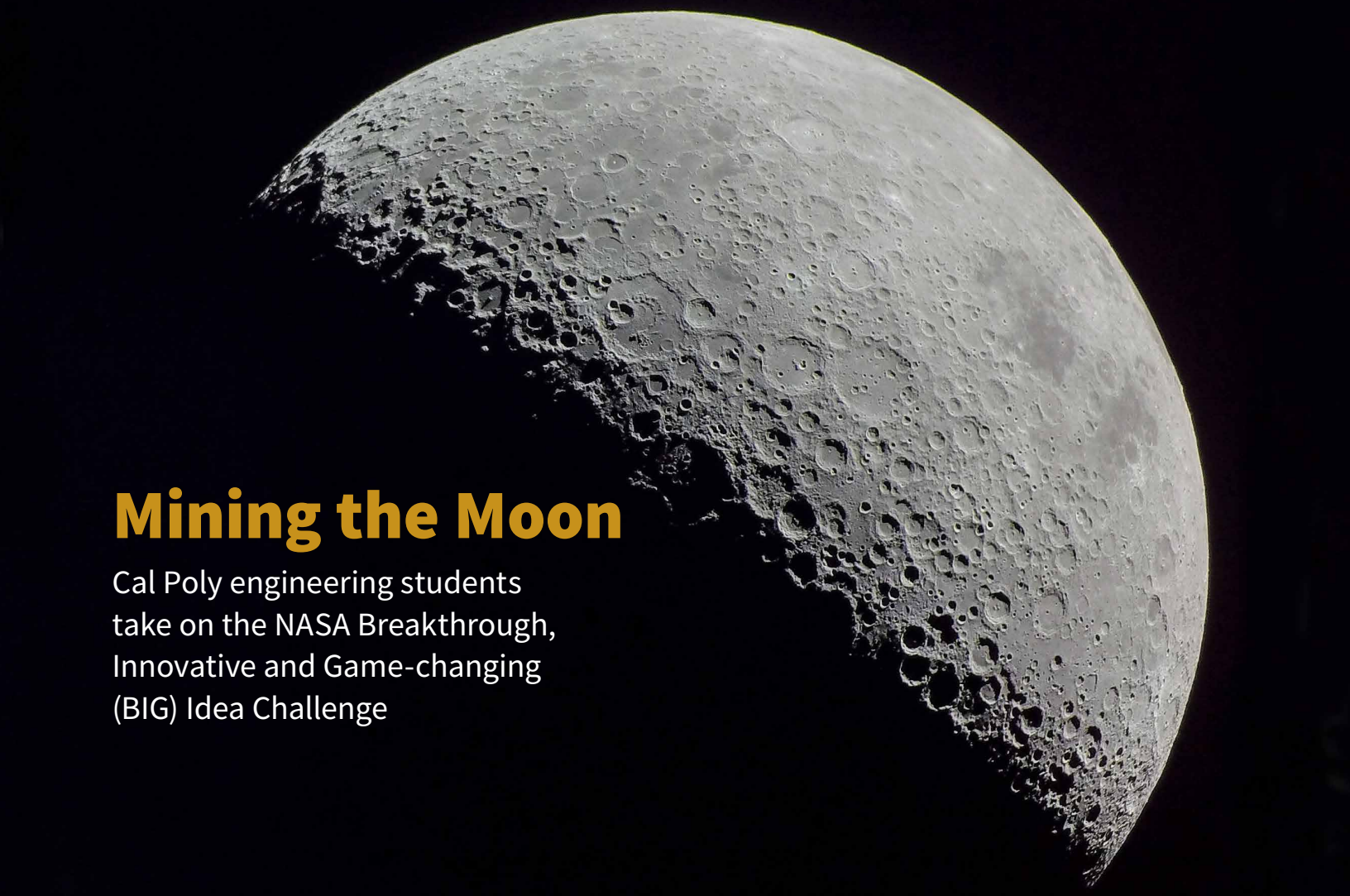
GENERALLY SPEAKING

General Engineering Program • Cal Poly College of Engineering • Winter 2023



Mining the Moon

Cal Poly engineering students take on the NASA Breakthrough, Innovative and Game-changing (BIG) Idea Challenge

CAL POLY
General Engineering
COLLEGE OF ENGINEERING

Letter from the Director

General engineering offers a haven for a unique and diverse group of students navigating through Cal Poly.

Many enter the program as freshmen without having determined a specific focus, while others jump in to pursue a specialized concentration.

No matter the case, all are welcome here.

The commonality of our students is their devotion to making a difference, shown in the stories of Claire Dossey who is combining her love of music and math for a career in acoustic engineering; Tommy Xu who will graduate with a degree in both chemistry and engineering; and Linnea Skinner who wants to ensure the impacts of engineering projects are considered on a global level.

Outer space has fascinated Callan Hill since he was a boy, and now he's drawing on that ardor as he competes in NASA's lunar challenge with an interdisciplinary team.

Members of Engineers without Borders continue their work to aid international communities, while members of oSTEM keep cultivating a safe, innovative environment for queer individuals on campus.

Each student has passions, gifts and challenges that as educators we must celebrate. I dream of an education system that honors the whole person; believes in their ability and desire to learn; and trusts them. When we are free to be ourselves, we can be more than we thought possible.

When I realized I could be an engineer and an educator, there was no stopping me. There still are not enough hours in the day to do all the work and learn all the things I want, but I'm committed to creating a better educational system for those students and teachers following in my footsteps.

Join me in building more support for underrepresented students and faculty, advocating for diverse paths through higher education and reimagining our view of education as a whole.

INSIDE THIS ISSUE

COVER — On flight day 20 of the Artemis I mission, Dec. 5, 2022, Orion captured the moon on the day of return powered flyby, the final major engine maneuver of the flight test. Photo: NASA

oSTEM Chapter Launched at Cal Poly

Group establishes place where all students are included

by Taylor Villanueva

Cal Poly oSTEM members show off the Rookie Chapter of the Year Award at the oSTEM national conference in Boston.

With a diversifying student population in science, technology, engineering and mathematics, a group of Cal Poly students wanted to make sure everyone felt included, especially in a space where LGBTQ+ identities can be overlooked.

Students Paige Ross (mechanical engineering) and Bonnie Brown (engineering management) were looking to create a place on campus with inclusivity for all students. In 2022, Brown attended the national Out in Science, Technology, Engineering and Mathematics (oSTEM) professional development summit in Atlanta, Georgia. The weekend retreat aimed to empower early career LGBTQ+ professions in STEM through introspective workshops, authentic mentorship and a supportive community. Through the summit, Brown learned about the national oSTEM organization and how to bring oSTEM to Cal Poly in the form of establishing a university chapter.

"There was a lack of space for queer individuals in STEM at Cal Poly," said Ross, co-president of Cal Poly oSTEM. "We wanted to create a chapter on campus, so we worked together for the past year and connected with industry members. We wanted queer people in STEM to get to know each other through social events and networking opportunities."

Cal Poly oSTEM is home to 130 members, with about 50 to 75 members in attendance for their general meetings.

The Cal Poly oSTEM board members have hosted icebreakers and member socials for people to get to know each other. One of their most recent projects was a pronoun campaign they implemented after seeing the lack of resources and discussions surrounding pronouns.

"The pronoun campaign is ongoing with a specific focus of educating, influencing and supporting Cal Poly's STEM students and faculty on the topic of pronouns," Brown explained.

As part of the outreach, oSTEM members are working to create buttons with pronouns for people to wear, along with creating instructional material for faculty members with education programming.

"We applied for the IDEAS grant, and we were awarded funds to buy pins with pronouns," Ross shared.

The Engineering IDEAS Grants Competition is a Cal Poly College of Engineering initiative to assist in funding small student and faculty projects.

"We have had breakout discussions among our club members and other students on how they feel about our outreach and what this campaign will do for them," Ross said.

"In our future pronoun campaign events, we plan on including faculty members to further the discussion of the topic and the impact of the campaign," Brown explained.

To advance their education surrounding inclusivity, Cal Poly oSTEM's officer team traveled to Boston to attend the national oSTEM conference in November 2022.

"This conference is a space for LGBTQ+ students and professionals in STEM fields to share their experiences and learn from one another through programming, ranging from safer spaces to talk about queer issues to discussing the latest in research to networking opportunities," Brown said.

At the conference, the group was awarded the Rookie Chapter of the Year Award given to new oSTEM chapters nationwide. The recognition highlighted the chapter's ability to cultivate a safe, innovative environment while creating a community that propelled the social and professional successes of their members.

Cal Poly oSTEM previously partnered with Texas Instruments to host a workshop for students describing what it's like to be queer in the workplace and the job opportunities available at the company.

In addition to their campus outreach, Cal Poly oSTEM members plan to participate in the upcoming Camp PolyHacks event, a student-run, multidisciplinary hackathon dedicated to social entrepreneurship and human-centered design.

"We are hoping to host our own hackathon in the spring," Brown said. "We are also planning to have a spring gala."

"Creating a space is important to have these conversations with each other to not feel alone and have conversations with professors or industry members who might not think about that," Ross explained.

Cal Poly oSTEM meets biweekly on Tuesdays from 7 to 8 p.m. in the Bonderson Projects Center, Building 197, Room 104. You can learn more about Cal Poly oSTEM and stay up to date on their latest projects via Instagram. ■

Taking on NASA's Lunar Challenge

Students compete with big idea for prospecting on the moon

by Emily Slater

From left, Cal Poly engineering students Christian Haranzo, Alex Lee and Callan Hill discuss their NASA metal on the moon project in the Bonderson Projects Center. Below, lecturer Karla Carichner discusses the project with Haranzo and the group during their interdisciplinary senior project class.

General engineering senior Callan Hill traces his captivation with the moon to an astronaut's visit to his third-grade class. The astronaut shared his adventures, signed autographs, and Hill was hooked.

"Space colonies will be a thing in my lifetime. We aren't an interplanetary species yet, but we will be and the implications of that are fascinating," said Hill, who brims with enthusiasm about the topic. "Space is my generation's new frontier."

He's now channeling his passion into an interdisciplinary senior project he hopes catches the attention— and funding — of NASA officials and paves the way for mineral prospecting on the moon.

Hill, along with teammates Christian Haranzo, Zach Diaz and Alex Lee, are developing the project in conjunction with NASA's Breakthrough, Innovative and Game-changing (BIG) Idea Challenge that seeks innovative ideas from university students about systems that can support the agency's exploration goals.

The 2023 Lunar Forge Challenge asks students to design and develop technologies that will enable the production of metal products on the moon for construction of pipes, power cables, roads, landing pads and other infrastructure.

After hours spent debating possibilities, Hill's team landed on designing a method to map the moon's subsurface with the goal of finding ore that can be used to build a lunar base.

They will submit their proposal to NASA with a chance to secure funds and support to test and develop their idea in the next phase of the challenge.

"I thought this was the coolest project ever," said lecturer Karla Carichner, who is advising Hill's team. "And I believe they have a good chance of moving to the next phase."

THE PERFECT INTERDISCIPLINARY PROJECT

When Carichner spotted NASA's BIG Idea Challenge, she knew she had to enlist a team of students passionate about space.

Carichner teaches a yearlong interdisciplinary senior project class with engineering professors Vladimir Prodanov and Jim Widmann through which students receive guidance as they create a product design for a sponsor.

The faculty members gather project ideas, then split the class of 50-80 students into teams of three or four and assign each a project.

"The parameters of the NASA challenge were so broad that I knew we needed seniors willing to put in the extra work," Carichner explained.

She also knew she needed seniors with various skillsets, so she chose Hill from general engineering, Lee from computer engineering, Haranzo from mechanical engineering and Diaz from materials engineering. All four had ranked the project at the top of their list.

The team bonded quickly as they tried to narrow the list of endless project possibilities.

"It was a bit of a rude awakening about what we had got ourselves into," said Hill, laughing.

Their original plan to pursue 3D printing went up in smoke as the team learned the moon's hot temperatures and thin atmosphere are not conducive to printing material.

Other ideas fizzled, until they discussed the possibilities of mineral prospecting with Physics Professor John Jabinsek, who encouraged their dive into electromagnetics.

"Locating minerals involves physics, electrical engineering, data science … it was the perfect interdisciplinary project," Hill said.

GETTING BELOW THE MOON'S SURFACE

While NASA has satellite images of the moon's surface, Hill's group aims to get below the surface to detect iron, titanium and aluminum that could be used in lunar construction.

Their conceptual design includes building sensors to mount on a rover that would navigate the moon's surface and send electromagnetic waves into the ground in search of magnetism.

Through the process, information could be obtained about the mineral composition and physical properties of rock formations for a sublunar map.

"The goal of this project is to map where the elements are, not provide a means to get them," Carichner explained. "Satellites are too far away so you have to have something on the ground that will provide a more accurate picture for the purpose of prospecting."

Hill's team aims to build a portable, automated system to offset the astronomical cost of labor on the moon.

"We want to automate the process so you could send out a rover on the moon that would map out minerals while you're sleeping," Hill said.

Developers then could use the high-resolution, 3D map to pinpoint prime locations for commercial mining.

"Ultimately, NASA could use our maps to build a cost-effective base using materials found on the moon," Hill said.

The team polished their proposal and created a budget for NASA's review in January. Selected teams will advance to the next phase of the competition and submit full technical papers and proof-of-concept testing results to a panel of NASA and industry judges.

"I would love to be able to present our idea to NASA," Hill said. "We're probably some of the only people who know how to prospect on the moon."

Carichner said the team impressed her with their initiative as they reached out to Jabinsek and other Cal Poly professors for help developing components of their plan.

"They used the resources they have right here who are experts in their fields," Carichner said.

"It's hard to know the ideas other schools will come up with for the challenge, but I think our team is on a good track," she said.

They will start prototype development and testing of their product if they progress to the next stage of NASA's challenge – a prospect Hill and Haranzo are optimistic about.

The two best friends who landed on the same senior project team by chance also dream about voyaging to the moon one day.

When independently asked whether they would launch into space, they didn't pause for a second.

"One-hundred percent," they both said.

General engineering student Callan Hill is in the middle of the interdisciplinary team that features computer engineer Alex Lee, left, and mechanical engineer Christian Haranzo.

"Artemis will be one of the greatest engineering feats in our lifetime," said Haranzo of the mission to establish a long-term human-robotic presence on and around the moon. "Kids growing up will see people colonize the moon."

Haranzo and Hill know building a lunar settlement is a vast feat but are energized by the infinite potential they see.

"We get the opportunity to figure it all out," Haranzo said. "And that's part of the excitement." ■

Cal Poly Engineers Without Borders team Implements Rain Catchment Tanks in Fiji

by Taylor Villanueva

The Cal Poly Engineers without Borders team took a trip to Fiji in the summer as part of their project to implement sustainable water systems.

The Engineers without Borders (EWB-USA) is a nonprofit organization with the goal of implementing sustainable engineering solutions to their partnered communities and empowering groups internationally to meet their basic needs.

The EWB-Cal Poly Fiji team is an interdisciplinary group of about 20 students representing nearly every college at Cal Poly. Students get hands-on experience with the different aspects of humanitarian engineering and human-centered design.

The team that traveled to Fiji this summer included project manager Geneva Newell (civil engineering), Cami Lowrey (bioresource and agricultural engineering), Andrew Klein (electrical engineering) and Jillian Buteau (civil engineering), along with advisers Dr. Peter Livingston and Dr. Dawn Neill.

"At Engineers without Borders at Cal Poly, we emphasize the importance of cultural understanding in our designs and implementation," Newell explained. "We implement this through different cultural workshops, including those about the history of colonization in Fiji, the political economy and differences between Indo-Fijians and iTaukei (native Fijians). In doing so, we can develop a better connection with the people we partner with thousands of miles away and better implement community-driven solutions that will be sustainable for the people that maintain them."

The Cal Poly Engineers Without Borders Fiji team worked on improving the quality and quantity of water in three rural villages in Fiji. Above: Work included designing a Vesi solar borehole pump system.

Members of the student-run nonprofit organization first formed a partnership with the villages of Nakawaga, Ligualevu and Vesi on Mali Island, Fiji, in 2017. The initial project was developed to combat coastal erosion, but after an assessment of the villages, the project focus pivoted to the issue of water quantity and quality.

"All of the water quality testing and tank monitoring during the trip was fully conducted by Cal Poly students," Newell said. "We conducted visual inspections of all the tanks for quality assurance and to better understand what was leading some tanks to be more contaminated than others."

The Cal Poly team performed tests on the water quality that would check for a range of problematic issues, such as lead and E. coli.

Before the Engineers without Borders team arrived in Fiji, locals relied on traveling to the main island of Vanua Levu to fill containers with water on a weekly basis during the three-month dry season, which was expensive and unsustainable. The Fiji team aimed to implement more sustainable changes.

During the five-year partnership, the Cal Poly students worked directly with 280 residents of Mali Island to install 33 rain catchment tanks that helped increase the island's water capacity. Students also implemented household water filters, first flush diversion systems and a solar-powered borehole pump system. As their partnership comes to a close, an additional 17 rain catchment tanks and first flush diversion systems are scheduled for remote implementation this spring.

"The Vesi solar borehole pump system was designed from basic survey data one of our previous travel teams gathered," Klein explained.

"The solar panels and pipes for the system were sourced in country, while we brought the RPS kit with us from the United States," Buteau said.

While working in Fiji, the students were hosted by their community contact Seru Moce, who first applied for assistance to EWB-USA in 2014. Since the formation of the partnership between Cal Poly and Mali Island in 2017, Moce has served on development committees at both the district and provincial level and acted as the liaison between the team at Cal Poly and the community of Mali.

"Seru Moce is the core of our project and the reason that Cal Poly has the opportunity to work with and learn from the people of Mali," Newell said. "His knowledge of the land and his community is unparalleled."

Cal Poly's Learn by Doing coursework helped the students get ready for their work abroad.

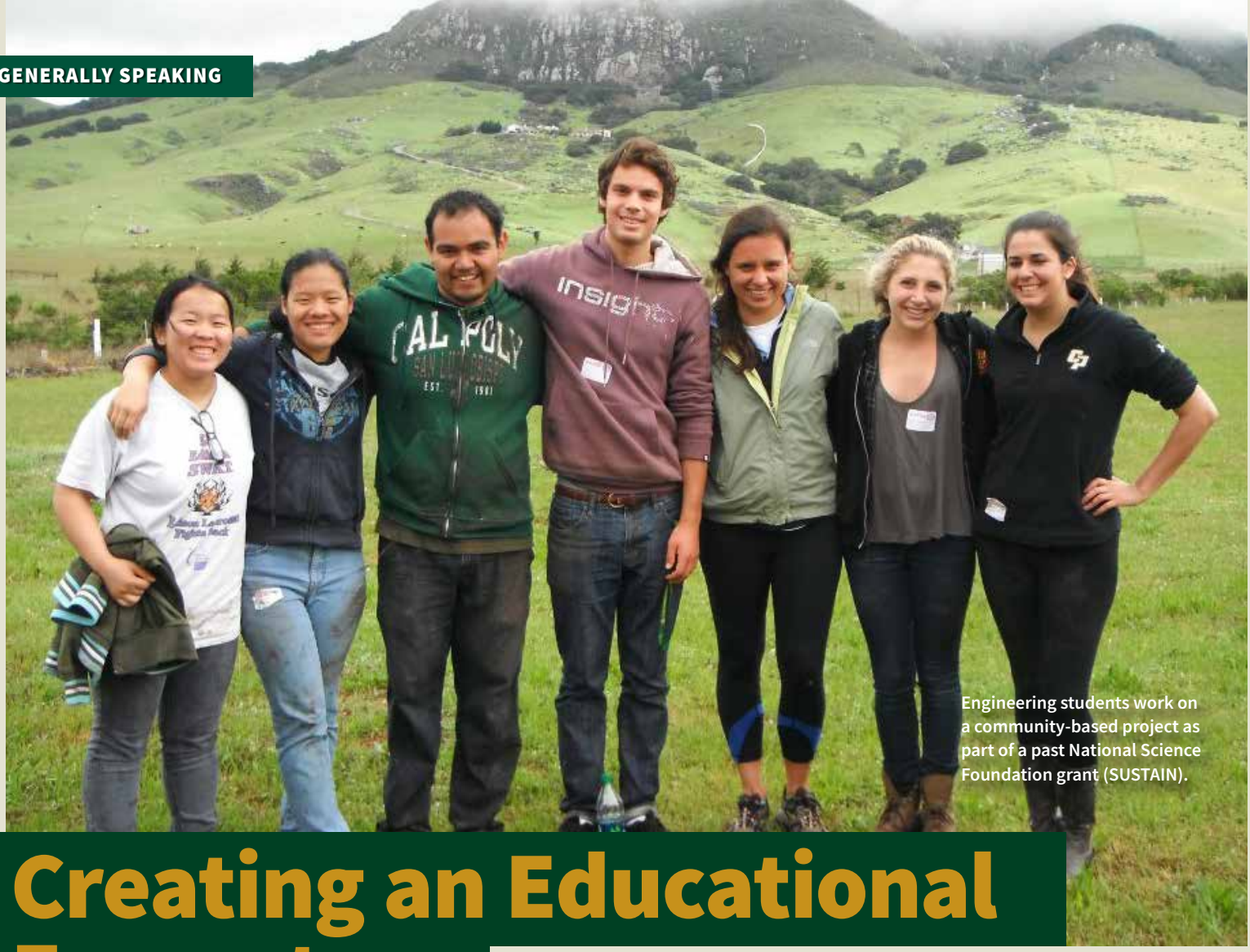
"My labs helped prepare me for our typical workdays in the village, such as collecting water samples, conducting water quality analysis and constructing first flush diverter systems," Lowrey said. "My classes also helped develop the organizational skills necessary to log data and plan the development of two designs – the first flush diverter system and a plastic biosand filter."

As for deciding to join Engineers without Borders, it was a no-brainer for Newell.

"I chose to pursue civil engineering at Cal Poly after learning about their Engineers without Borders' chapter due to their focus on cultural understanding and community-driven design," she shared. "I love how Cal Poly's philosophy of Learn by Doing is truly reflected in Engineers without Borders' work."

Their next in-person trip is scheduled for the summer, when the group will review the implemented systems and investigate opening a new project partnership with a different community in Fiji.

For more information and updates on their projects, visit the Cal Poly Engineers without Borders website. You can also donate directly to EWB-USA-Cal Poly HERE. ■



Engineering students work on a community-based project as part of a past National Science Foundation grant (SUSTAIN).

Creating an Educational Ecosystem

General engineering director pursuing research, projects to put students, faculty at the center

by Emily Slater

General Engineering Director Liz Thompson is committed to altering our view of education. Over her 30-year career at Cal Poly, Thompson has created a dynamic classroom where she engages an increasingly diverse set of students who come to Cal Poly with challenges as big as their dreams.

Outside the classroom, she has guided students as the director of women's engineering programs, CENG associate dean, co-director of liberal arts and engineering studies, and currently as general engineering director.

Thompson now is taking the lessons she's learned while championing students both inside and outside the classroom to make a difference on a higher level.

"My interest is always in institutional change, not fixing the students but the university as a whole," Thompson said. "Instead of asking whether students are ready for the university, we need to ask if the university is ready for students."

To this end, Thompson has joined colleagues from Cal Poly and beyond on research projects and programs that strengthen support for transfer students and faculty from underrepresented groups while challenging the traditional model of education.

"We have to advocate for a more diverse set of paths to a degree," Thompson said.

ENGAGE

A collaboration between Cal Poly, Allan Hancock College and Cuesta College is providing one of those pathways for low-income, academically talented students transferring from neighboring community colleges into Cal Poly.

A National Science Foundation grant is funding the Engineering Neighbors: Gaining Access, Growing Engineers program through which 100 students receive scholarships and support as they move through community college and into Cal Poly, where they can obtain a degree for entry into the STEM workforce or graduate program.

The collaboration began in 2018, with funding to run through at least 2023.

Professor Jane Lehr from the College of Liberal Arts, who is the driving force of the grant, and Thompson are coordinating research activities at Cal Poly.

"I think it's important that we do this work where we are located and with the students who are here," said Thompson, who is an integral part of the research and mentoring effort at Cal Poly.

Part of the work involves outreach and aid for Hancock and Cuesta students so they can hit the ground running at Cal Poly.

"We want community college students to form an early connection to Cal Poly so they can find their identity within engineering as soon

Above and below: Students in Liz Thompson's Engineering 110 class demonstrate lab activities developed for middle school students. The quarter-long project taught engineering design and allowed students to understand the various majors in the college.

as they arrive," said Thompson, adding transfers also are linked to extracurricular activities and clubs.

Throughout the program, students receive mentoring and financial assistance — an essential combination.

"Money for students who are typically under-resourced is super important but so is connecting students to the university and helping them create meaningful relationships with faculty," Thompson said.

Her goal is to publish what the research team has learned about mentoring, social justice and engineering, while seeking further grant funding to continue the initiative and even expand to other CSU campuses.

ECO-STEM

During the 2019-20 academic year, Thompson taught at Cal State LA and collaborated on research around equity and social justice. She also teamed up with her Cal State and Cal Poly colleagues in 2020 to secure a four-year NSF grant for a project that aims to change the culture of teaching and learning at the university level.

The team of researchers believes the key is shifting the mental model of stakeholders to view education as an ecosystem, which values all individuals and their unique abilities.

"We are trying to change the way people think about education," Thompson said.

In the current view, universities are like factories — moving students in an assembly-line style from class to class to deliver a "product" to industry. Efficiency and compliance are valued above the well-being of students, staff and faculty.

The ecosystem view, however, aspires toward an organic and healthy environment that nurtures students, staff and faculty to become individuals fulfilled professionally and personally, according to Thompson. The goal is to create a university that is "student-ready."

"Relationships are important in this model," she said. "We have to recognize that we are whole people who don't just execute a job and go home."

To drive the shift, the project has created various Eco-STEM communities at Cal State LA that bring together teachers, leaders and facilitators to reflect on issues ranging from social justice to systemic racism as they seek ways to propel a more diverse group into the STEM workforce.

Groups meet monthly as they focus on changing classroom culture along with the mental model of education.

Thompson runs a community of practice for department chairs, where she guides discussion and encourages reflective dialogue. She also is developing a survey that others can use to explore respondents' views of the education system. The survey will be published sometime this summer.

"I know changing the mental model is a heavy lift, but I don't want to stop because the well-being of our students matters," she said.

KIND

Thompson believes creating more diverse campuses involves attracting and retaining women and under-represented groups in STEM faculties.

To that end, Cal Poly is teaming up with Fresno State, San Jose State and Cal State LA on the Kindling Inter-university Networks for Diverse Engineering project funded by the National Science Foundation.

The goal is to spark systemic change by increasing the number of women teaching engineering across the 19 CSU campuses, including those from under-represented groups and those who are foreign-born or foreign-trained.

Beyond hiring more engineering professors from those groups, efforts must be made to support them.

"We've found that mentoring is helpful and especially if faculty can connect others with the same background and research areas," Thompson said.

Part of the project involves creating a dashboard that will display demographic data about faculty hiring and promotion in engineering colleges across the CSU system to identify barriers in recruitment and retention.

"It's an important way to have data transparency," said Thompson, who is hopeful more women will ultimately move into leadership positions on CSU campuses.

Having a more diverse group of thriving professors, including those from under-represented groups, is critical to the successful teaching and learning of all students in engineering classrooms, according to the project proposal.

"We are trying to build research networks across the CSUs with the idea that with more connections, a professor is more able to get things done, feel like they belong and are more likely to stay," Thompson said.

Throughout her myriad research projects, Thompson remains dedicated to building an educational ecosystem that reflects and celebrates the diversity of its inhabitants.

"We have to change the university to be more accepting of a variety of paths and the people on them," she said. ■

GENE Seniors Defined by Passion, Ingenuity

Students look to enter a variety of fields upon graduation

by Emily Slater

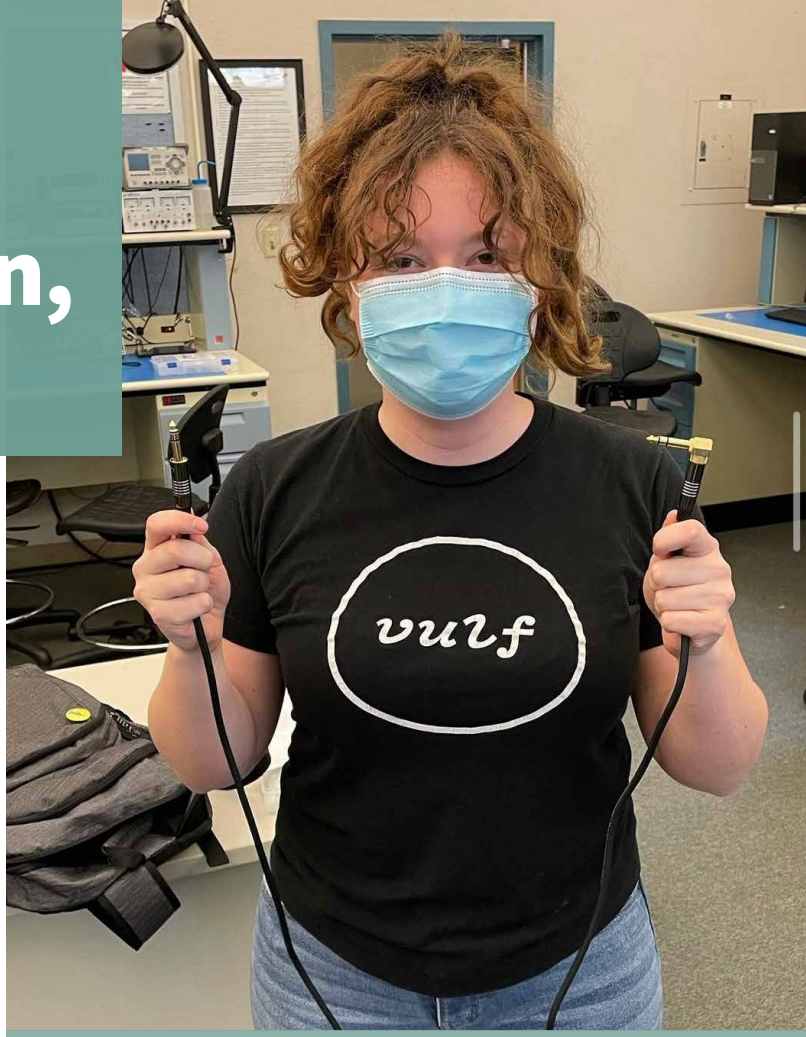
General engineering offers a home for a unique group of students within the college as they work to find or refine their passion.

"It's an amazing place for students who don't know what they want to do," said Liz Thompson, who took over as program director in summer 2021. "It's also a place for those who have a specific interest that doesn't fall under another department."

Almost 140 students were enrolled in general engineering as of fall quarter, including 21 seniors on track to graduate with concentrations ranging from acoustic engineering to ethics and sustainability.

"With this major we are trying to make engineering more equitable and give students more access," said Thompson, adding students can craft their own course schedules to align with their emphasis.

At the end of their educational journeys, general engineering seniors are poised to change the world in myriad ways. Here are some of their stories:



Claire Dossey

CLAIRE DOSSEY

ACOUSTIC ENGINEERING

When Claire Dossey began applying to colleges, she hadn't settled on a career path.

Her math skills made engineering an attractive prospect, but her love of music compelled her to consider a pursuit in that industry.

She didn't have the solution to her dilemma but knew just where to find one — Google.

Dossey searched "How can I be an engineer and do music" and received her answer: acoustic engineering.

"I committed from that point," she said.

Four years later, Dossey will graduate from general engineering and into a job that applies the science of acoustics and noise modeling to new construction, airports and highways.

In fourth grade, Dossey was given the choice of taking an art or music class at her elementary school in Covina. Since her older cousin had an alto saxophone she could use, she opted for music.

"I really liked it," said Dossey, who also plays violin and piano.

She joined the marching band, orchestra and wind ensemble before heading to Cal Poly, where she performed with the university's wind ensemble prior to COVID and its disruptions.

Dossey had an eye on general engineering from the start, researching the course catalog along with professors and their research areas, as she crafted a curriculum to complement a career in environmental noise control.

She added extra math and physics classes while seeking guidance from faculty.

"I think my education will help me stand out because employers can see that I'm all in for acoustics," Dossey explained.

An internship with an environmental noise consulting firm gave Dossey a chance to apply the science of acoustics and noise modeling to specific projects, confirming she was on the right track.

"It's perfect, exactly what I want to do," said Dossey, who will work full-time for the firm upon her graduation in the spring.

LINNEA SKINNER

ETHICS AND SUSTAINABILITY

Linnea Skinner's engineering journey has taken twists and turns but ultimately led her to pursue what she cares deeply about: ethics and sustainability.

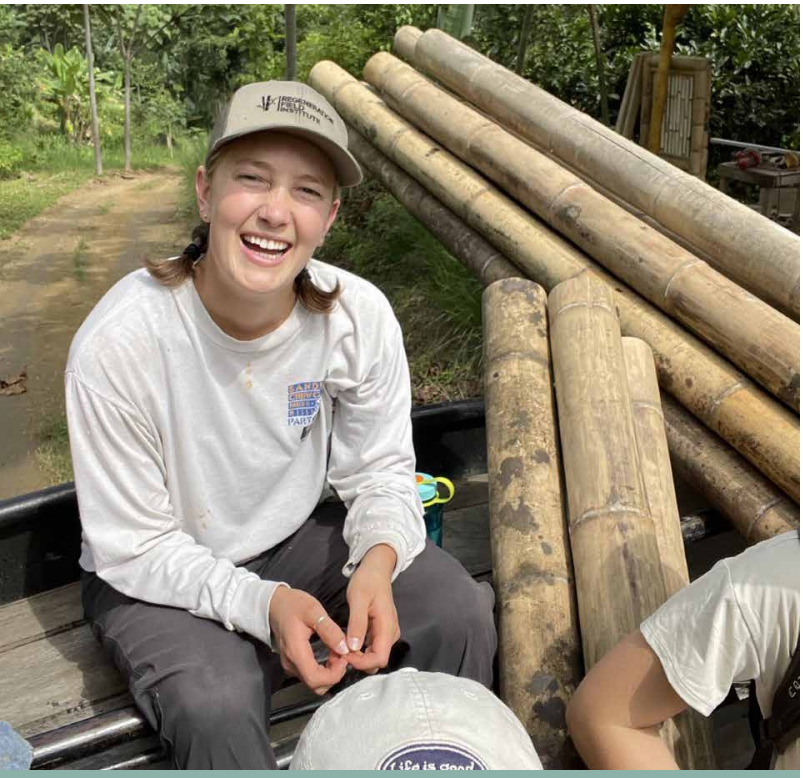
Skinner, who grew up on the Central Coast, started as a biomedical engineering major, then shifted to environmental engineering and even considered going outside engineering into biology or environmental management.

"I couldn't find an emphasis on social context and environmental impacts within the technical disciplines because they are so focused on one aspect," said Skinner, who described herself as a broad systems thinker.

She finally found her place in general engineering where she could craft her own concentration.

"I realized I don't want to go into a traditional technical engineering field, but I stuck with engineering because it is a field that has such a huge impact on our lives," Skinner said. "It's really useful to understand the process of creating things in this world."

Now, she hopes to use the broad base of knowledge she has built — as a consultant, perhaps — to evaluate the impacts of engineering projects on the environment or groups of people.



Linnea Skinner

"We have to consider the humanitarian aspects when we are designing projects or systems," Skinner said. "I wish all engineers were educated on the implications of what they are doing."

Traveling abroad and working on international projects also has given Skinner perspective.

Her senior project has involved partnering with a Ventura nonprofit that maintains water wells in the Democratic Republic of the Congo. Skinner and the interdisciplinary team from Cal Poly were tasked with building a well sensor to detect when hand pumps aren't functioning.

"It's been amazing working with a nonprofit working to provide clean water overseas," Skinner said.

At the same time, she recognizes any international project must be informed by the community it looks to serve.

"You can't put technology in another country to solve a problem without looking at the roots of the problem," she explained. "There may be a more effective solution to help the people there."

After graduating in the spring, Skinner will take the ingenuity and insight she gained at Cal Poly to Columbia, where she will volunteer with a nonprofit dedicated to women's empowerment and sustainable community-led projects.

"I'm very grateful to have met someone who cares deeply about the community she works with and I'm looking forward to contributing," Skinner said.

TOMMY XU

CHEMISTRY, GENERAL ENGINEERING

When Tommy Xu landed a research opportunity at the University of California, Riverside during his fourth year at Cal Poly, he was excited to put his passion into practice.

Xu was close to finishing his undergraduate classes in chemistry with aspirations to pursue graduate studies on his way to becoming a full-time researcher.

But Xu's plans dramatically changed after his research experience proved utterly uninspiring.

"It felt like I was pouring water for six hours every day only to do it again the next day," said Xu, who grew up in Alameda. "The topics were interesting but the practical work in the lab was boring, laborious and tedious."

Xu was a class away from a chemistry degree, so he opted to finish that program but also add another major – general engineering — as he pivoted to chemical engineering.

Since the College of Engineering doesn't offer chemical engineering as a major, Xu began crafting his individualized course of study, signing up for classes in statics, fluids and heat transfer — areas that excite him.

"The program has allowed me to take classes that I want to take and find interests that I might not otherwise have found," he said.

Two such interests are coding and mechatronics, which Xu discovered through his interdisciplinary senior project.

Xu's project team has been tasked with adding a weather station to the FarmBot system — an automated farming machine designed by mechanical engineering alumnus Rory Aronson for at-home precision farming. The machine can plant seeds, water, perform weed whacking and measure the moisture content of the soil.

Xu's team is developing the hardware and software needed to capture real-time weather data where the FarmBot is located, including temperature, ambient light, rainfall humidity and air quality indicators.

The project has captivated Xu, who now can visualize a job in coding or chemical engineering or some combination of the two.

Changing course, especially during senior year, has proven difficult for Xu who said, "There's not a flow chart for me," but he's hopeful that the knowledge he's gained from two majors will be a plus for prospective employers.

As for Xu's advice to fellow students who may be contemplating an alternate academic route: "If you feel like you need to switch your major, do it, but try not to wait until your fourth year," he said, laughing. ■

Tommy Xu

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