Blum Center for Developing Economies
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BLUM CENTER
FOR DEVELOPING ECONOMIES

Educating Changemakers and Fostering Innovative Solutions to Global Problems | 2020

The Berkeley-Darfur Stove requires less than half the fuel of traditional cooking methods, reducing the need to trade food rations for fuel and decreasing women's exposure to violence while collecting firewood.

MISSION

The Blum Center for Developing Economies at UC Berkeley leverages the talent, enthusiasm, and energy of the campus community to address urgent societal challenges globally and locally. We empower students, faculty, and researchers to build a more sustainable, just, and equitable world.

CONTENTS

This issue is dedicated to the memory of Blum Center Senior Fellow Dr. Bertram Lubin (1939-2020).

Overcoming Poverty Reduction Setbacks

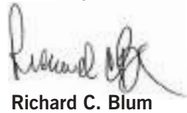
Twenty twenty was a terrible year in so many ways, but especially for low-income developing countries. Much has been written about the need for the international community to enable LIDCs to tackle the pandemic and recover strongly — about the need to guarantee essential health supplies, protect critical supply chains, ensure that developing economies can finance critical spending, restructure debt to restore sustainability, and keep sight of the United Nations Sustainable Development Goals.

Richard Blum

But what can the university do — and more specifically, what can UC Berkeley and the Blum Center do? I believe: *Plenty*. The year 2020 has made clear that the COVID-19 pandemic will be defeated only when it and its socioeconomic consequences are overcome everywhere. The pandemic is a universal wake-up call for environmental, social, economic, racial, and health justice. It is energizing a generation of young people to launch a new kind of human rights movement, one that is focused on poverty reduction and wealth redistribution at home and everywhere.

In my years of contact with Blum Center students and faculty from the Global Poverty and Practice and Development Engineering programs and from the Big Ideas Contest, I am certain we are educating changemakers and fostering innovative solutions to the world's most complex problems. The following pages are a testament to our efforts and to our hope and passion for a just and equitable future.

Sincerely,



Richard C. Blum
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When the pandemic hit, Uganda-based Takataka Plastics, a Big Ideas social enterprise that transforms plastic waste to building tiles, turned to producing face shields for local medics.

PHOTO COURTESY TAKATAKA PLASTICS

COVID-19 and Unprecedented Innovation at the Blum Center

At the Blum Center, 2020 was a year of unprecedented adaptation and innovation due to the COVID-19 pandemic. Like all centers and schools, we shifted to online teaching, advising, and working — as well as to racing to come up with solutions for mitigating the spread of the virus at home and abroad.

Shankar Sastry

The United Nations Development Programme estimated the socioeconomic fallout from COVID-19 for poor countries could take years to recover from, with income losses expected to exceed $220 billion and nearly half of all jobs in Africa lost. The March 2020 report states: "With an estimated 55 percent of the global population having no access to social protection, these losses will reverberate across societies, impacting education, human rights, and, in the most severe cases, basic food security and nutrition. Under-resourced hospitals and fragile health systems are likely to be overwhelmed. This may be further exacerbated by a spike in cases, as up to 75 percent of people in the least developed countries lack access to soap and water."

This means we must double our efforts in terms of funding, collaboration, and new life-saving technologies and programs. At the Blum Center and around the UC Berkeley campus, there has been a plethora of COVID-19 responses to meet this challenge and help developing and developed countries alike. The first target of a new AI research consortium, the C3.ai Digital Transformation Institute (of which I am co-director), addressed the application of machine learning to mitigate the spread of COVID-19.

Blum Center Research Director Dan Fletcher has worked around the clock to adapt the fluorescence microscopy function of his lab's mobile phone microscope, the CellScope, to assist in rapid testing. Dan and his colleagues are collaborating with virology expert Melanie Ott of the Gladstone Institutes and CRISPR pioneer Jennifer Doudna, among others, to provide the rapid remote detection portion of the team's CRISPR-based COVID-19 RNA detection method. Their goal is to provide test results in less than 15 minutes.

The team of SOMO, an entrepreneurship accelerator and Big Ideas "Scaling Up" winner based in Nairobi, pivoted during the pandemic to provide locally sourced care packages for vulnerable families.

Meanwhile, a coalition of UC Berkeley engineers led by Mechanical Engineering Professor Grace O'Connell, a member of our Graduate Group in Development Engineering, has been working to turn sleep apnea machines into ventilators for use in under-resourced hospitals and clinics. And Development and Mechanical Engineering student Paige Balcom prolonged her stay in Uganda, where there are 55 ICU beds with oxygen for a population of nearly 43 million people, using Big Ideas funding for her social enterprise Takataka Plastics to manufacture face shields for local medics.

As we ready to launch the UC Berkeley Master in Development Engineering (see details about this from Alice Agogino in the following pages), we will continue the Blum Center commitment to educate changemakers and foster innovative solutions to global problems. The year 2020 has given us unprecedented challenges. We aim to meet as many of them as possible. Fiat Lux!

S. Shankar Sastry
Faculty Director, Blum Center for Developing Economies
Siebel Professor of Electrical Engineering and Computer Sciences, Bioengineering, and Mechanical Engineering, UC Berkeley

Introducing the Master of Development Engineering Program

Two years ago, UC Berkeley's Graduate Group in Development Engineering made a commitment to extend its interdisciplinary technology and innovation program for doctoral candidates to master's level students. The motivation for the professional degree program: We heard from employers of the growing demand for professionals to apply technologies to benefit communities in need, and we observed expanding roles for tech in the aid sector.

Alice Merner Agogino

Thus the 32-member Graduate Group in Development Engineering — faculty from Engineering, Information, Business, Science, Public Health, Natural Resources, Social Science fields and more — set out to create a self-supporting professional master, administered by the Blum Center.

The program, to be launched in fall 2021, will foster "T-shaped" professionals who have a broad base of general skills along with deep knowledge in one area. The broad skills include the design and management of technology, knowledge of emerging technologies, evidence-based assessment techniques, economic development, and community engagement.

The program's depth curriculum will enable students to further their expertise in one of these five areas:

- AI/Data Analytics for Social Impact
- Energy, Water, and the Environment
- Sustainable Design Innovations
- Healthcare Transformations
- Self-Designed Concentration

We have established an Advisory Board for the MDevEng program, to bring seasoned practitioners into our classrooms to lecture and advise students and give them access to a robust employment network. Many of the Advisory Board members are Cal grads, including Ryan Shelby, Diplomatic Attaché and Supervisory Foreign Service Engineering Officer at the United States Agency for International Development in Southern Africa; Elizabeth Hausler, founder and CEO of Build Change; and Stephen Isaacs, former president and CEO of Aduro Biotech and founder of UC Berkeley's Alliance for Global Health and Science.

Although engineers have long worked in collaboration with others to improve livelihoods in low-income or low-resource areas, Development Engineering is a relatively new field of research. Development Engineering integrates engineering, economics, business, natural resource development, and social sciences to develop, implement, and evaluate new technological interventions that address the needs of low-income communities around the world. Our aim is ambitious: to train a new generation of leaders who can address the challenges posed by the United Nations Sustainable Development Goals. We believe UC Berkeley, with its world-class education and commitment to social and economic justice, is the perfect place to train these professionals.

***Alice Agogino** is the Roscoe and Elizabeth Hughes Professor of Mechanical Engineering, Education Director of the Blum Center for Developing Economies, and Chair of the Graduate Group in Development Engineering.*

One in four households globally lack access to safe water. Amy Pickering's novel in-line chlorine doser project in Bangladesh and Kenya automates chlorine dosing at the tap — a low-cost, electricity independent solution that reduced diarrhea by 23 percent in early field trials.

COURTESY AMY PICKERING

Welcoming new DevEng Faculty

UC Berkeley alum **AMY PICKERING** (M.S.'04 CEE) returns to campus as Assistant Professor in Development Engineering and Civil and Environmental Engineering, with a Ph.D. from Stanford and 15 years of field experience in Bangladesh, Benin, India, Kenya, Mali, Malaysia, Mexico, Sri Lanka, and Tanzania.

A native of Addis Ababa, Ethiopia, **REDIET ABEBE** is Assistant Professor of Development Engineering and Computer Science. With a Ph.D. in computer science from Cornell University and graduate degrees in mathematics from Harvard University and the University of Cambridge, Abebe is a co-founder of Mechanism Design for Social Good (MD4SG) and Black in AI.

For more information on the new MDevEng program, see **developmentengineering.berkeley.edu.**

Accelerating Healthcare Technologies

No year has focused the world's attention on global health and health care as much as 2020.

The COVID-19 pandemic has accelerated the needs for new diagnostics and therapeutics, made people rethink how health care is delivered, and highlighted many inequities and systemic problems.

Daniel Fletcher

This spring at the Blum Center, these concerns turned rapidly into action, as faculty researchers and student teams brainstormed ways to address the challenges of COVID-19, pivoted their research to address the pandemic, or took up health-related technology projects for the first time.

Even before this crisis, the Blum Center had begun plans to create a space specifically dedicated to researchers working on health technologies. The pandemic only increased the need. Before the close of the year, renovation will begin on the new Health Technology Collaborative Laboratory ("Health Tech CoLab") on the first floor of Blum Hall.

The goal is to create a space on campus that's a center of gravity for the development of new health technologies. We aim to harness this health crisis to inspire a generation of students and faculty to create technology solutions that will increase access to high-quality healthcare in the US as well as developing regions around the world.

A few projects are already slated to take advantage of CoLab space and resources as soon as renovations are complete. In a collaboration with Dr. Melanie Ott of the Gladstones Institutes and Prof. Jennifer Doudna of UC Berkeley's Innovative Genomics Institute, we are adapting the basic CellScope concept my students and I first introduced in 2007 into a mobile phone-based diagnostic tool for rapid COVID-19 testing — powered by Jennifer's Nobel Prize-winning discovery of CRISPR enzymes.

This potent intersection of medicine, molecular and cell biology, and engineering is exactly the kind of interdisciplinary collaboration we had in mind for the new CoLab — to identify critical problems that need solutions now, and to provide the space and resources for teams to be able to solve them.

PHOTO: REGINALD MADISON, JR.

Accelerating development of next-gen health tech

The new Health Technology Collaborative Laboratory ("CoLab") due to open in Blum Hall in spring 2021 will provide 2,115 square feet of collaborative workspace, including rapid-prototyping equipment, fabrication tools and supplies, and other resources. Located on the first floor of the Blum Center at UC Berkeley, the CoLab is envisioned as "a center of gravity for the development of new health technologies."

COVID-Scope: Mobile phone-based virus detection

A collaboration between Dr. Melanie Ott of the Gladstones Institutes, Blum Center Research Director and bioengineering professor Dan Fletcher, and Professor Jennifer Doudna of UC Berkeley's Innovative Genomics Institute is developing a CRISPR-Cas13a-based diagnostic to rapidly detect SARS-CoV-2 RNA. This mobile phone-based diagnostic technology aims to provide results in under 15 minutes and could rapidly increase diagnostic capacity worldwide.

PHOTO COURTESY VENTILATORSOS

VentilatorSOS: A low-resource treatment for COVID-19

A coalition of students and alumni led by mechanical engineering professor Grace O'Connell aims to convert CPAP and BIPAP machines designed for sleep apnea to treat COVID-19 patients. "This way, higher-grade ventilators can be reserved for patients with more advanced stages of respiratory disease," says O'Connell. To register a CPAP/BIPAP device for donation, see **ventilatorsos.org**.

With thanks to USAID for funding diverse research projects at the Blum Center.

The Beating Heart of Blum

Launched in 2007, the Global Poverty and Practice (GPP) program remains the central beating heart of academic programs at the Blum Center. Around 80 students a year graduate with a GPP minor from completing the program. Over the years, nearly 1,000 alumni have brought the program's transformative experiences — particularly its signature Practice Experience — out into the world.

One of the largest and most popular minors on the Berkeley campus, GPP draws students from across academic disciplines to think critically about issues of poverty and inequality and the ways in which the minor can supplement their major field of study, while the Practice Experience provides an opportunity for students to connect the theory and practice of poverty and its alleviation.

In 2020, however, the international engagement and field work that is a fundamental part of the Practice Experience was not possible during a pandemic, and the program needed to pivot to an online environment in spring. GPP educators feared a drop in enrollment come fall, but students came roaring back — spurred, not deterred, by the unprecedented year of national and global crises.

This year we welcomed Joeva Rock to the program as a GPP lecturer. With a Ph.D. in anthropology and development from American University, Rock taught at AU's Health Inequity and Care Program before coming to UC Berkeley. We also rolled out curriculum changes that have been in development for years, to refresh the program.

PHOTO: MCCALISTER RUSSELL

Fundación En Vía, Teotitán del Valle – Oaxaca, Mexico

"Mrs. Martinez Mendoza spins carded wool into yarn. The yarn will be used on a loom to make the tapestries traditional to her village of Teotitlán del Valle. She has been weaving since her childhood and, alongside her husband, has taught her three daughters and two sons how to weave. Fundación En Vía provides interest-free loans to her daughters, which enable them to continue this tradition and grow their business."

- McCalister Russell, Peace and Conflict Studies, Class of 2020

PHOTO: MAGGIE CHEN

Maji Safi Group – Shirati, Tanzania

"A young girl brings her 1L bottle to be filled with clean water by Community Health Educators. Today, the water is free and she proudly carries it home to help her family store as much as possible. But distributing free water is unsustainable, and community residents will soon be forced to choose between paying for water or using heavily polluted surface water."

- Maggie Chen, Civil and Environmental Engineering, Class of 2021

PHOTO: MIA PLUDE

Health in Harmony – Sukadana, Indonesia

"These farmers have created a complex system of organic farming that includes goats, manure, and catfish, all contributing to fertilizer. Fire is used to keep the mosquitoes away, as smoke is a natural pesticide. Produce is given to employees, and the farming methods are passed on to locals."

- Mia Plude, Anthropology, Class of 2020

Scaling Up to Meet Growing Needs

Six years ago, Development Engineering took root as an academic discipline at the Blum Center at UC Berkeley as a new interdisciplinary field integrating engineering with economics and business, energy and natural resource development, and social sciences. The goal is to create, implement and evaluate new technologies to benefit people living in poverty in developing regions and low-income areas in the U.S.

The InFEWS framework for approaching research:

- Recognize the novelty of integrating social and economic aspects into addressing technical research questions
- Seek out the engagement of invested communities into the design of the research
- Articulate the place, perspective, and impact of the "researcher" on the research process

To build the academic framework for this new field, Berkeley faculty members formed a Development Engineering Graduate Group. The group established a research agenda that includes human-centered design and requires innovators to develop "multiple skills in ethnographic studies, qualitative research, hardware, analytical tools, hypothesis testing, prototyping, business model development and continuous impact analysis," says Alice Agogino, Blum Center Education Director and UC Berkeley mechanical engineering professor, who chairs the group.

Since that time, the Dev Eng Graduate Group has supported a Designated Emphasis for Ph.D. students at UC Berkeley. Its students have produced a wide range of scholarship, and graduates have gone on to positions in academia, industry, and the nonprofit sector, or started their own enterprises.

In 2016, Development Engineering introduced InFEWS — Innovations at the Nexus of Food, Energy, and Water Systems — a program aiming to train a new generation of interdisciplinary researchers and practitioners to develop novel and lasting approaches and technologies for poverty alleviation and for positive global impact within the nexus of food, energy, and water systems (FEWS).

This year, Dev Eng announced its new Master's in Development Engineering program, Berkeley's first professional degree committed to solving complex global challenges across the corporate, nonprofit, and government sectors. The program is accepting applications now for a fall 2021 launch of the three-semester professional program.

PHOTO: ADRIEL OLMOS/CITRIS

Julia Kramer: Founder of Visualize

Julia Kramer has earned multiple advanced degrees at UC Berkeley: a Master of Public Health, a PhD in Mechanical Engineering, and a Designated Emphasis in Development Engineering. She co-founded Visualize, a nonprofit organization dedicated to empowering and supporting midwives to screen for cervical cancer (pictured here with a prototype of the device designed for this effort).

Christopher Hyun: Improving Sanitation

Christopher Hyun spent more than a decade in South Asia working on water, sanitation, pollution, culture, religion, and development before coming to Berkeley, where he became an InFEWS Fellow and completed his Ph.D. with a Designated Emphasis in Development Engineering. "Practitioners and researchers often base interventions on the 'sanitation service chain,' which defines the sanitation system as an engineering one as opposed to one with both social and technological dimensions," writes Hyun.

PHOTO COURTESY CHRIS HYAN

PHOTO COURTESY ALANA SIEGNER

Alana Siegner: Climate Literacy

InFEWS Fellow Alana Siegner completed a PhD from the Energy & Resources Group at UC Berkeley in 2020, with research on sustainable, agroecological food systems and farm-to-school programs as mechanisms for developing student environmental and climate literacy. She develops, implements, and evaluates food and climate change curriculum, and cites Washington's San Juan Islands as a case study of high-functioning school food programs and environmental education.

Co-InFEWS Tribal Partnership

Insufficient access to energy, water, and food infrastructure plagues the majority of Indigenous peoples worldwide, and climate change is exacerbating these challenges. While STEM (Science, Technology, Engineering, Mathematics) interventions can yield important contributions towards the sustainability of Indigenous groups, the development of these technologies too often does not consider Indigenous concerns, knowledge, and values. Research has shown that participatory and culturally sensitive approaches are critical to effective and long-lasting impact on community conditions. From this foundation, in 2020 a collaboration was launched between InFEWS, Diné College, the University of Arizona, and the University of South Florida — called Co-InFEWS — designed to articulate guidelines for researchers, students, community members and other stakeholders in participatory co-design and system thinking with Native American communities in the U.S. and Indigenous communities world-wide.

Big Ideas: Biggest Year Ever

Last year, the 14th year of Big Ideas at Berkeley, was the biggest year ever for the contest. More applications were received than ever before — for a total of 2,800 since the program's launch in 2006. That's 2,800 ideas, all vying to be Big Ideas and to make an impact on health, work, or a number of different social causes.

More students were involved in the program than ever before — a total of 438 teams applied, representing more than 1,200 students. And despite the unexpected events of this spring, students turned in their proposals, judges awarded 27 teams, and, with prizes averaging around $7,000, teams are in the field right now doing their work.

The 2019-2020 Big Ideas innovators come from 12 universities and 85 academic disciplines. More than 70 percent are undergraduates. Women-led teams made up more than half of the winning teams.

More than $2.6M in seed funding went to 500 winning teams — winning not just financial support (from $5,000 to the Grand Prize of $20,000), but also the boost and validation that the competition provides. With that support, winning teams have gone on to collectively secure more than $650M in additional investments over the years — a real credit to the students, their ideas, and the teams they've put together. It's also a credit to Phillip Denny, who has been the leader of the Big Ideas Contest at Berkeley from its beginnings in 2006.

"It started off as a smaller competition, an annual event just on the Berkeley campus," explains Denny. "Since then, it's evolved into a year-round social innovation program, with a robust support structure open to students across the UC system."

To keep the momentum going, they're adding courses and skill-building workshops to the Big Ideas portfolio. Starting in 2021, they're launching a Big Ideas lecture series, which will feature outstanding Bay Area innovators, some of whom are Big Ideas winners themselves.

PHOTO COURTESY CASEY FINNERTY/HELIOVAP

HelioVap

A 3D interfacial solar vapor generation method using sunlight to desalinate seawater

Team: Kelly Conway, Casey Finnerty, Druva Chandrasekhar

Across the 2,700 islands of Indonesia, one in eight households lacks clean water access. Traditional desalination technologies are expensive, energy depleting, and they discharge brine. HelioVap is a floating, stand-alone desalination device that can provide reliable purified water access to coastal communities through an off-grid, solar-powered, zero-liquid discharge process.

PHOTO COURTESY ACARÍ

Acarí

Team: Mike Mitchell, Sam Bordia

Acarí takes the armored catfish — or "devil fish," as this invasive trash fish is colloquially known in Mexico — and transforms it into tasty, nutritious food products to offer a healthy, sustainable, and ecological alternative to beef jerky as well as to increase employment in rural fishing communities.

PHOTO: JOSE LUIS VILLEGAS/UC DAVIS INSTITUTE FOR INNOVATION AND ENTREPRENEURSHIP

LiquidGoldConcept

Team: Anna Sadovnikova, Jeff Plott

If 90 percent of mothers breastfed for the recommended six months, the U.S. could save $13 billion per year. The most common breastfeeding problems can be prevented or alleviated with breast massage, which can also prolong breastfeeding duration. LiquidGoldConcept is the only research-driven, for-profit company with a sustainable, non-advertising-based revenue model creating evidence-based, tailored breast massage videos focused on educating parents and health providers.

Faculty

Leadership

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Professor of EECS, Bioengineering, and Mechanical Engineering

Alice Merner Agogino
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UC Berkeley alumnus Stephen Isaacs (BA '73 Biochemistry) leads the biotechnology company Aduro and founded the Alliance for Global Health and Science with Berkeley's School of Public Health.

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Our students have remarkable abilities and aspirations. With your generosity, their potential is limitless.

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To give online: **blumcenter.berkeley.edu**

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The Blum Center for Developing Economies at UC Berkeley belongs to a network of Blum Centers across the University of California system. See more about the Blum Center network at **blumcenter.berkeley.edu/about/locations**.

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