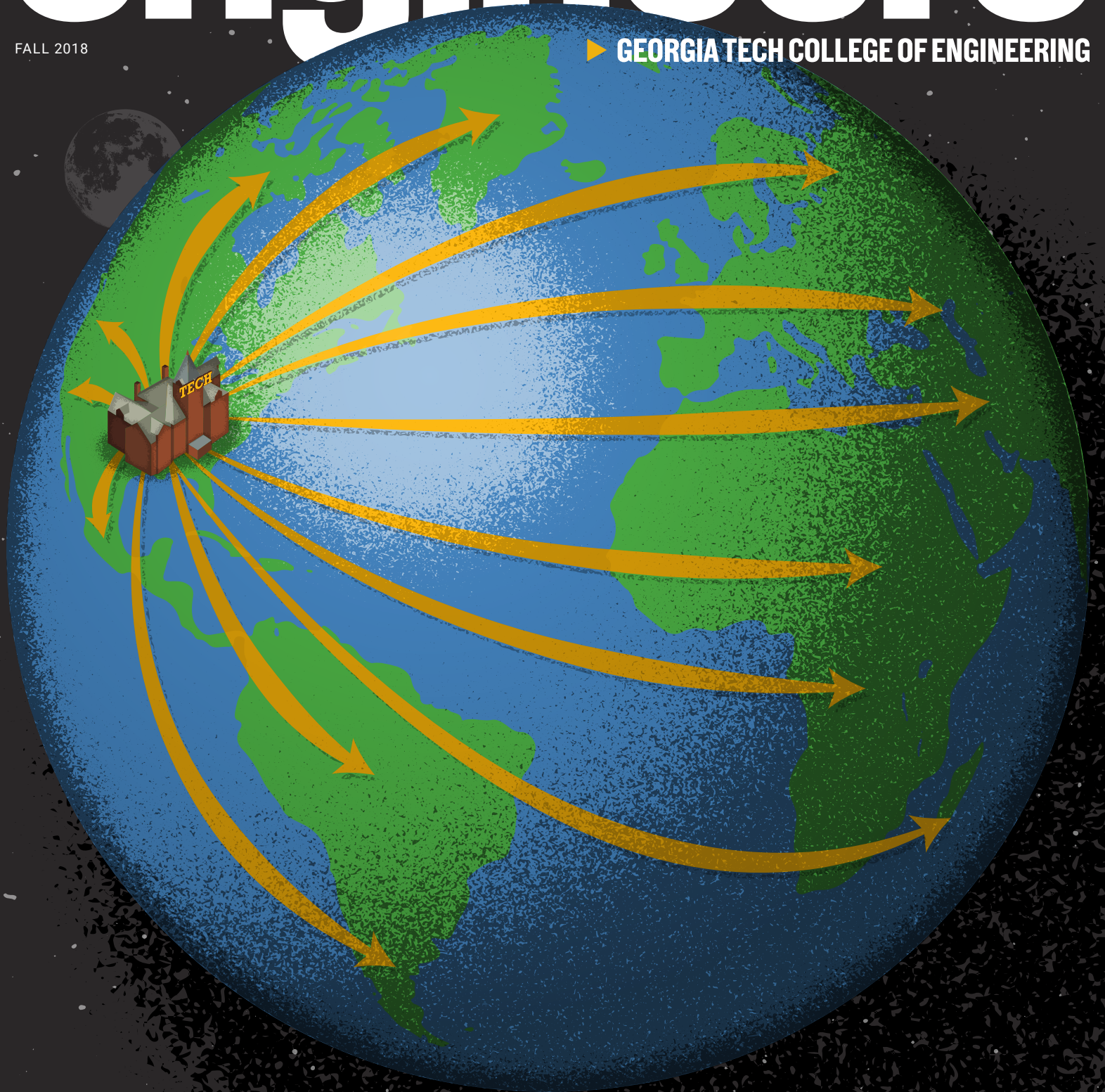


we are

engineers

FALL 2018

▶ GEORGIA TECH COLLEGE OF ENGINEERING



Social Impact: Hometown to World Renown

MESSAGE FROM THE DEAN



ENGINEERING DNA

Friends of the College,

Deep down I think it is in an engineer's DNA to want to make the world a better place. Not just for ourselves but for the 7.6 billion people on this planet. Our desire to serve also goes to the heart of Georgia Tech's motto of "Progress and Service." Since Tech's founding in 1885, it has always been our aspiration to produce engineers who think big and want to make an impact.

But what do those words — progress and service — really mean? How does engineering take on a cause to impact our state, nation and world? Can a single engineer truly make a difference in the lives of others, especially in underserved communities world over? In these pages, you will see the answer is an emphatic YES!

In doing this magazine issue on impact, we wanted to shine the spotlight on some of those GT engineers, both people and organizations, who have consistently demonstrated a commitment to social impact, humanitarian efforts, sustainability and service. These individuals

are devoted to addressing local and global challenges head-on and shaping the future. They are but a few of the countless others who each day tackle issues such as clean water, sanitation, poverty and more.

I am extremely proud of our students and alumni and also grateful that so many are not only involved in these important challenges and causes but are making headway to find real solutions. Let us know what you think about these stories. They are not only heartwarming and uplifting but indubitably show how bright the future is in the hands of these remarkable Yellow Jackets!

Steve McLaughlin
Dean & Southern Company Chair
College of Engineering

inside

WE ARE ENGINEERS > FALL 2018



▶ FEATURES

- 12** **Water Made Well**
A pair of Georgia Tech engineers take different paths to safeguard life's most essential resource.
- 18** **Outsmarting the Flu**
Georgia Tech engineers are developing unconventional tactics to vanquish the flu virus.
- 22** **The Greater Good**
Led by Joy Harris, engineering students give back to communities across the world.
- 28** **Powering Haiti**
A portable solar panel system provides light and cell phone power to change the landscape of Haiti.

▶ DEPARTMENTS

- 2** our voice
- 3** your voice
- 6** we are
- 36** in the field
- 40** 10 to end

On the cover: Georgia Tech engineers are making an impact all over the world, from Atlanta, Georgia, to Thoman, Haiti, to New Delhi, India.

WE ARE ENGINEERS
 GEORGIA TECH
 COLLEGE OF ENGINEERING
 MAGAZINE FALL 2018

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Dear Readers,

You are holding in your hands the newly redesigned issue of our College of Engineering magazine. We have been hard at work for more than a year updating the look and feel of our magazine based on innovative design practices and your content preferences. The magazine was started in 2014 — our then Dean wanted a unique publication to better connect with you. Since then, our readership has grown, and we've seen a real appetite for engineering stories coming out of the College.

It is our mission and purpose to bring you innovative, cutting-edge and exciting stories from with the College. These pages hold details on our students, faculty and alumni on topics that you care about. At the College, we are all about impact. And we hope to reflect that in our magazine.

We conducted a readership survey over a year ago, asking you what you thought about the content in our magazine. You answered, and we listened. Throughout these pages, you will see more stories about the impact we are having in the world, as well as timely research updates and more features on alumni and students. We promise you won't be disappointed.

Thank you for your continued support as we evolve our magazine. We hope you find the new issue to be engaging and inspiring — something you want to share with your peers. If you have any feedback on the new issue, please email me at editor@coe.gatech.edu.

Please enjoy *We Are Engineers*.

Sincerely,

Georgia Parmelee
 EDITOR

These pages hold details on our students, faculty and alumni on topics that you care about. At the College, we are all about impact. And we hope to reflect that in our magazine.



About the program

The Clark Scholars Program is a signature academic program that combines engineering, business, leadership and community service. Students also receive a four-year scholarship, fully based on financial need.

Above:
 David Torello, Faculty Mentor

Giving back.

The first group of Georgia Tech Clark Scholars arrived on campus this summer. After two weeks of intensive learning and bonding, they quickly assimilated and are ready to begin their journey at Tech.

An altruistic spirit and passion for community service is core to Clark Scholars. This year's cohort will engage with the community outside of Georgia Tech, working with not-for-profits in the Atlanta area or larger organizations in other parts of the world. The scholars already understand the value and importance of giving back to their communities, and they plan to continue the tradition of service while at Tech.

Here some stories of community service from this year's Clark Scholars.

Sierra Villerreal

Stafford, VA

“I really want to do humanitarian work after I get my education. With social media, you see a lot of different perspectives on what’s going on in the world. But you’re so removed from it. Seeing things in the world that I can’t control makes me feel powerless. And I don’t want to feel that way. I want to do something to make it better. I really want to impact the lives of others.”



Mackenzie Sicard

Kennesaw, GA

“During high school, I was on a Kell Robotics team. We worked with local government and universities to increase STEM opportunities for students. Here in Georgia, we have worked to get a policy passed to increase technology and robotics education in schools. We’ve been very successful so far, securing tax refunds for schools. We want to enable children to study robotics by giving them the resources to do it.”



Nate Tenorio

Downers Grove, IL

“In my community, I went to police auctions and gathered bikes that people did not claim. I then repaired and donated them to Working Bikes, which sends bikes overseas for impoverished people to use. In countries like Lesotho, everything is very far apart — villagers must walk miles to access a clean water source. The bikes empower the villagers to travel more efficiently and focus on what’s important with the time saved.”

Ivan Kirk

Fort Worth, TX

“Community service is important because we have underprivileged members of our community without access to the resources we have. We need to be supportive of those people.”



Sidney Winfield

Kankakee, IL

“Back home, I competed in the FIRST Robotics Challenge, which involved community service. I hosted and volunteered at events to promote STEM education where children were invited to view and drive the robots. It feels good to give back to the community and encourage kids who are excited about STEM.”

Victoria Jiang

Monroe, LA

“Community service is crucial to a healthy community because it allows young ones to extend warmth and generosity to those living in the community. For me, community service is a rewarding way to meet people while accomplishing meaningful service. I’ve served as a junior diplomat in the Ridgeland Chamber of Commerce, executing many events from blood drives to tutoring sessions.”



Alahna Smith

Washington DC

“During high school I served as Key Club International President where I organized many community service events, such as UNICEF fund-raising, Red Cross Blood Drives, community car washes, and other fundraisers where the proceeds would be donated to local charities. Community service is a major component of my life. I enjoy putting smiles on the faces of others by helping out in the community, and giving back can only contribute to making the world a better place.”



Simrill Smith

Decatur, GA

“I want to be an environmental engineer at Tech. I am passionate about sustainable development and the environment, and I’d like to apply that to my career. I’ve always known that I want to create things to make the world a better place. It would be great to contribute something that could make the world more sustainable.”



Suvash Rajesh

Kennesaw, GA

“Community service is important because you begin your life in your community, so you technically owe something when you come out of it and leave. Giving back to your community is something that everyone should be doing because your community raised you and made you who you are.”



Fatima Sherif

St. Louis, MO

“I’ve spent two years working for Youth Engaged in Philanthropy, a program that focuses on youth helping youth. As high school students, we all get together and look to fund programs that help other youth in the greater St. Louis area. We created a grant application form and review all submissions before deciding who gets the \$10,000 grant. I’ve really enjoyed this work because I get to meet other students like me and have an impact on their lives.”

Waste not, want not.

Sanitation startup in Africa turns waste treatment processes into fuel

Emily Woods was scrubbing the inside of a fuel tank one day when her life's purpose suddenly crystallized.

It wasn't the shipboard janitorial duties that called to her, but they did lead her to a critical realization.

"I laughed and thought, 'You couldn't pay me enough to do this, but if it's going to help someone, I don't need to be paid a cent.' At that point, I knew a life of service was for me," said Woods, who would go on to finish a degree in mechanical engineering at Georgia Tech. "I got an engineering degree so I could go anywhere in the world and make a difference in people's lives."

Woods found herself in that fuel tank between her second and third year at Tech. She had taken a year off to work on a nonprofit ship that sailed around the world delivering books to underserved communities without access to education. On the ship, Woods oversaw the cleaning and maintenance of fuel tanks, septic works and chimneys.

When she returned to Tech, Woods (Mechanical Engineering, 2010) wanted to keep getting her hands dirty — figuratively, anyway — and spent time doing research at the Georgia Tech Research Institute. One of her projects involved the solar treatment of human feces, which was thought to be a more energy- and cost-efficient method for treating waste in developing nations lacking modern sewage-treatment systems. Without underground pipe systems to control and manage waste, feces are often dumped into the street, which can create all kinds of public health problems.

Woods met Andrew Foote (EnvE, 2011) in Engineers Without Borders, and together they took the waste treatment research and applied it to a startup accelerator program in Chile under the name Sanivation. They worked to secure funding, develop a business model and begin prototyping. Because Chile had a working sewage system in most parts of the country, they quickly saw that it wasn't quite the right market for their ideas. They decided to jump continents to Kenya in 2013 where they suspected their approach would be in higher demand.

It was.

Today, Sanivation is a growing company with 75 employees and an approach that makes families healthier by improving their household sanitation and using their waste to make cleaner-burning cooking fuel. They call themselves a socially minded, for-profit company dedicated to improving the overall dignity, health and environment of urbanizing communities in East Africa by delivering clean, safe and efficient sanitation services.

To do that, Sanivation provides toilets to families that do not have one. For a small monthly fee, a company employee goes to the house twice a week to collect the waste from the toilet. It's transported to Sanivation's treatment site, where the waste is transformed into affordable, cleaner cooking fuel. Solar energy combined with low-cost infrastructure technology allows the company to be sustainable and rapidly scale.

"Sanivation is growing really fast," Woods said. "We hope to one day be the go-to sanitation provider for non-sewage systems. Right now, we have three factories that are all operating within cost margins, and we want to expand to nine more in the next three years."

Woods said it's critical to be working within the communities you want to serve so you can understand the customer demand and business model that's going to be successful. It wasn't until she moved to Kenya that she discovered how big an issue fuel was for the community.



“I GOT AN ENGINEERING DEGREE SO I COULD GO ANYWHERE IN THE WORLD AND MAKE A DIFFERENCE IN PEOPLE'S LIVES.”

Emily Woods

KENYA, AFRICA



At Sanivation, human waste is turned into fuel pellets for cost-effective energy.

"The people of Kenya spend so much money on fuel that even daily cooking is difficult," she said. "When we realized this and heard about the issues from the community, we realized that we needed to design a solution that solved that problem. And turning feces into a viable fuel was the solution."

Sanivation has grants and contracts from National Geographic, the CDC in Kenya, Grand Challenges Canada and USAID. Woods said contracts are now coming in from refugee camps, where they install and service toilets as well.

"The fuel revenue is adding up, and the factories are becoming net positive," Woods said. "This is really exciting because that is

really hard to do in the sanitation world. A lot of our growth and expansion will come from grants, and we will probably do a series A next year, our first significant round of venture capital financing."

Woods says the community was skeptical of Sanivation at first, not sure if the company would stick around — many aid groups come to Africa and leave shortly after a project starts. But with three years of operations under its belt, the community is starting to trust the company, providing candid feedback about what's working or not working for them.

Sanivation is also providing employment opportunities for the community — almost all of its 75 employees are from Kenya and

surrounding countries. Typically, in Kenya, less than a third of employees in the field are women; Sanivation boasts a 47 percent female workforce, a point of pride for Woods.

"We want to serve more than one million people by 2020," Woods said. "And to do this, we'll continue to deliver health and hygiene products to the doorstep of our customers across Africa."

► GEORGIA PARMELEE

Built with purpose.

CoE alum Jimmy Mitchell is a master at helping old materials find new life

“Come over here a minute,” Jimmy Mitchell says, with an unmistakable ‘wait-til-you-see-this’ tone in his voice. He walks briskly over to a dimly lit section of the warehouse where rough-hewn heart pinewood is stacked on the floor.

“These are floor joists from the original Tech tower, built in 1888,” Mitchell says, leaning over to touch the coarse boards. “If you look closely, you can see the original nails in some of them — they have a flat square head, unlike the round-head nails used today.”

The historic planks ended up here, inside Georgia Tech’s Grinnell Warehouse, after Mitchell got a call last year from a project manager overseeing the recent renovation of Tech Tower. He asked Jimmy: “Could you use these for anything?”

A project estimator for construction powerhouse Skanska, Mitchell (CE, 2005) had been looking for some kind of material to create an artifact to be auctioned by the Georgia Tech Alumni Association, for which he served as a trustee. He could do something with a scrapped joist. “I

cut four diagonal pieces out of one of them and made a picture frame out of it,” he said. “It sold for \$565.”

But he had another realization: The reclaimed timber also could be an important addition to one of the most ambitious building projects in Georgia Tech’s history: The \$25 million Kendeda Building for Innovative Sustainable Design, now under construction at Ferst Drive and State Street.

The story of the donated wood illustrates what Jimmy Mitchell does best: Create ways for old materials to enjoy a useful new life somewhere else.

The Tech Tower joists will be used as stair treads inside The Kendeda Building. Next to them in the

warehouse, a pile of polished granite slabs will get their own second act, too. “These came from the outdoor plaza of the old state Archives Building before it was demolished last year,” Mitchell says. “We’ll use them to build a system for processing gray water in the new building.”

Mitchell oversees the collection and use of recycled components inside The Kendeda Building, which goes above his usual duties of calculating costs for big projects at Skanska — but Kendeda is a crucial assignment. Using a specified amount of reclaimed materials is one of the requirements for the building to become certified through the Living Building Challenge, billed as “the world’s most rigorous, proven performance standard for buildings.” In achieving the goal, The Kendeda Building would join just 21 other Living Building Challenge-certified structures in the U.S. that actually produce more energy than they consume.

To manage the complexity of such an effort, it’s hard to imagine a better choice than Mitchell. Beyond being a skilled civil engineer and expert in green building, he’s dedicated to bringing more sustainability into the world.

“Salvaging and reusing materials is my career passion,” he says. “It makes the built environment more efficient and often reduces costs. It also carries on tradition and tells a story — of the effort to salvage, the historical context of where something came from and the missions of the organizations involved.”

To see evidence of Mitchell’s passion, look no further than Adair Park in southwest Atlanta. It’s here, on Murphy Avenue, that you’ll find a once mighty building that housed the Bailey-Burruss Manufacturing Company, maker of sprockets and pulleys for milling plants. The company shut down operations in the 1980s, and its football field-sized structure held other occupants before finally emptying in the early 2000s.

The façade is still weather-worn and graffiti-littered, but the building brims with new purpose as the Lifecycle Building Center (LBC), which Mitchell co-founded in 2011. The center accepts materials that are likely destined for the landfill, then sells or donates them for reuse, mostly in construction projects. By launching the nonprofit with three others, Mitchell gave Atlanta something



Inside the Lifecycle Building Center



A rendering of the Kendeda Building on Georgia Tech’s campus.



ATLANTA, GEORGIA



CRAIG BROMLEY

that was missing from its sustainability scene — namely, a central repository for collecting and redistributing doors, fixtures, wood and other items and materials.

In an era of convenience and disposability, such an enterprise is sorely needed. The EPA estimates that 170 million tons of building materials end up in U.S. dumps each year, yet much of it could be reused. LBC is doing its part to reduce such waste.

“So far, we’ve saved 3.8 million pounds of stuff from the landfill,” Mitchell says as he guides a visitor around the 70,000 square-foot facility. As an example, he points to a fenced mezzanine overhead. “Upstairs there, we’re storing subflooring and other construction items from an international trade display used by Jaguar. They donated 18 truckloads of material a couple of years ago.”

Who wants all of this stuff? Mitchell names contractors, artists, do-it-yourselfers — even TV and film companies. He shares a story about lab equipment given to LBC by a local medical research company before undergoing a renovation. “When the set designer of ‘The Walking Dead’ visited our warehouse and saw all of this equipment, her eyes got big,” he says. The show ended up buying six truckloads of items for lab scenes.

Perhaps the greatest beneficiaries of LBC’s largesse are area charities. “We set up a nonprofit match program, and over 160 nonprofits have received salvaged materials from us for free,” Mitchell says. The organizations use the goods not only for construction, but also to outfit or equip space with items.

While Mitchell’s formal role with the Lifecycle Building Center has lessened — he once chaired the board — he remains committed and involved as a volunteer, advisor and broker. Because sustainability is cyclical, the work can never be finished. Fortunately, Jimmy Mitchell is in it for the long haul.

► MICHAEL BAXTER, DESIRINA FREW

A sister stands up.

CoE graduate Segolene Muderhwa works to elevate girls in her home country

When Segolene Muderhwa describes her home country, the Democratic Republic of the Congo, she speaks with great pride — and great concern.

The Congo is abundant in mineral resources. Its people are welcoming and creative. But the Eastern provinces have been ravaged by decades of violence and instability. Rape has been used as a weapon of war, destabilizing communities where Congolese women are the heart of the family unit.

Today, Segolene (ISyE '17) talks of young people in the Congo taking the initiative to find ways of serving their country. She is one of them.

Segolene was fortunate to have been raised in the western capital of Kinshasa, away from the conflicts in Eastern Congo, but she witnessed the struggle of youth every day.

"I would see girls my age begging in the street," she recalls. "They would ask me to spare some cookies or water for them. I would see kids my age walking to school with plastic bags as school bags and torn up shoes."

She also had the benefit of a mother who taught her children to share. "She would always take us to the orphanage to donate things," Segolene says. That experience was a harbinger of what was to follow in Segolene's life.

As a second-year college student in the U.S., Segolene and her friends from Congo talked about how they might give back to their home country. They decided to launch a nonprofit, Soeur Leve-toi, which is French for "Sister, Stand Up," to help disadvantaged girls in Congo pursue and persist in their education.

"We decided to focus on young girls because it's most difficult for them," she says. "If you're a seven-year-old girl on the street, you cannot defend yourself. Not only that, girls have less of a chance of going to school. If a family can't send all the kids to school, they send the boys first, even if the girls are smart." The rationale, she explains, is that the boy will take care of the family when he grows up, whereas "the girl will marry and belong to another family."

Of course, a small nonprofit like Soeur Leve-toi can't correct such a societal imbalance alone. But Segolene and

"IF A FAMILY CAN'T SEND ALL THE KIDS TO SCHOOL, THEY SEND THE BOYS FIRST, EVEN IF THE GIRLS ARE SMART."

Segolene Muderhwa



her co-founders knew they could have a profound impact on the lives of some girls, all of whom live in orphanages.

Through Soeur Leve-toi, they created a network to connect the girls to adult supporters through a yearly "Women-to-Women" conference. They started a series of summer camps to build confidence and self-esteem. "The camps help them believe they can do something with their lives," Segolene says. "In camp, we work with girls who heard, every day, they can't do anything with their life."

Soeur Leve-toi also launched the Malaba Scholarship, which Segolene oversees, to help more girls take their studies further. Beyond financial support, the scholarship program provides personal guidance in the form of "godmothers," who meet frequently with the girls who receive the scholarships.

Maliyamungu Muhande, who heads communications for Soeur Leve-toi, also grew up in Congo. "The thing that's beautiful about Soeur Leve-toi is that girls and women unite to empower each other," she says. "Segolene is one of those. She's so disciplined, and that's one reason I really look up to her. We share a mutual yearning for change in our country."

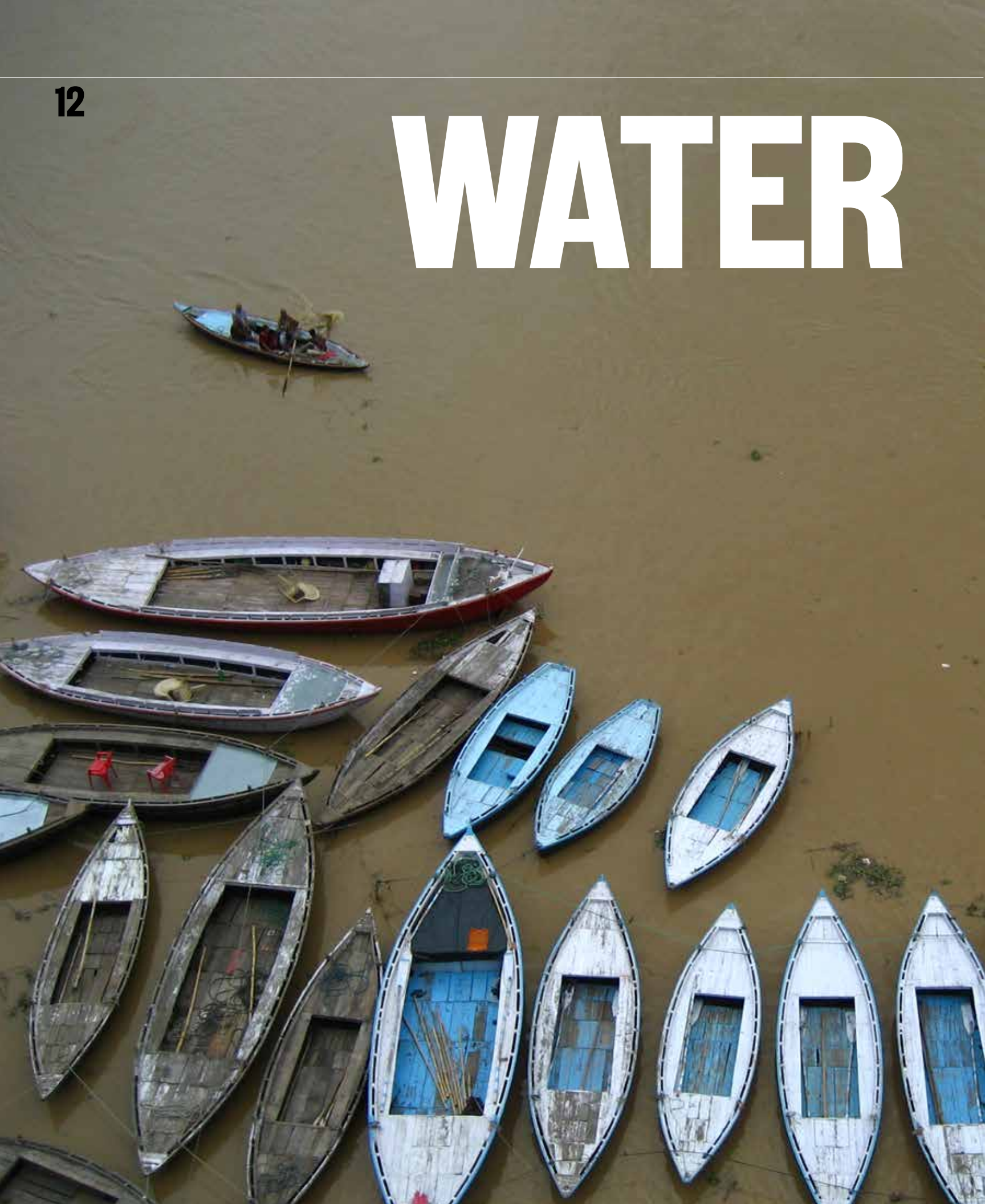
As for preparing for such a challenge, Segolene credits her Georgia Tech experience, which includes an M.S. in Analytics, as well as an undergraduate degree in industrial systems engineering. Perhaps one of those girls will also end up an engineer someday to bring about more change — in places where it's needed most.

► MICHAEL BAXTER

DEMOCRATIC REPUBLIC OF THE CONGO, AFRICA



WATER



WELL MADE

A PAIR OF GEORGIA TECH ENGINEERS TAKE DIFFERENT PATHS TO SAFEGUARD LIFE'S MOST ESSENTIAL RESOURCE



Pollution of the Ganges, the largest river in India, poses significant threats to human health and the larger environment.

When our water comes out of the faucet a little brown,

or we hear on the radio that a “boil water advisory is in effect,” we get a taste of what everyday life is like for millions of people.

For them, simply using water is a dangerous game of chance. Today, it might be fine. Tomorrow, it could bring illness that eventually ends a life.

In such places, factors like poverty and strife prevent the problem from ever being fully remedied. But sometimes, people from the outside step in to fill the void, lend a hand or propose a solution. Tracy Hawkins (ISyE, '85) and Arjun Bir (ECE '18) are two such individuals.

In very different ways, these Georgia Tech engineers leveraged the experience of their education to make an important contribution to improving water quality in the world. Tracy brought the simplest of water purification technologies to thousands in Tanzania; Arjun invented a tool that may well transform the widespread testing of water.

Though divergent, their paths have something in common. Both are a testament to the potential that a single engineer can make a difference.

The purifying magic of ceramic

Her first trip to Tanzania was a marriage of two passions — ceramics and volunteering. The year was 2005, and Tracy was in an East African nation helping youth learn how to make pottery to sell to tourists.

It didn't take long for her to see that the “volunteer vacation” would be more than an episode. After she returned, Tracy vowed to create a pottery department in one of Tanzania's vocational schools.

“So, I'm home in the U.S., and I'm looking to associate with an existing nonprofit,” Tracy recalls. “As I'm researching organizations, I come across one that makes

ceramic water filters in Nicaragua. As I read about them, I thought, hmmm, I drank bottled water the entire time I was in Tanzania. What do the people who live there drink?”

She made good on her promise of starting a school pottery department, but Tracy would go on to do much more for the people of Tanzania. She launched SAFE Water Now, a nonprofit that manufactures and distributes ceramic water filters to the citizens of Tanzania, many of whom live in extreme poverty in the most remote locations.

A man she'd met on her first visit — Mesiaki Yonas Kimirei, known to everyone as “Kim” — would factor prominently into her plans. “I was told he is the best kiln maker in Tanzania,” Tracy says. “We've now been working together for 13 years.”

Kim heads SAFE Water Now's sister enterprise, Safe Water Ceramics of East Africa (SWCEA), in Arusha, Tanzania, which actually makes the ceramic filters. The filters' design and function are elegantly simple. Fashioned from clay and sawdust — with the right measure of colloidal silver to enhance purification capability — the finished filter resembles a large garden planter.

Instead, it ends up inside a plastic utility bucket. Muddy, untreated water is poured into the filter; clear, drinkable water emerges from the dispenser. A single \$40 filter cleans the water for a Tanzanian family for about five years, providing an extraordinary return for a charitable gift. A dollar provides safe water for one person for one year.

Getting to this point, Tracy says, demanded perseverance and the ability to tap her industrial systems engineering education.

Tracy Hawkins (ISyE, '85)
Safe Water Ceramics of East Africa



TAYLOR JOHNSON

The filters' design and function are elegantly simple. Fashioned from clay and sawdust — with the right measure of colloidal silver to provide purification capability — the finished filter resembles a large garden planter.



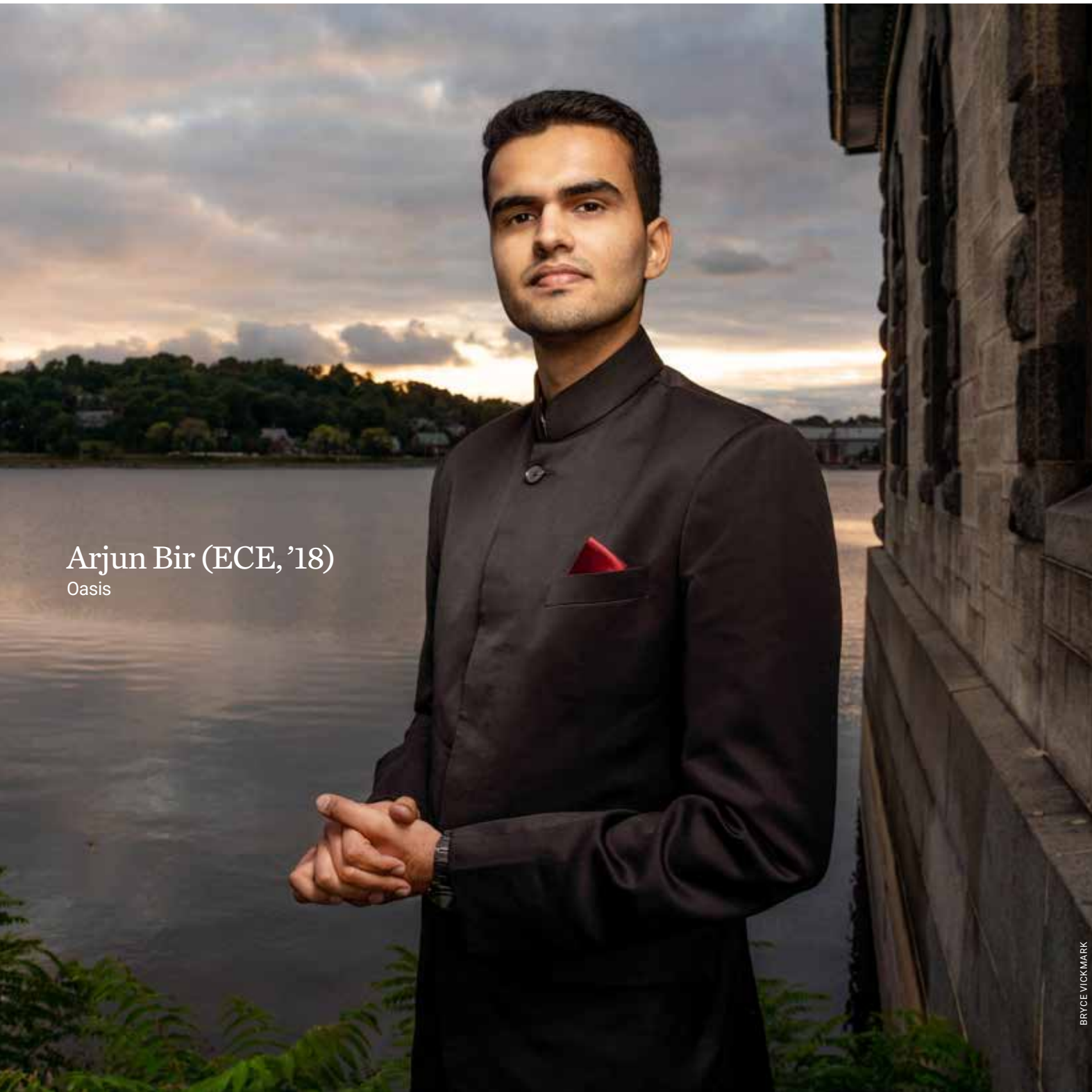
TANZANIA, AFRICA





INDIA

Both the cylinder and its cap are for scooping two water samples to pre-determined fill lines; each sample is poured into a pouch of powder. (The chlorine tablets are used later to decontaminate the samples.) Within 48 hours — or 24 hours, if an incubation heat source is available — the water samples turn red if the slightest amount of *E. coli* is detected.



Arjun Bir (ECE, '18)

Oasis

BRYCE VICKMARK

For one, the filter-making must take place around electricity outages. The area averages only 10 hours of power a day, and the timing of outages is not usually predictable. Nature is another factor. High humidity adds time to the drying of clay. When the rains came in 2015, flooding from nearby road work destroyed equipment and motors. They essentially had to start their operation all over again.

And then there's distribution. SAFE Water Now lacked the people and vehicles to get the filters into the remote households of those who need them.

"So we formed a partnership with tourist safaris," Hawkins says. "The tour guides are trained on how the filters work, and they're able to demonstrate that to the recipients. The tourists are excited to participate, and when they come back, they often raise funds to deliver more filters to families in need."

Today, if you ask Tracy Hawkins to describe the best day she's ever had in Tanzania, she doesn't hesitate to answer.

"I'm still waiting for it," she says, laughing.

Meaning: Where some see success, Tracy sees only potential.

"Sickness and diarrhea and dying children are normal here," she says. "But that is *not* normal, and it is very distressing to me. We can produce up to 2,000 filters a month, but we are far from capacity. We work in a region where most people can't afford a \$40 filter. It is up to us to find the resources to help where it's needed most. So there's still a lot of work to do."

Into the hands of the people: A \$3 water test

On this summer morning in 2018, Arjun is relaxed in the atrium lobby of Clough Commons, talking about Ojal, the water-testing kit he developed as a student in Georgia Tech's School of Civil and Environmental Engineering. He flashes a broad smile as he admits to being in what he calls a "save-the-world" phase when he first arrived on Tech's campus in 2014.

"I thought infrastructure was one place I could apply myself because of what I saw back home in India," he says. "Civil engineering touches people's lives in very important ways."

As an entering freshman, Arjun researched the backgrounds of faculty members and began contacting some of them to introduce himself. One was Joe Brown, Carlton S. Wilder Assistant Professor of Environmental Engineering.

"I remember Arjun walking into my office with a whole notebook of ideas and things he was working on," Brown says. "I saw a spark and thought, 'Here's a guy we need to get involved in research somehow.' So I invited him to a conversation we were having with Ph.D. students."

In very different ways, these Georgia Tech engineers leveraged the experience of their education to make an important contribution to improving water quality in the world.

Arjun eventually joined Brown's lab. On a field trip to La Paz, Bolivia, he and other students compared different methods to test local water for potentially harmful microbes. "Being in La Paz that one week showed me there was a real need for a low-cost water test," he says.

That sent Arjun on a mission to develop such a test, one that was not only inexpensive but incomparably easy to perform. The result was Ojal, a cardboard cylinder roughly the size of a tube of toothpaste. Inside are two pouches of formulated powder — commonly used in water testing, but modified — and a pair of chlorinated tablets.

Both the cylinder and its cap are for scooping two water samples to pre-determined fill lines; each sample is poured into a pouch of powder. (The chlorine tablets are used later to decontaminate the samples.) Within 48 hours — or 24 hours, if an incubation heat source is available — the water samples turn red if the slightest amount of *E. coli* is detected.

"*E. coli* is the target because if it's present, that tells you that the contamination for all other pathogens is open," Arjun explains. "It's like telling you whether the main door of your house is open so that a thief can enter. If it's open, if we see *E. coli* present, then it's safe to say there's something else harmful that's present."

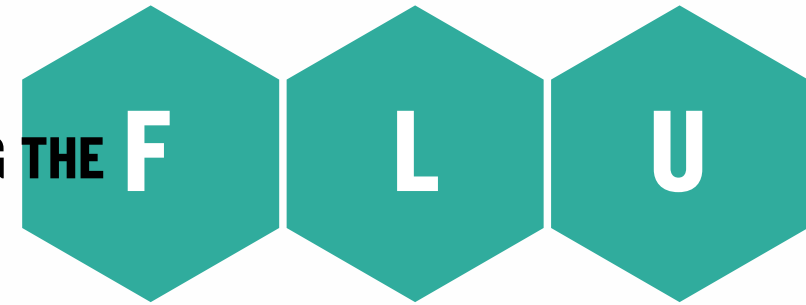
The test retails for \$2.99, far less than the typical cost of \$13, and its simplicity means anyone can use it. "Letting people explore their own water quality is powerful for behavior change," Arjun says. "We did a trial in Kampur, India, with 3,000 tests. In just one month, the mean count for *E. coli* dropped between 30 and 50 percent. Since we were making it easy for people to do their own testing, they knew to boil water or take other steps when they found something."

By providing simple and affordable water testing, Ojal also offers an avenue for gathering data on a massive scale. A mobile app allows testers to report their results, providing local governments with a current picture of water quality. That kind of impact could be far-reaching for local and national governments.

"Arjun is passionate about using his skills in engineering to solve really important problems," says his former professor Joe Brown. "As an undergraduate, he consistently turned in work as good as a Ph.D. And he's incredibly serious about changing the world."

Years from now, Arjun will likely be able to say he's done just that. The same is true for Tracy Hawkins — not to mention future Georgia Tech engineers who will follow their lead. ◀

OUTSMARTING THE



ENGINEERS ARE DEVELOPING UNCONVENTIONAL TACTICS TO VANQUISH THE FLU VIRUS

The 2017–18 flu season was a rough one everywhere, and Georgia was no exception. Local health officials called it the worst outbreak in decades. If you didn't get sick, you probably know someone who did – and that unlucky person likely battled aches, coughing and fever.

While most flu sufferers get by with bed rest and chicken soup, others are hit much harder. According to the Georgia Department of Public Health, more than 3,100 people in metro Atlanta were hospitalized with the flu this past season. Flu complications can even be fatal, killing 12,000 to 56,000 people annually in the U.S. alone.

Finding new ways to fight the flu is a top priority for researchers around the world, and Georgia Tech's College of Engineering is very much in the game. Here are two unconventional ways Georgia Tech engineers are tackling the challenge.



“THE SIGNIFICANCE IS THAT WE IDENTIFIED PREDICTORS THAT ARE COMMON ACROSS MULTIPLE YEARS OF VACCINES.”

Eva Lee

1

IMMUNOBIOLOGY INSIGHTS FROM MACHINE LEARNING

Engineering a better flu vaccine might seem like a job best left to a biologist. But Eva Lee, Virginia C. and Joseph C. Mello Chair and professor in the H. Milton Stewart School of Industrial and Systems Engineering, is proving that mathematicians can play a crucial role — and in her case, shape a new paradigm for developing vaccines.

Using a powerful machine learning approach that she pioneered, Lee found a way for scientists to determine how effective a vaccine is shortly after it's administered. Typically, it takes about four weeks to know whether a vaccine will create a strong enough immune response to protect a patient from the flu. But Lee's method reduced that time to just three days.

Here's how: In two major studies, biomedical researchers at the Emory Vaccine Center collected blood samples from people who received a flu shot. To chart participants' immunity over time, the scientists measured the level of flu antibodies produced in response to the vaccine. Lee analyzed this data using a highly sophisticated machine learning program she developed, called DAMIP. The program allowed her to tease out correlations that had never been seen before.

Her analysis revealed the presence of certain biomarkers in the vaccinated patients who later developed immunity, i.e., particular genes in white blood cells that get 'turned on' as the body prepares to manufacture antibodies. Because the emergence of these biomarkers happens quickly, Lee could offer a much earlier picture of the vaccine's effectiveness.

The flu studies that Lee participated in were especially useful because they took place over multiple flu seasons. Biologists could

apply Lee's predictions about the biomarkers to participants in later seasons and test how accurate they were. Using the genetic signatures she identified, the researchers could predict — with 90 percent accuracy — whether the flu vaccine would be effective for a specific individual just three days after that person received the vaccination.

“When I identified those genes, they had not been identified by any biologist in the past,” Lee says. “They validated the results in the lab, which were stunning.” Previously, researchers could measure the levels of flu antibodies a few weeks or a month after a patient receives a trial vaccine, indicating whether it worked or not. But Lee's findings illuminate the mechanisms underlying these responses — not just whether it worked, but why.

“The significance is that we identified predictors that are common across multiple years of vaccines,” Lee says. The new insights could help researchers design a vaccine that provides immunity from more flu strains, she adds.

Lee's work brought another benefit. Identifying the effectiveness of a vaccine within three days, instead of a month or longer, would greatly accelerate vaccine development. In an environment where developing and testing a new vaccine can take many years, any innovations that speed the process are welcome.

Lee's research also signifies a step toward a universal flu vaccine, a one-time immunization that provides long-term protection. The influenza virus is always changing, and it's not easy to confer immunity to a virus that technically doesn't yet exist. But work like Lee's could help counter this unpredictability by identifying common signatures across multiple flu strands, as well as patient populations.

2

THE PAINLESS SHOT

Developing the most effective flu vaccine possible is only one part of the puzzle. Because no vaccine is effective if you never receive it.

Right now, only four in 10 U.S. adults get their flu shot each year. Some never find the time to visit the doctor or local pharmacy; others are simply afraid of needles. Worldwide, the flu vaccine is unaffordable or inaccessible in many places, worsening the likelihood of the global pandemic that health experts fear.

So what if you could receive the vaccine without having to get a traditional flu shot? That's the question Mark Prausnitz has been pursuing — and it looks like he's found an answer.

The Georgia Tech Regents professor of chemical and biomolecular engineering created a peel-and-stick microneedle patch that painlessly delivers a vaccine with the ease of applying a Band-Aid. Granted, “microneedles” may not sound like something you'd be eager to encounter, but these microneedles are tiny spikes measured in microns. They're smaller than a millimeter — more like a few stacked grains of salt. At this size, they don't penetrate deeply enough to reach the nerves, so they don't cause any pain.

The process of creating a strong, minuscule needle out of water-soluble polymers is pretty high-tech. Prausnitz's lab uses state-of-the-art micro-fabrication equipment to craft the perfect prototype in the shape of the desired patch. “We had to spend a lot of time and effort making this master structure in the shape of the needle we want,” Prausnitz says. From there, they created an inverse silicon mold, sort of like the world's tiniest ice cube tray. They pour the vaccine mixture into this mold, where it hardens and dries. The mold can be used again and again.

Prausnitz's team has collaborated closely with researchers at Emory University to test the microneedle patch flu vaccine. In a Phase I clinical trial that concluded last year, the flu vaccine patch was shown

to be safe and effective, with no difference in measured immunity between the patients who received the patch from a professional and the ones who administered it to themselves. More than 70 percent said they preferred it to the traditional flu shot.

Because the main purpose of a Phase I trial is to verify safety, the participants were all healthy adults. Next, the researchers will test the microneedle patch's effectiveness with more participants, including people more at risk for severe flu complications.

The patch has advantages beyond being painless, especially in areas around the world where healthcare infrastructure is lacking. Because the vaccine is delivered in a dry state instead of the usual liquid, it doesn't require refrigeration and thus has a longer shelf life. And because the water-soluble microneedles dissolve directly into the skin, there's no biohazardous “sharps waste” to manage.

Could the microneedle patch help with a universal flu vaccine? Maybe.

“A universal flu vaccine is really challenging, and there's a lot of people working on it. There's not going to be a simple solution; it will require a collection of approaches,” says Prausnitz. But delivering the vaccine to the skin instead of the muscle appears to create a broader immune response, meaning the body produces a more diverse selection of antibodies — which might mean immunity to a wider variety of flu strains. More research is needed to test this possibility.

Exactly a century ago, the deadly 1918 Flu Pandemic swept the globe, sickening around a third of the world's population and claiming an estimated 50 million lives. Since then, public health officials have worked hard to prevent a recurrence.

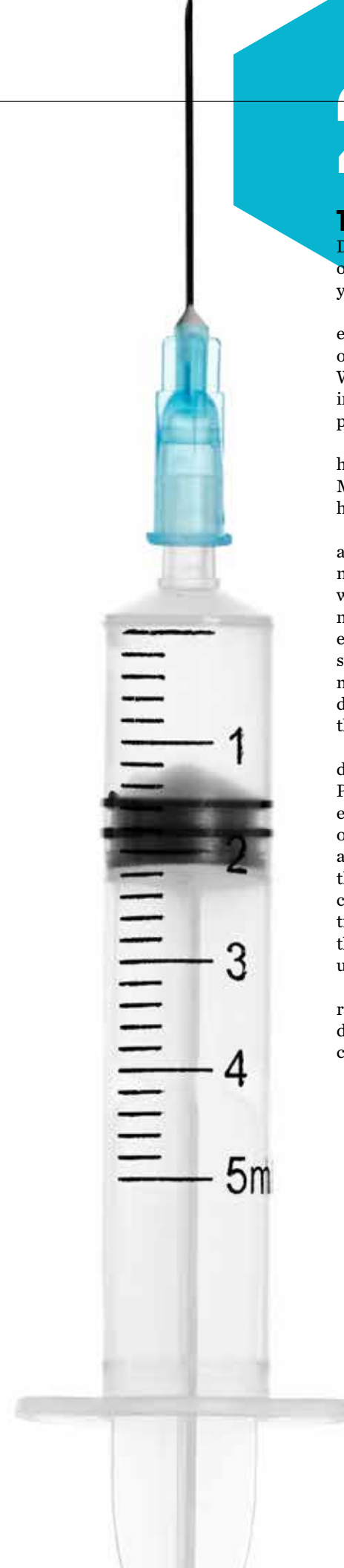
But the fast-mutating flu virus remains an ever-present threat. Experts say the next pandemic could strike at any time. When it does, the innovations of engineers like Eva Lee and Mark Prausnitz will give us the vaccination arsenal we need to strike back. ◀

“THERE'S NOT GOING TO BE A SIMPLE SOLUTION; IT WILL REQUIRE A COLLECTION OF APPROACHES.”

Mark Prausnitz



CRAIG BROWLEY



THE GREATER GOOD >

ENGINEERING STUDENTS GIVE BACK TO COMMUNITIES ACROSS THE WORLD



MARSABIT, KENYA

JENS KLINZING

The last time Joy Harris visited the small rural village of Marsabit, Kenya, she looked out her window and saw villagers drinking out of the same pond as the animals. During flood season, this pond becomes further contaminated with human waste that washes down from the streets. Villagers scoop water out of the pond with buckets to take home for drinking, bathing and cooking. It's an extremely unsanitary situation.

Harris immediately knew she wanted to develop a long-term solution to get clean water to people of Marsabit. It's the perfect project for her Engineering for Social Innovation (ESI) students to take on. In the coming year, mechanical and materials science students plan to design a filter for the pond water that would make it safe to drink. Communities across Kenya will use the filters to access clean water, vastly improving their quality of life.

Water quality issues across Africa are just one type of problem that engineers at Tech are solving through ESI. Harris is the proud founder of the program and has a vision for it to give every student on campus the opportunity to use their skills for social impact.

"My students are very focused on making the world a better place for others, and if they can do that through engineering, it's even better," said Harris. "ESI is a way for me to create a clearinghouse, a hub for social impact opportunities for students."

ESI provides many different opportunities for philanthropically-minded students to get involved and help those in need.

Providing mission and purpose

The student projects within ESI touch many individuals from across the world. For Harris, the mission of the program is to give all engineering students a way to make a social impact.

"When I graduated from Tech, I felt that as an engineer, I wouldn't be able to help people," said Harris. "At least, that's how it seemed. But the fact

is that's just not true. ESI helps us show students what they can do with their knowledge to help and empower others."

Students today are coming to Tech with an even greater desire to give back, looking to do something relevant.

"I feel like being an engineer is being a problem solver, and ESI provided me with a platform to use my knowledge to solve problems that are impacting people's lives," said student Fan Chen. "The communities can really benefit from our help, and it makes me happy to see that my work has made a difference somehow."



“MY STUDENTS ARE VERY FOCUSED ON MAKING THE WORLD A BETTER PLACE FOR OTHERS, AND IF THEY CAN DO THAT THROUGH ENGINEERING, IT'S EVEN BETTER.”

Joy Harris, Director of ESI

> The Greater Good

SPINNING CHIP BAGS INTO GOLD (ROPE)

Streets littered with trash are a common occurrence and major problem in many parts of India. In fact, New Delhi has seen a 2,000% rise in tons of garbage produced in a day. So, Risabh Datta (Mechanical Engineering, 2019) and Fan Chen (Electrical Engineering, 2017) teamed up with Waste Ventures in New Delhi to find effective ways to recycle trash.

Chip bags and other food packaging are often made with metallized film, which is a major contributor to environmental damage, as there is no cost-effective way to fully recycle it. Datta and Chen decided to come up with a plan to repurpose the waste.

After examining the properties of the metallized film, the students realized that they could heat the material with something as simple as a curling iron and bind the material together to make a rope that can withstand hundreds of pounds of pressure. The rope can then be used for packaging, or to make waterproof tarps or thermal blankets.

“I’ve always been a strong advocate for sustainable environmental practices,” said Datta. “So, the prospect of being involved in

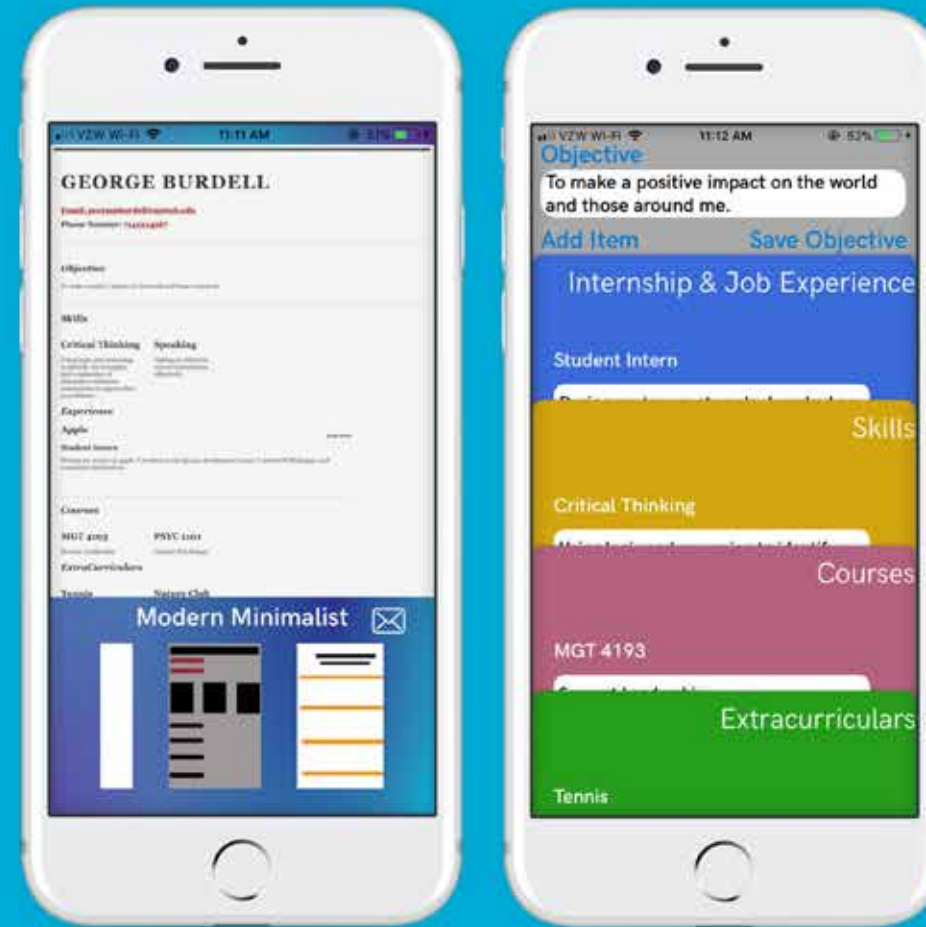
a project with real environmental impact appealed to me. I enjoy working on open-ended problems that solve real-world issues and seeing the impact we can make on people’s lives.”

The repurposed metallized film is highly versatile, with plenty of potential in poorer communities, where access to packaging, waterproofing or insulating materials is limited. Waste Ventures was highly optimistic about the prospect of teaching the local community to build their own rope, tarps and blankets from the chip bags, and estimated that the trash could solve common problems like water leakage faced by the community.

Datta and Chen hope the project will help clean up the streets of India and create a sustainable way for the local community to manufacture useful products.



INDIA



> The Greater Good

CREATING AN EXCEL-LENT RESUME

For individuals with intellectual and developmental disabilities (I/DD), writing a resume and keeping it up to date for job applications can be a daunting task. The Excel program at Georgia Tech’s Scheller College of Business has partnered with ESI to help I/DD students write resumes — a small part of its larger mission to provide career development and academic enrichment for I/DD individuals.

“Through Excel, I/DD students learn to be self-sufficient and develop skills that can be used for gainful employment,” said Rene Reese, career development coordinator, Excel Program. “We give students the chance to continue their education, become more independent, and earn certificates that set them up for success in the working world.”

Arya Mirshafii (Electrical and Computer Engineering, 2020) saw the opportunity to put his computer engineering skills to use to help the Excel program. According to Reese, resume writing is challenging for most college students, and for Excel students it’s even more difficult. With that in mind, Mirshafii created an app that allows users to input basic information like skills and job experience, and the app auto-populates a formatted resume, along with personal and academic information received

directly from Scheller. Anytime a user makes an update to the app, it automatically updates the resume as well, stored in Google Drive.

“I wrote the code for this app because I know how painstaking it is to update and reformat a resume,” said Mirshafii. “And if it’s hard for me, I figured it would be hard for others as well. I really like that I can apply my computer engineering skills to create an app that actually helps people.”

Mirshafii is also planning to create a system on Google Drive to allow Excel career counselors to access resumes and provide real-time feedback to students. The Excel app is already available in the App Store and will soon be on Google Play for Android devices.

“Excel students strive to be independent and self-sufficient, and tasks that require a higher level of critical thinking and writing skills are typically overwhelming and too often insurmountable,” said Reese. “So for us, the resume app complements our students’ desire to be independent and self-sufficient by simplifying the resume building process. It’s been invaluable for connecting students with employers and giving them the best shot at landing a job.”



> **The Greater Good**
CLEAN AIR FOR INDIA

In addition to trash, another major environmental issue in India is air pollution. Local traffic and factories emit microscopic cancerous particulate matter, making the air quality in New Delhi sometimes as bad as if a person smoked 44 cigarettes a day.

Growing up in Mumbai with asthma, Angad Daryani (Electrical and Computer Engineering, 2020) came to Georgia Tech motivated to study air purification. So, when he met Harris and joined ESI, it was only natural that he work to solve India's air quality problem.

"In high school, I realized I wanted to solve big problems that impact millions of people," said Daryani. "This has continued to be the drive behind my work to make India a cleaner, healthier place."

In spring of 2018, Daryani invented an air purification prototype, which will sit in the middle of traffic circles throughout New Delhi. It's an industrial-scale air filter that pulls in air and removes pollutants and carcinogens. A small model was created this summer and tested in Mumbai, and it worked.

Daryani is currently refining his product to a 20-foot cylindrical tower that sucks in air, separating pollutants in a five-phase, proprietary process. The tanks that collect the dust and carbon will only need to be emptied every one to two weeks.

The team is comprised of nearly 20 engineers and designers across many disciplines working to make his prototype a reality.

He's also been reaching out to independent investors, venture capital funds and angel investors to fund this project. He says he spends about 80 to 100 hours per week on the project.

"The biggest challenge in fundraising has been asking Indian companies for a \$135K grant for research — it's just not something they're used to," said Daryani. "Moreover, the investors are hesitant to invest in a company where the entire team is based out of the U.S."

The next step will be to raise his Series A.

Currently, Daryani and team are working toward a market-ready prototype that includes an intelligent system based on sensor data that identifies high pollution areas. The industrial designers and mechanical engineers will ensure the design and structural integrity of the device. The chemical and electrical engineers will try to minimize all emissions and maximize efficiency. And the computer engineers will build the web platform that can speak to these devices. The goal is to have all of this completed by December 2018 and start scaled testing early next year.

Eventually, Daryani would like to have his air filters in different sizes, placed across India in cities with a high concentration of vehicles and industrial facilities. He hopes this will be the start to helping the people of India breathe cleaner, healthier air.

> **The Greater Good**
A CAR THAT CAN HEAR

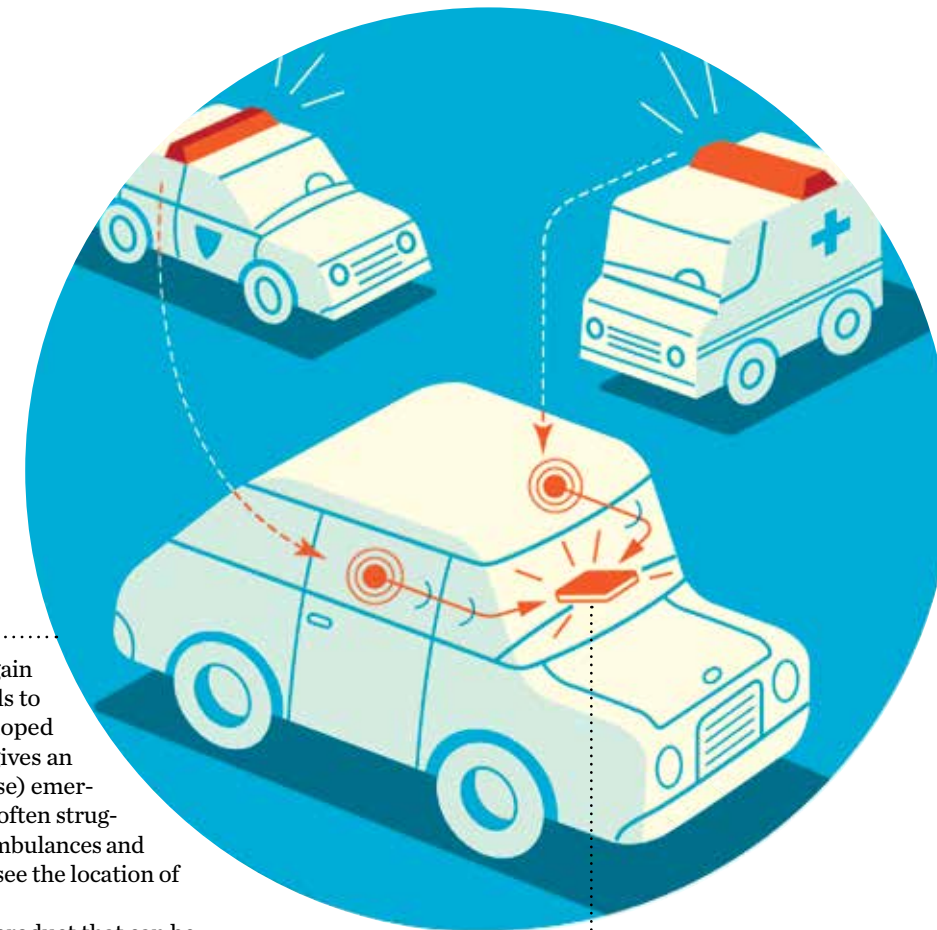
In addition to the Excel app, Mirshafii again applied his electrical engineering skills to help disabled individuals. He's developed a hearing car device that essentially gives an automobile the ability to hear (or sense) emergency vehicles approaching. Deaf drivers often struggle with knowing when to move over for ambulances and firetrucks. With the hearing car, they can see the location of the emergency vehicle in real-time.

The hearing device is an aftermarket product that can be attached to any car. It's comprised of two circuit boxes (micro-controllers) placed on either side of the car that can detect frequency. The device connects with the driver's smartphone, which can be mounted to the dashboard. The driver can then see a display that depicts the direction the emergency vehicle is coming from. It can even differentiate horns from sirens.

"I wrote the code for the microcontroller device in the car, as well as the app," said Mirshafii. "We've been working with the Idaho School for the Deaf to develop this prototype and tweak it based on their needs."

This fall, Mirshafii plans to refine the prototype and move it closer to a complete product. This will involve simplifying the electronics, circuitry and code for the microcontroller and updating the device from Bluetooth 2.0 to Bluetooth Low Energy to reduce energy consumption. He also wants to improve the iPhone and Android app user interfaces and make the code more efficient.

Mirshafii hopes to continue applying his coding skills for other projects in ESI that help individuals with disabilities. ◀



POWERING HAITI

A portable solar panel system that provides light and cell phone power is changing the landscape of Haiti





Thoman is a Haitian village 50 miles east of Port-au-Prince near Fond Parsien. It's nestled in the southeastern mountains with a population of about 5,000.



THOMAN, HAITI

JONAS STEWART

“That’s a great project, but do more,” challenged the audience member standing at the back of the room. “Don’t stop there. Do something that scales up.”

The request came during a campus debriefing for the Haiti solar power project, a multiyear effort where Georgia Tech students and staff worked with a Georgia church group to install solar panel arrays in the isolated village of Thoman, Haiti. One was installed on a medical clinic, and another on a church, which doubled as a community center.

But that wasn’t enough, according to the man at the back of the room, and he would know. The man was Wayne Clough, past president of Georgia Tech and professor emeritus in the School of Civil and Environmental Engineering.

“Dr. Clough told us that there are plenty of people in Haiti perfectly capable of doing what we did,” explained Alec Kumpf, a fifth-year ECE student who helped install the solar arrays. “They just needed training. He challenged us to find a way to take solar power to Haiti in a way that empowered the local people to create businesses and jobs.”

And that’s how phase two of the project began.

Working with Frank Lambert, a faculty advisor and research engineer from Georgia Tech’s Strategic Energy Institute and the National Electric Energy Research, Testing & Applications Center (NEETRAC), a group of students developed a portable solar panel system that connects to a battery that houses two USB ports. Those ports can be used to power LED lights or charge cell phones, meeting two major needs in Haiti.

“In Haiti, if you ask people to prioritize their needs, cell phone access is close to the top. It’s ahead of lighting,” explained Lambert, who was recently elected to serve as president of the IEEE Power and Energy Society. “Even in one of the poorest countries in the world, where people live in the most basic of buildings with no running water or electricity, cell phones are a priority. It’s how people interact



“It was important for most of the work and planning to be collaborative and inclusive. We didn’t want to play the role of ‘teachers,’ which would have been insulting to the locals and naive. Instead, we wanted to play the role of collaborators.”

McKenzie Rhone



with each other and the world. Being able to charge a phone is a big deal.”

In addition to charging phones, the solar arrays give people access to electric lighting, a rare luxury in rural Haiti with life-changing implications. Having lights provides children the opportunity to do their schoolwork and continue their education, without the dangers imposed by candles.

“When the sun goes down in Haiti, so do opportunities to learn,” said Kumpf. “Candles are dangerous and kerosene is expensive. We heard so many stories. One family home was burned to the ground when a 10-year-old girl put a candle too close to a kerosene lamp. Not everyone survived the fire, and unfortunately, stories like that are not uncommon.”

In order for the project to scale up and become sustainable, Georgia Tech students are working with the people of Haiti to come up with a business plan involving the arrays, which the locals have taken to calling ‘relays.’ Dubbed the Solar Entrepreneurship Program, the intent is for the technology developed at Georgia Tech to be a vehicle for transforming local communities. The relays

are a source of safe light, power for cell phones, and a vehicle for participants in the program to learn technical and business skills.

In May 2018, an interdisciplinary group of a dozen Georgia Tech students took 25 relays to Haiti. Some team members were participating as Opportunity Research Scholars (ORS), a program housed in the School of Electrical and Computer Engineering that gives teams of undergraduate students the chance to work on a research project under the mentorship of a PhD student. Others were recruited through the Georgia Tech chapter of IEEE (Institute of Electrical and Electronics Engineers).

The team was split into two groups—the small technical team worked on the relays, while the remainder of the students helped develop the business plan in conjunction with a group of about 15 Haitians put together by the BEL Initiative, a program under the Georgia Haitian-American Chamber of Commerce.

One of their biggest fears as a team was showing up in Haiti and trying to impose a solution that didn’t meet the needs of a local community. That’s why a partnership with the BEL Initiative was so vital.

“It was important for most of the work and planning to be collaborative and inclusive,” said McKenzie Rhone, a fourth-year economics and international affairs major who was on the business team. “We didn’t want to play the role of ‘teachers,’ which would have been insulting to the locals and naive. Instead, we wanted to play the role of collaborators.”

The challenge now, according to Lambert, is to scale everything up and find a model that works in Haiti.

“We’re trying to find a way to source the materials for the relays that makes them financially viable, and we think we can do that. Then we have to determine the market,” he said.

The group is hoping to have enough funding to take 100 or more relays to Haiti next May to test the market and promote the program. If that goes well, the plan is





“Not only does this impact the students who participated, it's also an opportunity to make a huge impact in Haiti and change lives. A small battery, lightbulb and solar panel sounds simple, but it changes the way the Haitians live.”

Alec Kumpf

to mass produce them and have the BEL participants run the program on their own. Lambert's hope is that Haiti acts as a test case, so the program can be expanded to other locations around the world that have limited electrical infrastructure.

Bria Matthews, a fourth-year electrical engineering student and ORS participant, is eager to get back to Haiti and help continue what they have started. Having been inspired by her experience, she wants to keep doing the same type of work when she finishes her master's at Tech. The Georgia Tech track athlete said the opportunity gave her a chance to test what she had learned in class and apply it to a real-life situation. Now she has a better understanding of her own capabilities, as well as the needs of other communities.

“I don't know what I want to do when I graduate, but if I could do something similar to what we did in Haiti, that would be great,” said Matthews. “I want to work abroad in a Francophone country and help people.”

Right now, the role Georgia Tech has been asked to play is to evaluate the business plans developed by the students and work on refining the technology and its supply chain. If all goes well, Dr. Clough's challenge will be met in the very near future. ◀



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in the field

Researchers across the College of Engineering are making cutting-edge contributions to their fields.

This 3D printed patch out of Michael Davis' lab (BME) enables doctors to apply stem cells directly to the hearts of children to aide in therapeutic repairs.



OPTIMIZING GLOBAL HEALTH

Noah Kafumbe reduced response time to disease outbreaks in Uganda to ensure patients quickly get what they need. Stany Banzimana developed a distribution system for malaria vaccines to service six regions in East Africa. And Diego Flores optimized delivery of supplies and medication to war-torn nations in Afghanistan and Pakistan.

These humanitarian workers have very different missions, but what they have in common is a certificate from Georgia Tech in Health and Humanitarian Supply Chain Management (HHSCM). This credential has given them the skills to create cost-effective systems and optimize their supply chain operations.

The certificate is granted by Tech's Center for Health and Humanitarian Systems (CHHS). Its mission is to help organizations better respond to emergencies and

plan long-term solutions more effectively by transforming health and humanitarian systems through education, outreach and innovative solutions. Graduates go on to tackle global challenges in logistics and supply chain management that ultimately save time, money and lives.

Kafumbe currently serves as an advisor on Commodities and Supply Chain to the USAID Global Health Bureau, one of the largest donor organizations in the world. Through CHHS, he learned forecasting and pre-planning strategy to determine whether lives may be saved when an outbreak hits. In Uganda, Kafumbe visits 60 different districts to map out the entire supply chain, from procurement to the last mile delivery, identifying constraints and using the forecasting and quantification tools he learned in the program at Georgia Tech.

"In the humanitarian sector, with low resources, you never have all of the information you need to make a decision, and you must act fast — if you haven't already built capacity, you can't deliver," said Kafumbe. "I'm now able to better visualize the overall system and lay the framework for strategic decisions to be made in conjunction with partners at local ministries of health who may not have a supply chain background."

Banzimana has been a key player in Rwanda's attempts to build capacity for vaccine and immunization management, particularly focused on clinic stockouts and supplies at the point of delivery. He credits a case study taught in the HHSCM course with preparing him to design a distribution system for malaria vaccines that would work for the six regions in East Africa.

Banzimana is working with others at the East African Regional Center for Excellence for Vaccines, Immunization and Health Supply Chain Management, covering Rwanda, Uganda, Kenya, Tanzania, Burundi and South Sudan. They seek to expand a training program focused on public health

“

IN THE HUMANITARIAN SECTOR, WITH LOW RESOURCES, YOU NEVER HAVE ALL OF THE INFORMATION YOU NEED TO MAKE A DECISION, AND YOU MUST ACT FAST — IF YOU HAVEN'T ALREADY BUILT CAPACITY, YOU CAN'T DELIVER.” Noah Kafumbe

Emergency supplies, such as plastic sheeting and hygiene kits, arrive in Manila from USAID's emergency warehouse in Dubai. The supplies are transported by the U.S. military to hard-to-reach areas.



U.S. GOVERNMENT PHOTO





Diego Flores



Noah Kafumbe



Stany Banzimana

Rudy Gleason in Ethiopia.

procurement and supply chain management offered through the University of Rwanda in collaboration with Georgia Tech and others.

Flores works in in the newly created Supply Chain Division at Doctors Without Borders. He oversees supply chain strategy across all operations in Afghanistan, Pakistan, Russia and Ukraine, from procurement to transportation, warehousing and distribution, as well as security and political challenges.

“For Doctors Without Borders, we have different supplies and drugs coming from manufacturers all over the world,” said Flores. “The supplies require distribution to remote, often war-torn places. The high-level planning requires complex system dynamics, networks and performance measurement — all that I learned at Tech.”

Flores also notes that the opportunity to network and share ideas with so many others from different organizations around the world working to solve similar problems proved one of the most valuable aspects of the program.

CHHS enables participants to practice applying new knowledge and decision-making tactics, data analysis and mathematical tools to real-world scenarios. By bringing together individuals from a variety of professional and geographical and cultural backgrounds, the program allows participants to share experiences and best practices

► MEGHAN SMITHGALL

A FIGHT FOR THEIR LIVES: TWO GEORGIA TECH RESEARCHERS PRIORITIZE WOMEN'S HEALTHCARE IN ETHIOPIA

Rudy Gleason and his wife were expecting their first adopted daughter to arrive from Ethiopia when they received devastating news. Shortly after she was born, baby Kennedy passed away from malnutrition.

“Our hearts were shattered, but the loss of Kennedy birthed in us a mission to dedicate our personal and professional lives to combatting poverty, malnutrition and health disparities in the developing world, particularly in Ethiopia,” said Gleason.

Since then, the Gleasons have adopted two healthy girls from Ethiopia, and they’ve established a nonprofit called “Because of Kennedy” to serve vulnerable children in Ethiopia by providing orphan support and education.

Gleason’s humanitarian work does not end with the foundation. His professional life is also intrinsically tied to Ethiopia. He’s an associate professor in the Woodruff School of Mechanical Engineering with a joint appointment in the Department of Biomedical Engineering, focusing his engineering research on global health challenges.

“The loss of Kennedy motivated me to work on maternal healthcare challenges in Ethiopia,” said Gleason. “In a country that has the fourth highest number of maternal deaths worldwide, it’s our duty to understand the complications and come up with solutions.”



ETHIOPIA HEALTHCARE BY THE NUMBERS

25%

of deaths of child-bearing Ethiopian women are due to maternal causes

1 in 64

Ethiopian women die due to complications with pregnancy

4th

Ethiopia had the 4th highest number of maternal deaths worldwide in 2015

3 to 8%

of all maternal deaths worldwide are due to obstructed labor

22%

Up to 22% of maternal deaths in Ethiopia are attributed to cephalopelvic disproportion-related obstructed labor



Hospital beds inside the Black Lion Hospital

labor. In Ethiopia, breast and cervical cancers aren’t diagnosed until they are at stage four, according to Gleason. Preventative care and early screening tests don’t exist because of lack of equipment in the extremely rural locations.

Stubbs hopes to develop a non-invasive diagnostic test for cervical and breast cancers that can hook up to a smartphone, where data

To do that, Gleason and his colleague James Stubbs, professor of the practice in the Department of Biomedical Engineering, are working with the Black Lion Hospital in Ethiopia to determine what’s needed. They also brought along a group of Georgia Tech students who are part of the Developing World Capstone program. This inaugural Capstone class will go to Ethiopia to work with clinicians to develop effective devices and solutions.

“On our recent trip, students were immersed in the Black Lion Hospital to observe, first hand, the challenges clinicians face,” said Stubbs. “Now, they will work on prototypes of devices and processes that can help patients. Should all go well, and additional sponsorship develops, we plan on expanding up to four teams in 2019 and beyond.”

After the Capstone students refine the medical devices, clinical validation will take place in Ethiopia, with the ultimate goal to transfer the manufacturing to an Ethiopian company. This last step will help make the medical device a part of the local economy. The Developing World Capstone program at Tech promises to bring more attention to resource-limited clinical environments.

“I was absolutely thrilled when I heard about this opportunity to learn and collaborate with doctors in Ethiopia for my Capstone project,” said Elizabeth Kappler (BME, 2019). “For as long as I can remember, I’ve wanted to study biomedical engineering to help advance global healthcare, and this chance to work with a team that shares my goals in a global setting seems almost too good to be true. Opportunities like this is the reason I came to Georgia Tech.”

Gleason and Stubbs have a few ideas for the team to work on that involve device design for clinical issues such as cervical cancer, breast cancer and obstructed

could be sent from remote village sites to central, urban hospitals for confirmation of diagnosis and recommendation for treatment options.

Another major healthcare issue is obstructed labor. Many women in Ethiopia are small in stature, having grown up malnourished. They then marry at a young age and become pregnant before the pelvis is fully grown, leading to obstructed labor. MRIs are costly, and X-rays pose a risk to the fetus, if the woman can even get to a hospital to have tests run.

Gleason is developing a device that leverages 3D cameras, such as the X-Box Kinect device and smartphone-compatible 3D cameras, to gain ultrasound-like images of pregnant mothers. A series of measurements are combined into a risk score to accurately predict the mother’s risk of obstructed labor.

“Our long-term goal is to develop, validate and translate low-cost methods for timely and accurate assessment for risk of obstructed labor in Ethiopia and the developing world,” said Gleason. “With the recent explosion in 3D camera technology for video gaming and virtual reality, we saw an opportunity to apply this low-cost, easy-to-use technology to help meet this goal.”

“Developing World Capstone wants to be able to innovate and develop products that can be put into operation in Ethiopia,” said Stubbs. “For me, helping these women is extremely gratifying, and with the help of the Capstone students, we can make a huge impact on many very quickly.”

► GEORGIA PARMELEE

10 TO END



10 Questions with Micron Intern Alicia Robang

Chemical and
Biomolecular Engineering,
2019

About Micron Technology

Micron Technology is a world leader in innovative memory solutions. The company has a broad portfolio of high-performance memory technologies, including DRAM, NAND, NOR Flash and 3D XPoint™ memory. Backed by nearly 40 years of technology leadership, Micron's memory solutions enable the world's most innovative computing, consumer, enterprise storage, data center, mobile, embedded and automotive applications. Micron's common stock is traded on the Nasdaq under the MU symbol. To learn more about Micron Technology Inc., visit micron.com.

1 ▶ Where are you from? Manila, Philippines. **2 ▶ Why did you want to come to Tech?** I knew I wanted to be a chemical engineer — my dad was an engineer. I wanted to come to Tech because it has the best and largest engineering program. **3 ▶ What was your first impression of Tech once you got here?** My first semester at Tech was also my first time being in Atlanta. I was surprised to find myself in a big city, on a large campus, with students and professors from all over the world. I quickly came to love being in the heart of Atlanta and meeting people of different backgrounds with a shared passion for science and engineering. **4 ▶ How do you want to make an impact as an engineer?** My dream is to gain as much experience as I can here in the U.S. and go back to the Philippines to work to improve science education for children. I want to inspire other students to go after a career in the sciences. In the Philippines, science education is not emphasized, so there is a real opportunity there, especially for women. **5 ▶ Who is your role model?** My dad. He's an engineer and has inspired me to work hard in anything I do. He taught me to always stay humble, ask for help when I need it, and never stop learning. **6 ▶ How are you involved in your community?** Back home in the Philippines I had been very involved in the community. After my freshman year, I spent a month volunteering with Pilipinas Shell Foundation Inc., whose mission is to enable the disadvantaged to become productive and responsible members of society. The foundation has many social programs in various areas to educate community members on how to better their lives

through sustainable development. At Tech, I've been on many service trips. Last fall break, I went to Asheville, North Carolina, for a Habitat for Humanity project. Before that, I traveled to Florida to help with oyster reef restoration. Throughout the school year, I seek out volunteer opportunities on or off campus that focus on environmental conservation and human empowerment. **7 ▶ What is your role at Micron?** I am a research and development intern at Micron's headquarters located in Boise, Idaho. Specifically, I worked on the physical failure analysis in a yield enhancement lab. Our manufacturing sites produce wafers, each containing several hundred memory chips, or as we call them, die. Each die can hold thousands of bytes of memory. With the hundreds of steps involved in the production of each wafer, there are several ways a die can fail electrically because of physical defects. My job involves using various electrical tools and chemistry lab techniques to identify where and how a die has failed. **8 ▶ What is your favorite thing about working at Micron?** I like the work-life balance at Micron. The company culture is warm, and everyone has a shared goal and passion for the work that we do. **9 ▶ What's your dream job?** Any research and development position in the semiconductor or electro-chemistry industry. I want a job where I don't ever stop learning. I want to be challenged every day. **10 ▶ What would you say to a young girl to get them interested in becoming an engineer?** Engineering challenges you to creatively think about the world. It's about not being afraid to ask big questions and finding new ways to solve problems.

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parting shot

A crane lifts new letters to the top of Tech Tower. Over the summer, the iconic letters were replaced. The new letters have an updated interior lighting component built with a newer technology, but they still have the same look and feel of the old ones.

