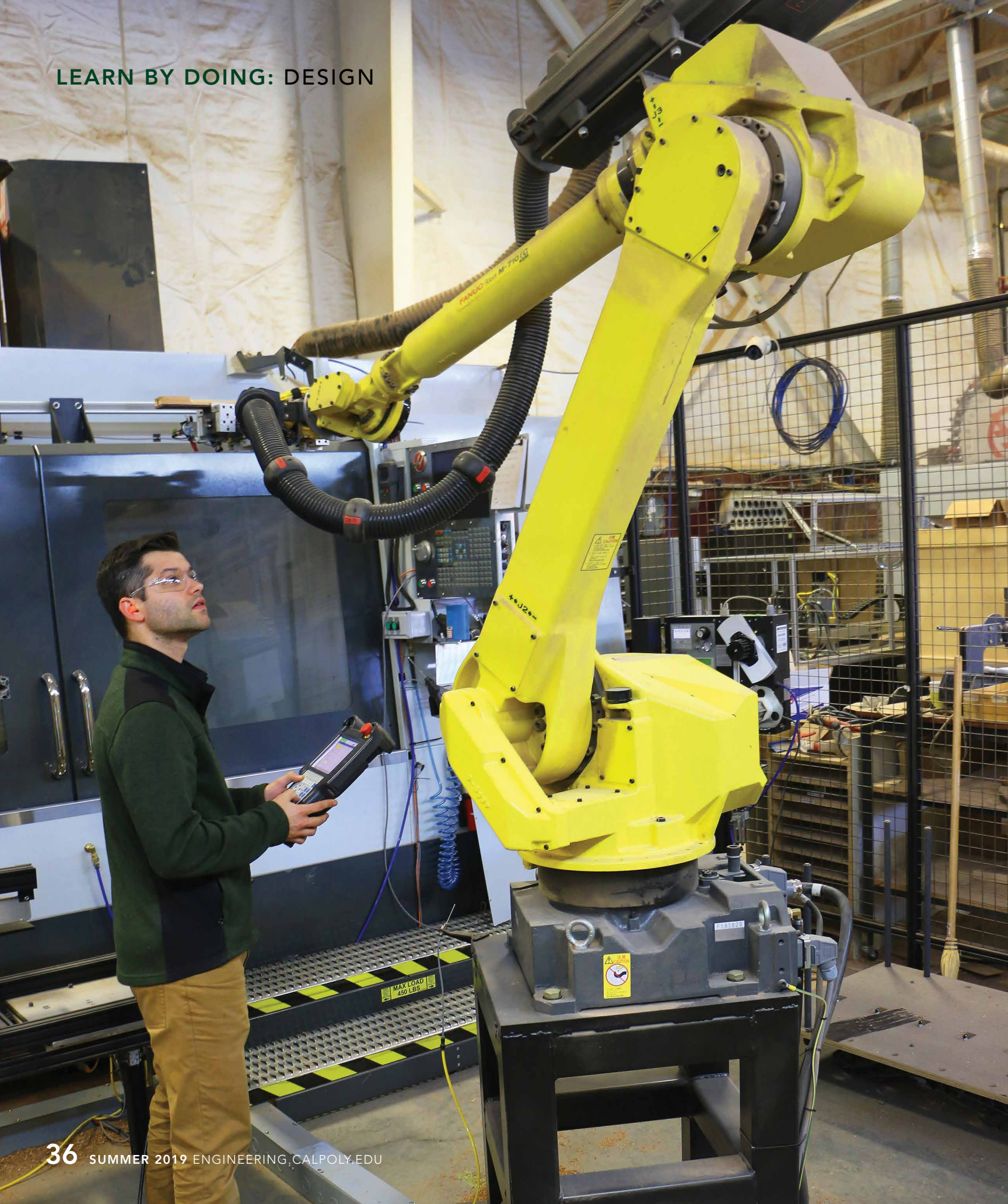
Today, professional athletes in baseball, football, basketball, hockey and soccer have embraced Keiser's technology. Yet, even though he rejected traditional forms of weight lifting, as an engineer, Keiser wants students to learn fundamentals on “old shop” machines.

“When you graduate and get out into the real world, not everybody has those high-tech tools,” he said. “Then what do you do?”

Hoping to spread that message, he was the founding chair of the Advanced Manufacturing Advisory Board. And Keiser Corp. sponsors shop technicians every year.

“Every bit of experience they can get on the manufacturing side is so valuable,” he said. ■

LEARN BY DOING: DESIGN



Keeping the Robots in Tune

MECHANICAL ENGINEERING ALUMNUS
KEVIN HENDRICKSON PROGRAMS 'BIG BIRD'
AND THE OTHER BOTS FOR SLO GUITAR MAKER

AFTER EIGHT YEARS OF MULTI-disciplinary engineering study at Cal Poly that included projects, internships, industry co-ops and lots of volleyball, Kevin Hendrickson is now sure his pursuit of a master's degree in mechanical engineering hit all the right chords.

"I feel really lucky to have a job that's awesome," the 2008 graduate said. "I mean, it's hard to beat. I build robots that make guitars!"

Hendrickson is head of automation for Ernie Ball Music Man, a family-owned company that has been building custom-crafted electric guitars and basses in San Luis Obispo since 1974.

Responsible for a group of robots, including one nicknamed "Big Bird," which feed milling machines that produce nearly 200 guitar bodies a week, Hendrickson credits his senior project, an automated guitar tuner, with landing an internship at the company in 2006. He said the job allows him to take advantage of the diverse engineering background he experienced at Cal Poly.

"In school I'd done a lot of industrial engineering, some electrical engineering, and I was actually heading in the direction of biomedical engineering when I took a year off and did two six-month co-ops back-to-back at St. Jude Medical and Alcon Labs in Los Angeles," he said. "It was all great experience, and I use all of my engineering education skills on the job, which is one reason why I really love it."

Hendrickson, who played setter and libero on the Cal Poly club volleyball team, admitted an obsession with the sport — "Some quarters I wasn't taking a ton of units because I was playing about five nights a



Kevin Hendrickson (Mechanical Engineering, '07) designs the programs that control the robots that build guitar parts at Ernie Ball Music Man in San Luis Obispo.

"I use all of my engineering education skills on the job, which is one reason why I really love it."

LEARN BY DOING: DESIGN

week” — also lengthened his education and describes his current job as designing a “process, not a product.”

“Here, you’re designing the up-front layout of the automation cells,” he said. “How is the robot going to move? How is it going to know what to do next? How is it going to know what part is next? These are all things that you essentially design into a process.”

Hendrickson said he has to be multilingual with his robots, using up to five different programming languages plus CAD (computer aided drafting) every day. “The robot has its own programming software, and there’s a lot of electronics and controls,” he said. “The challenge is to make everything talk with each other.”

Hendrickson’s deep dive into industrial automation hasn’t limited his design work at Ernie Ball Music Man. Along with designing bass tuning heads, guitar pegs and injection-molded battery boxes, Hendrick-

son was the lead designer for the Valentine guitar in Music Man’s signature series, which was based on the specs of Maroon 5 lead guitarist James Valentine. That design got him special tickets to watch the band play the halftime show at the 2019 Super Bowl.

“The Signature Series guitars we sell are the exact same guitars the musician plays, from the design to the electronics,” he said. “I’m connected to every part of that guitar, so it was awesome, and a little weird, to see the instrument out there on that big stage.”

Hendrickson lives in San Luis Obispo with his wife, Kate, a 2006 Cal Poly business marketing alumna, and daughters Zoe (4) and Piper (7 months). He still remembers the first big rush he got from an engineering project at Cal Poly.

“In Design 1 or Design 2, we had to make a walking robot — something that didn’t roll but moved forward and backward by taking steps, and that was

BELOW: As the head of automation for Ernie Ball Music Man, Kevin Hendrickson is involved in all facets of producing the many parts needed for the company’s electric guitars and bases. He also designs parts, including the guitar peg pictured at right.



“Here, you’re designing the up-front layout of the automation cells. How is the robot going to move? How is it going to know what to do next?”



ABOVE: Hendrickson said the specifications on the Ernie Ball Music Man guitar parts are exacting — especially the necks and fretboards — since the slightest deviation can affect the sound.

the first time I used a 3D printer,” he said. “It was probably the most fun I had working on a project at Cal Poly because you had to think about absolutely everything from the ground up.”

Learn by Doing projects like that was the impetus to Hendrickson’s decision to attend Cal Poly after he graduated in 2000 from Clayton Valley High School in Concord, California. Describing himself as a “maker” and a “doer,” he said knowing how to build things has been a lifelong passion.

“By the time I was a senior in high school, I knew I wanted to be an engineer,” he said. “I’d heard about Cal Poly and what a good engineering school it was. I came down to Open House and saw all the clubs and all the cool things

people were building. That opened my eyes to the possibilities, and I was sold. Cal Poly was the only school I applied to. Fortunately, I got in, and the rest is history.”

Hendrickson said they’re playing the same Learn by Doing song at Ernie Ball Music Man.

“That’s exactly what I get to do here — I get to design it, make it myself, test it and put it into production,” he said. “That’s a unique position to have. In bigger companies you get separated into a niche — you’re a designer, you’re a manufacturer, you’re in production. Here, I get to do everything from R&D to production. For me, it has been a perfect fit.” ■

“Cal Poly is the only school I applied to. Fortunately, I got in, and the rest is history.”

A Sense of Community

ENGINEERING STUDENTS MAKE UP MORE THAN A THIRD OF THE MUSTANG BAND

Whenever Jay Ingram shows up for new engineering classes, there's a good chance he'll recognize fellow students from the Mustang Band.

"I think so much of the band comes from engineering because band programs teach teamwork and hands-on learning," said Ingram, a materials engineering major who plays alto sax in the band.

Of the roughly 230 members of the band, 80 — or 35% of the band — are engineering students. While the College of Engineering is the largest college on campus, representing 28% of the student population, engineering students typically represent an even higher percentage of the band.

Victor Wei has a less scientific explanation for those numbers.

"I think it's because Cal Poly is such a huge engineering school to start with, but you could also attribute it to the fact that band kids are cool and engineering kids are cool, so you're just bound to have some overlap," said Wei, a software engineering student who also plays alto sax.

The full Mustang Band, including brass, woodwind, percussion and color guard, performs at all home football games as the Pride of the Pacific Mustang Marching Band. It also features

up to four stadium bands — roughly 50 members each — that perform at home volleyball matches and men's and women's home basketball games. The band also performs at various events, including Cal Poly's Open House and the Week of Welcome.

For Wei, the band provides a chance to unwind from studies and gives him a sense of community.

"We get to see our friends on a regular basis in a safe space doing what we love," said Wei, who has also played piano, clarinet and oboe. "We're all together for the purpose of making it look and sound as good as possible, and being a part of that mission is very rewarding."

While engineering can often be technical, performing in the band allows students to explore a different creative side.

"Mustang Band is meant to be fun and exciting to audiences, so the students are given almost complete freedom to be as passionate and excited as they want to be," Ingram said. "We do silly 'creative' things, and that is my creative outlet." ■



Materials engineering student Jay Ingram says playing alto sax in the Mustang Band is a hands-on learning experience.

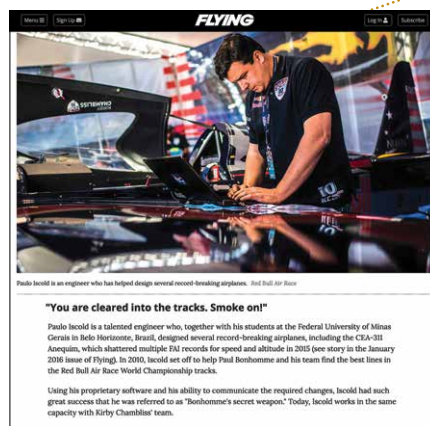
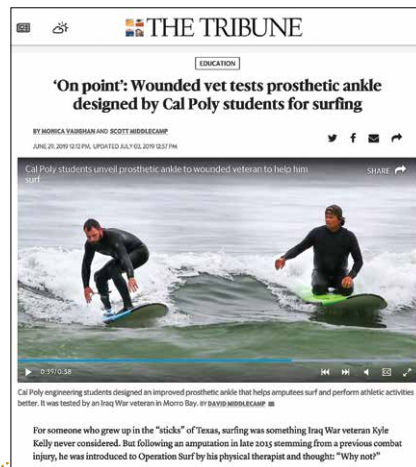




Plugged into a microphone for a solo, software engineering student Victor Wei plays his alto sax at halftime of a Cal Poly football game.

CENG IN THE NEWS

Working on projects that are making a difference, Cal Poly engineering students and faculty have been in the headlines across the country and around the world this year. Among the highlights:



Hands for Julien Project

Through the Quality of Life Plus (QL+) Club on campus, a multidisciplinary team of Cal Poly engineering students designed and built prosthetic hands for a 10-year-old Los Angeles boy who was burned in a suspected DUI crash. The story received coverage in newspapers, TV and radio stations, including the Los Angeles Times, Inside Edition, KSBY and ABC7-San Francisco

Parkinson's Project

While still in school, BMED's Sidney Collin created a device that would help those with Parkinson's Disease overcome a debilitation condition known as freezing of gait. Her device led to a company, De Oro Devices, which was featured on a KSBY-TV story.

Cal Poly in Space

The PolySat team from Cal Poly continues to play a key role in the deployment of a revolutionary spacecraft decades in the making. KCBX, the San Luis Obispo Tribune, KCOY, and the Planetary Society all featured stories on Cal Poly serving as mission control for Lightsail 2, a spacecraft propelled by solar wind.

AERO's Paulo Iscold

Flying Magazine, KCBX and the San Luis Obispo Tribune covered the story of aerospace engineering Professor Paulo Iscold's work as a race engineer and team tactician for an international air racing team that has broken nine world speed records.

Surfing Prosthetic

A QL+ Lab team of students began working on a prosthetic limb last winter that would improve the surfing experience for amputee surfers. The story was featured in the San Luis Obispo Tribune, KCBX and KSBY. ■

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They don't wait for they world to change. They change it.