SUMMER 2022

DEPARTMENT OF

Plant Biology

MSU College of **Natural Science** | *Newsletter for Alumni and Friends*

Monkeyflower power: Adapting to change

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MSU plant biologist David Lowry and his team are investigating the impacts of oceanic salt spray on plants by using the monkeyflower to build up a greater understanding. The group is studying the monkeyflower in central California, where coastal populations have adapted to withstand salt spray, while those growing inland can die from exposure.

CHECK OUT OUR ONLINE VIDEO

INSIDE

Greetings, friends and alumni.

In 2021-2022, the MSU Department of Plant Biology (PLB) experienced many challenging events. The tragic loss of PLB chair Danny Schnell last December had a truly sad impact on us all. Frances Trail, PLB associate chair, stepped in as acting chair in May 2021 after Danny became ill, and I became interim chair in August 2021. Together, we continued to address the trials and tribulations of the coronavirus pandemic, particularly related to the mental health of our faculty, staff and students. Throughout the pandemic, we had monthly faculty meetings and Department Advisory Committee meetings using hybrid or Zoom models. These meetings played an important role in holding our department together. We are currently searching for a new chairperson and expect to have a new chair on board in 2023.

"We all have experienced an extraordinary year, and one in which we have observed remarkable resilience and innovation in our plant biology community. . ."

There have been a number of faculty changes over the past year. Professors Kathy Osteryoung , Frank Telewski and Curtis Wilkerson retired following successful careers at MSU (see page 4), and Robin Buell and Marjorie Weber accepted new academic positions at other institutions. Alan Prather was appointed interim director of the W. J. Beal Botanical Gardens following Frank Telewski's retirement. In hiring news, I am pleased to share that two new assistant professors have joined our PLB family—Lauren Sullivan and Daniela Strenkert (read more on page 4). The department also welcomed 11 new graduate students in fall 2021, and 7 more will join us in fall 2022.

Our faculty members continue to impress, with several PLB faculty members receiving noteworthy awards since our last newsletter. Among them are Christoph Benning, who was elected a 2022 Senior Member of the National Academy of Inventors; three faculty members (Jiming Jiang, Emily Josephs and Berkley Walker) who received 2022 awards from the American Society of Plant Biologists, and Frances Trail, who was named a 2021 fellow of the American Phytopathological Society. Read more about these and other honors on page 4.

During the past year, our campus, college and departmental communities have increasingly engaged in more discussions and actions to address diversity, equity and inclusion in all facets of what we do. Our Diversity Advisory Committee reviewed the departmental bylaws on voting and created a set of recommendations to make voting more inclusive in the department. The proposed changes will allow voting rights to be extended to fixed-term faculty, academic specialists, and students on specific matters that are particularly impactful to those groups. We are also in the process of establishing transparent Workload Dashboards for our faculty—an evidence-based practice for achieving structural equity in work assignment and compensation—and have also amended our mentoring bylaws to ensure an equitable distribution of teaching assignments to new faculty members.

We all have experienced an extraordinary year, and one in which we have observed remarkable resilience and innovation in our plant biology community in the face of truly challenging circumstances. These times reinforce one of our core values—that "our success depends on diversity in both our science and our community, and in fostering a culture that invests in, supports, respects and promotes the success of every member of our community."

Thanks, as always, for your continued support. Enjoy the newsletter!

Jiming Jiang, Ph.D., Interim Chair
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ALUMNI CLASS NOTES

Frank Louws, Ph.D., botany and plant pathology, '94, is head of the Department of Horticultural Science at North Carolina State University in Raleigh.

Allison Hopkins, botany and plant pathology, '01, was recently promoted to associate professor in the Department of Anthropology at Texas A&M University in College Station. Her research focuses on peoples' use of plants for food and medicine in Latin America.

Ashley Wright, plant biology, '20, is a second-year Ph.D. student (at 22 years old) in plant breeding, genetics, and biotechnology at MSU. Her research focuses on resistance breeding of strawberry. Wright's goal is to search for sources of resistance while maintaining impeccable fruit quality and high-yielding plants. She received two honors this year: a College of Agriculture and Natural Resources Alumni Association Scholarship, and a Terry N. & JoAnn L. Turk Endowed Fellowship in Crop and Soil Sciences Award.

Hazel Anderson, plant biology and environmental biology, '21, is a Ph.D. student in the Department of Integrative Biology and the Ecology, Evolution, & Behavior Program at MSU, and a 2021 awardee under the National Science Foundation's Graduate Research Fellowship Program. She is conducting research in the MSU Spatial and Community Ecology Lab on large-scale spatial patterns of plant biodiversity/biogeography to help improve conservation in the neotropics (Central & South America).

In Memoriam

Danny Schnell, department chair, died on December 15 after a valiant fight against cancer.

Schnell joined the MSU Department of Plant Biology as chair in 2016 after serving as professor and head of the Department of Biochemistry and Molecular Biology at the University of Massachusetts, Amherst. He led the plant biology department for five years.

Schnell

Schnell was internationally recognized for research explaining the mechanisms of protein import into chloroplasts in plants' cells. His studies revealed new functions for major components of the import machinery, uncovered new mechanisms regulating the developmental and physiological specificity of chloroplast protein import, and yielded significant insight into the evolution of the import complex—all important for understanding how plants adapt the functions of their chloroplasts in response to growth, development, and physiological and environmental changes.

Recently, he applied his expertise to developing *Camelina sativa* as a sustainable bioenergy crop. Under his leadership, an interdisciplinary team centered at MSU was awarded a $10 million Department of Energy grant to continue this research, which remains active.

Schnell was selfless in his service to MSU and the scientific community. A fine researcher, teacher and mentor, Schnell was taken from life too soon and will be missed by his family, and numerous colleagues, students and friends.

Contact Us

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CONNECT WITH NATSCI

Retirements


Osteryoung

Katherine W. Osteryoung, professor, retired in August 2022, after working at MSU for 22 years. Osteryoung is an internationally recognized authority and pioneer in the field of chloroplast division and biology in plants. Her many honors and awards include being elected a fellow of the American Association for the Advancement of Science, appointed to the American Society of Plant Biologists (ASPB) Board of Trustees, named a fellow of ASPB, and named a member of the ASPB Legacy Society. Osteryoung, who has published 80 papers during her career, received her Ph.D. in plant physiology from the University of California, Davis.


Telewski

Frank Telewski, professor and director of the W. J. Beal Botanical Garden and Campus Arboretum, retired in October 2021 after 28 years at MSU. Telewski is internationally recognized for his work in tree biomechanics and tree growth responses to wind. Under his leadership, the Beal collection grew to include nonflowering vascular plants and specimens from Asia. He led the creation of the botanic garden as its own department, doubled the staff of the garden and moved the garden program from Infrastructure, Planning and Facilities to the Provost's Office. Other notable accomplishments include starting MSU Shadows, a sustainable wood recovery initiative from trees at MSU, and continuing the long-lived Beal Seed Experiment started by MSU botanist William J. Beal in 1879. Telewski published 92 papers during his career after receiving his Ph.D. in tree physiology from Wake Forest University.


Wilkerson

Curtis Wilkerson, associate professor, retired in October 2021, after nine years at MSU. Wilkerson conducted research on plant cell wall biosynthesis, with a focus on the production of hemicelluloses and their function in the cell wall. During his tenure, he served as director of the MSU Proteomics Facility and was a member of the Great Lakes Bioenergy Research Center, where he shared his expertise on efficient biomass conversion and sustainable cropping systems. Wilkerson, who published 29 papers during his time at MSU, received his Ph.D. in botany from the University of Georgia.

New Faculty


Strenkert

Daniela Strenkert, assistant professor, joined the department in August. Her research focuses on using systems biology approaches to gain a quantitative understanding of gene regulation in photosynthetic organisms, especially in response to different environmental cues. Strenkert received her Ph.D. from the University of Kaiserslautern, Max Planck Institute of Molecular Plant Physiology in Potsdam, Germany, and the Albert Ludwig University of Freiburg.


Sullivan

Lauren Sullivan, assistant professor, joined the department in August. She uses quantitative tools to explore plant movement ecology and is broadly interested in how different global changes influence plant reproduction and dispersal, and the subsequent consequences of this movement for population and community dynamics. Sullivan received her Ph.D. from Iowa State University and was most recently an assistant professor of biological sciences at the University of Missouri, Columbia, Mo.

Faculty Honors

Christoph Benning was elected a Senior Member of the National Academy of Inventors in recognition of his groundbreaking research innovations, success in patenting, licensing and commercialization, and mentorship and education. Benning was also recognized in the 2021 Highly Cited Researchers list, an annual compilation of the global leaders in scientific influence by Clarivate Analytics.

Three plant biology faculty members received 2022 awards from the American Society of Plant Biologists (ASPB). **Jiming Jiang** was named an ASPB Fellow for his research on plant gene expression and regulation induced by environmental stresses; **Emily Josephs** received an ASPB Early Career Award for her research on the evolutionary genetics of wild and domesticated plants; and **Berkley Walker** received the ASPB Robert Rabson Award for his research on resolving photosynthetic fluxes in a changing world.

Frances Trail was awarded the 2021 Mycological Society of America Weston Award for Excellence in Teaching and was named a 2021 fellow of the American Phytopathological Society for outstanding and innovative research on the biology of plant pathogenic fungi.

Student/Postdoc Honors


Huang

Jingcheng Huang (Ph.D., biochemistry and molecular biology, '19), a postdoctoral researcher in David Kramer's lab, is the 2021 recipient of the Kende Award, which recognizes the best doctoral dissertation in plant sciences at Michigan State University over the past two years. His thesis, "Development of structurally defined platforms for long-range biological electron transfer," explored how electrons can be moved over long distances through networks of biological electron carriers.


Mollema

Alyssa Mollema, a junior majoring in environmental biology/plant biology, is the recipient of the 2021-22 Michigan Garden Club Scholarship. Allyssa received a $1,000 scholarship to support her education in pursuit of her major. The aim of these scholarships is to serve, educate, stimulate and prepare students in the wise use of our natural resources and the preservation of our natural beauty.


SantaMaria

Toby SantaMaria, a doctoral student in Lars Brudvig's lab, received a $15,000 grant through MSU's Creating Inclusive Excellence Grants, to increase accessibility and inclusivity in the graduate school application process, and to host an Envision Ecology, Evolution and Behavior Program Graduate Preview Weekend, where historically excluded groups can receive professional development and application guidance.

Graduate Student Research Highlight

Flip the switch: Exploring how algae activate cell cycles

Researchers in the Christoph Benning lab have been looking into the signals for activating different states of the cell cycle in microalga, which has potential applications for future biofuel production and cancer research.

Algal cells have two main cell cycle states: the cell division cycle and a resting state known as quiescence. Theoretically, the cells switch between the two states to adapt to their environment. Benning and his team are looking at how the microalga *Chlamydomonas reinhardtii* switches into different cell states by altering this gene expression.

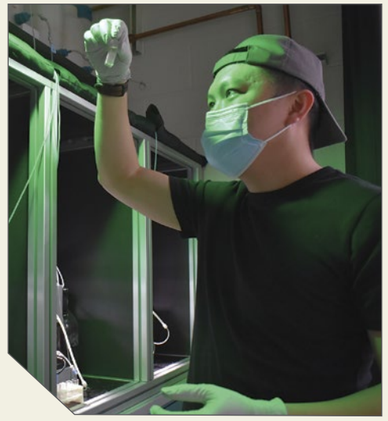
Yang-Tsung Lin, a former graduate student in the Benning lab (now a postdoc at UC Berkeley), was first author on the study, published earlier this year in the journal *G3: Genes, Genomes, Genetics.*

The study focuses on a cell cycle regulator in the microalga called CHT7. The researchers observed that the mutant strain, *cht7,* lacked this regulator and was unable to enter and exit quiescence properly. The researchers grew the *cht7* mutant cell in a photobioreactor and further analyzed it using RNA sequencing to better understand why this was.

"We found the *cht7* mutant cell has abnormally active DNA replication throughout its life cycle," Lin said. "Normally, an algal cell only duplicates its DNA for cell division at certain times during the day. The *cht7* cells seem unable to turn down the expression of genes for DNA replication and mitosis, which leads to higher DNA content and abnormal cell shapes in the mutant."

The CHT7 protein therefore seems to be the one to flip the switch, signaling the cell to enter or exit quiescence.

"Tsung's data suggest the existence of a master regulator of the cell cycle and cell division," said Barb Sears, Professor Emerita of plant biology and study co-author. "His meticulous investigation identified a massive number of genes that are under the control of the CHT7 gene and are essential to DNA replication,


Yang-Tsung Lin checks an algal cell culture grown in a light chamber.

chromosome organization, division of both chloroplasts and cells and genes needed for cell wall synthesis."

"Proteins similar to CHT7 can even be found in humans, where disruption of cell cycle control can lead to cancer," Benning added. "Hence, finding key players involved in the regulation of the cell cycle has implications ranging from the production of feed stocks for biofuels to addressing cancer in humans."

Monkeyflower power: Adapting to change

How biodiversity evolves in the first place is what plant biologist David Lowry has spent his career studying. His research focuses on identifying the genetic and physiological mechanisms of ecological adaptations, understanding how those adaptations contribute to the formation of new species, and developing approaches to translate this knowledge into the improvement of crop species.

> **"Every time we discover more about an adaptation in our work, we get closer to understanding how life works generally."**
>
> ADAPT

One of the key plant model systems used by Lowry's lab to conduct this research is the monkeyflower (*Mimulus*). The plant, so named for blossoms that resemble a monkey's face, is perfect for studying adaptive evolution for several reasons, according to Lowry.

David Lowry (left) discusses lab data on the yellow monkeyflower (Mimulus guttatus) with postdocs Leslie Kollar (center) and Lauren Stanley.

"Monkeyflowers have a very short lifespan, so we can produce three or four generations a year; they are small, making them easy to work with in a lab setting; they grow quickly and produce lots of seeds; they have a small genome sequence; and they have an easy-to-manipulate genetic system," Lowry explained. "In addition, they have successfully adapted to environments across the western United States and North America, including toxic copper mine tailings, coastal salt spray zones, alpine regions and even the geysers of Yellowstone National Park."

One of the exciting advances in the Lowry lab is a more precise understanding of how genome structure contributes to monkeyflower adaptation.

"When I was a grad student, I discovered a chromosomal inversion in the monkeyflower that is a big reason for the difference between coastal and inland populations of monkeyflowers, but I didn't have the tools to explore it further," Lowry said. "With today's technologies and a collaboration with the Chad Niederhuth lab, we've been able to sequence the genomes of multiple monkeyflowers and localize where, exactly, those breaks were that caused the inversion. With this information, we hope to gain a deeper understanding of how genome structure itself is involved in the process of evolution."

Building on this work, Lowry was recently awarded a three-year National Science Foundation grant to better understand how plants have evolved to withstand the ocean's salt spray. Lowry, along with plant biology postdocs Lauren Stanley and Leslie Kollar, will use the grant to uncover multiple dimensions of monkeyflower adaptations from the gene to the population level.

"Our research will focus on understanding how coastal monkeyflower populations evolved to avoid, resist and tolerate salt spray," Lowry said. Ultimately, the work will expand understanding of plant evolution and plant resilience in challenging environments, with potential applications for agricultural crops."

In addition to their research, the Lowry lab, in partnership with the MSU College of Education, is working with middle and high school students in the Flint, Mich., area to get them interested and engaged in science. Their approach has a novel twist—they have created a comic book about monkeyflower research to integrate into the classroom curriculum.

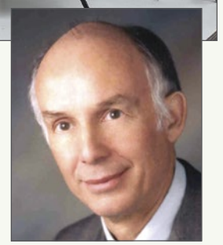
"The students interact with the characters in the comic book to learn about how to put together experiments and measure things," Lowry said. "It gives the students a great opportunity to understand how scientists conduct their job and carry out the scientific process."

"This research could ultimately lead to a better understanding of environmental fitness in all plants," Lowry said. "Every time we discover more about an adaptation in our work, we get closer to understanding how life works generally. That's inspiring."

Long-time supporter establishes Herbarium fund

Long-time MSU supporter James E. Rodman, Ph.D., (B.S., botany and plant pathology; Honors College, '67) created the John H. Beaman Memorial Herbarium Fund in 2020. The endowment honors the memory of Beaman (1929-2015), who was an MSU professor of systematic biology and curator of MSU's Beal-Darlington Herbarium.

MSU Herbarium display of the plant specimen, Rafflesia, in the foreground, collected by John Beaman with Eric Christenson in 1984.



Joihn H. Beaman

Over a 37-year career of teaching, research and mentoring, Beaman inspired dozens of students—including Rodman—to study, collect, research, contemplate and enjoy plants. Rodman, who served as program director for systematic biology at the National Science Foundation until 2006, is very involved in a community garden, and describes himself as a "rabid Master Gardener."

"A plant-collecting trip to Mexico in late summer 1967, with the whole family in tow, is just one of many fond memories of pivotal interventions by professor Beaman that shaped my career in botany," Rodman said.

With experience gained in hunting plant treasures in the montane forests in Mexico, Beaman hopped an ocean to explore botanical riches on Borneo's Mount Kinabalu and attracted new generations of colleagues and friends.

James Beach (B.S., botany, '76) also contributed to the fund.

"While I was an undergraduate, Dr. Beaman transformed my university experience by repeatedly offering research and teaching opportunities," Beach said. "He was an extraordinary academic mentor, and his munificent generosity, patience and thoughtfulness changed the course of my career and my life. John Beaman's legacy is sure evidence of the impact a single faculty scholar can have on incoming students who are still puzzling through all the intellectual and career pathways a large, prestigious university can present."

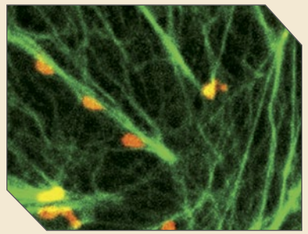
"He was kind and wise, and his Herbarium was a welcoming and nurturing place. In honoring Professor Beaman—the 'gentleman-scholar' from North Carolina—we donors are honored ourselves," Rodman added.

"One of John's legacies is the Herbarium—widely recognized as a go-to resource for anyone with an interest or need to study plant diversity," said Alan Prather, Herbarium director. "The John H. Beaman Memorial Herbarium Fund honors him in the best possible way: enabling the Herbarium and its students to continue documenting plant biodiversity in Michigan, the Great Lakes and around the world. This fund will support research, teaching and outreach that relies on the Herbarium and will help the Herbarium stay vibrant and dynamic."

> BIODIVERSITY
>
> **"[This fund will enable] . . . the Herbarium and its students to continue documenting plant biodiversity in Michigan, the Great Lakes and around the world."**

Today, the Herbarium is located in the basement of the east wing of the Plant Biology Building and contains more than 500,000 plant specimens from all over the world, including lichenized and non-lichenized fungi. Its vascular plant collection is the oldest in the state, with a number of historically important specimens.

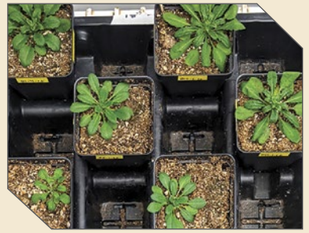
key grants



Jianping Hu received a four-year, $900,000 National Science Foundation grant to study the motility of cellular energy organelles—peroxisomes and mitochondria in particular. Along the cytoskeleton in the common mustard plant, *Arabidopsis thaliana*. The knowledge gained from this research will provide fundamental insights into the principles associated with the motility of plant organelles and how their dynamic behavior contributes to plant robustness and response to environmental stress.

The microscopy image above shows peroxisome movement along actin bundles in a tobacco epidermal cell.

Emily Josephs received a five-year, $ 1.9 million National Institutes of Health grant to study how evolution is affected by genetic and environmental forces. All organisms change in response to their environments, and understanding how these responses evolve is basic understanding of how the world works, as well as the evolution of human diseases. The Josephs lab will conduct plant experiments and develop evolutionary theory to study the evolution of environmental responses, including adaptative and non-adaptive processes.



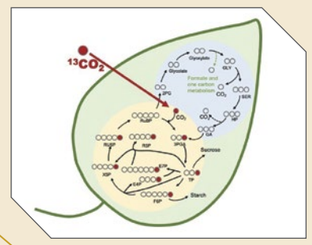
Arabidopsis plants, such as those shown, will be used to understand why there is genetic variation for environmental response.

David Lowry received a three-year, $772,572 NSF Division of Organismal Systems (IOS) grant to advance understanding about how coastal monkeyflower populations have evolved to withstand the ocean's salt spray. Ultimately, the work will expand the knowledge of plant evolution and aspects of plant resilience in challenging environments, with potential applications for agricultural crops.

Coastal monkeyflowers are being studied to better understand how plants have evolved to withstand the ocean's salt spray.

Melissa Lehti-Shiu and **Shin-Han Shiu** will use a three-year $1.4 million NSF IOS grant to advance knowledge of plant gene functions and their connections to traits to better understand how plants work and to create plants that can better withstand stressful environments. Their team will use artificial intelligence–based approaches to predict and test connections between DNA sequences, molecular activities, and traits, and to transfer information from data-rich, model plants to important but data-poor species.

Researchers are working across disciplines to bring the power of artificial intelligence to better understand how plants work.



Berkley Walker received two NSF grants since the last newsletter. The first is a four-year, $848,771 grant to explore the temperature response of photorespiration to determine how it will respond under future climates and seek strategies to improve its efficiency. The second is a three-year, $735,000-plus NSF grant to explore the intersection between photorespiration and one-carbon metabolism, two-plant biochemical pathways of critical importance to plant growth and human nutrition.

Labeled carbon molecules will be used in this research to determine how photorespiration and one-carbon metabolism are connected.

From photon to plate: Increasing photosynthetic efficiency of potatoes

Improving the photosynthetic "power-plants" in crops could mean using less fossil fuel–derived energy supplements—such as fertilizers—in crop cultivation, leading to a second Green Revolution.

Berkley Walker, plant biology assistant professor, and Heather Roney, a laboratory technician in MSU's Plant Research Laboratory, created a new life-cycle assessment (LCA) to calculate the amount of energy used to create fresh-cut French fries—from cultivation of the crop to when the fries arrive on the plate.

Only a small fraction of the solar energy that hits a plant's leaves ends up in the food we eat, with much of that energy consumed by photosynthetic inefficiencies. Fixing photosynthetic shortcomings in plants could mean less human-derived supplements will be needed to grow the crops we rely on. The LCA suggests that yield could be increased by changing processes within the plant, instead of relying on external resources.

"This is the first time researchers have combined plant physiology with human inputs into agriculture in quite this way," Berkley said. "The results help quantify how much improving photosynthetic efficiency would increase the sustainability of a sample food system—a vital consideration as we try to grow more food with lower ecological impact."

The study found that about 80 times more energy is dissipated by plants during photosynthesis than humans expend cultivating, shipping and preparing French fries. Walker calculated that if bioengineering strategies are used to improve the efficiency of photosynthesis, a five percent to 50 percent increase in energy efficiency could be seen. Strategies could include "turbo-charging" photosynthesis with a carbon concentrating pump or optimizing wasteful biochemical processes.

> **"This is the first time researchers have combined plant physiology with human inputs into agriculture in quite this way."**

Theoretically, with these improvements, the same number of crops could be produced using less supplemental energy, or more crops could be produced while spending the same amount of energy used now.

"Looking to the future, I believe it is important to understand energy entering and exiting systems, for example agriculture," Roney said. "Agriculture will always be a crucial field, and climate change will pose unique challenges we have to address. The theoretical improvements to photosynthesis proposed in this publication are key to a second Green Revolution, where more energy from the sun is incorporated in farming while using less fossil fuels."

"These types of studies are important for putting our research directions in context," Berkley explained. "We have to understand what the relevance of our research is to the current pressing needs of society."

Plant biologists Berkley Walker and Heather Roney created a life-cycle assessment looking at the amount of energy used to create fresh-cut French fries from the cultivation of the crop to when the fries are served–from photon to plate.

Beyond the human gut: Exploring impacts of nature's tiniest worlds

Humans benefit from gut microbes—bacteria, viruses and fungi—that protect their health. But humans aren't the only ones partnering up with these beneficial microbes. Researchers at Michigan State University are peering into the tiny world of microbiomes in plants and animals, searching for keys to a healthier planet.

Leafhoppers move native wild viruses among prairie grass species.

Carolyn Malmstrom, a professor in the Department of Plant Biology, is one of several MSU researchers exploring how wild organisms interact with microbes. She studies how the changes humans make to landscapes influence plant interactions with microbes, particularly viruses, and the emergence of pathogens. Despite how human infrastructure has broken up natural landscapes, microbes can still flow between urban, natural and agricultural areas.

"While we often think of viruses as pathogens," said Malmstrom, "the majority of plant viruses are not super pathogenic. Society tends to focus on the pathogenic species because they can affect crop production and thereby human health. But other viruses may benefit a plant by changing its gene expression in ways that increase the plant's stress tolerance or protect it from herbivores or other pathogens."

Malmstrom's research team investigates virus impacts on both crops and native plants. Hidden infections may influence the flavor of hops, for example, a key ingredient in craft beers. In prairies, viruses distributed by leafhoppers have shaped the evolution of native grasses and modulate their disease susceptibility.

"Viruses may sound scary," she said, "but viruses are important elements of nature that knit together the tree of life in ways that deserve more positive recognition."

Plant "ER": Using advanced genomics to reduce plant stress

Understanding plant responses to abiotic stress is critical for food production—and other vital applications.

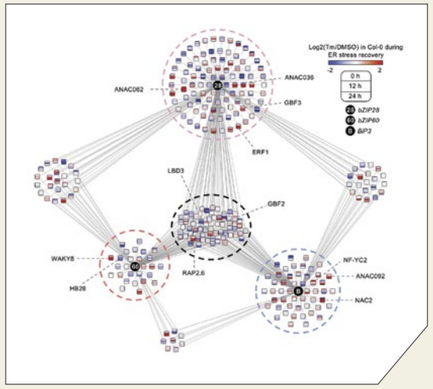
When a plant is exposed to stress, the functionality of the endoplasmic reticulum (ER) is impeded, which can stunt, or even kill, the plant. Researchers in the lab of Federica Brandizzi are exploring this ER stress and how plants respond and adapt to it. These researchers, including first author of the study and postdoc Dae Kwan Ko, investigated genes in *Arabidopsis thaliana*, which, when activated, helped mitigate ER stress. The study was published earlier this year in Nature Plants.

Researchers developed a multi-omics pipeline for *A. thaliana* in which different sets of genome-wide data were integrated for further analyses. Using this pipeline, they identified a hormone-associated regulator that calibrates gene expression changes, which helps alleviate the effects of ER stress.

"Because the ER produces most of the plant proteins and lipids that we use for consumption in our daily diets, a better understanding of the mechanisms that control the activities of this organelle is of paramount importance for our species' survival," said Brandizzi, a pioneer in the implementation of advanced confocal microscopy for the study of plant organelles.

This research also has implications in human medicine.

"Unresolved ER stress can cause many human diseases including diabetes and cancer," Ko said. "Since most molecular components for ER stress response and the mechanisms are highly conserved, the new regulators and their function found in this study are likely conserved in other eukaryotic systems, indicating a broad applicability of our finding."



This figure shows a gene regulatory network underlying ER stress responses, built on the protein-DNA interaction screen conducted in this study.

Instructors surveyed on using data science in life science courses

With the exponential growth of data around the world, how can we best prepare undergraduate students to use data science skills to tackle critical issues in the life sciences?

This is one of the main questions asked by Michigan State University plant biology academic specialist Nathan Emery and collaborators in a recent survey. They polled college/university educators from around the globe on teaching practices related to data science and how scientists use data science in their research. Their work offers a window into how data science is currently taught and how to best empower instructors to incorporate data science into future biology and environmental science courses.

A survey sent to college/university educators asks: "How can we best prepare undergraduate students to use data science skills to tackle critical issues in the life sciences?"

"The survey asked biology instructors to consider six categories of data science skills that they might teach, use in their own research, or view as important for biology or environmental science undergraduates," said Emery, who started as the STEM education coordinator at UC Santa Barbara in July. "Across institution types, undergraduate biology instructors viewed data management, analysis and visualization as the most important data science skills to use in research and teach in courses."

SURVEY

"Across institution types, undergraduate biology instructors viewed data management, analysis and visualization as the most important data science skills to use in research and teach in courses."

In contrast, the instructors placed less time and value on coding, modeling, or reproducibility; however, emphasis on these skills differed by career stage of the instructor. For some data science skills, the findings potentially represent an "aspirational gap" where instructors place a high value or importance on certain skills but are not teaching those skills to their students. For example, some skills had high importance and were frequently taught, such as data analysis. But other skills such as data visualization, management and reproducibility were valued by instructors, but a relatively low percentage of respondents teach those skills.

"The research suggests that curricula may be relying on students receiving these skills through classes in other departments, research experiences, or external learning opportunities. But it is unclear how effective this is for preparing undergraduates for the kinds of careers or graduate programs they may apply to upon graduation," said Matthew Aiello-Lammens, an assistant professor at Pace University. "The survey also investigated instructor perceptions of the greatest barriers to including data science skills into their existing classes or curriculum. The greatest barriers identified were instructor and student background, followed by perceived space in the curriculum."

The researchers in this study are a part of the recently NSF-funded Biological and Environmental Data Science Education Network. This network is dedicated to training life science instructors in evidence-based teaching techniques to incorporate core data science skills into their curricula and courses. The network aims to design short-format training workshops for undergraduate biology instructors, forming faculty mentoring networks related to data science teaching in biology, and generating curricular maps that can aid instructors or departments in scaffolding modern data science skills into existing coursework.

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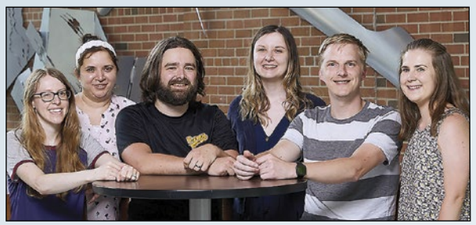
PBHS symposium: Experiential graduate student learning

On May 13, Plant Biotechnology for Health and Sustainability (PBHS) at Michigan State University held its ninth symposium and first in-person conference since the coronavirus pandemic began. About 100 Ph.D. students, postdocs, faculty and others gathered to network, learn about professional options and expand their biochemistry and biotechnology knowledge.



Members of the PBHS organizing committee (L to R):, Danielle Young, Jyothi Kumar (research assistant), Paul Fiesel, Hannah Parks, Rees Rillema and Mackenzie Jacobs. Absent members are Abby Grieb, Nick Schlecht and Kenia Seguraaba.

Launched in 2014, the program is a predoctoral, interdisciplinary training program funded by the National Institutes of Health to broaden professional development in the field.

"The goal of the symposium is to add value to the whole campus community," said Robert Last, University Distinguished Professor and PBHS program director. "As the program's annual capstone event, it brings people together and helps them get to know each other."

A student-led organizing committee arranges the entire event with help from plant biology research assistant Jyothi Kumar and Last. Choosing symposium themes and speakers, and working out logistics, allows the students to interact professionally with each other and with experts in their field.

The PBHS symposium consists of a full day of science, a half day of career-centric presentations and an evening of socializing and networking. Talks from expert faculty are interspersed with students presenting their research. Most PBHS students will get the experience of working on a symposium committee with many participating multiple times during their time at MSU.

"As a graduate student, I benefited from organizing similar styles of symposia and I want others to have that opportunity," said Kumar, who is also a program coordinator for the Integrated training Model in Plant And Compu-Tational Sciences, or IMPACTS. "Through this process, they learn practical and professional skills."

"In years to come, I hope to see many former program trainees returning to the symposia as invited guests," Last said. "That would be a measure of the symposia's success."

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