COLORADO ENGINEER

SPRING 2022: THE SYNERGY ISSUE

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Cover Photo courtesy of *Alexis LeMaster*
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NCAR Fire Photo by *Elliot Whitehead*

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MEET THE STAFF

Our CEM Mission

As staff of the Colorado Engineer, our mission is to inform and educate our readers and reflect pride in CU's College of Engineering & Applied Science world-wide.

Our student-led magazine seeks to provide a voice for CU's engineering students while also carrying on the 100-year CEM tradition: by students for students.

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The Colorado Engineer has been reporting on the "latest and greatest" from the engineering, science and technology community since 1904. We were there for the Model T, the jet engine, the IBM PC, the iPod — and we will continue to cover the future of human innovation. Today, we operate with a staff of 13 students and four advisers. We publish the magazine biannually, with a readership of over 8,000 individuals, reaching students at the university, researchers, professors and alumni. If you would like to join our staff or have questions and comments, email us at justin.wang@colorado.edu. Alternatively, check out our website at http://https://www.colorado.edu/studentgroups/colorado-engineer/. We always enjoy hearing our readers' feedback!

THE SYNERGY ISSUE

A variety of elements uphold the College of Engineering. We hope to present their coalescence, effects and contributions to the community.

Dear readers,

When I hear 'synergy' I think of an overenthusiastic corporate executive in a meeting describing a merger. But the definition of synergy stands for more than its business speak connotation: "the interaction of elements that when combined produce a total effect that is greater than the sum of the individual elements, contributions, etc…"

Engineering does not exist in a vacuum. Its purpose is to apply math and sciences to design and innovate technologies that contribute to a greater cause. Achieving this requires synergy.

It's often easy for students to fall into the habit of completing their schoolwork without thinking of the many ways their work can interact with other fields and disciplines. That, of course, is not the goal of the professors at the College of Engineering & Applied Science, but it's a mindset that many students, including myself, have fallen into at times.

Ron LeMaster was not one to fall into this frame of thinking. Last November, the Colorado Engineer Magazine lost LeMaster, previous board member, in a ski accident in Eldora. He graduated from CU Boulder in 1979 with a degree in mechanical engineering. While working as a software engineer, LeMaster was also a renowned ski instructor and author of influential books on the technique and biomechanics of downhill skiing. He combined his background in engineering and his love for skiing to make an impact on the world.

The Synergy issue was made to highlight the life of Ron LeMaster and to inspire our readers to use their skills synergistically to make a cross-disciplinary difference in their own lives. From electrical engineering student/pop star Dafna Margalit to the climate solutions initiative, Mission Zero, this issue highlights instances in our college where the collaboration of groups or disciplines led to more innovation and an ultimately greater impact.

My time at CU Boulder has been one of synergy between my multiple interests, both academic and recreational, and it's been a privilege to share so many of my experiences with the readers of this magazine for the past 6 years. I am so lucky to have been supported by many faculty, staff and classmates at CU Boulder, and I am extremely grateful to the CEM advisers, the board members, my fellow editors and the writers at the Colorado Engineer Magazine for working with me throughout my time here.

Journalism takes synergy, and this magazine would not be here without the work and support of so many amazing and talented people. I am proud of the work my team has put together, and I am both excited and humbled to introduce you to the Synergy issue.

Sincerely,

Justin Wang
Editor-in-Chief

Dear readers,

Through the past four years, I resided on the other side of campus studying journalism, staying as far away as I can from engineering curricula because it intimidated me.

I've worked for the Colorado Engineer Magazine since my freshman year. This publication introduced me to a wonderful array of engineers that, through conversations, helped me understand their incredible, complex feats in subjects beyond just math and science. I became less intimidated and more inspired.

Some of my most significant moments of journalistic growth came from conversations with my sources for the Colorado Engineer. From taking a tour through the engineering-business school connection, to students building a 700 foot bridge in Eswatini, to starting a new business, to operating under a global pandemic, to the political challenges of a dam expansion, to getting to know Interim Dean Keith Molenaar, I learned more about and was astounded by the many stories that compose the College of Engineering and Applied Science.

On Justin's note of, "making a cross-disciplinary difference in their own lives," one of my sources, Tanya Ennis, highlighted this in our interview. "As much as we say, 'we're engineers,' we are people, not objects…We get stereotyped and put in a box as well. And so I'm saying, 'knock down the walls of the box and let's bring it out,'" she said.

I did that interview my sophomore year and to this day I remember that specific line. Before starting at the magazine, I had my own sense of what engineering was. Exploring across colleges and intellectual boundaries to allow us "knock down the walls" of perceptions of one another and create that synergy we seek.

Everyone has a story to share, through the craziness of college, take the time to talk to your classmates, professors, baristas, whoever because you never know how much you may learn about yourself.

Sincerely,

Nikki Edwards
Copy Editor

REMEMBERING RON LEMASTER

A giant in the ski industry and the Boulder community

HANNAH SANDERS | PHOTOS COURTESY OF ALEXIS LEMASTER

Ron LeMaster was widely known as a world-class ski instructor, but the University of Colorado community and the larger Boulder community are lucky enough to know LeMaster as one of our own.

LeMaster was a ski coach for the CU ski team, the U.S. ski team, as well as for Vail and Aspen ski resorts. Described as an "artist of motion dissection" by CU Ski Team coach Richard Rokos, Ron LeMaster published several books, including The Skier's Edge and Ultimate Skiing.

LeMaster earned his bachelors in Mechanical Engineering at Boulder while with the CU ski team. After earning his degree, Ron LeMaster spent much of his career working as a programmer for IBM in Boulder. On the weekends, he worked with skiers everywhere on improving their technique.

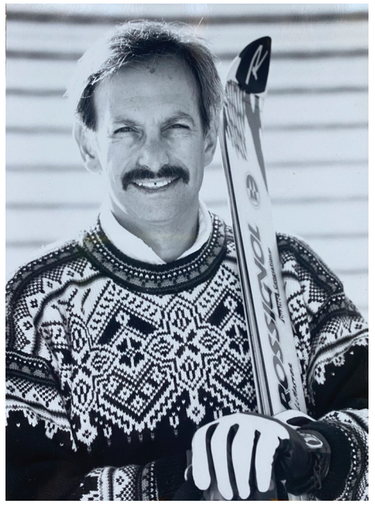
Daughter Alexis Lemaster describes how Ron LeMaster balanced his many interests throughout his life: "He did everything at the same time. [On the weekends] he would go teach skiing and at night he would just stay up writing articles about skiing. I remember I would fall asleep to him typing, because

> **"That was the basis of his work: What the physics is of what the skiers [are] doing."**

he would just be up until 2 a.m. working on something, and then he'd wake up and ride his bike to work."

In addition to writing books and articles, Lemaster became an advisor for our own Colorado Engineering Magazine, where he was able to use his editorial knowledge to support student work.

Ron LeMaster's teaching gifts touched the Boulder community in so many ways.



For a time, Ron LeMaster worked for Nobel Laureate Carl Weimann to develop a physics class that made content more comprehensible and engaging for students.

Knowledge of physics in particular is what made Ron LeMaster's work so unique as a ski instructor, as he could break down the science behind downhill skiing to improve speed and efficiency. LeMaster possessed such a depth of knowledge that he was an instructor to other coaches. He often attended conferences and seminars to share his knowledge across the country so that more could benefit from mastering the fundamental movements of downhill skiing. Also unique to LeMaster's work was the use of photography and videos taken by LeMaster himself.

Friend Carl Newman explains, "He would go to races and take pictures…in those days they were slides. He would take the slides and make a collage of them and draw angles and vectors, showing what [the skiers] weight distribution was, and that was the basis of his work: What the physics is of what the skiers [are] doing, what the right way to do it [is]."

Ron LeMaster's work in the ski industry showcases the qualities we all seek out in good teachers and mentors: expertise on a subject built through technical knowledge and personal experience, a talent for communication and a deep passion for those he worked with.

"So many different types of people go skiing,from all over the world, all different demographics," Alexis LeMaster said. "You're interacting with so many different types of people, so you start to learn how to interact with such a wide breadth of people and personality types, and you get better at learning where you need to assert yourself and where you don't. [Ron was] really good at finding a way for that specific situation or person to understand what he was trying to portray."

Ron LeMaster took some time early in life to focus entirely on ski instruction, later transitioning to work at IBM. Even off the mountain, he still did what he loved.

"He loved [computer engineering] and he always told me that he loved his job.

He was a big advocate of it [no] matter how much money it's going to pay you; if you don't like it it's not worth your time," Alexis Lemaster said. "He definitely lived the same kind of way he told people they should live."

> **"He was always a gentle and inquisitive person, he was always interested in what you were interested in."**

For many students in college, entering the workforce can feel like making a choice between a passion and a job. Ron LeMaster is an example of a better way: choosing to find a job you enjoy and are good at, while carving out time for the things you are passionate about.

"I think there is really something to be said about getting the opportunity to really figure out what you love and what can serve you within what you love [Ron] saw that engineering is… more reliable…but over time [both computer engineering and ski coaching] ended up both serving him in life," said Alexis LeMaster.

Although Ron Lemaster was known for his work, he was loved for investment in the lives of those around him.

"In undergrad, [Ron] was just a guy that loved to ski and when you skied with him you would come back at the end of the day better than when you went out," said friend John Clark. "Even in the old days I would ski with him, and I was just amazed that

> **"He definitely lived the same kind of way he told people they should live."**

he enjoyed skiing with me, even though he could have been out shredding the mountain with his high performance guys. He enjoyed the camaraderie of it, the friendship of it."

Often he would bike up Boulder Canyon, stopping to talk with friends that lived along his route. Friend Burr Touhey described how he would bike up and tell her about birds he had seen, as he knew Burr was passionate about birdwatching.

"That is what everybody loved about my dad…he had the time to take with you, and he was really curious and interested in just about anything, and so he'd talk to you about anything. He genuinely cared about people, you know, so he would remember special things," said Lemaster.

A beloved member of the Boulder community, Ron LeMaster touched the lives of so many, and inspires us to carve the perfect line between serving our communities and building a life we love living.

THINKING IN DIMENSIONS WITH JOHN CLARK

Supporting the Colorado Engineer Magazine's Role of imagining new opportunities for the profession.

HANNAH SANDERS | GRAPHICS VIA COLORADO ENGINEER MAGAZINE ARCHIVES

As student journalists in the field of engineering, we at the Colorado Engineer Magazine have the unique opportunity to share stories of CU engineers who shape our community through their expertise and contributions to the field.

Our work is supported by a board of directors that believes in the power of journalism in promoting innovation. Members of the board bring their unique insight from their personal experiences to help us shape each issue.

Former board member John Clark studied at CU, graduating with a bachelors of Civil Engineering and Business Management in 1964. After graduating, Clark spent his career in water management, where he developed a passion for incorporating sustainability into the engineering process.

Clark explains, "When you talk about sustainability, [the] scope is much broader than designing beams and columns. You start to get a mindset about the whole thing, whether it can sustain itself through the engineering process. You are building another dimension into everything. I always used to tell my younger engineers that the project has four dimensions, length, width, height, and time." Adding the fourth dimension of time accounts for the performance of a design over a given time period.

Clark's extensive work in the industry has made him passionate about the need for an engineering curriculum that prepares students to address climate change.

"Right now civil is the closest that we get to [a sustainability specialty] because we have a water/wastewater element where we treat waste. That's the Civils. It's important work," he said. "I get excited about [sustainability], I really do. It's a real challenge…[solutions] have got to be global, got to be a mindset. That can all start at the university level or below. [It is] essential that the profession goes back to the education process, maybe even [creating] another engineering speciality: sustainability engineers—why not?"

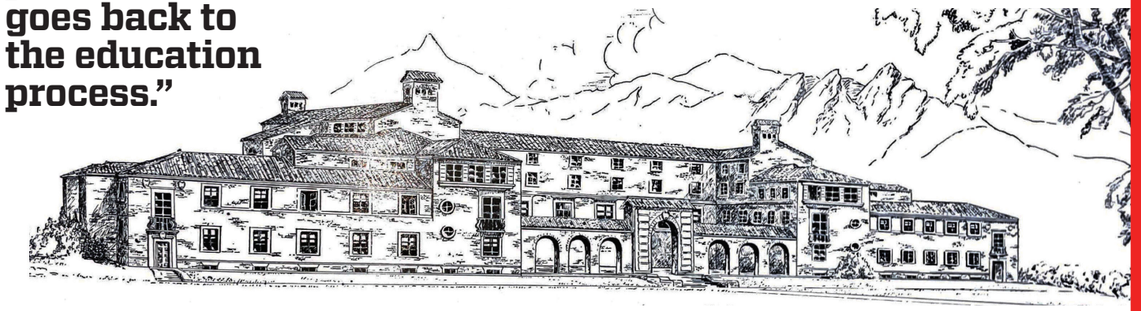
Our publication is able to address relevant topics such as sustainability in large part due to John's father, Mel Clark. A former editor-in-chief, Mel Clark established a fund to keep the magazine publishing after the magazine was disrupted by the Vietnam War.

"Engineers can act as citizen professionsals, builders and maintainers of the quality of life."

In his time at CU, Mel Clark earned his degree in Chemical Engineering 1937, then landed a job in the midst of the Great Depression with a publishing firm.

"The job that he obtained with McGraw Hill Publishing in New York was directly because he had the knowledge and the experience of the publishing business. He never forgot that. He was so grateful for that opportunity to work on [the Colorado Engineer Magazine]," said John Clark of his father.

"It is essential that the profession goes back to the education process."

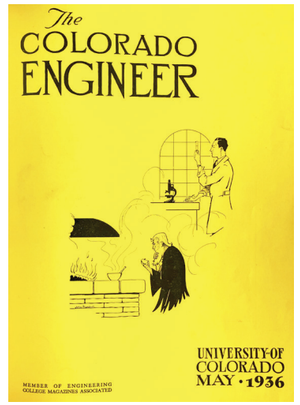


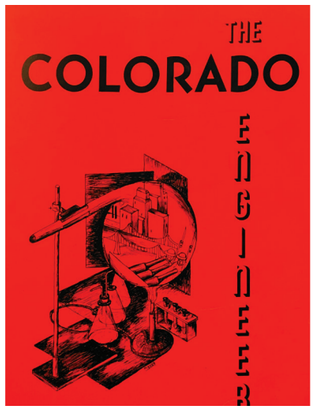
Previous issues of the magazines focused on employment, particularly during the Great Depression, even advertising when alum landed a position.

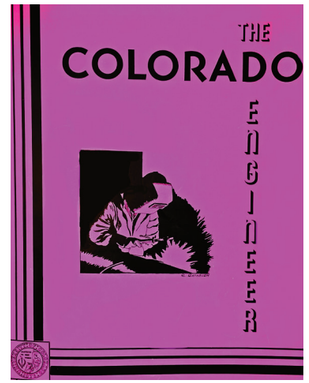
ALUMNEWS

1937

MELVIN E. CLARK, ch, is assistant editor of the *Chemical and Metallurgical Engineering*. He was elected secretary of the Society of Junior Chemical Engineers during 1938. In September, 1938, he married Miss Virginia M. Hiller of Frederick, Colorado.







At McGraw Hill, Mel combined his knowledge of both chemical engineering and writing to develop a new publication, Chemical Engineering.

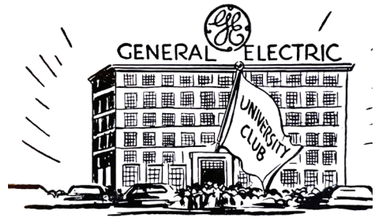
John Clark volunteered to fill his father's position on the CEM board to support the magazine in "trying to foster a meaningful dialogue with the readers."

Clark elaborates, "The human mind is capable of grasping a multitude of things that can't be seen…they're visions. We could add more dimensions…the CEM is a vehicle to doing that."

One vision Clark has in particular is engineers using their technical knowledge to communicate to legislators, stakeholders, and the general public by acting as "citizen professionals…builders and maintainers of the quality of life, not just in the US, but globally."

Clark explains, "Within that technical realm…political actions [with] technical background … could be [a] tremendous help in negotiating solutions. Engineers could be involved as citizens, and play a dual role in solutions. We can do a lot, but we have to have the mindset, and I believe that can be fostered and taught in education."

We at the Colorado Engineer Magazine thank John Clark for his time and input, and Mel Clark for his commitment to continuing the legacy of this publication.



Sun and Wind as Power Generators

Issues from the 1930s also highlighted emerging technology and innovations in energy.

FIRES AND BLIZZARDS

How the extreme shifts in weather are impacting our community

DAVID REMICH

Photo by Joshua Camp

Over the past couple years, life has become a perpetual cycle of ups and downs. More often than not, whenever there seems to be a positive story in the news or an uplifting movement on social media, it turns out to be the calm before the storm. For the residents of Superior and Louisville, the Marshall Fire changed everything. As a community, there was nothing we could do besides look on in shock as the Marshall Fire swept through Superior and Louisville on December 30th.

I live in Broomfield, right on the edge of Superior. I parked my car at the bus stop in downtown Louisville before I went out of town for the holidays. All I could do was watch and hope for the best with my family as I waited to hear from my neighbors if our apartment building had burned down. However, I was more worried about my car because I had no way to determine its condition and it was in the heart of the fire. Upon arrival, I was relieved to find my car undamaged. The bushes and trees directly in front of my car were charred and blackened. The stripmall across the parking lot was gone. I opened my car and all I could smell was smoke. The stench lasted for several weeks and outlasted many air fresheners. However, my story is nothing compared to the hundreds who lost their homes, but it just shows how much this has affected the entire community.

According to the Boulder Office of Emergency Management, 1,084 residential structures were destroyed, including 550 in Louisville, 378 in Superior, and 156 in unincorporated Boulder County and the total damage to homes is estimated to be upwards of $513 million. Unpredictable disasters can be disorienting when you look around the place you grew up and all you see is ash. Cars looking like they were just hit by a bomb and the blackened remains of homes you once visited on Halloween.

As if this tragedy wasn't enough, fewer than 24hrs after the fire began, the entire area was covered in a thick blanket of snow. "The snow can be positive and a hindrance," said Rocco Snart, the branch chief for the Colorado Division of Fire Prevention and Control. The sudden snowfall inhibited the fire from spreading as quickly as it had the day prior with the 100+mph winds. However, it inhibited most of the clean up efforts and blocked the Colorado National Guard from securing the impacted area successfully. Not to mention the hundreds of displaced citizens who now found themselves homeless and shivering just days before the new year.

Like adding salt to a wound, the first warm spring day in Boulder resulted in the NCAR fire. The Boulder Office of Emergency Management reportedly evacuated 1,629 people, including 699 housing units and 836 buildings by 11:08pm on March 26th. Boulder fire rescue crews were able to 100% contain this fire by March 31st, but not before it took hold of 190 acres southwest of the city's Table Mesa neighborhood, near the National Center for Atmospheric Research. The sporadic weather trends are nothing new to Colorado; however, the scale, intensity, and consistency of these recent fires has the entire state sitting on edge.

NCAR Fire photo by Elliot Whitehead

> "These sporadic **changes in our typical precipitation patterns** have had both an **immediate** and **prolonged impact** on the people and industries of Colorado."

Leading up to Christmas, the month of December was littered with 60 degree days and very little snowfall throughout the state of Colorado. The total snowpack was 0% going into 2022. Due to the late snowfall and previous years droughts, most of the state is experiencing an intensifying drought, classified as an "extreme D3 drought which has lasted a while" says Assistant State Climatologist Becky Bolinger. The National Oceanic and Atmospheric Administration (NOAA) cites that "the extreme drought category, D3, corresponds to an area where major crop and pasture losses are common, fire risk is extreme, and widespread water shortages can be expected requiring restrictions." These extremes seem to be increasing to the point of regularity and the cumulative impact can be dire. This long term environmental shift in water consistency is what set the stage for the Marshall Fire to be so destructive.

Within the next few weeks, there was a sudden reversal, with NOAA reporting that the total snowpack was at 127% of the average by the end of January. Currently, Colorado is at 104% of the average snowpack. However, the sudden shift does not mean we are back on track. Trends often happen across multiple years, so it will take a few good years to cancel out an extreme drought. These trends are begging us to ask the questions, what will happen if we do not get a giant snowfall to combat the lengthy droughts? What will our summers look like when that happens? Since mountains serve as natural 'water towers' that fill our reservoirs and supply us with fresh drinking water, if the towers run dry, will fires dominate our landscape?

These sporadic changes in our typical precipitation patterns have had both an immediate and prolonged impact on the people and industries of Colorado. This is perhaps most prominent and relatable during the skiing and snowboarding season. Some of the most lively and entertaining places in the winter are the mountain resorts. Unfortunately, with the minimal snowfall early this season, the only runs open at nearly every resort were the manmade groomers which were a limited departure from the typical Colorado experience. On December 18th, I took a trip up to Eldora, "Boulder's Backyard," to see how bad it really was. There were 12/65 trails open, it was a dismal day of rocks and grass along the mountain side. But then, like the changing of the tides, waves of snow began to fall, and with it, trouble.

As usual, there have been countless I-70 closures this season due to the heavy snow and icy conditions which greatly impacts the ski traffic and the infrastructural safety of the freeway. According to the Colorado Department of Transportation (CDOT), differing combinations of sand, a sand/salt mixture, and various liquid anti-icers and de-icers are used to combat differing intensities of winter conditions. A major problem with these types of extreme back and forth conditions is a drastic increase in potholes. Potholes form due to the freezing and thawing of water on roads, sound familiar? CDOT is responsible for maintaining and plowing all interstates and US highways, as well as most state highways with approximately 1,800 trained maintenance personnel. Closures are largely attributable to the inconsistent and often unique weather events.

According to the Environmental Protection Agency (EPA) the salts used on the roads runoff into the surrounding areas and nearby streams leading to further negative environmental impacts such as "contaminate drinking water, kill or endanger wildlife, increase soil erosion, and damage private and public property."

These fires & blizzards have shaken our community to its core, and they have everybody anxious about what the future might hold. However, we are Boulder Strong! There isn't much this crazy world can throw at us that we are not capable of overcoming so long as we stick together. Moving forward we will need to adopt a new mindset. Murphy's Law states anything that can go wrong, will go wrong. This motto has become today's standard and should be used as the rule of thumb when planning for the future. Expect the unexpected and you will never be surprised.

We had better get used to going through changes because they do not seem to be slowing down. In reality they are becoming more frequent and impactful on our everyday lives. For the younger generations who have lived through 9/11, the 2008 financial collapse, a worldwide pandemic, and the dismantling of peace in Europe all before turning 30 years old, it is nothing strange to be living in an uncertain time with continuous turmoil.

Heat, snow, and drought records are being broken annually. In Denver, a 123 year old temperature record fell on February 23st. Lows reached a frigid -7 °F, breaking the previous record of -4 ° F set in 1899. Nobody alive today was alive when this record was set. We are living in unprecedented times and the future is uncertain. However, if we stick together like we did during the Marshall Fire and all the other so-called "apocalypses," I am confident we will overcome whatever may lie ahead of us.

ENGINEERING AND ATHLETICS: THE ULTIMATE TRIATHLON

Finding the time to swim, bike, run and submit an assignment before 11:59 p.m. within 24 hours is a difficult task for any individual. Yet, Eli Hinerfeld found a way.

NIKKI EDWARDS | PHOTOS COURTESY OF ELI HINERFELD

Eli Hinerfeld's quads burned as she biked eight miles uphill to Boulder City, Nevada. She crossed the finish line of the CU triathlon's team meet, but she had no time to celebrate due to the looming deadline of her CHEM 3321 lab assignment.

Hinerfeld competed with the CU triathlon team for four years while completing her degree in environmental engineering. Being an engineering student-athlete, balancing school, establishing a regimented routine, having a social life and participating in a three-in-one sport came with an abundance of stress.

"[My] first semester sophomore year specifically, I was extremely stressed out," she said. Hinerfeld attempted 18 credits that semester. Her course schedule consisted of material energy balances, organic chemistry and physics. "I was trying to keep up with the team and train…I was just like, 'I'm failing everything right now.'" She made the switch from chemical engineering to environmental to ease the curricular burden.

Going into college, Hinerfeld knew she wanted to pursue both engineering and competing. All before her 10th birthday, she swam and ran for her local school in Fort Collins, Colorado. Her father got her accustomed to long bike rides.

In high school, a CU engineering undergrad spoke to Hinerfeld's physics class about her college experience. The woman informed the class about the world of collegiate engineering as well as the CU Triathlon team. This caught Hinerfeld's attention.

The CU Tri-team welcomed Eli and other new freshman members. The 18-time national championship winning team accepted a variety of skill levels.

Eli realized she was the one of the few engineers in the freshman class and she felt, "really stressed out and the odd one out." However Hinerfeld quickly acclimated to the new group as they all navigated the challenges of college life. "Some did have a lot of triathlon experience, some of us didn't... but it was nice because there was just a squad of us from the beginning and I think it helped make it less scary."

The Tri-team did indeed have an intimidating work out schedule with two to three practices everyday except Friday. The double practices were optional, but Hinerfeld tried to attend as many as her tight schedule allowed.

"I don't know, honestly, how I kept up with everything that [sophomore] year because I would go to the double practices and then my engineering classes," she said. "Then, I would run home and take an hour nap and keep going with my day."

The team's season begins in the fall semester. Many practices and a team sprint prepare the squad for the conference meet in late October. Hinerfeld's favorite was the Pumpkinman Triathlon at Lake Mead her freshman year.

Hinerfeld's group claimed the Cadillac Escalade as their road tripping vehicle while the other groups rode in minivans. "I got put in a car with the cool kids of the team," she said. "They took us under their wing and we had a lot of fun with them."

Unlike the other schools, the CU tri-team camped by the lake before the meet. The next day Hinerfeld completed her first Olympic distance in the Mars-like terrain starting with a 1500 meter swim, 24.8 mile bike ride and finishing with a 6.2 mile run. "We [the team] can do something that's ridiculously long even if we're not in the best shape of our lives…it's not really like, 'oh my gosh, I'm suffering right now,' it's like 'I'm working hard and getting through it.'"

Hinerfeld (left) and other members of the CU Triathlon team celebrate after a race

In late October however, Hinerfeld also had to work hard and get through her mix of midterms. "Especially us engineers too, we would get messed up by school and exams before that specific triathlon."

Before the Pumpkinman meet, Hinerfeld and two other tri-team engineers were all taking, "the horrible APPM calc classes," she said. She and her fellow engineers completed their exams and headed straight to the vans to leave for Lake Mead.

Hinerfeld had her coaches proctor her exam in a Starbucks and a physics exam in the car on the way to a meet. "While we were driving, my coach is just sitting behind me like, "Okay, you can start,'" she said. "On these travel races we always go find a Starbucks or something and we'll fill the whole place. We'll all be studying there together for a couple hours the day before the race."

Head coach Brad Seng and assistant coach Dave Sheanin are lenient with students attending practice because they understand that, "school comes first," she said.

The frequent and grueling 6 a.m. practices, the road trips, the bike ride gossip sessions, Starbucks study groups makes crossing the finish line a little easier. "A big part of the triathlon team is not even just the sport, but us all hanging out, doing fun activities together and living through college together," Hinerfeld said.

After Hinerfeld graduated this past December, she found herself back in her old high school physics classroom talking to the students about her engineering experience. She advised them to make friends their freshman year, focus on managing their time and sleep and read the FCQ reviews of professors before adding the class to their schedule. "They can really make or break a class," she said.

"Being an **engineering student-athlete,** balancing school, establishing a regimented routine, having a social life and participating in a **three-in-one sport** came with an abundance of stress."

THE POWER OF MUSIC

CU engineering student Dafna Margalit finds success and enjoyment in her music while completing her electrical engineering degree

NORA DREWNO | PHOTOS COURTESY OF DAFNA MARGALIT

Dafna Margalit's most listened to track "8NIGHTS" with 2.45 million streams starts with her singing about a common Colorado experience, "The smell of winter air. I see you standing there. Covered head to toe in snow."

The young artist and Boulder native is in her senior year at CU completing her degree in electrical engineering while creating songs from her surroundings and experiences in college.

Music is a significant piece of Dafna's life and her upbringing. When she was four years old, she started playing classical piano. In middle school, Dafna learned guitar, bass and drums and discovered her voice when singing in her school's musicals. She started to write music when she was 9 and was inspired to do so by her two older siblings, Noa and Guy, who also write music and graduated from CU with engineering degrees.

When she started at Fairview High School, she joined the choir to continue her musical and artistic passions. When she was 15, she won an opportunity through the eTown Handmade Songs Series program for highschool songwriters to have her song professionally recorded, which was a big opportunity and influence on her career.

Dafna learned a significant amount about songwriting and music production through this program. She said, "It was the very first time where I learned what producing was and how the process went. It was a great opportunity that inspired me to continue my passion with songwriting." With this experience under her belt and with the help of her older brother, Dafna learned how to make music on the computer and began producing her own music.

Dafna later entered in a Battle of the Bands competition twice while in high school. Singing solo with her keyboard, she earned second place in her first entry. But for the second time, she found a bassist, drummer, and guitarist to play with her and she ultimately won first place. Dafna realized that performing with a live band was crucial to her success, so when she started at CU she was on a mission to meet more musicians to perform with her.

When starting at CU, Dafna joined CU's only all woman's a capella group, On the Rocks, where she has been a member for the remainder of her time here. She not only made life-long friends through the group, but it was also where she found a few band members to perform with her at concerts. Still, however, she was missing a bassist and a drummer, and Dafna ultimately found those through her engineering courses.

"Capturing a **moment** or **feeling in a song** has made dealing with hardships much easier, and I know these are things that other people experience as well."

"You have to be resourceful and make connections to be successful, and I am lucky to have found bandmates through a capella, through my classes and even through posting on CU Facebook groups," she said.

Dafna said, "My education at CU has also helped with the promotional aspect of my music career. I learned how to code and develop websites through my classes, which has helped a lot with promoting my music."

"If you're thinking about doing something, work with the resources you have and make it happen," she said. Dafna's philosophy is to be proactive and resourceful, and she encourages aspiring musicians to do the same.

Since launching her musical career, Dafna has produced 2 albums, 1 EP and numerous singles, and she has amassed more than 100,000 listeners on Spotify with millions of streams.

Dafna's lyrics touch a variety of topics and people in her life. She enjoys singing and songwriting since it is a way of self expression and an emotional outlet. Her lyrics are a way to connect with people and to communicate her feelings. Dafna said, "Music for me has always been a form of self-expression of what's on my mind and also as a coping mechanism. In high school, I didn't have that many life experiences, so I drew upon books and other stories as inspiration. More recently, my music has become more personal and I am writing about my own experiences. Capturing a moment or feeling in a song has made dealing with hardships much easier, and I know these are things that other people experience as well."

All the while, Dafna has been a successful student at CU and has interned at Rival Games for the past 2 years. "I am passionate about both my engineering courses and my music career. I honestly haven't found it too difficult to balance the two - I enjoy both of them a lot, so I find it easy to make the time to do the things that I love.'

On May 5, Dafna will shake hands with Dean Keith Moleenar, saying 'goodbye' to her academic career. However, her music and engineering career are just getting started. She has accepted a full-time position at Rival Games and will be moving to Los Angeles to work as a software engineer. She has already made connections with the music industry there through her brother, Guy, and through songwriters on TikTok. She said, "I've been connecting with people through TikTok and meeting with them whenever I visit my brother. I hope to use my connections to perform at venues and continue with my music career in Los Angeles."

While her bandmates in Boulder will be parting ways, Dafna hopes that everyone finds a career they enjoy, and she is excited to be performing with her brother in a more 'scaled-back' setting. From starting in coffee shops in Boulder to performing with Covex at Red Rocks, and then headlining the Larimer Lounge in Denver, Dafna has come a long way since learning how to play the piano at four. Through her work as an electrical engineer and her emotional songwriting, Dafna is a living example of the true power of music.

HOW THE JAMES WEBB SPACE TELESCOPE VIEWS THE COSMOS

The James Webb Space Telescope gives an unprecedented view of the ancient universe through the use of deep range infrared light imaging

AARON SCHURMAN

Directly after the Hubble Space Telescope launched in the 1980s, observational scientists started discussing a follow-up technology that would use long wavelength or infrared imaging. This telescope, named after James Webb, director of NASA from 1961 to 1968, was originally supposed to launch in 2007 on a 500 million dollar budget. After failing to make launch dates in 2007 and 2013 due to construction delays, many people following this satellite's journey thought it was never going to be ready to take to the stars. Finally in October of 2021, the James Webb Space Telescope (JWST), coming in at a final cost of nearly 9.7 billion dollars (as estimated by NASA), was launched.

The JWST started its journey nestled on the head of the ESA Ariane 5 rocket and proceeded to make a 1.5 million kilometer journey to the second Lagrange Point. A Lagrange Point is a stable orbit point that maintains a smaller orbiting body's position relative to two larger bodies. In this case, gravitational forces keep the Earth in between the telescope and the Sun, which helps maintain a cool telescope temperature and limits the amount of infrared light coming from the Sun, which would effectively ruin the telescope's "night vision". This is an ideal place for the JWST to call home, as its sensitive instruments need to be kept very cold, a chilly -255 degrees Celsius, and can become oversaturated by the Sun's light.

The ability to pick up wavelengths of light that are far into the infrared spectrum is important for observational astronomers, such as Dr. Erica Nelson, an Astrophysical and Planetary Sciences professor here at CU Boulder studying the early formation of galaxies.

James Webb Space Telescope Mirror Seen in Full Bloom by James Webb Space Telescope is marked with CC BY 2.0.

The universe is expanding, and when light travels across space a phenomenon known as the Doppler Effect stretches out the light to be at a longer wavelength. This is often referred to as 'redshift.' In order to see further into the past, the JWST must be able to pick up light deep into the infrared spectrum that has been shifted there after traveling through billions of lightyears in an expanding universe.

Dr. Erica Nelson and her team are attempting to understand "how the universe evolved from its uniform state, shortly after the Big Bang, to the diversity of galaxies we see today." Through her prior research with the Hubble Telescope, Dr. Nelson categorized most galaxies that we can currently observe as forming like massive disks and also creating a majority of their stars as galactic disks. She said, "If we are going to understand how early galaxies evolve, we are going to have to understand how the stars that make them up formed." It is predicted that at earlier times in the universe, galaxies did not form in these massive disk-like structures, and at a certain point there was a time when galaxies evolved from a mess into an organized structure that Dr. Nelson describes as a 'dawn of disks.' Dr. Nelson is hoping to observe and understand this hypothesized shift to disk formations.

The formation of galaxies and stars is a chaotic process, and during their construction stars are surrounded by dust. Dust can become an issue for observational astronomers like Dr. Nelson, because it absorbs, heats up, and re-radiates up to 95% of the light that those emerging stars produce. Most of this light is emitted as longer wavelengths of infrared. A good example of this phenomenon is to look at the Pillars of Creation, a giant cloud filled with dust and gas, in visible and infrared light. In Dr. Nelson's words, "At earlier cosmic times galaxies are way dustier."

Another application of the JWST's ability to see through dust and small particles is to examine in more chemical and visual detail, past the icy clouds and waters of the ice giants Neptune and Uranus.

This will give scientists a new window to view Earth's celestial neighbors. The JWST will be able to pick up these long wavelengths of infrared, and it will be the first time scientists, such as Dr. Nelson, are going to see early galaxies and other previously opaque celestial bodies clearly.

Visible Light **The Pillars of Creation** **Infrared Light**

Hubble Goes High Def to Revisit the Iconic 'Pillars of Creation' by NASA Goddard Photo and Video is marked with CC BY 2.0.

THE RISE OF COMPUTATIONAL BIOLOGY

How one of CU's most recent minors has the potential to revolutionize the medical industry

ZANE PERRY | PHOTO BY ELLIOT WHITEHEAD

The field of medicine and health professions is a rapidly shifting and growing industry, constantly providing new sources of innovation in ways that benefit human health across the globe. The integration of rapidly emerging, new technologies into medical and biological research has led to exciting developments within the field. One noteworthy impact was the creation of computational biology, a field of study that seeks to use computing techniques to model and study a wide variety of biological systems. By effectively combining topics from diverse fields, such as molecular biology, biochemistry, neuroscience, computer science, data science and software engineering, computational biology has contributed to major breakthroughs in the modern world including the rise of biotechnology and the development of the COVID-19 vaccine.

In response to this cutting edge subject, the University of Colorado Boulder introduced a minor in Computational Biology in Fall of 2020 that teaches students the advanced computational tools and interdisciplinary ideas that will enable innovative biotechnology and biological research. This effort has been closely aligned with CU's BioFrontiers Institute, created in 2011 and dedicated to the interdisciplinary exploration of the life sciences and their societal benefits. Working alongside multiple disciplines from the College of Arts and Sciences and the College of Engineering, the vision of the BioFrontiers Institute is to "drive innovation without boundaries". The BioFrontiers Institute draws support from well-known computational biologists like Eugene Myers, Sean Eddy, and Gary Stormo, who attended CU for their graduate studies.

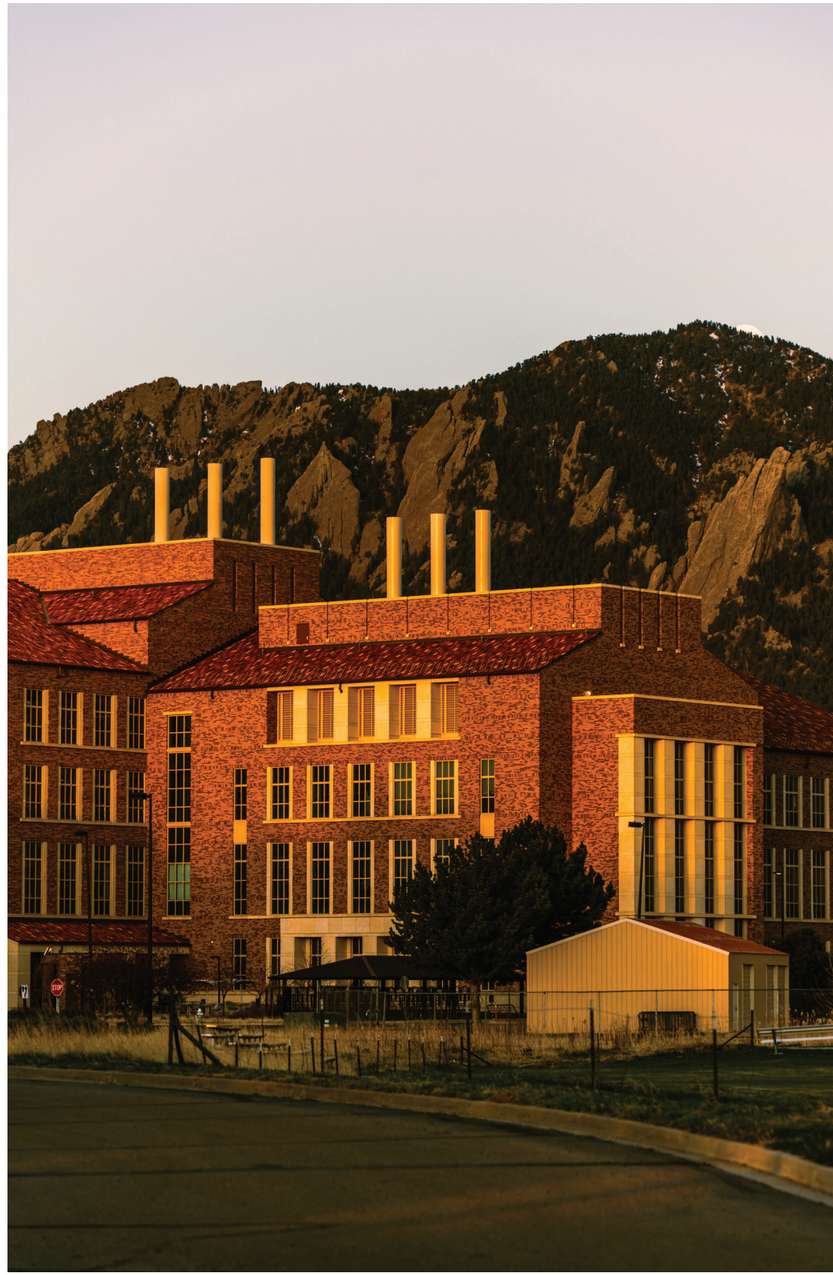
In 2017, Aaron Clauset, an associate professor in Computer Science at CU, and Kristin Powell, Director of Interdisciplinary Education at the BioFrontiers Institute, began the long journey to launch a Computational Biology curriculum at CU. To start, they worked with the talented faculty affiliated with the BioFrontiers Institute who had extensive experience in interdisciplinary research, as well as existing classes offered at CU. Their goal was to create a program that brought together students and faculty from a diverse set of majors and departments. Working with advisors Eva Lacy from the Computer Science Department and Kim Noice from the Biology Department, they discussed how to combine classes from both departments into a single program, as well as how to introduce several new courses tailored specifically to the minor. This provided students the opportunity to cross between disciplines to collaborate and learn from each other and from other students outside of their traditional colleges. For this reason, Clauset and Powell strongly believed that first establishing Computational Biology as a minor instead of a major program was critical to the success of students who desired to enter the field. This not only allowed them to cross departments for their studies, but also cross colleges between Arts and Sciences and Engineering. As such, it is one of the only minors at CU to date that spans multiple departments and colleges on campus.

Robin Dowell, an Associate Professor in Molecular, Cellular, and Developmental Biology who is also a faculty member at the BioFrontiers Institute, was instrumental to the formation of the Computational Biology minor. Because the minor is rostered by the Computer Science department, Dowell acted as a spokesperson for the biology departments in the College of Arts and Sciences, advocating on their behalf, and was a leader in the development of the minor's curriculum. Dowell herself is an excellent example of why this minor was an instrumental addition to CU for those interested in pursuing computational biology. She received bachelor's degrees in genetics and a second one in computer engineering from Texas A&M University because the concept of computational biology barely existed when she was attending school. Despite this, she knew that she wanted to find a way to combine engineering and genetics in a lab setting, and as a result ended up in the middle of the Human Genome Project at Washington University in St. Louis while obtaining her master's degree and Ph.D. Owing to her own experiences, Dowell was a strong advocate for the Computational Biology minor at CU so that younger students would not have to pursue multiple degrees to be qualified for the developing industry.

Despite existing for only two academic years, as well as launching during the COVID-19 pandemic, the Computational Biology minor already includes over fifty enrolled students that span about a dozen majors. The program has three areas that students complete over the course of their studies. A technical skills area covers mathematical and computational techniques, while a bio-electives area teaches students the fundamentals of biological concepts and theories. In the third area, composed of upper division courses, students integrate these ideas in a set of classes that focus on topics within computational biology and their applications to the real world. These upper division courses include topics like biological networks, computational genomics, computational neuroscience, optical imaging, biophysics, and more.

Both Clauset and Powell hope that the Computational Biology program at CU Boulder provides a model for other universities to follow in promoting this evolving field. Many other schools that offer similar programs restrict students to taking classes that are segregated between departments and lack the opportunity for collaboration for academic and research experiences. Looking forward to the future, Clauset and Powell hope that the Computational Biology Minor expands to include many more students and encourages others to appreciate the value of interdisciplinary work and its implications for innovation throughout the world.

"By effectively combining topics from diverse fields... computational biology has **contributed to major breakthroughs** in the modern world including the rise of biotechnology and the development of the COVID-19 vaccine."



Visit **www.colorado.edu/biofrontiers/cbiominor** or email **CBIOminor@colorado.edu** to learn more!

INTERDISCIPLINARY WORK FOR CLIMATE SOLUTIONS

CU Boulder professor Alex Fobes partners with The Mission Zero Fund

ERICA MCNAMEE | PHOTOS COURTESY OF IAN GLASS

From ravaging fires to late season snow storms, the city of Boulder has seen firsthand how climate change can affect its communities, but students and faculty alike are determined to find ways to help the cause.

Along with being a Teaching Assistant Professor in the Program for Writing and Rhetoric, Alex Fobes is a member of the sustainability committee at CU. One of his goals with the sustainability committee is aligning the committee with organizations that are trying to meet the same goals and have a greater impact. Insert Mission Zero.

Mission Zero is a donor-supported initiative that aims at helping university students work on climate solutions, with an overall vision of inspiring a university movement to save the planet.

"One thing that I really liked about Mission Zero is that they're focused on empowering students to be a voice for the change they want to see in the world," Fobes said.

Fobes has similar values and interests to Mission Zero, so he partnered with the organization to help with their vision.

"Even though I studied literature, I'm an avid outdoors person, and it's important to me to give back in some way, to do something in my own work that helps to conserve our natural world, protect the planet in some way."

A class that Fobes teaches in the Program for Writing and Rhetoric is called Technical Communications and Design. In this course, students partner with a client working on projects that the student is passionate about. This class style allows students to experience writing for a real world audience.

"I want all the work the students do for the course to make a difference," Fobes said. "There's a way that every student can think about what matters most to them and promote that aspect of the organization, of its mission."

This course is one of the ways Fobes has begun to work with Mission Zero. Scott King and Paul Grignon, the founder and COO of Mission Zero respectively, attended one of Fobes' classes to describe the work that Mission Zero does, and he generously offered to be an audience for donation proposals.

Fobes describes this connection, and particularly this course, as providing students with the tools and opportunities to continue to work on their passions.

"I'm going to be doing this for, I don't know how many more years, maybe 20 years if I'm lucky. But at some point other people are going to have to carry on and lead the way, so we are trying to empower them and give them all the tools they need to be effective," Fobes said.

After working on projects in the Technical Communications and Design course, students are given opportunities to participate in showcases such as the Sustainability Solutions Showcase in April, or to be a part of the UN summit on climate and health in December.

In addition to helping students find their path and connecting them to Mission Zero, Fobes works with other faculty in the Writing and Rhetoric program to discover the best ways to teach these profound topics. Together with the help of Dr. Eric Burger, Dr. Rebecca Dixon and Dr. Jay Ellis, Fobes has led Mission Zero Workshops for Writing and Rhetoric faculty working to find the best approach to teaching climate change storytelling. He is also working with the Hindsight Journal on a feature edition specifically about Mission Zero and climate change.

Science and communication are two genres seemingly on opposite ends of the spectrum, but finding the connection between them is vital in determining solutions for climate change.

"CU Boulder as a whole wants us to collaborate across the disciplines," he said. "It's one thing I love about being at a large university. There's so much going on, and we have experts in so many different fields. We need to be proactive sometimes to take advantage of all the university has to offer us. We need to reach out to people in other departments and other programs and combine our knowledge to tackle a lot of challenges. We can be stronger that way."

From the larger scale of the CU community down to each individual student in his classroom, Fobes is determined to make a difference in the climate change world, and partnering with Mission Zero is allowing him to do so.

"I would say Mission Zero is about readying ourselves for the future," Fobes said. "It's been said that the future is here, we are it, we are on our own, so I'd say it's about preparing ourselves for the future."

> "One thing that I really liked about Mission Zero is that they're focused on empowering students to be a **voice for the change** they want to see in the world."

HIKING INTO VOLCANOES

How I spent my time in college studying life in the world's most extreme environments

JUSTIN WANG | PHOTOS COURTESY OF JUSTIN WANG

As a child of two physicians and a grandson of a physics professor, I was "genetically" predisposed to face the existential conundrum that plagues many college freshmen: "what should I major in?" I loved my biology and astronomy classes and could tolerate physics and math, so I ultimately pursued a double major in astrophysics and molecular biology as an undergrad at CU.

The focal point of most of my interests, however, lay at the intersection of two distinct specialties: astrobiology, the study of life on other planets, and bioastronautics, the study of the effects of spaceflight on living organisms. So in my sophomore year of college, I sought to exercise what I was learning in my classes and reached out to many professors involved in this interdisciplinary work.

Brian Hynek is a CU Boulder professor in the Geological Sciences department and a research associate at the Laboratory for Atmospheric and Space Physics. He is also the founder and director of the CU Center for Astrobiology. Hynek's main research interests are "the geologic, hydrologic, and climatic histories of the planet Mars and all things related."

I began working with Hynek in March 2018, and I promptly started research in the laboratory to process some samples he took a year prior from the Poás Volcano in Costa Rica. The Poás Volcano is well-studied by Martian geologists, since it exhibits a lot of the similar geochemical processes that occurred on ancient Mars. It is a great place, therefore, to start to understand how life could have lived in ancient hot spring environments on Mars.

When I got involved, Dr. Hynek was in the process of publishing a manuscript in Astrobiology titled, "Lack of Microbial Diversity in an Extreme Mars Analog Setting: Poás Volcano, Costa Rica." He and his co-authors discovered that the crater lake of the Poás Volcano, called Laguna Caliente, harbored only a single bacterial species from the genus Acidiphilium (which is Latin for "acid loving").

This result was meaningful for two reasons: 1) it was surprising that anything could live in a lake that exhibited a pH of ~0; and 2) it was surprising that only a single species was found — microbes seldom live and work independently.

It was my job to extract DNA from new samples from the lake and to analyze the genetic adaptations to better explain the two surprising results in the study.

After studying (and smelling) the Poás Volcano for over a year and a half in the lab funded by the Research Opportunities Program (UROP), I finally was able to experience its strength and fervor firsthand.

While the extreme environments of volcanoes provide us with opportunities to mimic a Mars-like environment, it also presents unique challenges. At the same time that I was working in the lab, the volcano was exhibiting magmatic eruptions that prevented Laguna Caliente from reforming, so it was impossible to take any new samples. After two years of activity, the volcano finally calmed down and Laguna Caliente reformed. Within a month of the lake reforming, I was on a plane to Costa Rica.

Sampling from Laguna Fumarolica

On November 15, 2019, I hiked into the Poás Volcano with Dr. Hynek and our collaborator Dr. Geoffroy Avard, a volcanologist at the Observatorio Vulcanológico y Sismológico de Costa Rica (OVSICORI).

We drove to the crater rim and then spent an hour hiking down to Laguna Caliente. The Poás Volcano lies an hour outside of San José in the middle of the Costa Rican jungle, but once you hike below the rim it feels like you're on another planet. Besides some trees and shrubs near the tourist observation deck, the Poás Volcano is devoid of natural life. The acidic sulfuric gasses kill anything that tries to grow within the crater and corrodes the rock, making unsteady ground when hiking down. The worst of it was the gasses that rise from the hydrochloric acid, which sting the eyes and taste more sour and bitter than I could have ever imagined.

Once we neared the floor of the crater, we had to put on gas masks to protect ourselves, and we also placed our cell phones in special bags to prevent corrosion. Surrounding us were car-sized tephra, rock fragments ejected by volcanic eruptions that occurred only months ago. We made it to the lake by walking on paths specially carved by Avard to avoid the many potholes of boiling water and mud.

Hiking into the crater of the Poás Volcano

Visiting fumaroles near Laguna Caliente in the Poás Volcano

Hiking into the Poás Volcano remains the most memorable experience of my time at CU Boulder. While in Costa Rica, I also sampled from two additional hot spring environments called Laguna Fumarolica and Borinquen, but they weren't nearly as extreme as Laguna Caliente.

I was also fortunate to travel to Iceland in August 2021 with Dr. Hynek and Dr. Aileen Yingst from the Planetary Science Institute. Near Húsavík in northern Iceland, we performed field work to study how to best optimize the operations of the Perseverance rover and Ingenuity helicopter on Mars. For my personal days on this research trip I took the liberty to visit the Fagradalsfjall Volcano, which was erupting at the time.

There were many reasons why I decided to stay at CU Boulder for my master's after finishing my undergrad, but the main reason was so that I could see my astrobiology research to completion.

I wrote my undergraduate honors thesis about the Poás Volcano, which eventually led to my first academic paper, "Microbial Survival in an Extreme Martian Analog Ecosystem: Poás Volcano, Costa Rica." It was published in Frontiers in Astronomy and Space Sciences with a press release, which caught the attention of multiple media outlets including the Daily Mail, New Scientist, and CNN. For the first time, I was on the other side of the aisle and was being interviewed by journalists about my 9000-word research paper.

I was hoping to visit Costa Rica again while a graduate student to sample from the Poás Volcano and try some new methodologies that I was studying. At the time that I was applying to do my master's in aerospace engineering, however, the COVID-19 pandemic swooped in and made a lot of the work (and funding opportunities) that I wanted to do as a graduate student impossible.

With COVID restrictions relaxing, I received a Beverly Sears CU Graduate Student Fund award to return back to Costa Rica and perform the work I have been eager to do for so long. If all goes to plan, I will be returning to Costa Rica on May 6, 2022, one day after my graduation from the University of Colorado Boulder. This time, I'll be visiting three volcanoes: the Turrialba Volcano, the Rincón de la Vieja Volcano, and my favorite, the Poás Volcano.

While I won't be at CU to perform all of the follow-up research for this project, the time has finally come for me to pass the baton to two new undergrads that I have been training in the lab to continue this work.

My time at CU was defined by many things. I've worked with astronauts on the International Space Station, I've interviewed numerous faculty and students for the magazine, I've made life-long friends, I've experienced love and heartbreak, I've hiked across the country, I've guided rafts through roaring rivers and I've hiked into active volcanoes.

CU Boulder has provided me with more opportunities than I could have hoped for when I started here nearly 6 years ago. I'm grateful to Dr. Hynek and all the people at CU who have provided these opportunities for me, and I will always cherish the experiences that I have had here. I could find no better way for me to conclude my career at CU Boulder than to hike into volcanoes for research once again.

NEW FACULTY IN THE COLLEGE

The new faces of the College of Engineering and Applied Science here to share their knowledge on a variety of topics

DAVID KATILIUS, AARON SCHURMAN, AND ZANE PERRY | PHOTOS COURTESY OF FACULTY

Alexandra Le Moine is a new Assistant Teaching Professor in the Aerospace Engineering Department. Her professional career mainly revolves around the study of fluid dynamics after graduating with two bachelor degrees in Aerospace Engineering and Mathematical Sciences from the Florida Institute of Technology and a master's degree in Mechanical Engineering from the University of Wisconsin-Madison. She chose to come to CU Boulder due to its unique commitment to hands-on experiential learning so that she could pass on her knowledge to the next generation of engineers. She loves CU Boulder so far and owing to her arrival during the pandemic, loves the opportunity to see her student's faces now. In her free time she likes to play volleyball, go on hikes with her family, play video games, and continue her exploration of computational fluid dynamics.

Though **Arthur Mizzi**'s is an Assistant Research Professor within Mechanical Engineering, he has always been interested in the outdoors and in environmental protection, which is why his field in mechanical engineering focuses more on the environmental engineering parts of science. He got his undergraduate and masters degree in Environmental Science from the University of Virginia and specified his degree towards atmospheric modeling. He ended up moving here after NCAR offered to put him through school, in which he picked Applied Mathematics to continue modeling atmospheric mathematical models. Currently one of his favorite parts of working here at CU is how he gets to involve students with his research on air quality forecasting and data assimilation, as he loves to see the unique ideas and thoughts that students bring to his research. Outside of work you will see him over at the mountains either hiking, climbing, kayaking, skiing or basically anything else mountain related!

Danna Gurari is a new Assistant Professor in the Computer Science Department at CU Boulder. She fell in love with computer science while pursuing an undergraduate degree in biomedical engineering at Washington University in St. Louis and decided to stay an extra year to get a master's degree in Computer Science. She then received her Ph.D. from Boston University and served as an assistant professor at the University of Texas in Austin. She decided to come to CU because of the enthusiastic learning environment from both faculty and students alike, and the Rocky Mountains are a huge plus. Her research focuses on computer vision and human-computer interactions. In her free time she loves to explore Colorado with her family.

Hisham Ali is a new Assistant Professor in the Aerospace Engineering Department. His interest in aerospace began after he attended Space Camp at the US Space and Rocket Center in Alabama. He eventually interned at NASA, leading to a NASA fellowship that enabled his graduate school studies. He chose to come to CU because of its tremendous reputation in aerospace and planetary exploration, as well as the growing aerospace industry in Colorado. His research focuses on aerospace plasmas and how they can enable human exploration of planetary bodies. He is excited to fully establish his research lab and begin teaching in the classroom soon. In his free time he likes to be around his family, experiment with technology, explore new places, cook new dishes, and watch sports.

Teaching Assistant Professor **Katherine Ramos** studied Materials for her undergraduate degree and then went on to receive a PhD in mechanical engineering. During her time in graduate school she noticed that most of the women were dropping out of graduate school as most of them were feeling unsupported, unhappy, and imposter syndrome. Due to this she felt the need to become an engineering educator to help support women in STEM, specifically engineering. She chose to come to CU to the Engineering Plus program to help improve our DEI (Diversity, equity, and Inclusion) efforts by working with different organizations within CU like STEM routes, and Society of Women Engineers (SWE). Outside of CU she is starting to become an avid hiker and is enjoying snowboarding in the mountains next door.

Dr. **Luca Corradini** is an Associate Professor at CU Boulder in the ECEE department focusing his research on power electronics. In 2006, during his PhD years at the University of Padova in Italy, he first visited Boulder as a visiting scholar at the Colorado Power Electronics Center (CoPEC), hosted at CU-ECEE. After completing his PhD, he returned to Boulder and worked as a postdoctoral research associate at CoPEC. In August 2021 he joined CU-ECEE as a visiting faculty member, and he has been a tenured associate professer since January 2022. He wasn't an expert on power electronics when he started his PhD, except that it was a very relevant discipline in the broad context of efficient and clean energy usage, and that he wanted to be involved in it. He was pleasantly surprised to see how multi-disciplinary power electronics is as a field. Power electronics is, at its core, a classical EE field: application-oriented, rooted in circuit design, with a strong experimental component. At the same time, it involves aspects of semiconductor physics, electromagnetics, control theory, signal processing and advanced modeling. It really is a rewarding discipline to master, and its crucial role for a clean energy revolution adds to its appeal.

Assistant Professor **András Gyenis** hopes to bring quantum computing to CU Boulder. He came to CU Boulder for its already thriving quantum computing program and hopes to expand it with the creation of a 2-3 qubit quantum computer. When he is not building quantum computers Professor Gyenis enjoys biking, running, and cross country skiing. When asked what message he would like to leave to the world he exclaimed "Quantum is Cool!!"

HERBST FELLOWS

Meet the six students from across the College who embody the Herbst Certificate Program's commitment to ethical practice and engaged scholarship

Samiha Singh is a junior studying Environmental Engineering

Throughout my career, I have had the opportunity to interact with many people who are ready to tackle the climate change challenge. All of these engineers strive to develop technologies and systems that can be used to mitigate the impacts that humans have on the environment. However, engineering alone is not enough to "solve" the climate crisis. In fact, many of the technologies we need to combat climate change already exist.

The fundamental issue is not the lack of technology, but the fact that these technologies haven't been implemented on a wide scale due to limitations in politics, public perceptions, and the implications that new technologies have on people's lifestyles. To overcome these challenges, engineers need to understand not only the technical aspects of how to build solutions, but also the social aspects of how to gain public support, advocate for, and implement these solutions.

If engineers serving as policy advocates in their local communities becomes commonplace, the role that engineers play as experts in their field who advise new policies could help to, not only propel meaningful change, but to rebuild a sense of trust in science among the general public.

Emma Gustavsson is a sophomore studying Chemical and Biological Engineering

The intersection of my passion for science and my desire to help the world are what ultimately led me to pursue engineering school, so why is it that the longer I've been here at CU, the more I feel out of touch with my original motives?

With this question as my guide, I found that there exists a proven cultural disconnect between those within engineering education and the relevance of ethics to the field. We, as a culture, have a perspective problem that must be addressed, that being the deep and enduring assumption that our role in society will be satisfied only as technical professionals. Technology has never been a neutral, apolitical, or inconsequential force within our society, and yet the very people responsible for its future are in a culture that argues the opposite.

Historically, engineers have had a hand in the course of events through eras like the Holocaust or the industrial revolution that lead us to the climate crisis. Rather than hiding in the falsehood that our duty as future engineers will only be technical, we must adapt to the world and not only re-center ethics as a priority but acknowledge the inherent public influence within the profession.

Taylor Bata is a sophomore studying Aerospace Engineering

All humans are imperfect, therefore all of humanity's creations are inherently built with flaws. Nothing online is truly secure. Hackers know this and break into systems to wreak harm on both a personal and international scale. One day you could fall for a phishing scam on your phone, revealing personal information from keystroke tracking. The next day a foreign government official could mistakenly install malware designed to worm its way into an unseen system weakness, resulting in an enemy state destroying their country's entire nuclear program. Intelligence and sabotage are achieved with no boots on the ground.

Whether you like it or not, a copy of yourself lives on the internet in electronic databases containing tax and health records, credit reports, and social security numbers. Social media may make it easier for interpersonal surface level searching, but the people who really want your data know where to look in the internet's catacombs. The best offense is a robust defense. Measures can be taken to protect your immediate online circle. However, society may be too acclimated to data leaks for third party accountability to become a reality.

Zahraa Abbasi is a senior studying Computer Science

Clarifai, an AI startup, was committed to philanthropic practices such as donating software to charities and socially-beneficial causes. This was the Clarifai that employees were familiar with when they joined the company. Several months later, they found themselves in a workplace with a vastly different character. The office, which had paper covering the windows, was dubbed "The Chamber of Secrets" due to the clandestine nature of their meetings.

Outsiders, along with the engineering team themselves, were unsure of what they were building but the CEO assured them that they were "saving lives." Shockingly, the team discovered that they were creating software for autonomous weaponry.

Despite the unethical nature of their work, only one person decided to leave Clarifai. Indeed, stories in the media exposing tech companies, such as Clarifai, highlight the gap between the ethical behavior people believe they ought to have versus the behavior they actually have. So, why do people continue to contribute to unethical projects when their intent is to do what is right? Ultimately, my work explores the five compelling situational and social forces that corrode the ethical decision-making process in tech.

Hermann Klein-Hessling Barrientos is a freshman studying Chemical and Biological Engineering

A common misconception is that eugenics practices rooted in pseudoscience and racism first originated in Nazi Germany. However, well established eugenics movements existed within the United States as early as the 1920's.

Actions such as the encouragement of fertility amongst those high up on the socioeconomic totem pole were encouraged whereas forcible state mandated sterilization of those from lower socioeconomic groups and communities of color was set into action.

Presently significant investments have been poured into furthering genetic knowledge and biotechnological innovation. To fully grasp the advantages that biotechnological innovation sets forth, as well as the potential risks we must consider the intersectionality of the current state of healthcare/medicine, genetics, and race.

Reconciliation and moving forward proves challenging in a race conscious society such as the United States, in which historical events and contemporary relationships are still shaped by distinct and inherently different racial groups.

The acknowledgement and education of how disenfranchised groups were stripped of their human rights in order to advance medical research, must be done intentionally and broadly.

There needs to be further opportunities for disenfranchised communities and individuals to have their voices heard in forums about genetic research and technology.

As new technologies are introduced, adequate control measures to ensure equitable accessibility and protection for groups traditionally taken advantage off in the research and development stages.

Maddie Karr is a senior studying Environmental Engineering

Climate change has impacted many aspects of the environment as we know it and will continue to do so in significant ways in the future. One of those ways will be reshaping human migration patterns.

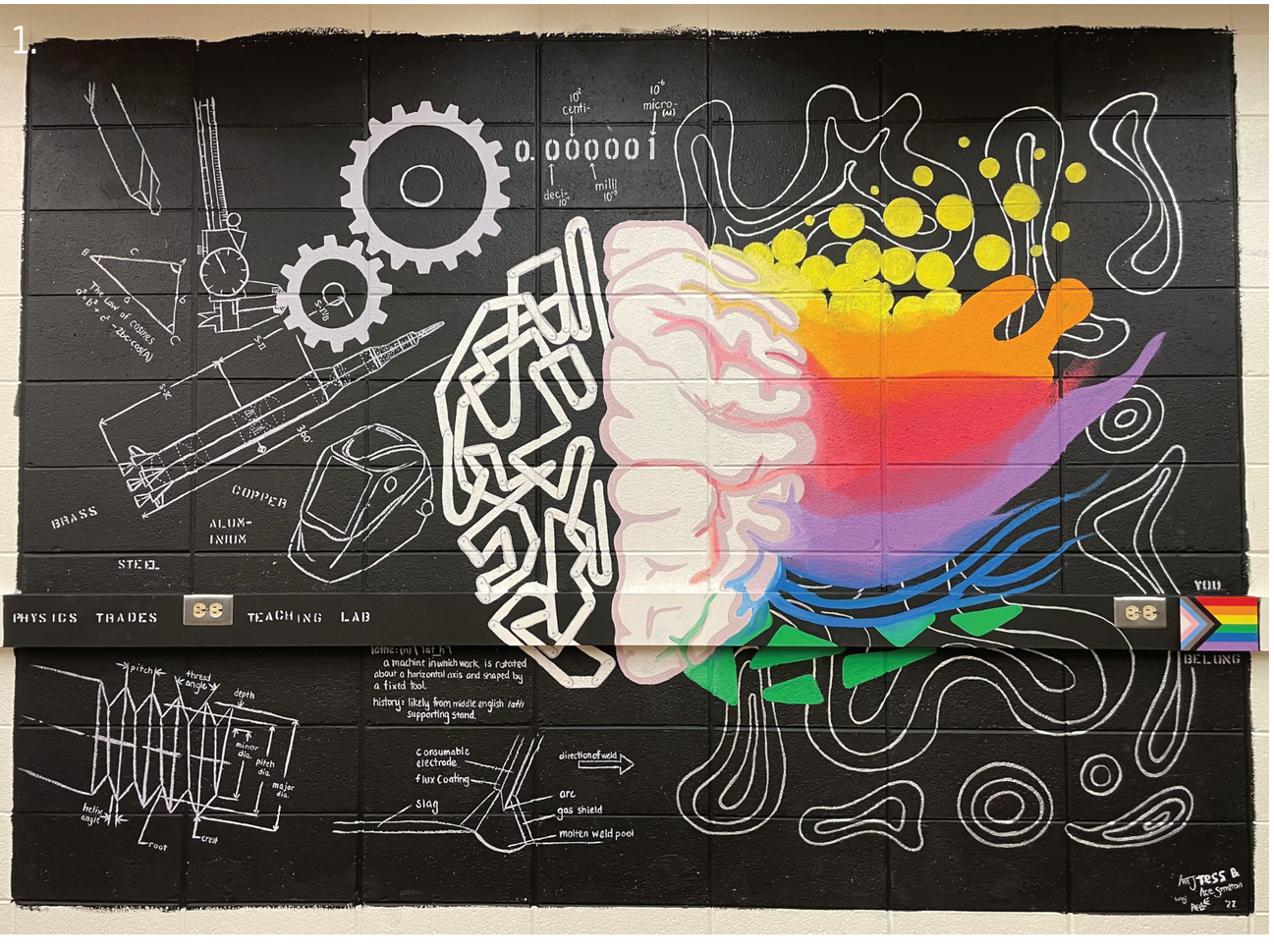
Migration can happen within a country or to other countries. The UN predicts anywhere between 25 million to 1 billion environmental migrants by 2050. There is a growing number of climate migrants or people who leave their homes because of climate stressors, although they differ from refugees fleeing conflict, it is important to recognize the reasons for human migration and what people can do to help those displaced.

As a future engineer myself, I would like to shine a light on those opportunities and actionable items of both the technical and social solutions to this ever growing challenge.

ARTISTS & ENGINEERS: ONE & THE SAME

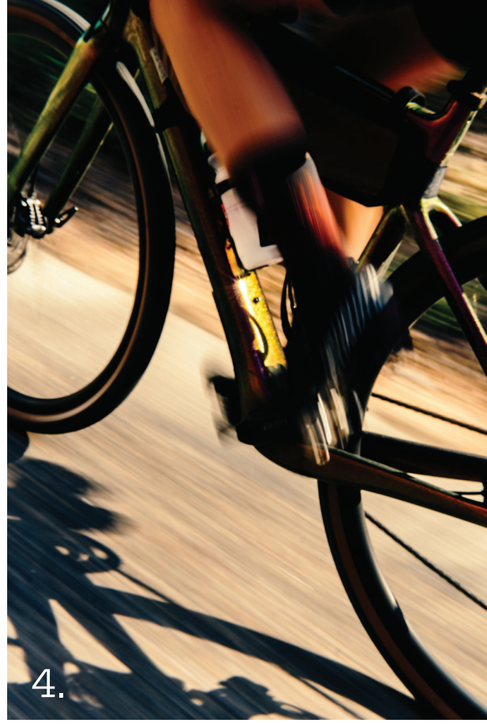
Engineers are too often seen as students who only excel at math and sciences, but these engineering students defy the stereotype

If you would like to submit your own artwork, please email Hannah.Sanders@colorado.edu!



1.

2.



4.

5.

3.

1. Ace Stratton: Senior
Major: Aerospace Engineering
Title: Mechanical Requires Both Artistic Vision and Mechanical Precision
Inspired by: Paul Wingrove
Medium: Latex Paint on Concrete Bricks
Size: ~6' x 8'
Contributors: Anna Jonsen, Tess Brodsky, Victoria Pelle, and Jake Wojack

2, 3. A. Tanvir: Junior
Major: Aerospace Engineering
Medium: 35mm Analog Photograph

4. Elliot Whitehead: Senior
Major: Geography & Computer Science
Title: Mechanical Engineer Micaeala V. Bara en route to Gold Hill
Medium: Digital Photograph

5, 6. Nora Drewno: Senior
Major: Mechanical Engineering
Medium: Digital Photograph

7. Luca Bonarrigo (he/him): Junior
Major: Aerospave Engineering
Medium: Digital Drawing

7. Maddie Karr: Senior
Major: Environmental Engineering
Title: Brilliance to Brilliance
Medium: Paint on Canvas
Contributors: Rishi Assar, Alexander Chan, Carter Bennett, Gabrielle Dunn, Grace Geer, Isha Karki, Eve-Amabelle Diby, Ashlynn McGrattan, Ushmi Akruwala, Wes McEvoy, Natalie Hanson, Adeline Loesch, Cousteau Reining, Sara Skuladottir, Riley Menke, Brooklyn Lash, Julia DiTomas, Alexander Bergemann, Joelle Wescott, Madaline Muiz, Landon Watts, Annie Cai

7.

ENGINEERING BINGO

Couldn't find a study spot in the EC	Skips class to go skiing	Misses class due to a COVID scare	"That's not what I thought your face looked like!"	Not sure if you should shake hands or wave
"Didn't sleep last night, but I'm okay"	Met someone you had Zoom class with in 'real life'	"I'll study over break." Doesn't study over break	Calling someone wearing a mask by the wrong name	Presents slides for the first time without practicing
Zoom office hours are empty	Forgets mask and can't enter building/ store	Does Bingo Challenge (FREE SPACE)	Forgot how to behave in public	Misses class due to vaccine side effects
Has 3 midterms in one week	"My eyes need a break from looking at a screen"	"It's like the person grading this didn't even read it!"	Roommate has COVID	"I'll get my work done over the weekend" but doesn't
Scores a job/ internship with a CU connection	Downloads homework assignment 3 times in a row	Doesn't recognize someone with a mask	"I thought that I would like coming to class in person"	Wifi crashes

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