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Application Summary

Competition Details

Competition Title: 2024 Education Partnership Award

Category:

Cycle:

Submission Deadline: 02/9/2024 11:59 PM

Application Information

Application Title: Saad Bhamla

Application ID: 11733

Submission Date: 02/9/2024 2:12 PM

Personal Details

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Primary School or Department

School of Chemical and Biomolecular Engineering

Primary Appointment Title: Assistant Professor

Application Details

Proposal Title

Saad Bhamla

Cover Sheet


Education Partnership Award Application

Center for Teaching and Learning


Georgia Institute of Technology

February 2024


Partnership Members

DocuSigned by:

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- **Dr. Saad Bhamla,**
Assistant Professor,
School of Chemical & Biomolecular Engineering,
Georgia Institute of Technology
Tenure: 2017 - present

DocuSigned by:

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- **Dr. Elio Challita,**
Ph.D., Bhamla Lab (2018-2023) at Georgia Tech
Current Position: Postdoctoral Researcher,
John A. Paulson School of Engineering and Applied Sciences,
Harvard University

DocuSigned by:

F88B85AAECAD4AT...

- **Ms. Janet Standeven,**
Biotechnology Teacher and iGEM Advisor, Lambert High School (2012-2023),
Current Position (since 2023): Program Director, Frugal Science Academy
School of Chemical & Biomolecular Engineering,
Georgia Institute of Technology

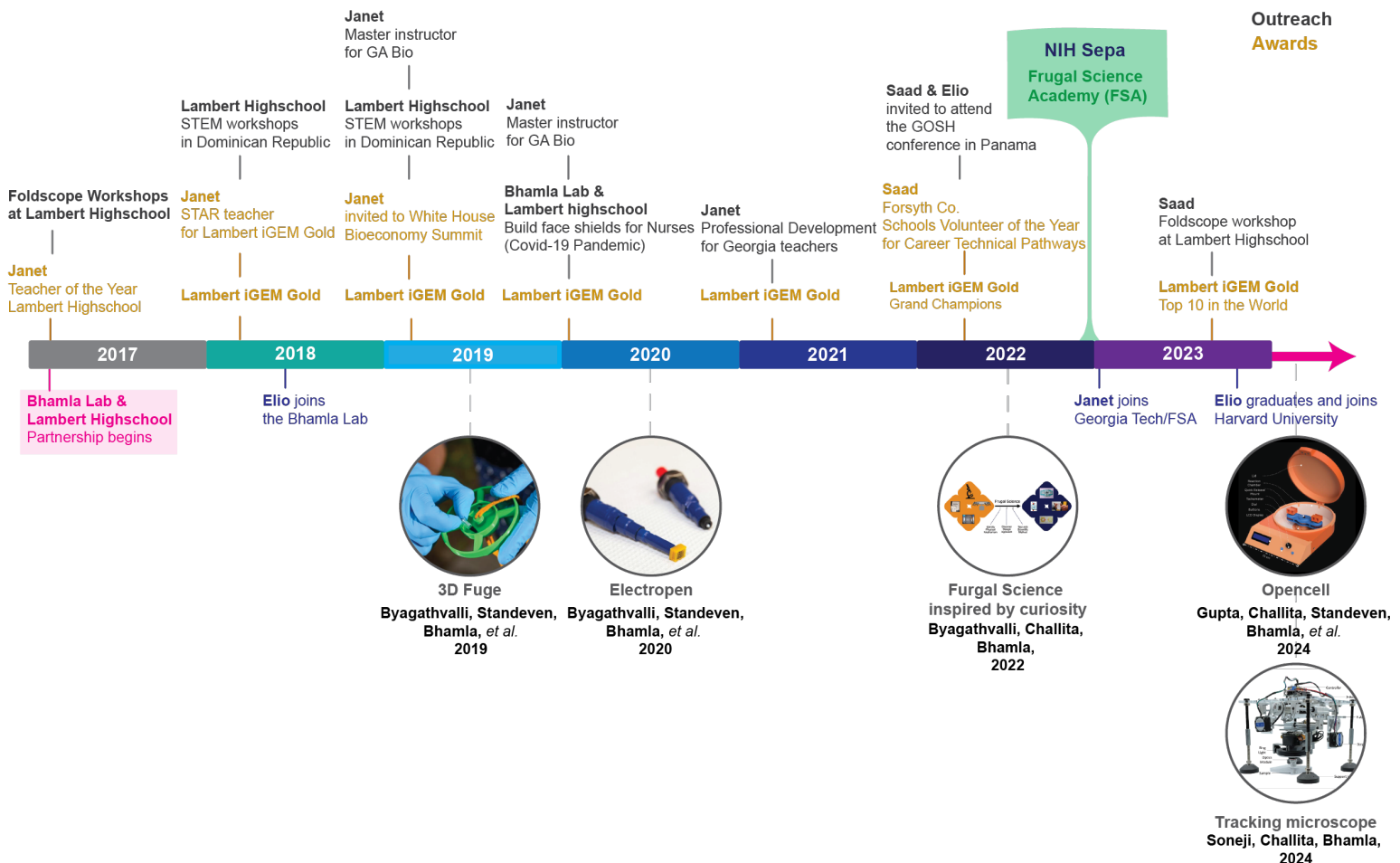
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Statement of Partnership

Georgia Tech has a long history of supporting local K-12 schools, significantly enhancing STEM education in Georgia and beyond. The collaboration of Prof. Saad Bhamla, Assistant Professor in the Chemical and Biomolecular School of Engineering, Ms. Janet Standeven, Biotechnology teacher at Lambert High School, and Dr. Elio Challita, a former Ph.D. student in the Bhamla Lab, stands as a prime example of how successful partnerships can have a multiplying effect on individuals, local school communities and STEM education at large. Over 7 years, this partnership has yielded impactful frugal devices such as the 3D-fuge (*PLOS Biology* 2019), Electropen (*PLOS Biology* 2020), OpenCell (*PLOS ONE* 2024, in press), and Trackoscope (*PLOS ONE*, in review), published numerous papers in peer-reviewed scientific journals with high school students as lead authors, and founded a National Institute of Health funded Frugal Science Academy (FSA) at Georgia Tech. These initiatives have created a pipeline that guides high school scholars to become undergraduate researchers and professional scientists. We aim to outline the critical aspects of this partnership and its significant impact on the participants, their students, and the wider community.

Foundation of the Bhamla-Lambert iGEM Collaboration. In 2017, Standeven, a biotechnology teacher and adviser for the International Genetically Engineered Machine (iGEM) team at Lambert High School, faced the common challenge of limited lab equipment for her high school (HS) team's synthetic biology projects. iGEM, an international collegiate synthetic biology competition, encourages teams to engineer, test, and present novel biological systems to address diverse problems ranging from global health to food insecurity. Meanwhile, Bhamla was a postdoctoral researcher at Stanford's Prakash Lab, innovating ultra-low-cost diagnostic tools. Standeven contacted Bhamla about his work on a low-cost paper centrifuge (Bhamla et al. *Nature Biomedical Engineering* 2017) as he transitioned to Georgia Tech as an Assistant Professor, sparking a generous and collaborative venture. Challita joined Bhamla's lab in 2018, quickly becoming pivotal to the partnership with his mechanical engineering skills, creative ideas, and drive to mentor high school students.



Standeven’s hands-on experience with iGEM and synthetic biology underscored the need for affordable and accessible lab devices. At the same time, her high school educational expertise added valuable insight to integrate the ideas within the school curriculum. Bhamla contributed his creative problem-solving, lab resources, and scientific legitimacy to transform these high school inventions into scientifically rigorous devices with robust benchmarking. As an early career Ph.D. student, Challita brought innovative ideas, implementation perspectives, and substantial mentorship to high school students, from using scientific instrumentation and conducting rigorous mathematical & statistical analysis to creating figures and writing papers. Together, the trio tackled the STEM education barrier posed by the scarcity of lab equipment, creating a fruitful pipeline that leveraged Bhamla’s commitment to science democratization, Standeven’s vision for empowered high school students to participate in cutting-edge synthetic biology research, and Challita’s dedicated mentorship.

Empowering Innovation: Synthetic Biology and Frugal Hardware. Lambert High School’s team, composed of at least 54% female and over 50% Asian students, highlights diversity in STEM. In the last seven years, Standeven, Bhamla, and Challita have mentored over 60 students in developing frugal devices for enabling synthetic biology in high school settings. This partnership has earned the Lambert iGEM team international recognition, including Gold Medals and Special Awards, and significantly influenced career paths: 92% of HS participants continue in STEM undergraduate degrees, with 25% choosing Georgia Tech.

A case in point is the Electropen, conceived during discussions among Gaurav Byagathvalli, a Lambert HS student, Standeven, and Bhamla. Inspired by a simple barbeque lighter, this 23-cent electroporator, subsequently published in *PLOS Biology* (Byagathvalli et al., 2019), exemplifies necessity-driven innovation. Its validation by iGEM teams worldwide and coverage in media outlets like Scientific American (DIY Tool Lets High Schoolers Practice Gene Editing) demonstrates its role in democratizing scientific hardware. Byagathvalli’s subsequent enrolment at Georgia Tech and collaboration with Bhamla and Dr. Mark Prausnitz (ChBE) led to the ePatch, a microneedle device utilizing the team’s Electropen invention (*PNAS* 2021). This project culminated in the founding of Piezo Therapeutics¹ with Byagathvalli as the CEO (raising \$2M), marking a significant stride towards enabling more affordable mRNA vaccines in low-and-middle-income countries and eliminating the bottleneck of cold-chain storage (-80C).

A second example is the OpenCell device, spearheaded by Aryan Gupta for the 2019 iGEM competition. While still at Lambert, Gupta initiated the design and prototype of this 3-in-1 device, which integrates a bead homogenizer, vortexer, and centrifuge, under Standeven’s guidance. His transition to Georgia Tech as an electrical engineering major under the mentorship of Challita and

Impact of Partnership on Lambert iGem Student

Outcome	Specifics	Number
Start-up Company	Piezo Therapeutics Former Student CEO	1
Patent	E-Patch	1
Journal Articles - Student Authored	Frugal Devices	5
Journal Articles - HS Teacher Author	Frugal Devices and Sythetic Biology	6
HS Enrolled	Pipeline of High School Enrolled at Georgia Tech	19
Gender	Male/Female	44% / 56%
STEM Majors	Enrolled as STEM Undergrad	92%

n = 64 iGem Students from 2018-2024

¹ <https://www.prweb.com/releases/piezo-therapeutics-launches-to-transform-delivery-of-nucleic-acid-medicines-884236950.html>

Statement of Partnership

Bhamla led to the publication of this work (*PLOS ONE, In Press, Feb 2024*), drawing global attention to its potential in point-of-care diagnostics and synthetic biology applications.

Institutional Accolades & Recognitions. Standeven, Bhamla, and Challita have garnered significant recognition for their collaborative achievements. Standeven earned the Teacher of the Year from the Georgia BioED Institute in 2016, Lambert High School in 2017-18, and was named Forsyth County's STAR Teacher in 2019 and 2022. In 2022, Forsyth County Schools honored Bhamla as Volunteer of the Year for his substantial contributions to Lambert HS students. He also received the CTL Junior Faculty Teaching Excellence Award in 2023. Challita's support of HS student internships earned him recognition from the Fulton County Schools in 2023.

Expanding Reach with the Frugal Science Academy (FSA). In 2020, we collectively submitted a grant to actualize our shared vision, formalizing and expanding the Lambert-Bhamla Lab collaboration with schools and teachers across Georgia. In 2022, this effort culminated in securing a 5-year \$1.25M NIH Science Education Partnership Award for the FSA, with Bhamla as the PI, and Standeven as the Program Director.

The FSA has been instrumental in offering internship opportunities for historically excluded and underrepresented HS students and professional development for rural Georgia's teachers, alongside developing frugal alternatives to traditional, expensive lab equipment. In its inaugural year, the FSA successfully mentored 24 HS students and 16 teachers through 60-hour professional development sessions, collaborated with the K-12 Inventure Prize and Georgia BIO Education Institute, and extended its frugal device training, including OpenCell and Trackoscope, to international K-12 partners in Thailand. Georgia Tech undergraduate and graduate students mentoring FSA high school scholars have fostered a reciprocal educational environment, with these scholars further guiding their peers. The FSA's teacher cohort has impacted over 2,000 classroom students, demonstrating the significant, multi-layered, and multiplicative impact of frugal innovation in addressing local and global challenges in STEM education.



Sustained Impact and a Blueprint for STEM Partnership. The collaboration between Bhamla, Challita, and Standeven exemplifies the essence of productive academic outreach, significantly enhancing STEM engagement, facilitating research opportunities for HS students and their teachers, training inventors, entrepreneurs, and engineers, and fostering professional and personal growth. This partnership's hallmark lies in its enduring impact. Through an NIH-funded program, it has institutionalized effective methodologies, ensuring the perpetuation of benefits to K-12 education and the broader scientific community.

Our collaborative efforts with diverse partners, including iGEM teams, international nonprofits, rural schools, and academic research groups, have broadened the dissemination of frugal innovations. Adopting an open-source ethos, we've augmented the sustainability and scalability of our contributions since all our designs are available on GitHub and peer-reviewed publications are in open-access journals. The Frugal Science Academy is a testament to our commitment to empowering educators, graduate students, and professors to emulate our achievements and unlock the full potential of vertical STEM education.

Over 7 years, Bhamla, Standeven, and Challita have realized significant personal and professional development, a testament to the power of collaboration. This partnership has fostered a culture of scientific inquiry, mentorship, and leadership, setting clear objectives, ensuring long-term impact, and nurturing a spirit of empowerment in STEM education. Receiving the Center for Teaching and Learning Education Partnership Award would affirm our pioneering work, blending synthetic biology and frugal engineering to forge a sustainable STEM education pipeline, offering a new blueprint for integrating academic research with high school education.

As a first-generation college student, I see education as more than cognitive exercises; it's a transformative journey, reshaping lives beyond the classroom. My mission at Georgia Tech transcends teaching technical material; I aim to spark curiosity and inspire a sense of wonder in students, from graduate scholars to high school dreamers.

Since joining Georgia Tech in ChBE in 2017, I have mentored the Lambert High School iGEM team, a partnership initiated by Ms. Janet Standeven's email inquiry about my invention. Over 7 years, our collaboration has clinched multiple golds at the iGEM competition – a rare feat for an HS team competing against undergraduates. This success laid the groundwork for the 5-year, 1.25M NIH-funded Frugal Science Academy (FSA) through the Science Education Partnership Award (SEPA) mechanism, designed to advance synthetic biology education, with Ms. Standeven at its helm.

Initially, the concept of partnering with HS students felt unfamiliar. A senior faculty member early in my career advised that focusing on HS collaborations could distract from achieving traditional academic success metrics such as publications, funding, and Ph.D. graduations. Despite good intentions, this advice during my challenging first two years—marked by unsuccessful grant applications and two of my initial Ph.D. students departing with a Master's degree—sowed doubts about the value of K-12 outreach. However, this advice to delay HS student mentorship as a 'lower priority' until after achieving tenure only strengthened my dedication to these efforts.

A moment that vividly stands out for me was drafting a PLOS Biology paper with HS student Gaurav Byagathvalli as the 1st author, and Janet as co-author. A senior GT faculty member criticized listing Gaurav's high school affiliation, fearing it might lead reviewers and editors to question our work's quality. Despite academia's skepticism about high school students' research abilities, our publication in PLOS Biology proved their potential. Not only did it get published with Gaurav and Janet's affiliations clearly stating Lambert High School, but it also helped Gaurav become CEO of a GT spin-out, raising \$2M. This success, along with further publications in journals like *PNAS* co-authored with Gaurav, underscores the significant impact of nurturing young scientific minds.

ElectroPen: An ultra-low-cost, electricity-free, portable electroporator

Gaurav Byagathvalli^{1,2}, Soham Sinha¹, Yan Zhang¹, Mark P. Styczynski¹, Janet Standeven², M. Saad Bhamla^{1*}

¹ School of Chemical and Biomolecular Engineering, Georgia Institute of Technology, Atlanta, Georgia, United States of America, ² Lambert High School, Suwanee, Georgia, United States of America

This experience unveiled academia's hypocrisy: outreach receives public acclaim, yet significant involvement with K-12 is deemed a diversion from 'more important' priorities. We're encouraged to mention HS outreach in NSF Career's broader impacts but cautioned against 'over-investing' our efforts as early career faculty. Despite this, my dedication to meaningful science education engagement hasn't faltered, demonstrated by our commitment to the FSA. Our initial NIH grant was rejected due to concerns about the program's scale, with a reviewer noting, "*The numbers of student involvement in the multiyear full programmatic system is small.*" Nevertheless, our resubmission, anchored in our vision of transforming HS students and their teachers' lives, succeeded, reinforcing my firm belief in long-lasting mentorship's transformative potential.

Our work, transforming students like Gaurav Byagathvalli from a napkin concept to CEO and educators like Ms. Standeven from teacher to FSA's program director, transcends classroom boundaries, making tenure concerns seem trivial compared to the joy of mentoring future 'Edisons' and inspiring 'Maria Montessoris'. Their successes have ripple effects beyond individual achievements, sparking greater change, inspiring initiatives, and fostering a culture at GT that values educational innovation and engagement.

Reflecting on my mentor's concerns about my tenure due to this focus, I now see such worries as minor. My role as an educator transcends age, academic level, and institutional boundaries. Whether teaching my 4-year-old, educating taxpayers through multilingual comics, or mentoring HS students, my mission is clear: to light up discovery and innovation paths for all learners. This journey has transformed me as much as my students. Moving from doubting the value of HS outreach to experiencing its profound impact, mentorship has become core to my educational identity, reshaping my teaching, research, and commitment to inclusive, democratic science education.

We have to go from what is essentially an industrial [fast-food] model of education, a manufacturing model, which is based on linearity and conformity and batching people. We have to move to a model that is based more on principles of agriculture. We have to recognize that human flourishing is not a mechanical process; it's an organic process. And you cannot predict the outcome of human development. All you can do, like a farmer, is create the conditions under which they will begin to flourish.

— Ken Robinson

Echoing Ken Robinson, I aim to transform education by personalizing it, fostering environments where students' unique talents can flourish. My journey at Georgia Tech, mentoring HS students and their teachers from concept to publication, embodies this transformation, proving that real education is about lighting a fire, not filling a bucket. With each student and teacher whose life we touch with our FSA, we're not just teaching; we're launching a revolution in education.

Education is not the filling of a pail, but the lighting of a fire. – W.B. Yeats

It is an honor to be nominated for the CTL Education Partnership Award alongside Prof. Saad Bhamla and Janet Stander, in recognition of our fruitful collaboration over the past five years (2018-2023). Throughout this period, I directly mentored four high school students who subsequently pursued their undergraduate studies at Georgia Tech. Our collaborative efforts not only resulted in several scientific publications, and several iGEM Gold awards but also significantly enriched my development as a future principal investigator, laying the foundation for my ongoing and sustainable engagement with high school students in the years ahead.

Through our collaboration, we adhered to the philosophy of democratizing science through "frugal science" — a principle that deeply resonates with my personal and professional ethos. My journey into scientific research began as an undergraduate student in Lebanon, where conducting research presented significant challenges due to the lack of funding and equipment. My team and I were compelled to adopt creative approaches to develop low-cost tools, utilizing a T-shirt heat press for fabricating electrodes, attempting microscope repairs with makeshift lenses, and engineering our own electro-analytical circuits. These experiences, born of necessity, reinforced my conviction in making equipment accessible, especially for young students and citizens. I carried this belief through my graduate studies, drawn to Prof. Saad Bhamla's work on the paperfuge—an elegant, low-cost yet powerful tool embodying the democratization of science by making legitimate research accessible to all.

As the partnership between the iGEM team at Lambert Highschool and the Bhamla Lab launched, we set the challenge of developing a scientific device meeting three key criteria: 1) affordability for high school budgets, 2) simplicity enabling construction and operation by students, and 3) an innovative contribution that engages scientists while advancing research. In 2019, my collaboration with Aryan Gupta, a member of the iGEM team, marked the start of an enriching journey. Together we integrated a bead homogenizer, vortexer, and centrifuge into a versatile 3-in-1 device that enabled accessible DNA extraction in classrooms and fieldwork. Building on this foundation, I teamed up with Gaurav, initially a high school and later a Georgia Tech undergraduate. We co-authored a perspective article, transitioning frugal science from a curiosity-led concept to a pragmatic approach with clear theoretical-to-practical steps. Our article invited scientists worldwide to engage with and advance the frugal science movement, providing a blueprint for developing widely-accessible, low-cost technologies that overcome traditional barriers. These collaborative experiences catalyzed my evolution as a scientific leader and mentor.

The recognition of our work at Lambert High School sparked interest from students not only in Georgia but across the United States. During the challenging times of the COVID-19 pandemic, Priya, a student from Milton High School, reached out to our lab with innovative ideas for a project on developing a low-cost device to track swimming microorganisms. Leveraging the mentorship skills developed through this partnership, I provided comprehensive virtual support - from technical feedback to troubleshooting advice - empowering her to complete her project as the leading author. This successful experiment paved the way for further virtual menteeships. In 2021-2022, I mentored Vinod Ruppak-Kasani from Chattahoochee High School in Georgia and Varun Puvvala from Valley Christian School in California, collaborating across states on a project leveraging finger flicking physics for early arthritis diagnosis. This demonstrated the viability of impactful remote research while underscoring the value of interdisciplinary partnerships in advancing science.

Through this partnership, my commitment to mentoring goes beyond guiding students in research; it is about fostering their potential as future scientific leaders. Through this partnership and beyond, my approach has seen me mentor nine students from diverse geographical backgrounds and minority groups underrepresented in STEM. This involvement varied from formulating research questions to navigating the technical and professional landscapes of scientific inquiry. Four of my mentees have published or are on the verge of publishing their first 'first-authored' papers, a remarkable feat especially for the two who started their projects in high school. Their accolades, including prestigious fellowships and awards like the Regeneron research scholar, NSF GRFP, and PURA at Georgia Tech, speak of their growth and wider appreciation of the scientific community. Many have secured admissions into renowned institutions like MIT, Georgia Tech, and the University of Pennsylvania.

Overall, this partnership has had a profound impact on me and the young minds we made science accessible and inclusive for. It laid the groundwork for ongoing and sustainable collaboration. The partnership our team built culminated in the Frugal Science Academy, establishing the foundation for continued teamwork between the Bhamla Lab, Lambert High School, and beyond. On a personal note, this experience catalyzed my growth as a leader and mentor. As an aspiring principal investigator, I am committed to advancing this vision by integrating community outreach and mentoring as core components of my future lab. I hope our mentees pay it forward, spreading this mission of democratizing science to the next generation of scientists they teach. This award would highlight the sustainability of university-high school partnerships in continuing to expand access, inclusion, and innovation across the scientific landscape.

I am humbled to be nominated for the CTL Educational Partnership Award with Dr. Elio Challita and Dr. Saad Bhamla. As a longtime educator it is a privilege to work with such visionary and dedicated professionals. I taught biotechnology and scientific research at Lambert High School from 2012-2023. The synergy between my partnership with Dr. Bhamla and Dr. Challita has ushered me through a profound journey of professional development, transitioning me from an educator to a scientist, culminating in my current role as the Director of the Frugal Science Academy. Our partnership has a significant impact on me and through me to the thousands of students and educators I work with.

I started the International Genetically Engineered Machine (iGEM) team in 2013 as a research opportunity for students while I was teaching biotechnology at Lambert High School. I had limited background in synthetic biology gained from internships in the Styczynski Lab at Georgia Tech, 2013-2016, but no experience in the process of publication. My iGEM team's projects were limited by a lack of basic lab equipment and we began to tinker with frugal devices in 2015-16 like the ChromeQ, a light chamber and phone app that quantified colored proteins. Inspired by the Paperfuge (Nature 2017) I contacted Saad. We quickly recognized in each other kindred spirits who were passionate about igniting students' curiosity. Over the ensuing seven years, he, along with Dr. Elio Challita, and his team of graduate students, played an instrumental role in enhancing the research competencies and opportunities for numerous biotechnology students at Lambert High School. Between online meetings and in-person visits Saad and Elio have increased research skills and opportunities to countless students at Lambert HS. Saad encouraged the high school students to take lead authorship on papers and we published the 3D fuge (Plos Biology 2019), ElectroPen: a 23 cent electroporator (Plos Biology 2020) with high school student Gaurav Byagathvalli as lead author, and OpenCell (Plos One 2024) with Aryan Gupta and Elio Challita as authors. These achievements, a rarity for high school students, significantly boosted enrollment in Lambert's Biotechnology program.

I became a Master Instructor for Georgia Bio Education Institute in 2019 due to my increased scientific skills gained from the partnership with Saad and Elio. I've delivered professional workshops for hundreds of teachers. Hearing stories of limited resources from many peers around the state reinforced the need for frugal device development. These experiences led directly to the vision we wrote in the NIH SEPA grant proposal. 1) Recruiting curious high school students to experience academic research from ideation to publication as they develop frugal devices. 2) Sharing these frugal devices with educators and housing curriculum for replicating the devices for their local needs. After dedicating 28 years to the field of high school education, I reached a point where I believed I had maximized my contributions at that level. However, I also felt a strong sense of unfulfilled potential and a desire to embark on new endeavors. In 2023 we opened the NIH funded Frugal Science Academy at Georgia Tech fulfilling a shared vision of the partners.

Over the span of three decades in education I have taught in a variety of settings encompassing rural Title I, private, and large suburban schools educating close to four thousand students. Now as the director of the FSA it is motivating to have a multiplicative effect by teaching the teachers, especially teachers in underserved communities. Synthetic biology, equipment and training possess the transformative potential to address global challenges by empowering anyone anywhere to actively engage in science. Scarcity of resources will no longer dictate who can contribute to the bioeconomy. Our partnership over the last 7 years has led to the highlight of my professional career, overseeing the FSA. I work with students developing innovative devices, teachers who are excited to bring leading edge synthetic biology and innovation to their classrooms, and international partners democratizing access to scientific research. This endeavor represents the crowning achievement of my career, and I am energized by the profound impact it promises to bring to the world of education and scientific exploration.



**Georgia Institute
of Technology®**

February 5, 2024

CTL Education Partnership Award

Dear Award Selection Committee:

It is my pleasure to nominate Dr. Saad Bhamla, Assistant Professor in the School of Chemical & Biomolecular Engineering, Ms. Janet Standeven, former Biotechnology teacher at Lambert High School, and Dr. Elio Challita, formerly a PhD student in the Bhamla Lab, for the 2024 **CTL Education Partnership Award**. Their collaborative efforts over the past 7 years epitomize the power of partnership in magnifying the impact on individuals, local school communities, and STEM education at large.

Dr. Bhamla's venture, initiated through a serendipitous interaction with Ms. Standeven concerning the paperfuge, a frugal science innovation, has blossomed into long-standing and highly successful collaboration. This partnership has not only led to the development of groundbreaking frugal devices such as the 3D fuge, Electropen, and OpenCell but also to the publication of multiple papers with high school students taking the lead, showcasing the real-world impact of our educational endeavors.

The inception of the Bhamla-Lambert iGEM Partnership in 2017 marked a turning point in this collaboration, leveraging Dr. Bhamla's expertise in frugal science alongside Ms. Standeven's profound understanding of high school education. Dr. Challita's fresh perspectives and mentorship have been instrumental in guiding high school students through the intricacies of synthetic biology and device development.

The results speak for themselves: the Lambert iGEM team, under their mentorship, has achieved international recognition, securing Gold Medals and Special Awards for their innovative solutions. This partnership has also significantly influenced student trajectories, with 80% pursuing STEM undergraduate degrees and 25% joining Georgia Tech, a testament to the transformative educational pathway they've established. So far, they have mentored over 60 HS students, notably including Mr. Gaurav Byagathvali, who went on to spin-out a start-up based on technology he co-invented as part of this K-12 education partnership.

The Frugal Science Academy (FSA), a brainchild of this partnership and funded by an NIH Science Education Partnership Award, further extends their impact. It offers internships to underrepresented high school students and professional development for Georgia teachers, democratizing access to scientific education and equipment. In its inaugural year, the FSA

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Feb 8, 2024

Dear Committee Members,

I am delighted to extend my strongest endorsement for Dr. Elio Challita for the CTL Education Partnership Award. As an advisor and mentor to Elio during his Ph.D. program at Georgia Tech from 2018 to 2023, I have witnessed firsthand his remarkable dedication to democratizing science education through frugal science principles. His collaborative work with the iGEM team is a testament to his creative spirit and commitment to making science inclusive.

During his tenure in our lab, Elio demonstrated incredible dedication to making scientific research more accessible to the broader community. Having faced major resource barriers during college in Lebanon, I recall Elio reaching out to our lab because he was inspired by my previous work on the low-cost paper centrifuge. Motivated by this device, he was determined to develop similar frugal technologies that would not only bridge the divide between advanced research and high school education but also inspire other students from disadvantaged backgrounds - just as he was.

Elio has everything you could ask for in a student mentor. He embodies our mission to make science accessible through extensive mentoring initiatives, directly guiding 4 iGEM high school students and underprivileged minorities on creative projects yielding 3 publications with him and his high school mentees as co-author. He has made complex concepts engaging for young minds while patiently guiding them to lead their own investigations. His frugal innovations like the OpenCell and Trackoscope, developed alongside high school students Aryan and Priya, showcase his creative problem-solving and leadership skills through his dedication to advancing science inclusively. His work with Gaurav on a perspective article concretizing frugal science into implementable guidelines is an impactful outreach inviting all researchers to participate in this frugal innovation movement¹. Ultimately, his mentorship reached other high school students across the US - beyond this core partnership - igniting in them an enduring passion for science and helping them get into their dream undergraduate schools such as Georgia Tech, MIT and others.

Moreover, Elio's dedication to frugal science has been instrumental in establishing our "Frugal Science Academy" - an initiative poised to significantly expand our collaborative reach, ensuring this philosophy continues enriching students for years ahead. His ability to inspire, guide, and collaborate showcases the rare leadership talents that will undoubtedly make him an outstanding principal investigator steering change. This formative experience lays the groundwork for sustainable partnerships moving forward while serving as a blueprint for future Ph.D. mentors on holistically nurturing talent and "paying it forward."

Overall, Elio's work embodies the CTL Award's spirit, demonstrating a commitment to both accessible, inclusive education and scientific innovation. His achievements showcase how frugal science can transform teaching and research while highlighting the immense power of mentorship in shaping young scientific minds - sparking mutual growth between mentors and mentees. In wholeheartedly endorsing Elio, I am confident his recognition will further this mission of

¹ Byagathvalli, Gaurav, Elio J. Challita, and M. Saad Bhamla. "Frugal science powered by curiosity." *Industrial & engineering chemistry research* 60.44 (2021): 15874-15884.

democratizing science globally, opening doors for greater creativity, collaboration, and real-world impact across educational and scientific communities worldwide.



Saad Bhamla, Ph.D.

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**Greater Development LLC
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Gary Davison, Founding Principal
Lambert High School- Retired

January 25, 2024

To Whom It May Concern,

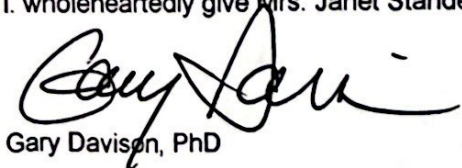
This letter is intended to verify that Mrs. Janet Standeven was a teacher in exemplary standing with Lambert High School from 2012 - 2023 and has my highest recommendation for the Georgia Tech Education Partnership Award. Not only has her teaching been exemplary, but the relationships and impact of those relationships have been monumental. The latter is noted by the many students who are working in the field as research scientists and graduate students.

I have been lucky enough to employ Janet in a variety of positions, as a teacher and sponsor of many organizations. Her instruction, leadership and dedication has been exemplary. Her areas of strength are her abilities to make connections with students of varying abilities, plan and execute outstanding lessons and programs, develop a warm, nurturing environment, participate in many extra curricular activities, and give in any way that the school, and students, need. I can easily attest to her dedication, ability, and collegiality. She is currently serving as the Program Director of the Frugal Science Academy at Georgia Tech.

She has shown exemplary abilities at the high school and university classroom level. She led our most prestigious student focused/academic team... i-Gem (International Genetics Engineering Machine). Her abilities far exceed those of any teacher that I have ever had the pleasure to employ. She is a true gem.

Her dedication, intelligence, compassion, caring, and abilities to be flexible are exemplary and will serve as an asset to the Frugal Science Academy. Saad Bhamla, GT Professor, and Janet have worked together since 2017. He has been a guest speaker for clubs and classes, opened his lab and mentored Lambert students to be the first authors on peer reviewed academic papers. They have co-authored funded grants including a National Institute of Health, SEPA Award. These grants have provided materials and resources for Lambert's students. In fact, as recognition of his dedication he was recognized in 2022 as a Forsyth County School Volunteer of the Year.

I wholeheartedly give Mrs. Janet Standeven and Dr. Saad Bhamla my highest recommendation.



Gary Davison, PhD

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Publications:

Bold Partnership participants
Student High School Student

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Media

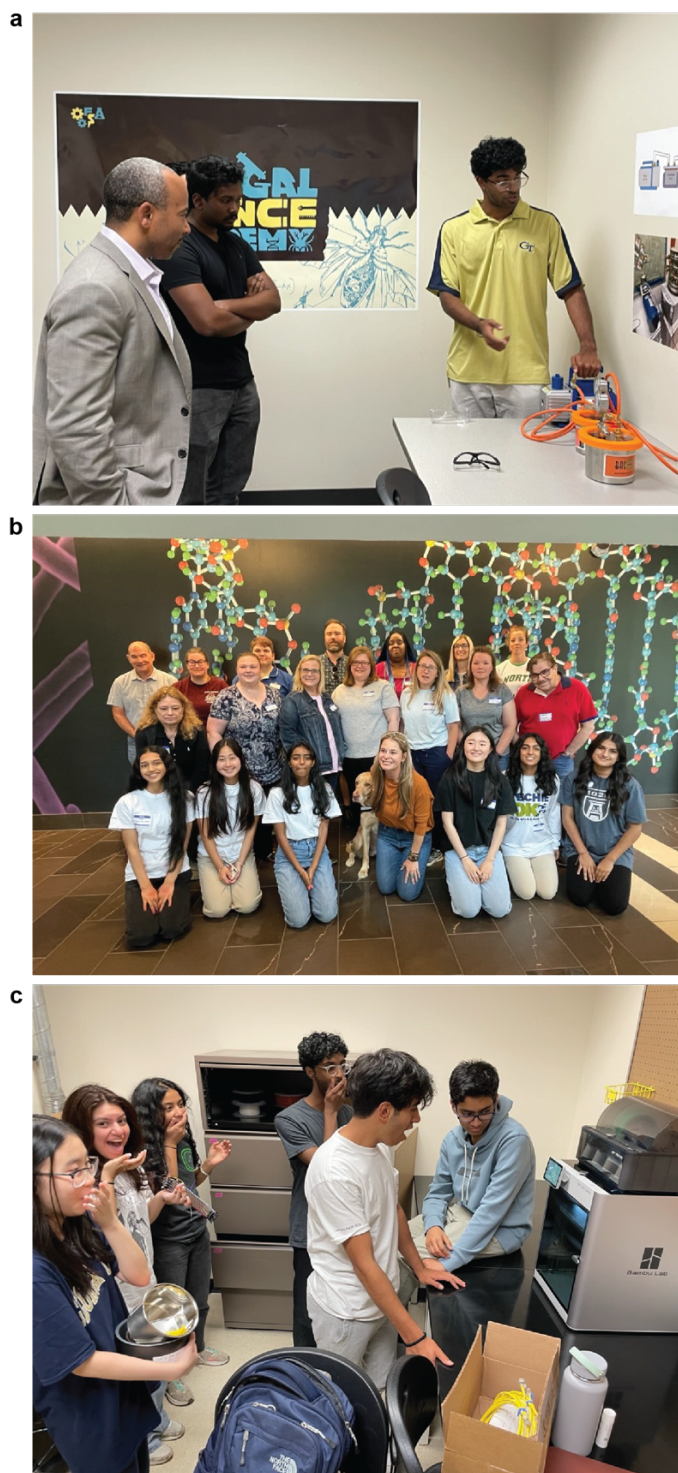
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IGem Team 2017-2023



Frugal Science Academy 2023



a) Frugal Science students demonstrating a frugal hardware device in the new lab space in Ford ES&T. **b)** Teachers and student lab aids for the 2023 Teacher Training Cohort at Athens Technical College. **c)** FSA Summer interns are using the new 3D printer in the new FSA Lab in Ford ES&T.

Awards & Honors



a) Lambert iGEM team 2017 is being recognized for their achievements at the Georgia State Capitol. **b)** Janet Standeven represented iGEM at the White House Bioeconomy Summit of 2019. **c)** Srirag Tartavarti, Lambert iGEM 2022 Star Student with Janet Standeven, Lambert Star Teacher 2022. **d)** Janet Standeven and Dr. Brittney Cantrell of Lambert High School are celebrating multiple special awards at the 2018 iGEM Jamboree. **e)** Madhav Gulati and Vineeth Sendilraj of Lambert iGEM - Genes in Space Finalists August 2022. **f)** Special Awards from iGEM Jamboree 2018 recognizing: Best Measurement, Best Hardware, Best Integrated Human Practices, and Best Presentation. **g)** Certificate of Appreciation for Elio Challita for mentoring High School students from Fulton County Schools 2023.

Bhamla Lab & iGem Team 2017-2023



a) Saad and Elio mentoring members of the 2017 iGEM team. **b)** Virtual meeting of Lambert iGEM with Saad and Elio for the 2018 iGEM project. **c)** Brainstorming meeting on campus 2018 with Lambert iGEM and Saad and Elio. **d)** Frugal hardware specific meeting 2018. **e) f)** Lambert iGEM students and FSA intern signing the GT banner in May 2022. A long-held tradition at Lambert. **g)** Aryan Gupta wearing the face shield design for Covid Healthcare workers at Northeast Medical Center. Aryan led the iGEM team and other students to 3D print over 600 face shields during the early days of the pandemic. **h)** David Standeven, Lambert iGEM 2016-17 demonstrating the ChromeQ prototype. **i)** Lambert iGEM 2019 students demonstrating multiple frugal devices.

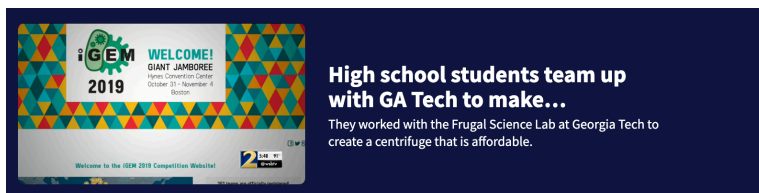
Frugal Science Workshops



a) Saad demonstrating the Foldscope, Origami microscope to Lambert iGEM 2018 and biotechnology pathway students. **b)** Packed house attendance for a Lambert iGEM 2022 presentation on the CADLock iGEM project. **c)** Saad demonstrating the Foldscope to Lambert iGEM and biotechnology students in 2018. **d)** Lambert students demonstrating the Foldscope to a school in the Dominican Republic in 2019. **e)** Lambert Foldscope Workshop 2018. **f)** Teach the Teacher Foldscope workshop in the Hato Mayor Province, Dominican Republic, 2019.

Media Highlights

Forsyth News (2019)

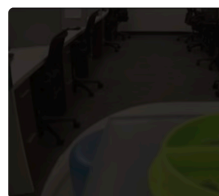


FORSYTH COUNTY

Local high school students help develop a low cost tool used in lifesaving research



August 02, 2019 at 9:53 am EDT



High school students team up with GA Tech to create a centrifuge that is affordable.

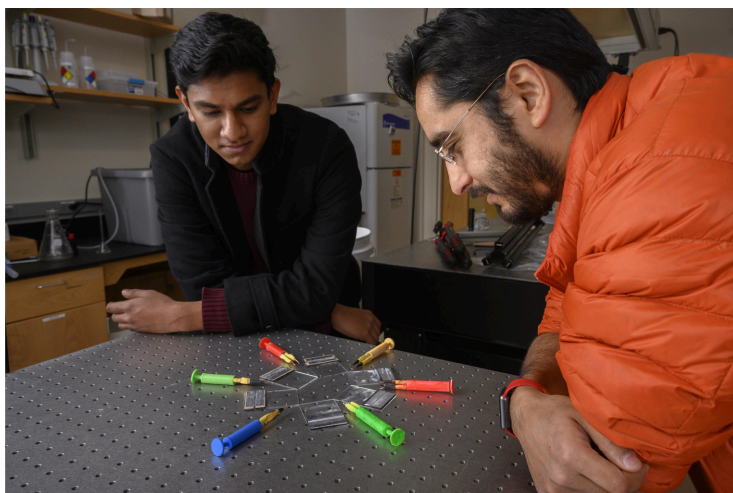
FORSYTH COUNTY, Ga. — Scientific equipment used in life saving research can cost thousands of dollars, of many scientist and students. But a group of Forsyth County High School students teamed up with a G one critical device accessible to all.

Source: <https://research.gatech.edu/frugal-science-brings-research-opportunities-high-schoolers>

Georgia Tech News (2020)

Scientists Transform Barbecue Lighter Into a High-Tech Lab Device

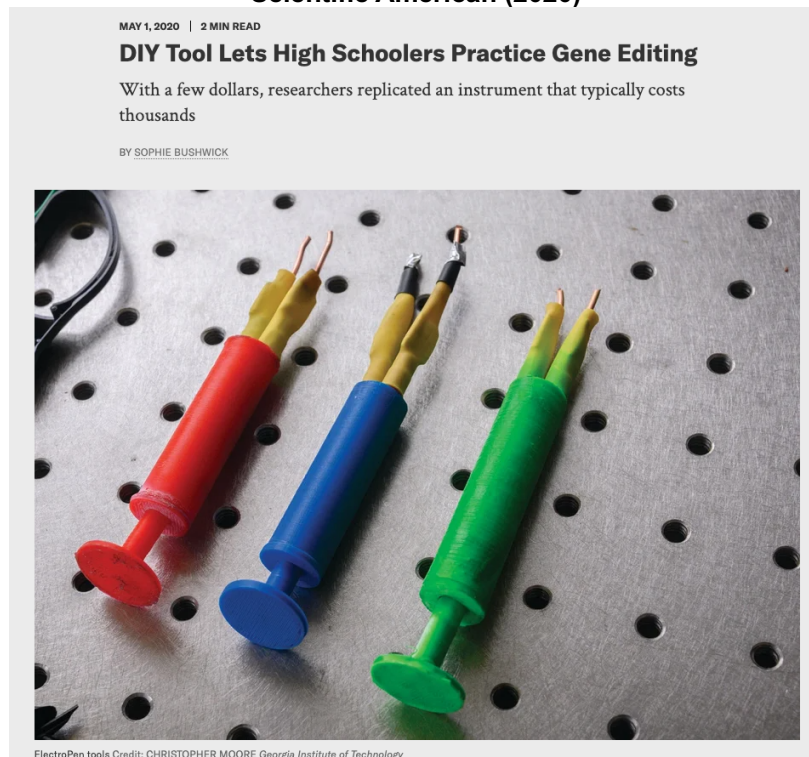
Researchers have devised an inexpensive technique for building a laboratory device known as an electroporator.



Georgia Tech undergraduate student Gaurav Byagathvalli and Assistant Professor Saad Bhamla with examples of the inexpensive ElectroPen – an electroporator device useful in life sciences research. (Credit: Christopher Moore, Georgia Tech)

Source: <https://news.gatech.edu/news/2020/01/11/scientists-transform-barbecue-lighter-high-tech-lab-device>

Scientific American (2020)



Source: <https://www.scientificamerican.com/article/diy-tool-lets-high-schoolers-practice-gene-editing/>

Forsyth News (2022)

Forsyth Commissioners recognize world champs on iGEM team at Lambert High School



Lambert High School's iGEM team stands together before the 2022 Grand Jamboree. Photo courtesy of Lambert High School.

Source: <https://www.forsythnews.com/news/education/forsyth-commissioners-recognize-world-champs-igem-team-lambert-high-school/>

Georgia Tech ISYE News (2023)

H. Milton Stewart School of Industrial and Systems Engineering

College of Engineering

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It's All Starting to Click for Gaurav Byagathvalli

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May 4, 2023

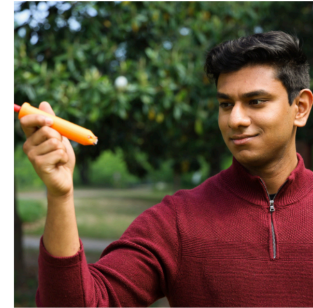


When Gaurav Byagathvalli first encountered genetic engineering as a teenager, he didn't expect the field would shape the course of his life.

He met researcher Saad Bhamla through a partnership between his high school and Georgia Tech and began working in Bhamla's lab at the School of Chemical and Biomolecular Engineering (ChBE). He fell in love with the research, and before long, he was driving to Tech's campus from his high school in Suwanee to work in the lab until late at night.

Byagathvalli and Bhamla were working on building low-cost medical equipment that would be accessible to more people around the world — part of Bhamla's "**frugal science**" push to democratize access to synthetic biology research.

They wanted to develop a cheaper version of a device that uses electric pulses to allow DNA or RNA through a cell membrane, a process called electroporation.



Gaurav Byagathvalli

Source: <https://www.isye.gatech.edu/news/its-all-starting-click-gaurav-byagathvalli>

Georgia Tech research news (2023)

Research

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Home ▸ Frugal Science Brings Research Opportunities to High Schoolers

Frugal Science Brings Research Opportunities to High Schoolers

With a new grant, scientific research can be democratized at schools across Georgia.

Source: <https://research.gatech.edu/frugal-science-brings-research-opportunities-high-schoolers>