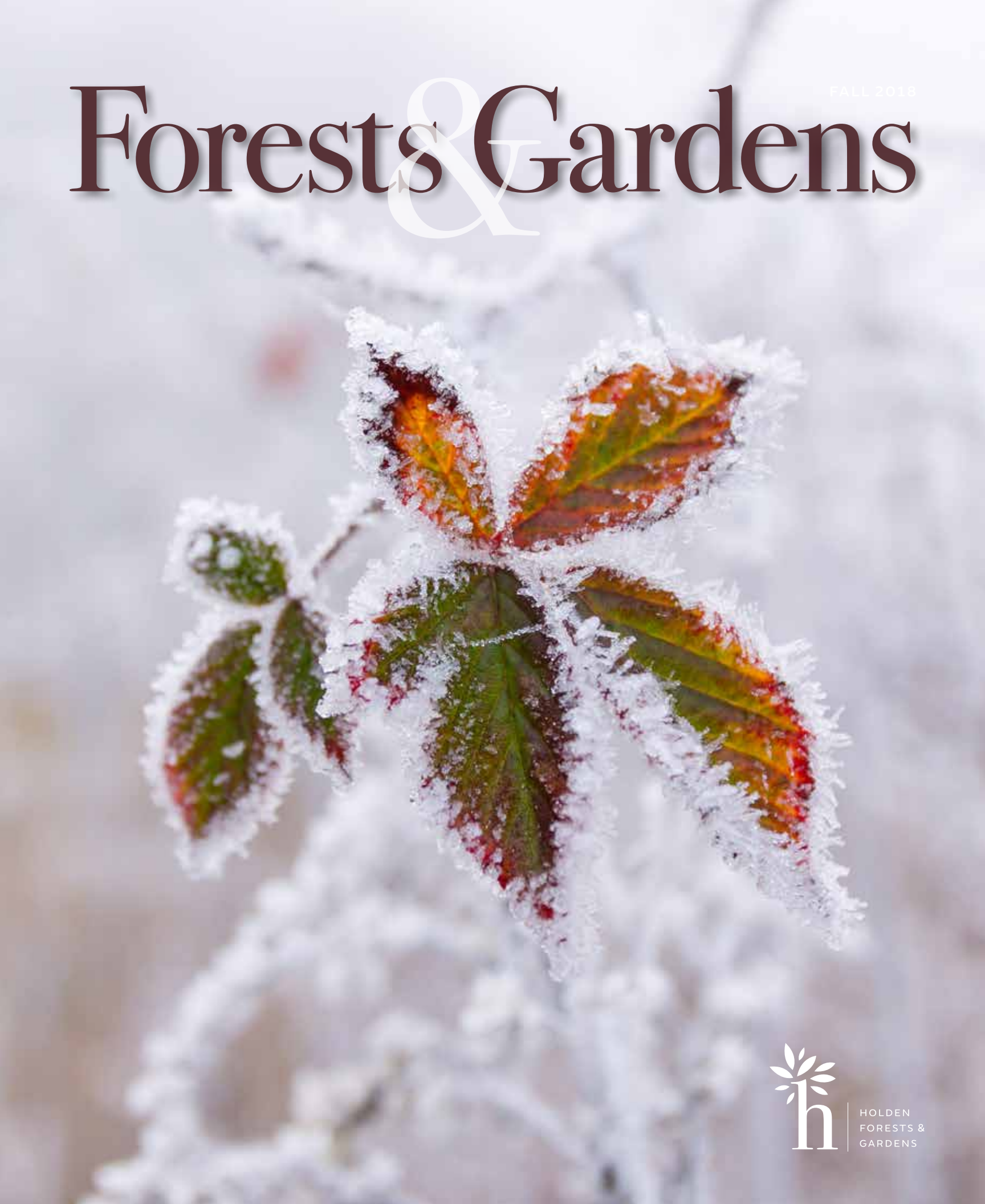
FALL 2018

Forests & Gardens



HOLDEN
FORESTS &
GARDENS

Forests & Gardens

WINTER 2018-19, V3/1

Forests & Gardens is the member magazine for Holden Forests & Gardens, which includes the Holden Arboretum in Kirtland and the Cleveland Botanical Garden in Cleveland.

Our Mission: Advance and inspire a deeper understanding of plants to enhance life.

Our Vision: Vibrant green communities and diverse native forests of the Great Lakes region will flourish and sustain life.

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HOLDEN FORESTS & GARDENS

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PRESIDENT'S COLUMN

Dear Friends of Holden Forests & Gardens,

My first anniversary as president and CEO of Holden Forests & Gardens is just around the corner. This year has been one of listening, learning and building. And, then listening and learning some more. I've had the chance to meet, talk and get feedback from many of you. I want these conversations to continue. Your stories, comments and questions have been invaluable to me and the entire team as we plan for the future of Holden Forests & Gardens.

The Volunteer Recognition Event this past September was themed, "Volunteers Make Holden Forests & Gardens Sing." I was lucky enough to have the chance to express my gratitude to the volunteer force that is 1,700 people strong, and the theme called my attention to an observation cited by Daniel H. Pink in his recent book, *When: The Science of Perfect Timing*: "Choirs are peculiar. A lone voice can sing a song. But combine a few voices, sometimes lots of voices, and the results transcend the sum of the parts."

Not only was this statement fitting to describe the impact of volunteers at the Arboretum and Botanical Garden campuses, but I also think it describes the conclusion that has surfaced time and again as we build vision for the future of Holden Forests & Gardens:

"The sum of Holden Forests & Gardens, formerly the Holden Arboretum and Cleveland Botanical Garden as separate organizations, transcends the sum of the parts, and promises so much more mission impact in Cleveland and Northeast Ohio."

In this issue, members of the new newly shaped leadership team will share a bit about their roles and the reasons they choose to work at HF&G. The team is enthusiastic, creative, knowledgeable and ready to roll their sleeves advance the mission. I'm proud to have them as partners and look forward to introducing them to all of you.

The development of a new five-year strategic plan is a top priority during the coming year. We look forward to engaging you in the process. We want to know how you see the Botanical Garden and Arboretum working to benefit the needs of you, your neighborhood and Northeast Ohio.

In the meantime, I'm excited to give you a preview of our plans for the coming months following extensive planning work over the summer.

We will be advancing initiatives that focus both internally and externally to grow attendance, build a sustainable financial model, position HF&G as a relevant and impactful nonprofit, lead regional urban and community forestry efforts, and implement new professional standards and practices for the organization. All our initiatives have the same desired outcome to serve our community and to inspire a deeper understanding and connection to plants and the natural world around us.

The Botanical Garden and Arboretum campuses are grounded in rich legacies of horticulture, science, learning, and beauty. As destinations, they are tremendous assets to our region. We will continue to invest in making our campuses inspiring and engaging places to visit.

You will see enhanced programming and exhibitions that make visits fun and worth coming back for, but also programs with even stronger mission ties leveraging the knowledge and expertise of our team.

We will build on traditions like Goblins and GLOW, and pilot new ideas such as more as more active winter programming at the Arboretum. Our programs will be designed to reach audiences of all ages, but we are committed to ensuring a robust program schedule for children and young families to help advance the next generation of plant enthusiasts.

You will also be seeing Holden Forests & Gardens out in the community and maybe even your neighborhood. We are putting great emphasis on work that expands our impact beyond the borders of the Arboretum and Botanical Garden campuses.

continued on page four

Preschool student takes part in SPYS.

Green Corps students learn more about soils in a workshop led by Larry Phelan, a professor of entomology at Ohio State University.

Here is just a sampling of work that will continue and grow in the community:

Sprouting Young Scientists (SPYS), a new preschool multi-season outreach program encouraging hands on exploration of the world of plants using live plant materials. This year, 40 classrooms will take part in the second round of field testing.

The Cleveland Learning Experience for Science Collaborative, better known as CLE4SCI, is a group composed of Holden Forests & Gardens, the Cleveland Museum of Natural History, Shaker Lakes Nature Center, Great Lakes Science Center, Greater Cleveland Aquarium and Cleveland Metro Parks Zoo. Each organization provides hands-on science programming for a particular grade level in the Cleveland Metropolitan School District. We are field testing a new third grade program on the life cycle of plants and butterflies to 50 classrooms. Generous funding from several sources allows us to provide this unique opportunity at no cost to the Cleveland Public Schools so their students can make a connection with science and the world around them.

Green Corps, an urban agricultural, work-study program for high school teens ages 14 - 18 started in 1996 by the Cleveland Botanical Garden, and now a part of Holden Forests & Gardens. With youth forming the core of the program, our focus revolves around using urban agriculture as a tool to teach job, leadership and life skills. During the 2018 season, Green Corps employed 50 teens from 23 high schools in Cleveland and its inner-ring suburbs to work at one of our four urban farms.

Trees Corps, a pilot work force development and urban forestry program that seeks to train individuals for a career in urban forestry and arboriculture. During its successful first year, a crew of eight participating in a the 19-week program, which combined classroom learning and hands-one training. Crew members planted 500 new trees and completed multiple certification programs while actively assisting local communities with tree care, maintenance on 1,000 area trees.

Working Woods, funded by the Sherwin Institute for Woodland Management and centered at the old sugar bush located across from Corning Lake on Sperry Road. The goals are to demonstrate sustainable, ecologically sound forest management practices for the forestry community, large land owners and the general public; to test conservation methods that may be used for restoration or improvement of young forest stands and advance science within this area through active research and education of college students. We have numerous public and private partnerships supporting this work that we hope will advance excellent management practices, especially on the 70 percent of land held by private landowners.

Academic Research, which is often a program area little known to the general public and even our members. We are focused on raising the prominence and aware of our science and research program housed at the Long Science Center. The team conducts original research in our collections and natural areas and publishes research in peer-reviewed international scientific journals to advance knowledge. We have partnerships with regional and national universities and our staff hold faculty appointments at Case Western Reserve, Kent State and Ohio State universities. This work benefits from access to our plant collections and naturals. We hope to encourage more people to attend staff led hikes and public talks, including the Scientist Lecture Series celebrating its 10th year.

There is no shortage of opportunity as the journey continues in the coming year. Our vision can only be accomplished together, with your support. You are community leaders, ambassadors, cheerleaders, members, donors and friends. Your passion for our mission inspires us every step of the way. We are grateful.

With gratitude,
JILL KOSKI
President and CEO

10th Anniversary of the Scientist Lecture Series

By Cait Anastis, Editor

For the past decade, the Scientist Lecture Series has been showcasing the work of researchers from around the country as they unravel the mysteries of nature and search for solutions to the challenges facing Earth's diverse ecosystems.

Introduced in 2008, the lecture series at the Holden Arboretum focused on giving our members and guests the opportunity to learn more about the work taking place in the Arboretum's research labs and collections. Presented by members of the Arboretum's research staff, the first lecture focused on sugar maple decline in the northeastern United States and the role air pollution may be playing in that process. The second explored research conducted at the David G. Leach Research Station on plant diseases affect rhododendrons.

In its second year, the scope of the series expanded, with researchers from partner institutions invited to share their work with Arboretum audiences. The first, Tom Rooney, from Wright State University, presented research on the ecological impact of the white tail deer on Ohio's ecosystems. Since then, Holden Forests & Gardens audiences have welcomed scientists from botanical gardens and universities around the country.

The lecture series serves three important purposes, said David Burke, chief program officer for research, horticulture and conservation.

"The first is to help educate the public on environmental issues," he said. "Increasingly, there is a disconnect between science and the public, with a lack of public understanding of science and how scientist work. We need an informed public when it comes to deciding what kinds of environmental policies to support, as well as a public that understands the importance of science education."

The series may also help stimulate an interest in plants among young people, Burke said. "We see universities abandoning plant biology and botany programs. There just aren't a lot of students going into plant biology anymore."

Finally, the lecture series helps to showcase Holden Forests & Gardens' research program and facilities, leading to new collaborations between the HF&G scientists and researchers from outside agencies, Burke said. These collaborations are fundamental to advancing our understanding of how forest ecosystems function and finding new and better conservation practices.

The lectures have been a hit with Holden Forests & Garden audience, with 40 to 50 people attending each talk to learn more about science. The audience is diverse, with HF&G members mingling with college and high school students and faculty members from area universities.

Holden Forests & Gardens kicked off the 10th anniversary year of the talks in October, when Jennifer Ison, PhD, from the College of Wooster, shared her work on plant-pollinator mutualisms. Presentations planned for the winter months include *From Microbes to Mountains, Exploring Environments in a World of Change* by Aimée Classen, PhD, of the University of Vermont on Jan. 16 and *Mentor Marsh: History, Tragedy, Recovery* by David Kriska, PhD, from the Cleveland Museum of Natural History. To learn more about these talks, see page 15 of the Classes & Events schedule or visit our website at holdenfg.org.

Leading the Way

Team of New Hires and Seasoned Veterans Guide Holden Forests & Gardens

By Cait Anastis, Editor

The past year has brought a number of changes to Holden Forests & Gardens as President and CEO Jill Koski has worked to move the organization forward in pursuit of the its vision to help support greener communities in the Northeast Ohio.

To help propel those efforts forward, Koski has built a new leadership time that is a dynamic mix of seasoned Holden Forests & Gardens veterans and talented newcomers, drawn from the non-profit and business world.

JOEL ALPERN, CHIEF OF EDUCATION AND GUESTS EXPERIENCE

The newest member of the leadership team, Alpern joined the staff in August. Describing himself as a lifelong "museum geek", Alpern previously served as director of exhibitions at the Cleveland Museum of Natural History where he oversaw the museum's permanent and temporary exhibition programs. Prior to joining the staff at the Cleveland Museum of Natural History in 2006, he worked in exhibitions at the Peggy Notebaert Nature Museum in Chicago.

The chance to be a part of Holden Forests & Gardens was an opportunity Alpern didn't want to pass up. "Having spent nearly my entire career in service to environmental science focused cultural institutions, the opportunity to lead and transform programs and experiences at HF&G's two incredible campuses was the chance of a lifetime," he said. "On meeting Jill and the team, I found their passion and drive was contagious – I was all in!

Alpern's Education and Guest Experience team will be key player in fulfilling HF&G's mission to advance and inspire a deeper understanding of plants to enhance life. "My team's role is to bring that to life through spectacular experiences, whether in our forests, gardens, classrooms, community and the broader world," he said.

DAVID BURKE, PHD, CHIEF PROGRAM OFFICER SCIENCE, HORTICULTURE AND CONSERVATION

While Burke may have stepped into a new role this year leading the diverse team that includes HF&G's conservation, community forestry, horticulture and research staff, he joined the staff at the Holden Arboretum in 2006 as a scientist in the research department. Burke earned his doctorate in biology from Rutgers University in New Jersey with an emphasis in ecology and evolution. His research focuses on plants and beneficial soil microbes. In 2012 he was named chairman of the research department, his team's work advances HF&G's outreach efforts.

"All life depends on the conservation of nature and the natural resources nature provides. The science programs are dedicated to growing our understanding of plant and environmental science so that we may be effective stewards of the natural world and enhance the life and well-being of all our communities," Burke said. "Clean air, clean water – these are essential for the maintenance of all life and the well-being of our society. And plant conservation is the foundation of clean air and clean water. At HF&G, we are dedicated to this public service mission of conservation and knowledge, and we work to share our knowledge, experience and excitement about plants and nature with other scientists, conservation practitioners and the public. Educating people about the wonder and importance of nature in our lives so that we can learn together, and be effective stewards of the world entrusted to us is a primary focus of the public service mission of the science programs."

ELLEN GREVEY, CHIEF OF EXTERNAL AFFAIRS

Joining the Holden Forests & Gardens team in May, Grevey will lead HF&G's philanthropy and communications programs. She joins us from Franklin Park Conservatory and Botanical Gardens (FPC) in Columbus, Ohio where she served as vice president of philanthropy and previously, director of visitor experience. At FPC she led a successful $22 million capital campaign, exceeding goal and completing four major projects focused on growing visitation, earned and contributed income. Before this, Grevey worked in communications for a privately held technology company, handling public and media relations, internal communications, publications, website and social media. Her department will advance the HF&G mission by raising both awareness and dollars.

"External Affairs will advance Holden Forests & Gardens through philanthropy and communications," she said. "We are excited to share the stories of our work in community forestry, urban farming, youth education, scientific research and much more. Stewarding and serving our community of members, volunteers, donors and visitors is top priority. Holden Forests & Gardens thrives because of the participation and support of 17,000+ member households, 375,000 annual visitors, and the kindness of many generous donors. I am looking forward to welcoming more people from greater Cleveland and beyond to enjoy our unique gardens, collections, programs and exhibitions.

"What attracted me the most was the opportunity to support, elevate, and promote this amazing institution that I loved as a child" she said. "Holden Forests & Gardens impacts so many lives through its rich and diverse natural resources, incredibly talented staff and excellent programs. It is an essential part of the landscape, history and fabric of the Northeast Ohio community and I am truly proud to be a part of its continued success."

KATHY HEFLIN, CHIEF FINANCIAL OFFICER

Heflin joined Holden Forests & Gardens from Brandmuscle, a start-up marketing services technology company that grew to offices across four cities and over 700 employees. During this time she led a broad range of financial, accounting and administrative activities as the vice president of finance. Her career began in public accounting and progressed across consumer goods, telecom and construction industries prior to joining Brandmuscle.

Accepting the position at Holden Forests & Gardens was an opportunity to put her talents to work at nonprofit dedicated to creating a greener Northeast Ohio. "Having spent the better part of my career in the for-profit world, I was excited for the opportunity to dedicate my time and energy to a mission-based organization that I completely connected with," she said. "Jill's vision for the organization's future, including bringing together two world-class institutions while leveraging the assets of both campuses, really convinced me to make the move!"

Her extensive experience will help keep the organization on solid financial ground as it moves forward. "My teams supports the organization as they provide outstanding programming in service to the community, keeping in full sight all fiduciary responsibilities in delivering our mission," she said.

BRIAN PARSONS, CHIEF PLANNING OFFICER

Parsons started his career at the Holden Arboretum as a student intern in 1977 after graduating from Beloit College. He later joined the full time staff as assistant superintendent of grounds, holding numerous positions over the years, including field naturalist, natural areas coordinator, and then director of conservation. In his spare time, he served as the organization's computer systems manager and learned how to propagate native plants. He has left a lasting mark on the grounds of the Arboretum, helping to design and build the Myrtle St. Holden Wildflower Garden and the Arlene and Arthur S. Holden Jr. Butterfly Garden. In 2009, he stepped into the role of project manager for the New Leaf Master Plan.

Now as the chief planning officer, he oversees facilities, safety and security, and planning. "In general - this team is part of the behind the scene support groups that assist with implementing the "Clean, Safe, Ready" program at both locations. We work to ensure that staff has a clean and safe facility to work in, that our guests have a clean and safe facility to visit, and that the equipment staff use to deliver programs is likewise safe and ready," he said. "Within facilities we seek to help the organization achieve its goal of a fiscally sustainable budget by looking to conserve resources through ongoing preventative maintenance, making sound decisions about repairs, equipment replacements, and working with other staff to implement critical capital improvements that enhance the guest experience.

Even after 40 years at the Arboretum, Parsons is passionate about the work being done at Holden Forests & Gardens. "Be it the Holden Arboretum, the Cleveland Botanical Garden or Holden Forests & Gardens, I still love the land, the landscapes, Northeast Ohio region and the mission of the organizations," he said. "Over the past 41 years I have been very fortunate to have had the opportunity to serve many roles in the organization and as long as I feel I am having a positive impact and helping the organization achieve its goals I will continue to answer the call to be of service to the organization."

American Tree Sparrow

Spizelloides arborea

By Rebecca Thompson, Manager of Academic Programs

Strictly winter visitors, American tree sparrows, can be commonly seen in old fields, grassy meadows and at bird feeders. Despite their name, American tree sparrows are not associated with trees, instead foraging and nesting on the ground. Instead their name comes from European settlers because the birds reminded them of the Eurasian tree sparrow.

Fall through spring American tree sparrows are herbivores, eating plants that primarily include sedge, ragweed, knotweed, goldenrod and other seed bearing plants. They will on occasion eat berries, catkins, insects, insect eggs and larvae when available. In the winter they frequently scratch at exposed soil to uncover seeds that have been buried. During the summer months their main diet also includes insects such as beetles, flies, leafhoppers, wasps, moths and caterpillars. They will also eat snails and spiders.

American tree sparrows breed in low shrubby growth along the northern Canada's tree limit. In up to seven days females construct their coarse grass, weed stem nest on or near the ground at the base of a shrub, grass tuft or deal branch. They line their nest with fine dry grass, moss, feathers and hair. American tree sparrows synchronize hatching and fledging. Females lay one pale bluish or greenish, with brownish spotting, egg per day until she has laid three to six eggs. Despite males visiting the nest, only females incubate the eggs over the next 11-13 days. The young hatch within hours of each other and may not hatch in the order their eggs were laid. The young sparrows leave the nest about nine to 10 days after hatching, but don't fully master flight for another five days. Because of this, both parents tend to the young for another nine to 10 days.

American tree sparrows are abundant and widespread because most nesting areas are remote from human disturbance. Partners in Flight estimates the global breeding population at 20 million. In the winter range, they adjust readily to disturbed habitats, human settlement and capitalize on foraging at backyard feeders.

BIRD FACTS

SIZE: 5.5-6.5 inches Wingspan: 9.5 inches

DESCRIPTION: Gray head with rusty cap and eye line; streaked brown, black and white back; Gray to buff unstreaked breast with a dark central spot.

RANGE: Breeding most of Alaska and Northern Canada. Winter includes southern Canada and the United States, except the western states and all of Florida.

VOICE/SONG: High whistled tseet tseet followed by short whistles Call: multiple musical twitter teedle-eet

BEST LOCATION TO VIEW: Arboretum — Thayer feeders, Corning Lake Botanical Garden — Areas with seed bearing plants

Panicle Hydrangea

Hydrangea paniculata

By Ethan Johnson, plant records curator

Native to sunny or fairly open slopes, valleys and mountain tops in China, Japan and the island of Sakhalin, *Hydrangea paniculata* is an outstanding summer blooming shrub for Northeast Ohio landscapes. It is easily cultivated, requiring a bit of late winter to early spring pruning to keep it looking its best from year to year. If just the tips of the branches containing the seed heads are pruned the plant will have relatively small inflorescences and eventually reach 10-12' in height. If established plants are pruned moderately to 3-5' from the ground every year the shrub will not exceed 6-10' in height, and its inflorescences will be larger. If pruned hard, back to 1' or less from the ground, the new stems will be willowy and floppy with even larger inflorescences, but this is not recommended. For pollinators, the less dense the inflorescence the better, with beetles, bees and even a few butterflies being attracted. In recent decades many cultivars of panicle hydrangea have been developed in the Netherlands.

At both the Holden Arboretum and Cleveland Botanical Garden, *Hydrangea paniculata* 'Limelight' has been excellent. It is a commercial success in part because of its precocious nature, bearing flowers on small potted plants at garden centers. Vigorous plants grow to 8-10' tall. In Northeast Ohio, the "lime" part of the name refers to the color of the floral bracts or sepals from September to frost, with chartreuse on the young inflorescences in late June or early July that soon turn bright white.

Visitors to the Arboretum can see examples of these hydrangeas on Beech Knoll in the Layer Rhododendron Garden and at Lantern Court near the circle in front of the house. At the Botanical Garden, look for them outside the fence adjacent to the southwest corner of the Western Reserve Herb Society (WRHS) Herb Garden. Although 'Limelight' is not a good variety for attracting pollinators due to its dense heads packed with showy sterile sepals, it has attracted a grey tree frog or two – amusingly light green – at Lantern Court, who are no doubt awaiting six-legged snacks.

Other cultivars of panicle hydrangea at the Arboretum and Botanical Garden include:

- Little Lime a.k.a. 'Jane,' selected for its more diminutive stature, growing to only about 4.5' tall for us after being planted in 2014 near the Corning Visitor Center behind the top row of the amphitheater and in 2015 at the Botanical Garden near the circle adjacent to the WRHS Trial and Cutting section. The white inflorescences are a bit smaller than 'Limelight' and turn light green with pink highlights once the tiny fruit are forming in September and October.
- Quick Fire® a.k.a. 'Bulk' was selected for its relatively compact growth habit (6-8' tall), fairly dense white inflorescences with many fertile flowers late June through July with the sepals turning pink by August. It can be found at the Botanical Garden adjacent to the WRHS Trial and Cutting section, and at the Arboretum on the north and south ends of the Paine Rhododendron Discovery Garden, in the Layer Rhododendron Garden, Holden Butterfly Garden and at Lantern Court by the south terrace.
- Pink Diamond™ a.k.a. 'Interhydia' grows 8-10' tall, fairly dense white inflorescences with many fertile flowers July and August with the sepals turning pink in September. Visitors can find Pink Diamond in the Sunken Garden near the north side of the Botanical Garden, and at the Arboretum on the south side of the Display Garden, at Lantern Court on the rise east of the drive, and in Paine Rhododendron Discovery Garden, north of the overlook and south of the rest rooms, where it was pruned hard near the ground, resulting in floppy and leggy growth.
- Pinky Winky® a.k.a. 'Dvppinky' grows 6-8' tall, fairly dense white inflorescences with many fertile flowers July and August with the sepals turning pink in September. Planted by the courtyard at Lantern Court.
- 'Tardiva' grows 8-10' tall, fairly open white inflorescences with abundant fertile flowers August and September. Planted in the Sunken Garden at the Botanical Garden, and in the Sally Gries Entry Beds by Sperry Road, on the northeast side of the Layer Rhododendron Garden and by the north terrace at Lantern Court at the Arboretum.

PLANT FACTS

LIGHT: Full sun to part shade

SOIL TYPE: Moist, yet well drained, acid to neutral

MATURE SIZE: 8-12' with equal or greater spread

BEST LOCATION: USDA Zones 4a-8a

SOURCE: Local garden centers

The Gift of a Holden Forests & Gardens Volunteer

By Tracee Patterson, Volunteer Coordinator, Botanical Garden campus

During this season of giving, we especially appreciate the gift of our many volunteers who share their time and talent, their energy and creativity, their passion and commitment to supporting the mission of Holden Forests & Gardens. In September, we honored their collective contribution at our 2018 Volunteer Recognition events with the theme of Volunteers Make Holden Forests & Gardens Sing! In her opening remarks to volunteers attending the Arboretum campus event, President and CEO Jill Koski noted the inestimable value of having dedicated volunteers working together on behalf of our organization. "I know that you are far more than the specific roles and work you provide while directly fulfilling your volunteer commitment. You are community leaders, ambassadors, cheerleaders, members, donors and friends. We are grateful. Thank you for being a part of the choir that makes Holden Forests & Gardens sing!"

Ed and Yvette Slusarski with Jill Koski and Brad Turner.

In addition to acknowledging the vital support of all our volunteers, several volunteers at both campuses received special recognition. At the Cleveland Botanical Garden Recognition Brunch, Sally Hanrahan was presented with the 2018 Botanical Garden Volunteer of the Year Award by last year's recipient, Rodrick "Rod" Chima. Nominated by Kate Nickley, coordinator of the Hershey Children's Garden, Hanrahan has been a familiar and frequent face in any volunteer activity involving children for the past 10 years. Be it at a special event such as Glow, Boo-tanical Bash, or Egg Hunt or through her weekly efforts in the Children's Garden, she can be seen engaging, exciting and educating our youngest guests about the magical wonders found in our gardens. Hanrahan was also singled out for her "hard work, creativity and kindness" and the many ways in which she goes "above and beyond" to provide support and encouragement to staff and other volunteers. Hanrahan was congratulated on her award by Holden Forests & Gardens Chief of External Affairs Ellen Grevey, Board Chairman Bradley E. Turner, and Volunteer Coordinators Tracee Patterson and Sarah Hartley. Joining her at the podium were the 2018 Botanical Garden campus Lantern Award winners, Hollis Hamilton, Yvonne Morbitzer and Marianne Stern; and Birdhouse Award winners, Sharon Skora, Debbie Smith and Lori Whittington.

Sarah Hartley, Sally Hanrahan and Tracee Patterson.

At the popular Holden Arboretum Recognition Clambake, Yvette Slusarski received the R. Henry Norweb Jr. Volunteer of the Year Award from 2017 winner Maria Stannek. A volunteer since 2011, Slusarksi was recognized for her significant contributions to the education department. Nominating staff member Vanessa Pierce, manager of family engagement, shared that in addition to her work as a school guide and on special events and projects, "Yvette took over the difficult and time-consuming job of coordinating our Tree Tale Tellers program last spring. She was able to improve the program by making new bags and materials, as well as coordinating the training session and library visits. She handled everything with a professional demeanor and friendly smile. Her hard work paid off as we were able to reach 24 libraries, and 644 people were served in just two months." Slusarski was thanked for her service by Koski, Turner, Hartley and e Patterson. Also recognized were the 2018 Arboretum campus

Lantern Award winners, which included Jane Brockway, Tish Collier and Amy Goletz, as well as Birdhouse Award winners, Jennifer Ault, Richard Beck and Al Cowger.

Volunteers with a lifetime achievement of contributing 1,000 hours or more to Holden Forests & Gardens were also presented with certificates at this year's events, and included volunteers Hank Andrews, Marilyn White, Joyce Smith, Susan Lombardo, Hap Howle, Enid Kraus and Sister Pat McHale.

Both individual and group volunteers share the gift of their time in a variety of activities and programs at both our campuses. If you are interested in joining our volunteer community, please contact Sarah Hartley, Arboretum volunteer coordinator, at 440.602.8003 or Tracee Patterson, Botanical Garden volunteer coordinator, at 216.707.2822 for more information.

Richard Beck, Jennifer Ault and Al Cowger

Debbie Smith

Marianne Stern, Yvonne Morbitzer and Hollis Hamilton

Jane Brockway, Tish Collier

Hap Howle, Hank Andrews, Susan Lombardo and Marilyn White

Enid Kraus, Sr. Pat McHale, Ellen Grevey and Brad Turner

Phys-Fest 2

Participants Use Hyperspectral Camera To See The Unseen

By Michelle Audie, Phys-Fest 2 Scientist, Washington State University

Holden Forests & Gardens hosted 40 researchers from universities around the country at Phys-Fest2 last July at the Holden Arboretum. During the training for plant eco-physiologists, participants had the opportunity to learn new research and communication skills while conducting research using the Arboretum's laboratories and the Murch Canopy Walk and Kalberer Tower. As part of the communications training, some of the participants were asked to write articles for Holden Forests & Gardens magazine about the research techniques they were using.

What happens when sunlight interacts with leaves? Some of the light passes through the foliage, some is reflected and some is given off in the form of heat.

We are able to see the color of the leaves because our eyes can detect a portion of the reflected light. But how do leaves interact with the light that our eyes cannot see, including ultraviolet (UV), which is the light that causes us to get tan at the beach; or near-infrared (NIR), which is the light used to create heat in a space heater?

Scientists use a highly sensitive camera to measure the reflected sunlight from a material, such as a leaf, which splits light into hundreds of wavelengths (spectra), including many that humans cannot see, such as UV and NIR.

Because different materials have different properties, they react with light differently, each has a unique spectral signature in the same way that every person has a unique fingerprint. This spectral signature describes how intensely each wavelength of sunlight is reflected and can be used to answer questions about what we cannot see with our eyes alone.

During Phys-Fest, attending scientists used a hyperspectral camera to image leaves to determine if it is possible to predict if the American beech leave are infected by beech leaf disease based on their spectral signatures using a hyperspectral camera.

Although the process only takes a few minutes the resulting images unlock an immense amount of detail about how sunlight interacts with these leaves. In the same amount of time it takes to microwave a bag of popcorn, the hyperspectral camera was able to capture 270 narrow wavelengths of reflected light from the target leaf. For comparison, a digital cameras can capture an image of the leaf in only three broad color wavelengths: red, green, and blue, matching the colors detectable by the human eye.

The images from the hyperspectral camera reveal subtle differences in the intensity of reflected wavelengths of light, which in turn allow scientists to determine from the leaf if the plant is under stress from overheating or displaying lower photosynthetic activity as a result of disease. Researchers can then use these measurements to detect differences between vigorous, healthy leaves and those showing symptoms of disease or stress. Likewise, scientists can observe how individual leaves on a tree differ (e.g. photosynthetic rate and water usage) depending on whether they are exposed to consistent sunlight at the top of the canopy or are well-shaded closer to the ground.

During PhysFest2, scientists were able to differentiate leaves from American beech trees infected by beech bark disease, even when symptoms of the disease were not visible to the naked eye. We found that infected leaves seem to reflect less light in the visible wavelengths, while reflecting more light in the NIR when compared to uninfected leaves. These differences in the NIR could potentially be used in future research to examine the degree of infection in these trees or to understand how the infection spreads. It is amazing that these powerful cameras can detect differences that are invisible to us!

Editor's note: Kinzie Bailey, University of Arizona; Aaron Kamoske, Michigan State University; and Luiza Aparecido, Arizona State University contributed to this story.

Sorting through the data collected during Physfest2.

Physfest2 participants gather on the canopy walk to examine leaf function.

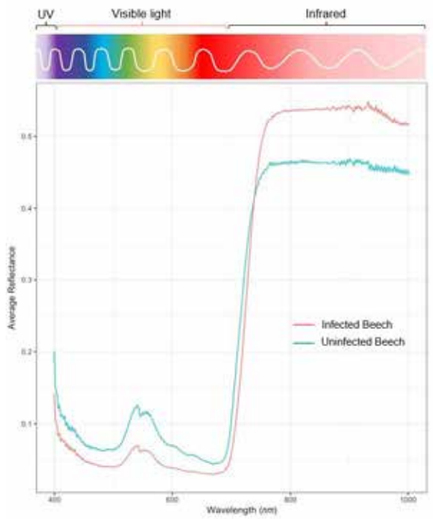

Figure 1. The average spectral wavelength of an infected (red) and uninfected (blue) beech leaf. The infected beech leaf has lower reflectance in the visible and higher reflectance in the infrared portions of the spectrum. The difference in reflectance between these two leaves suggests that infected leaves may be photosynthesizing less than uninfected leaves.

The top two leaves show withering and dark spots, a sign of beech leaf disease. The bottom two leaves are healthy.

RESEARCH

Phys-Fest 2

Scientists Take the Temperature of Holden Forests & Gardens Conifer Collection

By Michelle Audie, Phys-Fest 2 Scientist, Washington State University

On a hot summer day, you may notice the leaves on your plants or backyard trees looking a tad thirsty. The hotter and drier it gets outside, the more water these plants use and lose. The leaves may even begin to wilt in response to overly hot conditions.

Our observations tell us that this phenomenon often affects some plants to a greater degree than others, but what triggers the wilting to occur in the first place? Most plants are anchored to one location by their roots and cannot escape rising temperatures. They have no choice but to acclimate to the stress they are undergoing, if they are not already adapted to withstand these conditions. Sometimes trees within the same species might vary their response when growing in a hot environment. Plant physiologists have aptly dubbed this plant response *heat stress*. When the temperature heats up, plants may simply lose more water to maintain functionality, and consume more water later to compensate.

In studying how heat stress affects plants, scientists have found that many plant species experience adverse consequences. These unfavorable conditions can affect plant growth in many ways, such as reducing photosynthesis. Scientists have also discovered that some species, and even sometimes certain individuals within a species, can resist heat stress quite well. This is great news because we want strong, healthy plants that can survive the unpredictable weather!

Holden Forests & Gardens is an excellent place to study how plants with similar leaves may respond differently to temperature. For example, its conifer collection features evergreen species from all over the world growing together in one collection at the Arboretum. Although these conifers all have needle-like leaves, they vary in length, number and *greenness* between species.

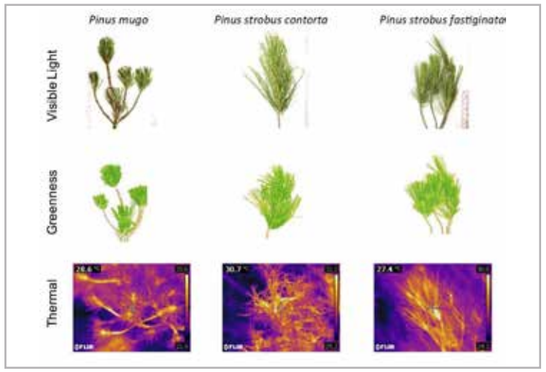

Figure 1. Measuring heat stress in pines.

At Phys-Fest 2, scientists used portable thermal imaging cameras to detect infrared waves, or heat emissions, that are later converted into temperature signatures. Infrared radiation (IR) comprises a narrow range of the electromagnetic spectrum just beyond the red side of the rainbow that we see with our eyes.

Every object gives off infrared (IR) radiation, and the amount of radiation relates to the temperature of the object. Although we can feel heat, we cannot see heat because IR is a wavelength that our eyes cannot detect. We need the assistance of IR thermal imaging to ***see the heat*** invisible to our eyes.

Scientists at Phys-Fest 2 were able to detect temperature differences between three species of pine growing in the Arboretum's conifer collection. They found that the tree different pines had different temperatures. Curious about whether these pines were undergoing temperature stress, they looked at greenness. A healthy plant will be very green, while a stressed plant will be less green. In *Figure 1*, we see that the long-needle pines are different from the others.

Scientists also found that the leaf temperature of pines (*Pinus*) were a few degrees hotter than the cedars' (*Calocedrus*) leaf temperature. The pines exhibited a much greater spread of leaf temperatures than the cedars, and one of the pines had a leaf temperature almost 5 degrees Celsius hotter than the cedars!

What can all of this tell us about heat stress in plants? These studies help us gain insight about species habitat preference and how they adapt their leaf structure to cope with environmental stress. We can also make some inferences about which trees are more likely to tolerate prolonged heat waves and which trees need a cooler climate, information that will help horticulturists and property owners select plants better suited to survive changing climate conditions. Similarly, we see that trees with different leaf shapes (shortleaf versus longleaf; twisted versus flat needles) respond differently to the environment even though they were grown in the same location.

Editor's note: Phys-Fest 2 scientists Laura Ladwig, University of Wisconsin; Kinzie Bailey, Montana State University; and Jamie Mosel, University of Minnesota, contributed to this story.

Welcome Winter with our New Seasonal Programs

By Ellie Rial, Manager of Adult Education

It can be easy to let Cleveland's winter get you down, but thankfully, you can kick cabin fever to the curb, get off your couch and out of the house by checking out one of Holden Forests & Gardens many new winter programs. Whether you're looking to get into your stride with your fitness resolutions, be transported to a warmer and more vibrant place, or are interested in learning a new skill or meeting new people, there is something for you.

Many of us live our best life in January; we're still committed to our "New Year, new you" resolutions and are eager to get moving and active. Instead of hitting the gym, get outdoors and give snowshoeing a try. This fun, low-impact activity is a great workout for all ages. Visit our Holden Arboretum campus to rent a pair – $5 per each two hours for adults and $2 per each two hours for children – and explore the trails in all of their winter wonder. If you've never tried snowshoeing but are interested in learning, pop in to our new, free Pop-up Learn to Snowshoe classes offered with several days advance notice. This will help us ensure ideal weather resulting in a great introductory snowshoe experience. As winter weather sets in, be sure to check our Facebook page for notifications on program dates and times, as well as how to register.

Do you tend to find yourself with a case of the winter blues? What better way to cure them than channeling the tropics by submersing yourself in the sights and sounds of Costa Rica. Join local artist Susan Danko in her full-day acrylic painting workshop in the Costa Rica glasshouse where participants can find inspiration among plants, birds and butterflies of a rainforest. This workshop can only accommodate eight people due to limited space in the glasshouse, so reserve a spot before they're gone.

Another option to add a splash of color to your winter is through Susan Morse's Botanicals with Brusho Crystal Watercolor class. In this class, you'll learn how to add eye-catching hues and unique texture to your paintings. All skill levels are welcome as participants will explore the limitless potential of this medium using their own unique artistic vision.

Are you looking for ways to spread some holiday cheer this season? Join Horticulturalist Mark Bir as he shares tips and tricks for propagating and encouraging your seasonal houseplants to flower and thrive. Each participant will take home three plants that are famous for their winter blooms; Christmas cactus, amaryllis and poinsettia. Keep all three for yourself or give them as gifts that will surely keep on giving for many winters to come.

In many homes, winter décor is synonymous with the holiday season. Live boughs of evergreens, branches of snowberries, pinecones and boxwood can make your home feel a little more festive this winter. Join Avalon Nursery owner Mary Slingluff at our Winter Greens Make-it Take-it workshop where she'll demonstrate how to create an elaborate holiday wreath and mixed greens garland. After the demonstration, participants can choose which of those projects they would like to create and take home, with personalized tips and tricks from Slingluff.

These programs offer a variety of opportunities to embrace all the wonder that winter has to offer. For more information about these and all of our other winter programs please visit holdenfg.org.

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9500 Sperry Road
Kirtland, Ohio 44094

holdenfg.org

Orchid Mania at Cleveland Botanical Garden, Saturday, January 26 through Sunday, March 10.

Forests & Gardens is the member magazine for Holden Forests & Gardens, which includes the Holden Arboretum in Kirtland and the Cleveland Botanical Garden in Cleveland.

Our Mission: Advance and inspire a deeper understanding of plants to enhance life.

Our Vision: Vibrant green communities and diverse native forests of the Great Lakes region will flourish and sustain life.

HOLDEN arboretum
HOLDEN FORESTS & GARDENS

9550 SPERRY ROAD, KIRTLAND, OHIO 44094
HOLDENARB.ORG 440.946.4400

HOURS
DAILY: 9AM - 5PM

ADMISSION	CANOPY WALK & TOWER TICKETS
ADULTS: $12	$4
CHILDREN (3 - 12): $8	$2
MEMBERS: FREE	FREE

The Murch Canopy Walk and Kalberer Emergent Tower are open April 1 - Nov. 1

CLEVELAND botanical garden
HOLDEN FORESTS & GARDENS

11030 EAST BLVD, CLEVELAND, OHIO 44106
CBGARDEN.ORG 216.721.1600

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