For Future Generations

2022 ANNUAL REPORT

DONALD DANFORTH
PLANT SCIENCE CENTER

For Future Generations

Doing something larger, systematically, and sustainably takes longer, but ultimately has greater potential to improve more lives. At the Danforth Center, scientists are unlocking the power of plants to address global food security and energy challenges and to mitigate and adapt to climate change. We partner with impacted countries and educate the next generation of scientific leaders to help create a brighter, greener future for all.

Contents

Letter from the Chair

Sustainability can seem like an overused word these days, but sustainability is at the core of everything the Donald Danforth Plant Science Center was established to do:

- Feed the world, but with crops demanded by farmers and with in-country capacity-building, so that our scientific colleagues in Africa and Asia can perpetuate the system.
- Protect the planet—not by giving up existing systems, but by modifying them with resilient crops and crops that can help mitigate climate change while also feeding the world.
- Enhance the region. By planting our flag as *the* world center for plant science research, more companies and talent will grow here.

In just one year, we are witnessing big leaps forward in our mission to feed the world and heal the planet: improved cowpea approved in Ghana, the first-ever harvest of enriched rice in the Philippines, the identification of key microbes that contribute to drought-tolerance, and new strides in bioenergy research. Our innovation ecosystem is growing too: the Danforth Center's new Start-Up Initiative is already bearing fruit, and the new field site is a major gamechanger for the pace of research.

All of this progress is made possible thanks to the support and interest of our community. Thank you.

Todd R. Schnuck

Letter from the President

One of the things I love about the Danforth Center is how it changes year after year. Despite the fact that our mission – *to improve the human condition through plant science* – remains constant, our people, our facilities, and our modes of working are constantly morphing and improving.

In 2022, we welcomed new graduate students, postdoctoral scientists, undergraduate researchers, and members of support teams across the Center, raising our community size to over 400 individuals. We welcomed Armando Bravo as a new Assistant Member and Principal Investigator. Armando has initiated an interesting program to understand how beneficial microbes within plants function and evolve.

We established a new 140-acre Danforth Center Field Research Site in St. Charles County. This is already providing a unique resource to extend research out of the lab and into a flexible field setting. We also started seeing results and positive outcomes from recent strategic initiatives, like the SINC Center to reduce greenhouse gas emissions in agriculture, and the Danforth Center Start-Up Initiative.

The Danforth Center is a dynamic, ever-evolving place. And I thank all of our community members and supporters who enable and drive such positive change!

James C. Carrington

Principal Investigators

Our principal investigators lead cutting-edge research in plant biology and genetics to create solutions for food security and environmental challenges. In 2022, the Danforth Center welcomed **Armando Bravo, PhD** from Boyce Thompson Institute in Ithaca, NY.

Doug Allen, PhD
Member and USDA Research Scientist
The Allen lab uses isotopes combined with computational methods to assess plant growth and productivity at the molecular level that contribute to enhanced biomass production and value-added seed compositions.

Rebecca Bart, PhD
Member
The Bart lab combines genetics with molecular and computational biology to study host-microbe interactions in important crops including cassava, sorghum, corn, and cotton.

Ivan Baxter, PhD
Member
The Baxter lab uses advanced technologies to understand the diverse ways plant genetics interact with the environment to enable growth.

Armando Bravo, PhD
Assistant Member
The Bravo lab investigates the mechanisms that control mutually beneficial interactions between plants and fungi that can be used to increase plant nutrition sustainably.

Tessa Burch-Smith, PhD
Associate Member
The Burch-Smith lab studies communication between plant cells and between plants and viruses to improve crop yield and resistance to infection.

Kristine Callis-Duehl, PhD
Executive Director of Education Research and Outreach
The Education Research & Outreach lab studies how to effectively engage students in authentic STEM research at all grade levels, K-16, in formal, informal, and virtual learning environments in an effort to recruit, train, and retain the next generation of diverse STEM and agtech scientists and leaders in St. Louis and around the world.

James Carrington, PhD
President and CEO
The Carrington lab focuses on how plants respond to viruses, mechanisms of epigenetics, and how crops can be improved to increase productivity.

Kirk Czymmek, PhD
Director, Advanced Bioimaging Laboratory
The Czymmek lab uses advanced imaging approaches to understand the inner workings of plants, microbes, and their interactions with each other and the environment.

Bradley Evans, PhD*
Director, Proteomics and Mass Spectrometry
The Evans lab uses high-performance mass spectrometry, proteomics, and metabolomics for connecting molecular phenotypes with the macroscopic form and function of organisms.

Andrea Eveland, PhD
Associate Member
The Eveland lab uses experimental and computational approaches to investigate the regulation of architecture traits and yield potential in cereal crops.

Noah Fahlgren, PhD
Director, Data Science Facility
The Data Science team is a computing and data analytics hub that develops and deploys technologies in computational biology, computer science, mathematics, and statistics to accelerate discoveries from data and models in plant science.

Malia Gehan, PhD
Assistant Member
The Gehan lab develops high-throughput phenotyping approaches to study mechanisms of crop resilience under temperature stress.

Elizabeth Kellogg, PhD
Member, Robert E. King Distinguished Investigator
The Kellogg lab studies genomes, growth, and development of sorghum, maize, and their wild relatives, using biodiversity research to make ecosystems and agriculture more sustainable.

Toni Kutchan, PhD
Member, Oliver M. Langenberg Distinguished Investigator, VP for Research
The Kutchan lab studies the production of the anticancer compound cyclopamine in corn lily, the modification of plant medicinals by the soil microbiome, and the oilseed crop camelina as a source of renewable fuel.

Mao Li, PhD
Senior Research Scientist and Principal Investigator
The Li lab develops mathematical methods, models, and computational tools to extract and analyze comprehensive plant morphological features from 2D and 3D imaging data to fully utilize new technologies and accelerate biological discoveries.

Donald MacKenzie, PhD
Executive Director, Institute for International Crop Improvement
Dr. MacKenzie leads the Institute for International Crop Improvement (IICI). The IICI is committed to delivering precision genetics technologies to meet the most significant food and nutritional security challenges faced by smallholder farmers everywhere.

Blake Meyers, PhD
Member and Professor, Division of Plant Science and Technology, University of Missouri – Columbia
The Meyers lab uses experimental and computational approaches to study plant reproduction and fertility to enhance yield gains in crop plants.

Allison Miller, PhD
Member and Professor of Biology, Saint Louis University
The Miller lab explores how long-lived plants respond to dynamic environments, with the goal of developing perennial crops that support ecologically sustainable agricultural systems.

Todd Mockler, PhD**
Member, Geraldine and Robert Virgil Distinguished Investigator
The Mockler lab uses genomics, high-resolution phenotyping, and computational biology to understand plant responses to environmental stresses to improve productivity in food and energy crops.

Dmitri Nusinow, PhD
Associate Member
The Nusinow lab focuses on increasing plant productivity by studying daily and seasonal responses to the environment.

Sona Pandey, PhD
Member
The Pandey lab uses molecular, biochemical, and functional studies to understand the mechanisms of stress tolerance and yield improvement in plants by heterotrimeric G-proteins.

Dilip Shah, PhD
Associate Member
The Shah lab investigates modes of action of antifungal plant defensins and defensin-like peptides to enable development of these peptides as bioinspired fungicides and fungal disease resistant crops for yield protection.

Nadia Shakoor, PhD
Senior Research Scientist and Principal Investigator
The Shakoor lab develops and uses integrated digital agriculture systems to study the effects of phenotype, genotype, and the environment on crop productivity and resiliency.

R. Keith Slotkin, PhD
Member and Associate Professor, Division of Biological Sciences, University of Missouri – Columbia
The Slotkin lab seeks to uncover how plants determine which regions of their genomes should be expressed, which regions should not be expressed, and to create new technologies in plant biology.

Nigel Taylor, PhD
Associate Member, Dorothy J. King Distinguished Investigator
The Taylor lab applies biotechnology to enhance disease and pest resistance, and to improve nutritional quality of the African staple crop, cassava. Activities include all steps from the laboratory and greenhouse to field trials, regulatory approvals, and the deployment systems required to deliver these products to benefit smallholder farmer households in East and West Africa.

Christopher Topp, PhD
Associate Member
The Topp lab studies root systems, the "hidden half" of plants, using cutting-edge phenomics to develop more sustainable and productive cropping systems that regenerate the soil.

James Umen, PhD
Member, Enterprise Rent-a-Car Institute for Renewable Fuels and Joseph Varner Distinguished Investigator
The Umen lab investigates the genetics and cell biology of green algae to enable development of sustainable sources of biofuel and other high-value compounds.

Veena Veena, PhD
Director, Plant Transformation Facility
The Veena lab explores novel approaches for plant genetic engineering and genome modification technologies to enable plant biology research for crop improvement.

Xuemin (Sam) Wang, PhD
Member and E. Desmond Lee Professor, University of Missouri – St. Louis
The Wang lab focuses on lipid signaling in plant response to environmental changes, including nitrogen/phosphorus/water deficiencies; and regulation of lipid metabolism and vegetable oil production.

Bing Yang, PhD
Member and Professor, Division of Plant Sciences, University of Missouri – Columbia
The Yang lab uses enhanced genetic and molecular tools to increase the understanding of plant responses to biotic and abiotic stresses that can be coupled with enabling technologies to develop improved crops.

Ru Zhang, PhD
Assistant Member
The Zhang lab studies how photosynthetic cells, especially photosynthesis, responds to high temperatures in order to engineer more heat-resistant crops and algae for improved food and biofuel production.

Indicates a member of the National Academy of Sciences. Membership is among the highest honors bestowed on scientists in the US.

In 2022, Dr. Blake Meyers was elected, joining Danforth Center President Jim Carrington and Distinguished Investigator Elizabeth Kellogg in this prestigious body.

** Dr. Evans left the Danforth Center in December 2022.*
*** Dr. Mockler passed away in January 2023.*

Food as a Human Right

Feeding the world has never been more urgent. Climate change, soil degradation, water scarcity: plant science is critical to addressing these serious challenges. Danforth Center scientists are working to deliver new crop varieties that are more resilient, productive, and nutritious—to empower farmers and ensure food security for all.

In 2022, PBR cowpea was approved for commercialization in Ghana. With the help of the Danforth Center, it is already in farmers' hands in Nigeria, where the focus is now on scaling seed supply to meet the huge demand.

The **Institute for International Crop Improvement** focuses on increasing the productivity and nutritional value of staple food crops in developing regions of the world that are generally underserved by commercial agriculture.

"Hunger is a complicated issue. It's exacerbated by conflict. It's exacerbated by climate change. But science gives us the tools to make a difference."

-Don MacKenzie, PhD, Executive Director, IICI

Success Breeds Success

PBR Cowpea Approved in Ghana

With regulatory assistance from the Danforth Center **Institute for International Crop Improvement**, Ghana has approved pod-borer-resistant (PBR) cowpea for commercialization. If all goes well, seeds could be available to Ghanaian farmers in 2024. Cowpea is a crucial source of protein for more than 200 million people, but it is susceptible to the devastating pod borer insect which can destroy yields by up to 80%. The Danforth Center was previously instrumental in helping the improved variety find approval in Nigeria where it is now in farmers' hands. PBR cowpea seed output in Nigeria increased nearly 60% in 2022 in response to farmer demand, and the team is focused on scaling in-country seed production capacity.

Cowpea is the most important indigenous legume in West Africa both in terms of food security and income generation for smallholder farmers.

Cowpea farmers formerly had to spray pesticides up to 10 times per season, often with little protective gear. The new resistant variety promises better yields, less expense, and better health.

The first ever harvest of enriched "Malusog Rice" took place in the Philippines, where it is expected to serve as a complement to vitamin A deficiency interventions.

"Growing up on a farm in Ethiopia, I know first-hand that our success will bring immense benefits for farmers."

-Getu Beyene Duguma, PhD
Senior Manager,
Regulatory Science

Teff is an orphan grain consumed by more than 100 million people in Ethiopia. Researchers at the Danforth Center led by Dr. Duguma have succeeded in shortening its stature, the first step in combatting lodging.

Rice Reaches the Public

First Enriched Rice Harvest in Philippines

The year 2022 marked the first commercial harvest of enriched rice in the Philippines after the Danforth Center helped secure commercial propagation approval there the year prior. Malusog (or "healthy") Rice is the name given to enriched rice that contains higher levels of beta-carotene, a precursor to vitamin A in the body. Vitamin A deficiency is a major health issue in many developing countries and can cause blindness or even death. Only 1 out of 5 Filipino households meets the requirement for vitamin A intake in their diet. Enriched rice has the potential to become an effective complementary intervention.

A First Step for Teff

Stature Successfully Shortened to Combat Lodging

More than 100 million people in Ethiopia rely on the ancient grain teff for sustenance and nutrition. It is naturally gluten-free, iron-rich, and contains high-quality protein, but despite its many advantages, teff is an orphan crop that has not benefited from advanced breeding. Teff farmers lose about 25% of yield because the unimproved plants grow too tall and fall over, a condition known as lodging. In 2022, researchers at the Danforth Center led by **Dr. Getu Beyene Duguma** deployed cutting-edge technology to create semidwarf teff that resists lodging—the first step toward an improved variety.

THANKS TO OUR PARTNERS

*Each of these projects is a multinational partnership with funding from governmental agencies, private and corporate foundations, and donors like you. To learn more, visit **danforthcenter.org**.*

Rooting against Climate Change

Climate change jeopardizes the very foundation of our global food systems. Rising temperatures, shifting rainfall patterns, increased frequency of extreme weather events, and changing pest and disease dynamics all contribute to the mounting challenges faced by farmers worldwide. Researchers at the Danforth Center are working urgently to mitigate these risks and adapt food crops for the future.

These 6-foot growth cubes are loaded with sensors to allow the study of full-size living root systems. Principal Investigator Chris Topp invented these mesocosms and is using them in SINC Center work to help unlock the secrets of plant-microbe interactions.

Unlocking the Secrets of Plant-Microbe Interactions

Pioneering Research for Sustainable Agriculture and Beyond

Beneath our feet lies a hidden world bustling with activity, where tiny organisms shape the destiny of plants and influence the health of our planet. The Danforth Center's **Subterranean Influences on Nitrogen and Carbon (SINC) Center** investigates the complex interactions between plants and soil microorganisms with a goal of creating a more sustainable future for agriculture and beyond.

- In 2022, SINC Center Co-director **Becky Bart, PhD**, and a multidisciplinary team used a new data modeling strategy to identify key microbes that help plants tolerate drought and low nitrogen conditions. This discovery has the potential to improve crop resilience in the face of climate change. The researchers worked with sorghum and are now tackling corn.
- Fellow SINC co-director **Chris Topp, PhD**, has developed a groundbreaking new system to study and visualize root systems. Using large plant growth boxes called "mesocosms" equipped with sensors, Topp's team can analyze complete, living root systems in 3D. By studying roots, the Topp lab aims to improve water and nutrient uptake and enhance carbon capture for a more sustainable agriculture.

The SINC Center was made possible with a founding gift from Phil and Sima Needleman and with support from Bank of America.

"Climate change is the challenge of our age. The SINC Center harnesses diverse scientific expertise to lower the impact of agriculture on climate."

- Chris Topp, PhD
Danforth Center
Principal Investigator

The **Enterprise Rent-A-Car Institute for Renewable Fuels** explores the potential of plants to create green solutions for global energy challenges.

Sorghum has great potential as a bioenergy crop, but little is understood about the genetic underpinning of the crop's drought tolerance and water efficiency. Danforth Center scientists are working to change that.

Sorghum for Food, Fuel, and Climate

Unlocking Sorghum's Secrets for a Sustainable Future

A close relative of corn, sorghum is emerging as a super-grain of astonishing versatility. Sorghum is naturally resilient in adverse growing conditions such as drought, high temperatures, and poor soil, making it a valuable climate-resilient crop. It is also an extremely efficient converter of solar energy, making it a leading candidate for bioenergy feedstocks.

- *Growing Greener* – Danforth Center Principal Investigator **Nadia Shakoor, PhD**, and her lab are partnering with the National Sorghum Producers and sorghum farmers across a six-state region to develop climate-smart sorghum production. Sustainable practices can help increase carbon capture and reduce greenhouse gas emissions, benefitting both farmers and the environment. *Funding from USDA Climate-Smart Commodities.*
- *Bioenergy Basics* – Sorghum's natural resilience to drought stress and excessive heat allows it to grow on marginal lands, making it a leading bioenergy candidate. But little is understood of how the 30,000+ genes in sorghum create this resilience. Danforth Center Principal Investigator **Andrea Eveland, PhD**, is leading a multi-institutional project to deepen genetic understanding of sorghum drought response. *Funding from the Department of Energy.*
- *Liquid Leverage* – Water is a major limitation for crop production of all kinds, but especially bioenergy crops. Danforth Center Principal Investigator **Ivan Baxter, PhD**, is leading a multi-institutional project to deepen the understanding of water use efficiency (WUE) in sorghum. *Funding from the Department of Energy.*

Dr. Nadia Shakoor (right) is collaborating with National Sorghum Producers to bring more sustainable practices to farmers—and ways of quantifying them so that farmers share in the benefits.

Center scientists have identified new microbes that help with drought tolerance. The work is part of the SINC Center, which seeks to decrease the use of chemical nitrogen fertilizers.

Scientist taking core samples at the new Danforth Center Field Research Site. The Center acquired the 140-acre property in St. Charles County in 2022.

Leading Global Innovation

Danforth Center's New Field Site and the Power of Partnership

The Danforth Center stands at the forefront of scientific innovation, supported by its cutting-edge infrastructure and state-of-the-art cores. These exceptional facilities serve as a launchpad for groundbreaking discoveries and transformative solutions to global agricultural challenges.

- In 2022, the Center added a new 140-acre **Field Research Site** to existing tools for researchers. Located in St. Charles County, this proprietary field site allows scientists closer proximity and more control over their existing field work—and the opportunity for longer term projects. *With generous support from John and Anne McDonnell and Beau and Suzy Brauer.*
- The Danforth Center joined seven other leading research institutions this year in founding the new **Taylor Geospatial Institute** with a goal of positioning the region as a geospatial science leader. *Funding by Andrew C. Taylor.*
- The Danforth Center has joined forces with **Saint Louis University** to deploy "edge computing" in order to more broadly share farm intelligence. Smart farm technology generates vast amounts of data. Researchers are collaborating to create a cyber-physical system to better speed and share information from the field. *Funding by National Science Foundation.*

Danforth Center Vice President for Research Toni Kutchan, PhD (third from right) at the Taylor Geospatial Institute announcement. The Danforth Center is a partner in the new Taylor Geospatial Institute.

YOU ARE HELPING

These projects to preserve our planet are funded through governmental grants, corporate and foundation grants, and by donors like you. Thank you.

From St. Louis to the World

The Danforth Center's innovation ecosystem is intentional. By connecting scientists, innovators, industry leaders, and investors, the Center accelerates the translation of cutting-edge research into practical solutions for global challenges in agriculture, food security, and sustainability. And our work creates opportunities for people who live here in St. Louis. Together, we are paving the way for transformative, worldwide impact.

The Danforth Center campus, including BRDG Park, had an economic impact of $412 million on the St. Louis region in 2021 (the most recent year of data). In 2022, the Center launched a new Start-Up Initiative to further spur growth.

39°N

39 North is a 600-acre agtech innovation district home to the Danforth Center, BRDG Park, Helix incubator, Yield Lab, Bayer Crop Science, Benson Hill, and CoverCress. The district celebrated 5 years of rapid growth in 2022. Learn more at 39northstl.org.

New Start-Up Initiative

Bridging the Gap from Lab to Market for Agtech Innovations

Danforth Technology Company

Building on the success of existing ventures like Benson Hill and RNAissance Ag, the Danforth Center has launched the Danforth Center Start-Up Initiative, aiming to accelerate the transformation of cutting-edge research into practical solutions through the formation of agtech companies. The initiative supports principal investigators by identifying marketable applications, securing intellectual property, funding proof-of-concept research, and providing entrepreneurial guidance. The subsidiary **Danforth Technology Company** facilitates funding to speed innovative start-ups at the intersection of agriculture and the environment.

Fighting Fungus with Nature and AI

Peptyde Bio, First Start-Up of New Initiative, Develops Sustainable Biofungicides

peptyde BIO

Peptyde Bio, the first company to emerge from the Danforth Center's new Start-Up Initiative, is combatting fungal diseases in agriculture with innovative biofungicides. Leveraging artificial intelligence and the natural antimicrobial peptides derived from plants, Peptyde Bio's environmentally friendly and cost-effective solutions offer novel modes of action against fungal diseases. Co-founded by Danforth Center Principal Investigators **Dilip Shah, PhD**, and **Kirk Czymmek, PhD**, the start-up has already secured patents and investments, positioning it as a promising player in the agtech industry.

Peptyde Bio is developing sustainable solutions to fungal disease. It was co-founded by Dilip Shah, PhD (left), who is an expert on antimicrobial peptides derived from plants, and Kirk Czymmek, PhD, who is director of the Advanced Bioimaging Lab.

Battling Bugs with Precision

RNAissance Ag, a Danforth Center Start-Up, Offers Sustainable Pest Management Solutions

RNAiSSANCE AG

Co-founded by Danforth Center Senior Research Scientist **Bala Venkata, PhD**, RNAissance Ag is revolutionizing pest management with its groundbreaking RNA interference (RNAi) technology. By developing highly specific and biodegradable sprayable biopesticides, the company addresses the urgent need for effective, affordable, and environmentally sustainable solutions to combat insect pests. RNAissance Ag's targeted approach, which preserves beneficial pollinators, offers hope in the face of evolving pest challenges exacerbated by climate change.

Seeding Success

Wells Fargo IN² and Danforth Center Collaborate to Accelerate Promising Agtech Solutions

Innovation Incubator IN²

For four years, the Danforth Center and Wells Fargo Innovation Incubator (IN²) have joined forces to expedite the development of sustainable agtech solutions. The partnership pairs agtech start-ups with Danforth Center principal investigators, providing validation and support to drive their progress. The fourth agetch cohort focused on biological solutions to enhance global resilience of food systems. The four companies selected in 2022 were: Cytophage Technologies (bacteriophage tech), Edison Agrosciences (sunflower-based rubber), Peptyde Bio (natural biofungicide), and Robigo (targeted antimicrobials).

RNAissance Ag field trial site. The Danforth Center's Bala Venkata, PhD, co-founded the biopesticide company, which offers targeted solutions to insect pests while protecting beneficial pollinators.

Founders paired with Danforth Center principal investigators for the Wells Fargo IN² 2022 agtech cohort. All four start-ups feature a focus on biological solutions for a more resilient agriculture.

Science Education for the Future

STEM education equips students with the knowledge and skills to tackle pressing global challenges—and provides long-term career and life opportunities. By sharing plants' role in food security, climate change mitigation, and environmental sustainability, we empower future generations to develop innovative solutions, preserve biodiversity, and cultivate a healthier planet for all.

The Research Experience for Undergraduates welcomed 21 students in 2022. It was joined by a new authentic research internship program for high school students.

A Pipeline of Plant Science Students

REU is joined by New High School Pilot Program

The **Research Experience for Undergraduates** (REU), funded by the National Science Foundation, has been part of summer at the Danforth Center for 20 years. In 2022, more than 157 undergraduate students from around the country competed for 21 spots at the rigorous 11-week program. Students received hands-on research experience and mentoring, as well as exposure to industry and innovation ecosystems. The program was managed by Principal Investigators **Sona Pandey, PhD**, and **Tessa Burch-Smith, PhD**, with assistance from Judy Mitchell and Monica Alsup.

In 2022, REU was joined by a pilot program for high school students from across the St. Louis region. Nearly 20 students were hired in the first class of what is now called the Research Experience for High School (REHS).

At far left: Raspberry Pi Jam returned in October 2022. The event welcomed 379 people to explore hands-on science, tinkering, and robotics fun for the whole family.

"The program helped me see the potential of a plant science degree. I hope to pursue a PhD in plant breeding."

- 2022 REU Intern

2022 WHD FELLOW

A fifth-year PhD student at Washington University in St. Louis, **Kiona Elliott** was named the 2022 William H. Danforth Plant Science Fellow, an award for outstanding PhD students whose research demonstrates great promise for advancing plant science. Kiona was a member of the lab of Principal Investigator **Becky Bart, PhD**, and studied the genetic mechanisms underlying cassava susceptibility to *Xanthomonas*-induced bacterial blight.

JJK FAN UNFURLS

The Jackie Joyner-Kersee Food Agriculture Nutrition Innovation Center (JJK FAN) held a ribbon-cutting April 2022. This unique collaboration between Danforth Center, JJK Foundation, the University of Illinois Urbana-Champaign (UIUC), and Lansdowne UP seeks to provide quality youth and community programs in STEAM+Ag, food production, nutrition, and physical activity in East St. Louis and beyond. The Danforth Center is a key partner in curriculum development and program implementation.

PROFESSIONAL DEVELOPMENT

The Danforth Center's Education Research and Outreach lab holds professional development sessions for educators throughout the year. Each training provides an instructional deep dive for a specific Authentic Research Experience (ARE), such as Mutant Millets, Discovering Volvox, and Plants Fight Back. Teachers bring knowledge of cutting-edge research tools and techniques back with them to the classroom.

Achieving Excellence

Danforth Center Principal Investigator Blake Meyers, PhD, runs marathons, literal and figurative. Together with a great team, this determination led him to develop novel applications of the first generation of high-throughput DNA sequencing. It's why his group continues to make groundbreaking discoveries (such as this year's noncoding ex-RNAs). In 2022, Blake was elected to the National Academy of Sciences.

2022 By the Numbers

405
Danforth Center community members

36
countries represented

TOP WORK PLACES 2022 — ST. LOUIS POST-DISPATCH
Danforth Center is a 2022 Top Workplace!

#1
midsize STL nonprofit workplace[1]

31
principal investigators

13 patents filed
11 issued patents
17 patents pending
15 disclosures filed

100,105
unique website visitors

$18.2M
grants awarded

$412M
annual economic impact of the Danforth Center campus and Helix

The University of Tennessee Knoxville · MU · UMSL · Washington University in St. Louis · Saint Louis University

36
graduate students

132
publications
(1,737 total since inception)

411
Danforth Society members

Platinum Transparency 2022
Candid.

The Platinum Seal of Transparency is awarded to fewer than 1% of the 1.8 million nonprofits profiled on Candid's leading charity-rating website, *GuideStar.org*

[1] Voted by employees in St. Louis Post-Dispatch Top Workplace 2022.

Friends Committee

The Danforth Center is grateful to the Friends Committee, which promotes the work of the Center and grows membership and financial support through annual giving.

2022 FRIENDS COMMITTEE

Tim Halls, *Chair*
Cicardi Bruce
Bruce Buckland
Harold R. Burroughs
Molly Cline, PhD
Joan Culver
Maebelle Danforth
Michael Davies
Ann Desloge
Steve Epner
Courtney Evans
Glenn Fischer
George Fonyo
Roberta (Robbye) Frank
Gary Halls
Phil Hellwege
Ruth Kim
Jim Klingler
Paul Kravitz
Gary Mindel
Rashmi Nair, PhD
Jay Nouss, Jr.
David Rath
Tim Rodgers
John W. Rowe
Jared Spader
James R. von der Heydt
Matt S. Wolfe

"The Friends Committee works to engage the public and expand donor support. In 2022, we celebrated Danforth Society membership growth for the first time since the pandemic began. Welcome to our new members! And to everyone reading this: you are an essential part of the Danforth Center's success. Thank you! "

- Tim Halls,
Chair, Friends Committee

Conversations "Going for the Gold" featured Olympian Jackie Joyner-Kersee in a robust panel discussion about the Danforth Center's new partnership to empower schoolchildren in East St. Louis.

The event was attended by more than 260 people in person and livestreamed to many more. Watch the recording on our website.

Conversations

Organized by the Friends Committee since 2003, Conversations are free public events that provide the opportunity to learn about the work of the Center and our partners. In 2022, the event was in person and livestreamed. View the recording on our blog at danforthcenter.org.

GOING FOR THE GOLD IN EAST ST. LOUIS | AUGUST 25

The leaders of three institutions came together at the Danforth Center's Conversations event to discuss a new effort that will change the lives of young people in our region. That initiative is the Jackie Joyner-Kersee Food, Agriculture, and Nutrition Innovation. Located in East St. Louis, this new enterprise is dedicated to teaching young people about health, nutrition, agriculture, and STEM through engaging lessons that promote equitable opportunities. It is a partnership represented by **Dr. Jim Carrington**, president and CEO of the Danforth Center, **Robert J. Jones, PhD**, chancellor of the University of Illinois at Urbana-Champaign, and **Jackie Joyner-Kersee**, Olympic legend and founder of the Jackie Joyner-Kersee Foundation. More than 260 people attended the program in person with an additional audience watching via livestream. **Sarah Fenske**, executive editor of Euclid Media Group, moderated.

Media sponsorship by:

HEC

"Being partners with Danforth Center—they took a chance investing in us, coming across that river and investing in our young people."

- Jackie Joyner-Kersee, Olympian and Founder, Jackie Joyner-Kersee Foundation

Young Friends

The Danforth Center is grateful to the Young Friends, a group of professionals, 40 and under, who raise friends and funds to advance the mission of the Danforth Center.

2022 STEERING COMMITTEE

Davey Oetting, Jr., *Chair*
Matt Plummer, *Vice Chair*
Logan O'Connor, *Chair Emeritus*
Erica Agnew
Melanie Bernds Smith
David Culver, Jr.
Meghan Donovan
Jackie Hayes
Ben Hjelle
Michael Hollo, Jr.
Tom Hough
Erin Jones
Powell Kalish
Anna Krane
Zach Mandel
Ted Maritz
Katie Murphy
Harry Pettey
Mireya Rivas
Drew Roznowski
Andrew Rzonca
Kelcee Sachtleben
Peter Schankman
Dan Schindler, CPA
Justin Scholz
Scott Smithson, Jr.
John Wahl
Michael Williams

"The Young Friends group was excited to bring back our signature Party with the Plants event in 2022, now as the capstone to the Grow Challenge online week of giving. We had a great time—and surpassed our goal in support of STEM education at the Danforth Center."

- Davey Oetting
Chair, Young Friends

Party with the Plants featured in-kind supporter booths and tables of food, spirits, and other experiences. There was also a plant and wine pull.

Grow Challenge Party with the Plants

Established by the Young Friends in 2017, Party with the Plants is a cocktail party to raise funds for the Danforth Center Impact Fund. After a two-year pandemic hiatus, the Party returned in 2022 as part of the Grow Challenge week of giving.

PARTY WITH THE PLANTS | SEPTEMBER 23

An unforgettable night of drinks, magic, music, and mingling! Hosted by the Danforth Center Young Friends, Party with the Plants welcomed ticketed attendees to socialize in the beautiful Danforth Center building. The event was the culmination to a very successful Grow Challenge week of giving, which raised nearly $115,000 for Danforth Center STEM education and outreach.

Social media selfie. The Grow Challenge week of giving raised nearly $115,000 for Danforth Center STEM education and outreach.

Many thanks to our Young Friends Steering Committee members who successfully relaunched Party with the Plants in 2022.

Grow Challenge™

The Danforth Center is grateful to the many generous individuals and companies who supported Grow Challenge and Party with the Plants in 2022.

2022 GROW CHALLENGE SPONSORS

Platinum

BANK OF AMERICA

NOVUS

Gold

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WHD Legacy Society

*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.***

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Founding members of the society include Dr. William H. Danforth†, Mary† and Oliver† M. Langenberg, and Mrs. Jefferson L. Miller†.

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The Danforth Center is grateful to these legal and financial planning experts who provide assistance with the promotion of planned gifts to the Center.

Kenneth J. Bower, Clayton Financial Group
Stephen B. Daiker, Harrison & Held, LLP
Matthew G. Perlow, Husch Blackwell LLP
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"It knocks my socks off, the comprehensiveness of what Bill Danforth created. I hope that others feel as inspired by his legacy as I do."

- Dr. Phil Needleman
WHD Legacy Society member

Danforth Leadership Council

The Danforth Center is grateful to the Danforth Leadership Council, a group of prominent St. Louisans interested in the role of plant science in the future of the region.

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"The Danforth Leadership Council aims to build corporate support for the Danforth Center mission. This year we were pleased to welcome many new supporters while deepening existing relationships. We are grateful for this continuing partnership."

- Chris Danforth
Danforth Leadership
Executive Committee

AgTech NEXT 2022 featured three days of spotlights and panel discussions on finance, talent, and trade, with a goal of reimagining the food system.

AgTech NEXT

The Danforth Center has been curating and hosting agtech events since 2009 with presentations and panels from the industry's most sought-after thought-leaders. AgTech NEXT was a successful online event in 2020 and 2021 and launched as a hybrid event in 2022.

REINVENTING A FOOD SYSTEM IN CRISIS | OCTOBER 11 – 13

AgTech Next 2022 convened around the topic of a food system in crisis. Noting that our regional and global food systems are subject to increasing strain from climate change, resource scarcity, and sociopolitical strife, presenters and panelists sought paths to forge a more resilient future for food. Topics included leveraging innovative technologies, developing a diverse talent force, and co-creating more equitable trade programs. There were three keynote speakers: Dr. Cynthia Rosenzweig, Dr. Vasit Sagan, and Julie Borlaug. The event was a success with 270 people attending in person and another 371 virtual participants.

Networking events and vendor displays provided in-person attendees with breaks to refresh and recharge between deep dives.

There were 270 people who attended AgTech NEXT in person with 371 virtual attendees. The event included three keynote addresses by national figures.

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The Danforth Center is grateful to our corporate, industry, and organization partners for their generous support in 2022.

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Tributes

The Danforth Center is grateful to donors who chose to honor or memorialize their friends, loved ones, and colleagues with a gift to the Center in 2022. To make a tribute, visit danforthcenter.org/donate.

In Honor of...

Jane Bond
Ms. Martha W. Bond
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Peg and Blanton Whitmire
Gary D. Curl & Carol Jones-Curl

Docents

The Danforth Center is grateful to our highly trained docents who led tours and increased public awareness of the Danforth Center in 2022.

Molly Cline, PhD
Joan Culver
Steve Epner
Martha Ferdinand
Glenn Fischer
Roberta (Robbye) Frank
Gary Mindel
Rashmi Nair, PhD
Fred Perlak, PhD
Matthew Rubin, PhD
Rich Schumacher, PhD
Austin Tao
James von der Heydt

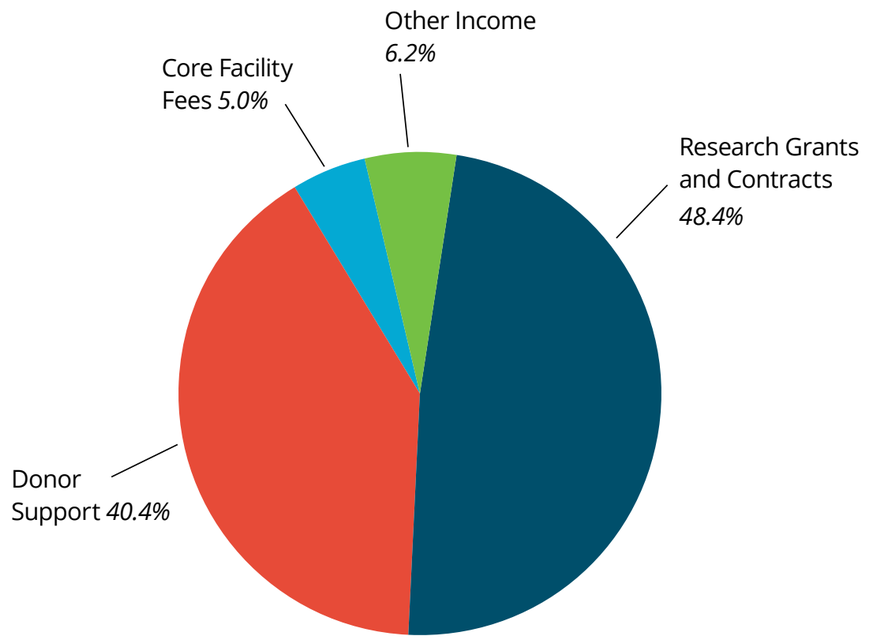
Longtime docent Rich Schumacher, PhD, leads a tour. Docents are highly trained and essential to introducing the public to the mission of the Center.

Selected Financial Data

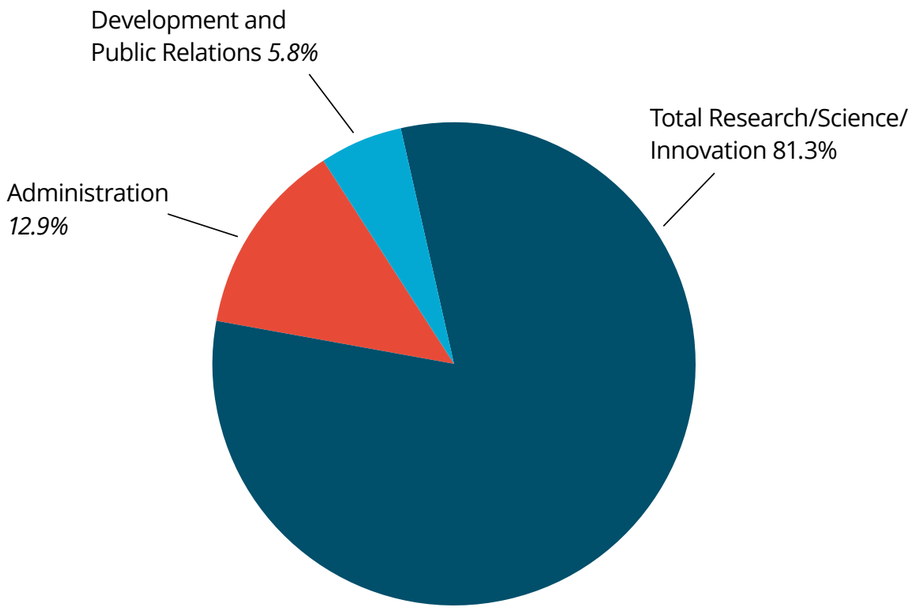
Fiscal Year Ended December 31, 2022
(Unaudited)

			2022 ($000's)	
UNRESTRICTED OPERATING REVENUES[1]			**Revenue**	**Source %**
Research Grants and Contracts			$20,847	48.4%
Donor Support			$17,457	40.4%
Annual Gifts	$2,248	5.2%		
Endowment Draw	$15,209	35.2%		
Core Facility Fees			$2,174	5.0%
Other Income			$2,685	6.2%
Total Operating Revenues			$43,163	100%
OPERATING EXPENSES[2]			**Expenditures**	**Expenditure %**
Total Research/Science/Innovation			$33,818	81.3%
Administration			$5,374	12.9%
Development and Public Relations			$2,435	5.8%
Total Expenses from Continuing Operations			$41,627	100.0%
CAPITAL EXPENDITURES				
Lab and Core Facility Equipment			$470	
All Other			$217	
Total Capital Expenditures			$687	
REPLACEMENT AND RENEWAL EXPENDITURES			**$981**	
NON-OPERATING EXPENDITURES				
Debt Principal Payments			$741	
DEPRECIATION EXPENSE				
Depreciation of Fixed Asset			$7674	

2022 Operating Revenues[1]



2022 Operating Expenses[2]



[1] Cash basis and excludes income(loss) on Endowment investments and reimbursement for subcontracted research.
[2] Excludes subcontracted research on Grants and Contracts and Depreciation Expense.

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Bust of Dr. William H. Danforth in the Danforth Center touring corridor. Bill Danforth united people to create the Donald Danforth Plant Science Center, and with his final estate gift, he helped propel its future. His example challenges all of us to take action on big challenges.

OUR MISSION

Improve the human condition through plant science

As a world center for plant science research, our discoveries will help:

Feed the hungry and improve human health

Preserve and renew our environment

Enhance the St. Louis region

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PLANT SCIENCE CENTER

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