



DONALD DANFORTH  
PLANT SCIENCE CENTER



# the Leaflet

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SUSTAINABLE INNOVATION  
TO FEED THE WORLD

*The Leaflet is a publication for partners,  
friends, and supporters of the Donald  
Danforth Plant Science Center.*



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## Sustainable Innovation to Feed the World

In a world with a rapidly growing population and changing climate, the need for sustainable innovation in agriculture has never been more critical. At the Donald Danforth Plant Science Center, we have made it our mission to harness the power of plant science to tackle this challenge head-on. Our dedicated scientists, researchers, and partners are at the forefront of creating transformative solutions that will ensure a food-secure future for generations to come.

In this issue, you will discover how our team is harnessing the potential of advanced biotechnology, precision breeding, and cutting-edge technology to increase the productivity and resilience of crops. You will learn about our work in improving crop nutritional content and yield and enhancing the sustainability of farming practices. We are committed to empowering farmers and communities worldwide—and to improving crops that can benefit historically underserved people and nations.

As you dig into the pages of this issue of the *Leaflet*, you will witness the power of science and innovation to address global food security issues while preserving our planet's precious resources. Join us as we explore the groundbreaking research and innovations that are shaping the future of agriculture. **Together, we can make a difference and create a more food-secure and sustainable future for all.**



### Contact:

975 North Warson Road  
 St. Louis, MO 63132  
[development@danforthcenter.org](mailto:development@danforthcenter.org)  
 314.587.1234

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On cover: Hands holding teff. Learn more on pp. 10-11.

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### Mission & Vision

**MISSION:** Improve the human condition through plant science

**VISION:** As a world center for plant science research, our discoveries will help feed the hungry and improve human health, preserve and renew our environment, and enhance the St. Louis region.

**VALUES:** Collaboration • Diversity and Inclusion • Innovation • Integrity and Respect • Environmental Sustainability • Stewardship



The Danforth Center holds the highest rating from both Charity Navigator (four stars) and GuideStar (the Platinum Seal of Transparency).

## News &amp; Events

## BLAZING A TRAIL

In a history-making moment, Danforth Center Graduate Student **Amie Fornah Sankoh** became the first deaf, Black woman to receive a PhD in any STEM discipline when she successfully defended her thesis on April 21. Amie joined the Danforth Center along with Principal Investigator **Tessa Burch-Smith, PhD**, and her lab in 2021. As a PhD student from the [University of Tennessee, Knoxville](#), Amie's research focused on intercellular signaling in plants. Completing a PhD is a challenging undertaking for anyone; to do so without easy access to the kinds of verbal communication that hearing people take for granted, along with the unique challenges of being a Black woman in science, requires a whole different level of determination. Congratulations, Amie!

## WELCOME, 40 UNDER 40

[St. Louis Business Journal's](#) 2022 class of "40 Under 40" attended a luncheon at the Danforth Center on May 17. The Center's Vice President of Research, **Toni Kutchan, PhD**, addressed the attendees before they received a behind-the-scenes tour of the Danforth Center's cutting-edge facilities. The annual list, published each November, recognizes 40 emerging St. Louis-area business leaders under the age of 40 who are highly engaged with the St. Louis community.

## DANFORTH TGI FELLOW

Principal Investigator **Malia Gehan, PhD**, was recently selected to be part of the [Taylor Geospatial Institute's](#) inaugural class of TGI Fellows. The five individuals chosen are recognized as rising stars and renowned scientists. The program enables TGI member institutions to recruit and retain distinguished researchers in geospatial science fields, develop the next generation of scientific leaders, and catalyze collaboration to accelerate the region's development as a global geospatial center of excellence. The Danforth Center is a founding member of the TGI, which seeks to position St. Louis as a global geospatial leader.

## 2023 TOP WORKPLACE

The Danforth Center continues to be a "Top Workplace" in [St. Louis Post-Dispatch](#) rankings for the third year in a row. The award recognizes employers that do well in the eyes of their employees. In this year's survey, Danforth Center community members gave top scores to professional development, interdepartmental cooperation, and open-mindedness. The honor is a reflection of the work we do together as a "team of teams," and of the values we uphold. Read what some of our community members had to say about the Center in a post on our blog.

## NEW BOARD DIRECTOR

A new director joined the Danforth Center Board in April, bringing the total number of directors to 27. Michael W. Riney is founder and managing director of QRM Capital, where he identifies and makes investments in private companies, private equity, and venture capital funds, and oversees the philanthropic mission and gifts of his family foundation. Prior to founding QRM Capital, Michael worked at Scottrade from 2008 until its sale in 2017. He holds a BS in Finance from [Washington University in St. Louis](#) and an MBA from [Webster University](#) and has served on the Danforth Leadership Council since 2020.

## BESTING BIAS

Citation bias in the sciences often leaves women and minorities behind. Despite concerted efforts in recent years to achieve equity in science and academia, both implicit and explicit biases persist and remain a concern. In an article published by [The Plant Cell](#), **Sona Pandey, PhD**, and **Tessa Burch-Smith, PhD**, discuss the impacts of citation bias and suggest five recommendations to address and rectify the inequalities of citation bias. See our website for a link to the full article.

• Amie Sankoh, PhD



• 40 under 40



• New TGI Fellow



• 2023 Top Workplace



• Michael W. Riney





## Big Ideas take Center Stage

EARLY-CAREER RESEARCHERS SHINE AT BIG IDEAS 3.0

On the evening of Thursday, August 31, more than 600 people faced a difficult choice: deciding which of three potentially life-changing ideas should be the first to advance.

It was the pivotal moment of an event at the Danforth Center called “Conversations: Big Ideas 3.0.” Combining TED Talks and *Shark Tank*, this inspiring evening featured three teams of early-career Danforth Center researchers—each pitching their own groundbreaking concept for how to use plant science to better our world.

The program on August 31 marked the third iteration of this highly popular event, which debuted at the Center in 2017. After remarks from the evening’s moderator, Chip Lerwick, Missouri Market Leader at Aon, the first team took the stage for their pitch.

After each presentation, a trio of panelists asked probing questions to test the team’s knowledge and grace under pressure and to shine a light on the project. The panel included Janet Wilding, Assistant Vice Chancellor of Economic Development at the University of Missouri-St. Louis; Dr. Benjamin Ola Akande, Sr. Vice President at Stifel Financial Corp.; and Marilyn Bush, President of Bank of America St. Louis.

Following the presentations, the packed AT&T Auditorium and Langenberg Theater at the Danforth Center (plus an additional audience watching online) were tasked with voting for their favorite concept—and thus choosing who should win a \$10,000 grant to pursue their idea.

After all the votes were counted, Anne Phillips and Kaushik Panda, members of the past two winning teams of Big Ideas, announced the third: Team Metablify. With this win, the team will have funding to help turn their big idea into a reality, and hopefully soon, change the world.

### CONVERSATIONS

Organized by the Friends Committee since 2003, Conversations are free public events that provide the opportunity to learn about the work of the Danforth Center and our partners. View the recorded event on our blog at [danforthcenter.org](https://danforthcenter.org).

### THE NEXT BIG IDEA

By supporting the Danforth Center, you can help bring even more big ideas to life by providing critical funds for similar groundbreaking early-stage research projects. Help create innovative solutions to our greatest challenges: make a secure donation online at [danforthcenter.org](https://danforthcenter.org).

MEDIA SPONSOR:



“This is what I would characterize as not just best practice, but **next** practice.”

- Dr. Benjamin Ola Akande, SVP at Stifel Financial Corp and Big Ideas 3.0 panelist

#### Team EcoTAG | Allen lab

*Presenters:* Somnath Koley, Poonam Jyoti, and Stewart Morley

*Big Idea:* A new, sustainable method of bioenergy oil production in plant leaves, using cover crops—or crops grown to maintain farmland in between growing seasons of traditional food crops.



#### Team Whatley | Education Research and Outreach lab

*Presenters:* Zach Stafford, Antonio Brazelton, and Kurly Taylor Jr.

*Big Idea:* Living-laboratories to reduce food disparities, including greenhouses, gardens, test kitchens, and more, to inspire the next generation of plant scientists while feeding and empowering marginalized communities.



#### Winner: Big Ideas 2023

#### Team Metablify | Baxter lab

*Presenters:* Louis Connelly, Allen Hubbard, and Britney Millman

*Big Idea:* New tools that will enable scientists to detect chemicals within plants that are essential to crop nutrition as well as the production of many important medicines.



#### FOR EVENT SPONSORSHIP INFORMATION:

Contact Lee’at Bachar, Corporate and Foundations Relations Officer at 314.587.1210 or [lbachar@danforthcenter.org](mailto:lbachar@danforthcenter.org).



Soybean is a crucial crop, but one that has resisted hybridizing and the increased yields such breeding would bring. Danforth Center scientists have developed technology that can help.

## A “Big Idea” for Better Soybean

A LEAP TOWARD HIGHER YIELDS AND SUSTAINABLE AG

A project that came to life at the first Big Ideas event in 2017 has resulted in an exciting new development. Researchers at the Danforth Center and Cornell University have made a breakthrough discovery that could help increase the productivity of one of the world's most important crops: soybean.

Soybean, sometimes called the "golden bean," is a vital global crop. It provides essential protein for human and animal consumption, and plays a key role in oil production, manufacturing, and biofuels. In 2022, the US produced 4.3 billion bushels of soybeans; however, meeting the ever-growing demand for soy is becoming a challenge. Hybrid breeding would, of course, help increase yields, but for soy this has proved an elusive goal.

Hybrid breeding for increased vigor has been used for over a century to boost agricultural outputs in crops like corn, cotton, and sorghum without requiring higher inputs. However, soybean sets inconspicuous flowers that self-fertilize before opening, resulting in very high self-pollination rates. Now, as published in *Plant Biotechnology Journal*, researchers from the Danforth Center and



Ryan DelPercio, Patricia Baldrich, and Margaret Frank of the Meyers lab first presented their idea to hybridize soybean at the first Big Ideas event in 2017.

### THE FIRST BIG IDEA

What we now recognize as the first Big Ideas event was held on November 16, 2017. The event “Conversations: Meeting Grand Challenges” pioneered the hugely popular format of three teams of early-career scientists competing to win seed money for their big idea. The second Big Ideas followed on March 7, 2019 and the most recent one is detailed on pp. 6-7.

Cornell University have discovered how to turn male soybean's fertility on and off as needed. The work is the first step in establishing a hybrid soybean line.

This work is supported by Foundation for Food and Agricultural Research to Margaret Frank, as well as previous support from Sima & Phil Needleman and the United Soybean Board.

## Secret of the Pods: Photosynthesis

Under the direction of **Doug Allen, PhD**, USDA-Agricultural Research Service scientist and member at the Danforth Center, a team of scientists led by Research Scientist **Somnath Koley, PhD**, have elucidated an often-overlooked role of the pods (formally “siliques”) that surround seeds during development. Their study, published in the journal *Science Advances*, shows that, contrary to dogma, leaves are not solely responsible for capturing light and carbon dioxide in plants. Siliques can play a significant role in photosynthesis that supports seed growth and contributes to yield. This discovery presents a new and promising avenue for enhancing crop productivity and was supported by the USDA-Agricultural Research Service, National Science Foundation, and USDA-National Institute of Food and Agriculture.

## Boosting Soybean Oil

As published in *New Phytologist*, scientists at the Danforth Center, in collaboration with the USDA and other institutions, have made an important step in engineering soybeans with higher seed oil levels. Research from the lab of **Doug Allen, PhD**, led by Research Scientist **Stewart Morley, PhD**, documented that oil in seeds could be increased through targeting the enhanced activity of malic enzyme. This discovery builds on prior flux analyses predictions from the lab and has exciting implications for developing sustainable biofuels and petroleum replacements. The research was supported by the USDA-Agricultural Research Service and the Nebraska Soybean Board.



Somnath Koley (left) and Doug Allen at the Danforth Center have discovered that siliques contribute to photosynthesis, supporting seed growth and higher yields.



Soybean pod. Stewart Morley in the Allen lab led a study documenting soybean seed metabolism that resulted in increased seed oil production.



● *Getu Duguma and team survey the teff field at the Danforth Center field site. Researchers are trialing the new semi-dwarf variety developed here.*

### As Seen on PBS

Don't miss the special PBS "Market to Market" segment on teff featuring the Danforth Center. The episode aired November 3 and can also be viewed at [MarkettoMarket.org](http://MarkettoMarket.org).



"I grew up on a farm in Ethiopia, so I know first-hand that if we succeed, the benefits will be immense for our farmers."

- **Getu Duguma, PhD, Senior Manager of Regulatory Science, Danforth Center Institute for International Crop Improvement**

### Thank You

Donations to the Danforth Center supply the Impact Fund with support for early-stage projects. Dr. Duguma and team were able to gather the initial data on teff with help from donor support. Thank you.

## Terrific Teff

### SHORT STATURE COULD YIELD BIG FOR ETHIOPIA

Teff, a small grain indigenous to Ethiopia, serves as a dietary cornerstone for over 80 million people, providing up to two-thirds of the country's protein and dietary fiber. This ancient grain, renowned for its adaptability to diverse growing conditions and drought tolerance, is a promising candidate for a climate-resilient crop. Notably, teff is gluten-free and rich in essential minerals such as iron, calcium, and magnesium.

However, despite these inherent benefits, teff has not yet reaped the rewards of advanced breeding. The challenge lies in the tall growth of teff plants, which causes them to fall over, a phenomenon known as "lodging." Each year, farmers lose up to 25% of their teff harvest due to lodging, impacting both crop productivity and the livelihoods of subsistence farmers in the Horn of Africa.

But those losses may soon be a thing of the past thanks to the pioneering work of **Getu Duguma, PhD**, senior manager of regulatory science in the Danforth Center's [Institute for International Crop Improvement \(IICI\)](#).

### THE FIRST HURDLE

Dr. Duguma and his team are working to do for teff what the Green Revolution did for wheat and rice: creating semi-dwarf varieties to defeat lodging and increase yields. "I grew up on a farm in Ethiopia," said Dr. Duguma, "So I know first-hand that if we succeed, the benefits will be immense for our farmers."

With the support of the Impact Fund, and working with the Danforth Center's [Plant Transformation Facility](#), Dr. Duguma was able to edit teff to produce a variety that was "28-42% shorter than the original and had lodging-resistant qualities." The results were published in

*Plant Biotechnology Journal* in 2022. This breakthrough, which shortens teff's height without compromising its nutritional value, has the potential to improve harvests by up to 20%.

### ANOTHER HURDLE CLEARED

Once the semi-dwarf variety was bred and trialed in the greenhouse, the next step in crop development is a field trial to see how the crop performs outdoors in nature. However, certain genome-edited crops require special USDA permissions. In April, the team received great news: a regulatory review determined that the semi-dwarf teff is not subject to biotechnology regulations.

"We are greatly encouraged by this USDA decision as it establishes an important precedent for future teff plant breeding innovations to tackle productivity constraints, such as pod shattering, small grain size, weed control, and climate change," said **Donald MacKenzie, PhD**, executive director of IICI. "Our semi-dwarf teff lines will be undergoing field performance evaluation this year at the Danforth Center's field research site." (For more on the Danforth Center's new Field Research Site, see [page 14](#).)

Data is currently being analyzed from the first season as part of this multi-year field trial.

### IMPORTANT PARTNERS

The new semi-dwarf teff was developed by Danforth Center researchers, who are collaborating with the **Ethiopian Institute of Agricultural Research** to improve teff productivity using new plant breeding techniques. The project has also received support from [Corteva Agriscience](#).



*Height comparison of edited and unedited teff plants. The Danforth Center's Dr. Getu Duguma and team have developed a semi-dwarf variety that could improve yields up to 20%.*



*Research Associate Kemi Olofintila showing the tiny seeds. Teff is small but mighty: it is gluten-free, drought-tolerant, and rich in protein and minerals.*



Three of the six Danforth Center principal investigators involved in this research (from left): Noah Fahlgren, Keith Slotkin (lead), and Malia Gehan (not pictured: Mao Li, Blake Meyers, and Sona Pandey).

## The Persistence of Memory

UNLOCKING PLANT "MEMORY" TO SURVIVE CLIMATE CHANGE

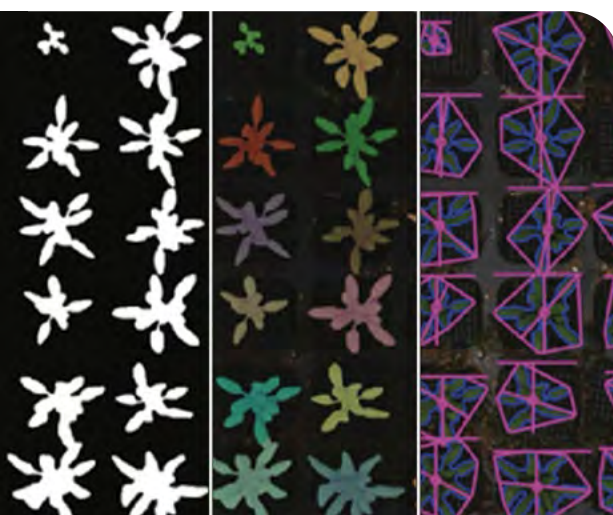
New research, led by Danforth Center Principal Investigator **Keith Slotkin, PhD**, and his team, has unveiled how plants pass on a "memory" of high carbon dioxide (CO<sub>2</sub>) levels to their offspring, paving the way for a future of resilient crops and ecosystems. The article was published in *New Phytologist*.

Unlike animals, plants cannot escape harsh conditions. Instead, they have evolved a remarkable mechanism to pass on knowledge about these conditions to their descendants. This process, known as DNA methylation, essentially marks the DNA without altering its code, providing future generations with crucial information on how to adapt and survive.

Slotkin emphasizes the importance: "Plants passing on clues about the environment to their offspring helps them respond efficiently. It's 'what doesn't kill you makes you stronger' in action, across generations."

The study's focus on two key plant species, moss and *Arabidopsis*, is significant. It offers hope that this remarkable behavior is universal among a wide variety of plants, providing us with a powerful tool to mitigate the impacts of climate change. With this knowledge, crops like corn could be primed to thrive in extreme heat, ensuring food security in a warming world.

This groundbreaking research was made possible through a grant from the National Science Foundation and through the generosity of donors like you. For more information on this exciting research and how you can help, visit [danforthcenter.org](http://danforthcenter.org).



Plants imaged by Raspberry Pi cameras and analyzed using PlantCV software. The Danforth Center's world-class facilities, especially Data Science, played a pivotal role in the success of this research.

## Nature's Time & Temp

In the face of climate change, understanding how plants adapt to temperature fluctuations is not just about botany—it's about securing our global food supply and a sustainable future for humanity. Researchers at the Danforth Center, led by Principal Investigator **Dmitri A. Nusinow, PhD**, and former Nusinow graduate student **Maria L. Sorkin, PhD**, have unveiled the crucial role of the circadian clock in plant temperature response. Their breakthrough, published in *Plant Physiology*, reveals a novel protein complex involved with helping plants adapt to changing temperatures.

This work received support from the [National Science Foundation](#), the [National Institute of Health](#), and other key institutions, and involved collaboration with the Danforth Center's [Plant Growth](#) and [Proteomics & Mass Spectrometry](#) facilities.



Dr. Sorkin (at microscope) was a graduate student when she began this project in the lab of Dmitri A Nusinow (left). They have announced the discovery of a novel protein complex that regulates temperature response.

## Big Data & Resilience

As climate change worsens, scientists are pioneering new collaborations to speed plant research. Danforth Center Principal Investigator **Ru Zhang, PhD**, and Graduate Student (now Postdoc) **Erin Mattoon, PhD**, teamed up with [Mizzou](#) Professor Jianlin "Jack" Cheng, an expert in AI and deep learning for protein structure prediction, to tackle the challenge of rising temperatures. Using cutting-edge computational tools, researchers identified the genes that help plants thrive in high-temperature conditions. They conducted experiments with a green alga called *Chlamydomonas*, systematically breaking genes to pinpoint those essential for heat tolerance. Their findings, published in *Plant, Cell & Environment*, provide a foundation for engineering heat-resistant crops.

The work was supported by the [US Department of Energy](#), [Joint Genome Institute Community Science Program](#), [National Science Foundation](#), [National Institutes of Health](#), and by donors to the Danforth Center.



Zhang Lab researchers grew this algae to highlight their partnership with Mizzou. The labs are working together to identify the genes for heat tolerance.



The Danforth Center's Field Research Site, only about 25 minutes from the Center, is a crucial new facility for plant research.

## Down on the Farm

### THE DANFORTH CENTER'S NEW FIELD RESEARCH SITE

In St. Charles County sits a 140-acre farm that has been transformed into a hub of agricultural innovation. This is the Danforth Center Field Research Site, a place where scientists delve into the intricate relationships between crops and their environment, striving to unlock the secrets of sustainable farming for a changing climate.

The venture began just over a year ago when the Danforth Center acquired the property. While the farm has a rich history, the newly established Field Research Site is poised to become a crucial asset for scientific exploration. The location boasts several barns and a historic farmhouse dating back to 1883, which the Danforth Center plans to renovate as a home base for on-site offices. But the real transformation is happening in the fields, where science and agriculture converge.

### A BUSY FIRST YEAR

In just 12 months, the Field Research Site has already been an invaluable resource to the Danforth Center and the greater agtech community. Eight Danforth Center labs ran experiments at the Field Research Site this season. These included an educational "maize maze" led by the [Eveland lab](#), which was developed for Education and Outreach programming. [Edison Agrosiences](#) grew sunflowers as a potential source of natural



Farm Manager & Field Research Operations Coordinator Terry Beeler and Senior Research Scientist Molly Hanlon at the site.



Left: The Danforth Center partnership with Taylor Geospatial Institute has flourished in the field where geospatial tools like drones assist in data capture.

Right: Ground penetrating radar (GPR) is a tool that allows for non-intrusive data collection underground.

rubber through a [Wells Fargo Innovation Incubator \(IN<sup>2</sup>\)](#) project with the [Kutchan lab](#). The [Taylor Geospatial Institute](#) has also played an important role in measuring plants from the sky.

Geospatial technology can provide essential data for much of the research done at the Danforth Center. Geospatial science seeks to link the "where" with the "what, when, why." Commonly used tools in the geospatial sector include satellites, GPS technologies, and uncrewed aerial vehicles (UAVs) or drones. In plant science, these tools can be applied to measure and assess plants as they grow without disturbing them. That allows for the study of plants outdoors, in the field, while in their natural environment.

### A POWERFUL PARTNERSHIP

The TGI team has been collecting data throughout this first season at the Field Research Site, providing precise plant measurements at all scales, from the ground to UAV flight images and satellite data. Danforth Center principal investigators (Shakoor, Topp, Miller) and the [Phenotyping Core Facility](#) are collaborating with TGI in a bid to better understand the relationship between roots (the below-ground portion of the plant) and shoots (the above-ground portion), among other projects.

"By working together, we can answer new scientific questions and make new discoveries that no single group could do alone," said [Katie Murphy, PhD](#), Danforth Center director of phenotyping and principal investigator.



One of eight labs running experiments at the Field Site using a GPS-enabled precision planter.



A corner of the Maize Maze, a project of the Eveland lab, which provided educational opportunities.





Founders from the 2023 IN<sup>2</sup> agtech cohort. Startups are paired with Danforth Center principal investigators to validate their technology.

## "Climate-Aligned Ag"

### WELLS FARGO IN<sup>2</sup> PROGRAM ANNOUNCES NEW COHORT

The Wells Fargo Innovation Incubator (IN<sup>2</sup>) sustainable agriculture initiative pairs agtech startups with Danforth Center principal investigators to de-risk their technology and accelerate progress to market. Companies also receive financial support and access to investor networks.

This summer, the 12th cohort was announced. Dedicated to "climate-aligned agriculture," these startups focus on mitigating and adapting to the impacts of climate change on global food systems. The 2023 startups are:

- **HabiTerre** (St. Louis, MO) — using remote sensing, process models, and AI to create a holistic picture of farm production systems past, present, and future. PI: Chris Topp, PhD.
- **Impetus Ag** (St. Louis, MO) — developing next-generation crop insect control products. PIs: Bala Venkata, PhD, and Nigel Taylor, PhD.
- **Impossible Sensing** (St. Louis, MO) — boosts soil management, merging in-situ sensors with regular farming operations. PI: Allison Miller, PhD.
- **InnerPlant** (Davis, CA) — develops seed technology to code crops to communicate early and specific stresses via optical signals. PI: Katie Murphy, PhD.
- **Mirai Solar** (Mountain View, CA) — uses photovoltaic shade screen technology to reduce greenhouses' operational costs. PI: Ru Zhang, PhD.
- **Running Tide** (Portland, ME with offices in BRDG Park) — designs and deploys nature-based interventions that remove carbon, combat ocean acidification, and increase understanding of ocean ecosystems. PIs: Noah Fahlgren, PhD, and Malia Gehan, PhD.
- **Sentinel Fertigation** (Lincoln, NE) — leverages remote sensing and geospatial data to empower precision nitrogen management. PIs: multiple.

"This year's companies have commercially viable technologies with tremendous potential to deliver environmental, economic, and societal benefits."

- Dr. Elliott Kellner, Danforth Center Director of Commercial Innovation.



## Introducing: Cultivar!



St. Louis is set to enhance its global presence in the agri-food tech sector with the launch of Cultivar STL. This strategic effort, led by prominent organizations such as the Danforth Center, BioSTL, and the World Trade Center St. Louis, aims to strengthen partnerships with Latin American counterparts, promoting economic growth and contributing to global food security. The initiative kicked off in October with a visit from over 30 startup executives, investors, and ecosystem builders from nine Latin American countries. [Read more on our website.](#)



Cultivar STL is the new strategic effort to strengthen partnerships with Latin America.

## Launch of the PheNode

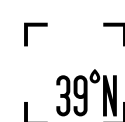


Agrela Ecosystems, a startup founded by Danforth Center Principal Investigator **Nadia Shakoor, PhD**, has launched its flagship innovation: the PheNode<sup>®</sup>. This environmental sensor platform is set to revolutionize data collection, offering unparalleled flexibility and scalability. PheNode has already gained traction with users like the Taylor Geospatial Institute and the Salk Institute. It is also set to play a pivotal role in community-ag projects, such as the Danforth Center partnership in the Jackie Joyner-Kersey Food Agriculture Nutrition Innovation Center (JJK FAN).



The PheNode<sup>®</sup> is the pilot launch of Agrela Ecosystems, a Danforth Center spinout.

## The Future of 39 North



The Danforth Center, along with six other anchor institutions, have joined forces to establish 39 North as an independent 501(c)(3) nonprofit under the leadership of its first Executive Director Emily Lohse-Busch. Building upon the unique strengths of St. Louis, 39 North aims to bring people, resources, and facilities together to foster cutting-edge plant science research, create economic opportunity, and further the region's reputation as a global agtech hub. [Read more at 39northstl.org.](#)



Emily Lohse-Busch speaks at the announcement of 39 North as an independent nonprofit organization.



With support from Boeing, the Danforth Center “piloted” a new geospatial summer opportunity for middle-schoolers this year: Drone Ranger Camp.

## The Drone Rangers!

### BOEING AND DANFORTH CENTER CULTIVATE FUTURE GEOSPATIAL SCIENTISTS

Geospatial technology can play a pivotal role in addressing critical issues like food security and nutrition, particularly in underprivileged areas. In a quest to bridge the gap between technology, agriculture, and community development, the Danforth Center [Education Research and Outreach Lab](#) has launched a new geospatial science initiative. Thanks to a generous grant from [Boeing](#) that aims to address education gaps, especially in map reading and math, this initiative offered a new program this summer: “Drone Ranger Camp.”

In partnership with the [Jackie Joyner-Kersey Food Agriculture Nutrition Innovation Center \(JJK FAN\)](#), the Boeing grant enabled **Sandra Arango-Caro, PhD**, Danforth Center senior education researcher and program manager, to create a multifaceted program, comprising afterschool initiatives, a summer camp, and high school internships, catering to middle and high school students from East St. Louis. This program not only familiarizes students with geography and geospatial technologies, but also highlights their real-world applications in STEM+Ag (Science, Technology, Engineering, Mathematics, and Agriculture), including solutions for food security challenges.

“Drone Ranger Camp” ran from July 24 to 28. During the camp, students participated in an array of exciting activities, such as programming and flying drones, observing professional drone flights, and attending presentations on the data collected during these flights. They also engaged in map-related geography concepts

and even delved into the fascinating world of artificial intelligence. Students were not only introduced to geospatial technologies, but also encouraged to explore the diverse career opportunities this field offers.

Activities were offered by Danforth Center and JJK FAN partners with critical support provided by JJK FAN Instructor Zachary Stafford and Kurly Taylor Jr., JJK FAN strategic partnership manager.

The Boeing Company and the Danforth Center share a commitment to inspiring and preparing the next generation of innovators. The Danforth Center is grateful for Boeing’s support.

## EMBARK-ing on a Career in Science

High school students with dreams of entering the biotechnology field now have an exciting opportunity through the EMBARK program, a collaborative effort between the Danforth Center and [St. Louis Community College](#). EMBARK is a dual-credit and dual-enrollment program that allows students to earn a life science lab assistant certificate before graduating from high school. Students who complete the program are prepared for work in bioscience laboratories and are well positioned to continue studies to complete bioscience and biotechnology degrees. With reduced tuition rates and access to state-of-the-art lab facilities, this initiative equips young minds to become future solution-creators. Learn more at [stlcc.edu](#).

## Meet the 2023 REU Students

Each summer, the Danforth Center opens its doors to exceptional undergraduate students from all corners of the nation, welcoming them into the [Research Experience for Undergraduates \(REU\)](#) internship program. This transformative experience equips budding scientists with hands-on exposure to the intricacies of modern scientific research, from designing experiments to conducting them alongside world-class plant scientists. Made possible by the [National Science Foundation](#), the program aims to shape the next generation of scientists to tackle the most significant challenges of our era. The class of 2023 is motivated by a desire to play a pivotal role in devising solutions for climate change, clean energy, ecosystem restoration, and sustainable agriculture. [Visit the Danforth Center’s blog](#) to meet some of this year’s team and learn how they hope to change the world.



Danforth Center Education Research and Outreach lab is partnering with St. Louis Community College on the EMBARK program for high-school students.



The 2023 REU class concluded their summer internship by gaining practical, hands-on experience in labs utilizing state-of-the-art tools and techniques.



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## Thank You, Grow Challenge™

Thank you to everyone who played a part in this year's Grow Challenge Week of Giving (Sept. 25-29) and Party with the Plants. Together we raised more than \$110,000 for plant science innovation and local STEM education, making this year's fundraiser one of our most successful ever. Thank you to our Young Friends committee and to our donors and sponsors.



## Party with the Plants

On September 29, nearly 300 people joined in the fun, as we celebrated a successful Grow Challenge. (Images courtesy of Ladue News. See more at [laduenews.com](http://laduenews.com))





Christine and William Linnenbringer have chosen to create a legacy of hope at the Danforth Center.

## Meet the Linnenbringers

“So many of us take the resources of the Earth for granted. We expect we will have food to eat and clean water to drink. Unfortunately, our planet does not have an unlimited supply, and this is causing inequality, poverty, and misery around the world,” says Christine “Chris” Linnenbringer. She’s been asked to explain why she and her husband Bill support the Danforth Center.

Donors since 2011, the Linnenbringers joined the [Danforth Society](#) in 2019, and then in 2022, they opted to become part of the [WHD Legacy Society](#) by making a planned gift. The society, named in honor of the Danforth Center’s founding chair, Dr. William H. Danforth, has a special meaning for the Linnenbringers, as their involvement with the Danforth family spans decades.

After receiving a copy of *I Dare You* by Dr. Danforth’s grandfather for his high school graduation, Bill Linnenbringer went on to build a career at [PricewaterhouseCoopers](#), where he had business with the Danforth family. Later, when their son entered [Washington University](#), the Linnenbringers came to admire Chancellor Danforth even more. When they learned about the plant science center, they knew they wanted to be a part of “Bill Danforth’s vision.”

**“We want to support organizations that benefit the St. Louis area as well as make an impact on some of the world’s most critical issues,” says Bill.**

Adds Chris: “We wholeheartedly support the mission of the Danforth Center. The need for research is urgent in order to escape an impoverished and destructive future for humanity.”

### You can make a difference.

There are many ways to be part of the Danforth Center mission. Visit [danforthcenter.org/get-involved](https://danforthcenter.org/get-involved) to learn more.

### TRIBUTES

The Danforth Center is grateful to donors who choose to honor or memorialize their friends, loved ones, and colleagues with a gift to the Center. Gifts listed here were received by Oct. 31, 2023. To make a tribute, visit [danforthcenter.org/donate](https://danforthcenter.org/donate).

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The Danforth Center is grateful to donors who have planned for future needs of the Center by designating an estate gift. To learn more about estate giving, visit [legacy.danforthcenter.org](https://legacy.danforthcenter.org).

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