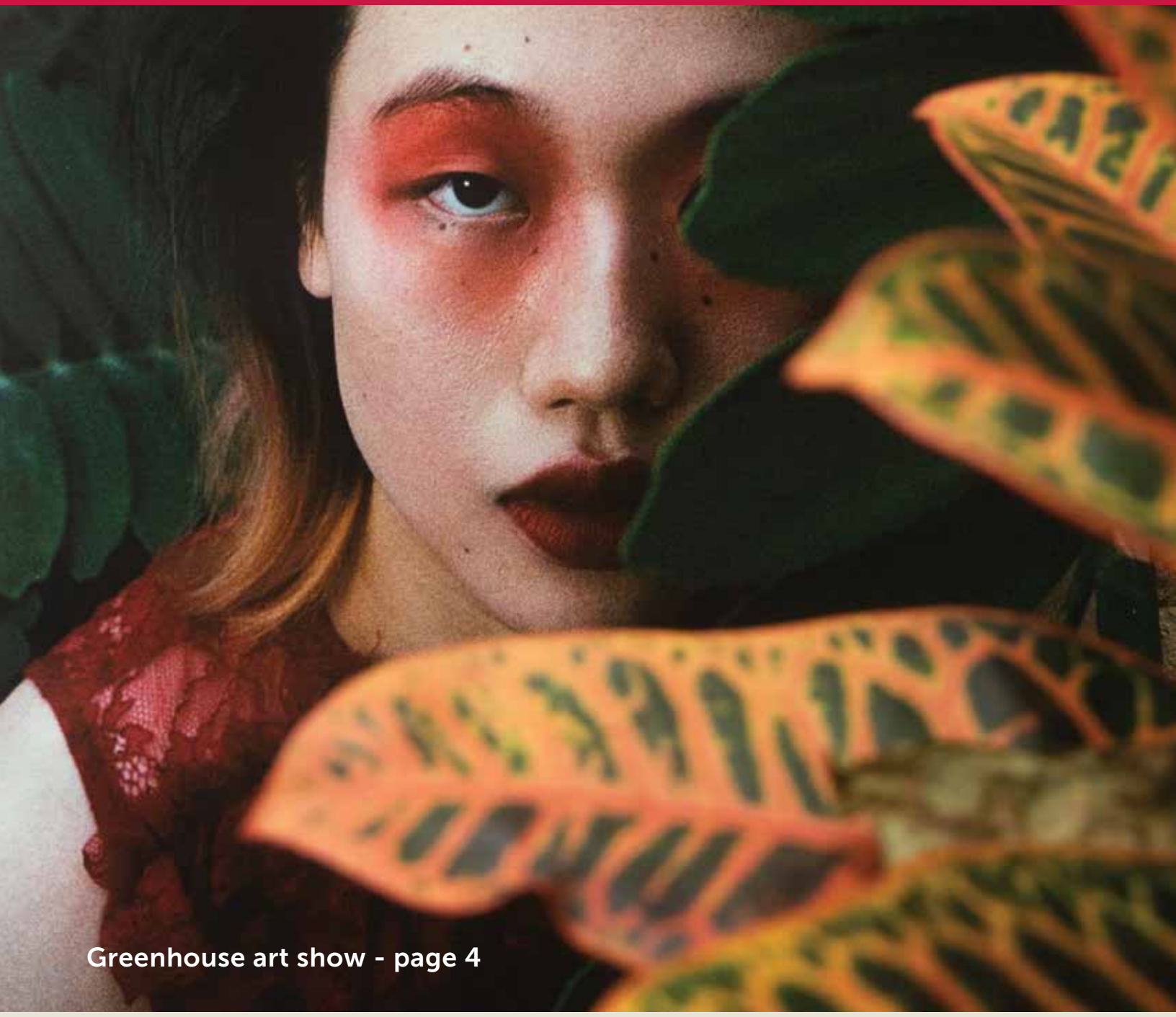
Botany & Conservation

A newsletter for alumni and friends of Botany and Conservation Biology

Fall/Winter 2019



Greenhouse art show - page 4

Photography by Xiaoyue Pu in the Botany Gareenhouse

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College of Letters & Science
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Chair's Letter

Six months ago I addressed the graduating Botany and Conservation Biology seniors and reminded them that no other university in our country can offer the *breadth* or *depth* of knowledge and experience that they had gained over their last four years. It was a joyous day filled with celebration, but also a serious moment as I reminded them that the fate of our planet and our own species soon will be in their hands. All of us felt our stomachs drop when the UN released a summary of its landmark report from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services earlier that week. There is no way to sugar coat their findings…"Nature is declining globally at rates unprecedented in human history — and the rate of species extinctions is accelerating, with grave impacts on people around the world now likely. Some 1 million animal and plant species are now threatened with extinction, many within a just a few decades. We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life, worldwide." The report goes on to state that "The essential, interconnected web of life on Earth is getting smaller and increasingly frayed. This loss is a direct result of human activity and constitutes a direct threat to human well-being in all regions of the world." But, the report also tells us that "it is not too late to make a difference if we start now at every level from local to global." Through transformative change Nature *can* still be conserved, restored, and used sustainably.

As alumni, your education at UW-Madison actually helped train you to be an agent of that transformative change. Sure, you memorized a lot of facts out of textbooks when you were students, but your education here and through internships and study abroad resulted in something much more important . . . you learned to connect the dots – to make *connections* among subject areas that seem unrelated, at first glance, and also to solve complex problems using critical thinking skills that are based on the fundamental comparative and scientific methods. You see patterns in Nature that others do not; I suspect that not a single one of our alumni would be diagnosed with 'plant blindness'. Each of you is able see the bigger picture. This is critical because each of us now has the potential to make a difference in our planet's future in one way or another. As I look to the future, it is because of *you*, the alumni of Botany and Conservation Biology, that I have hope for our planet and our shared humanity. Be that agent of change -- and please support your alma mater so that we can continue to offer an unparalleled education to future generations.

Prof. Ken Cameron

Chair

This newsletter is published by the Department of Botany at the University of Wisconsin-Madison.

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Going Organic: IPM Inside and Out By Ingrid Jordon-Thaden

The central location of the Botany Garden and Greenhouse means we have a regular flow of people in and around our plant collection. Because of this, one of my goals in this position as director has been to go organic both inside the Botany Greenhouse and in the Botany Garden to provide a safer place for our students, scientists, and visitors as well as our birds, insects, and small animals.

In the Botany Garden we have stopped spraying weeds with anything but a little horticulture vinegar, and with the grumbling of our staff, are mostly using manual labor to remove them. We add corn gluten to the lawn to reduce weed seeds, and adjusted the overall lawn care methods to encourage a more diverse set of plants such as clovers, and other mow-able flowers and bulbs. To read more about our organic lawn care changes, visit our web page created by our Information Technology Academy intern, Raya Ronaghy. We also are leaving most of our perennials intact over the winter to provide habitat and food for birds and insects. Another change is our experimentation with introducing live compost tea to the garden. With these modifications, we are seeing an increase in pollinators, and our perennials are growing big and strong!

Inside the greenhouse we have ramped up our use of beneficial insects from the occasional to almost bi-weekly releases and eliminated all restricted-use pesticides. While this may cost more and require more training of our staff in entomology, ultimately it is for the better. And in some cases, our beneficials have

(continued on page 5...)

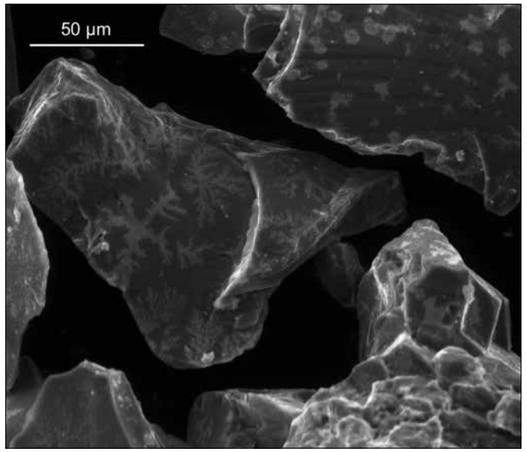
Lifelike chemistry created in lab search for ways to study origin of life by Eric Hamilton

The Baum Lab in the Botany Department has cultivated lifelike chemical reactions while pioneering a new strategy for studying the origin of life.

The work is far from jumpstarting life in the lab. Yet, it shows that simple laboratory techniques can spur the kinds of reactions that are likely necessary to explain how life got started on Earth some four billion years ago.

The researchers subjected a rich soup of organic chemicals to repeated selection by constantly paring down the chemical population and letting it build back up again with the addition of new resources. Over generations of selection, the system appeared to consume its raw materials, evidence that selection may have induced the spread of chemical networks capable of propagating themselves.

On longer timescales, these chemical changes oscillated in a repeating pattern. This boom-and-bust cycle isn't yet fully explained, but it is good evidence that the chemical soups established feedback loops resembling those found in living organisms.



Under ultra-high magnification, the researchers found distinctive fractal shapes spreading along pyrite grains after their chemical soups went through multiple generations. The researchers believe these fractals are salty deposits induced to form by a thin layer of organic material spread along the mineral. Image courtesy of David Baum Lab

David Baum and his team published their findings Oct. 23, 2019, in the journal *Life*. The work was funded by the National Science Foundation and NASA.

Now, other researchers can use this experimental approach and help untangle what components are necessary to encourage lifelike chemical systems and whether those chemical networks can go on to evolve more complex traits.

If this system can generate greater complexity, it might help solve the puzzle of how simple chemicals eventually gave rise to something as intricate as the cellular ancestor that spawned all life today.

"A core question in the origin of life is: How do you get evolution before there was genetic information like that within DNA or RNA?" says Baum. "What we've now realized is that the evolution of chemical networks may solve that problem, and that's something we can tackle in the lab."

To test the idea of chemical ecosystem evolution, the researchers assembled a rich soup of chemicals. In seawater, they dissolved amino acids, sugars, common organic compounds, trace minerals and the building blocks of nucleic acids. To give the system even more of an edge, the scientists spiked the rich seawater with ATP, a high-energy molecule that drives nearly all of life's reactions today but was unlikely to exist in primordial times.

"Not all of these chemicals might have been available on early Earth, but we're trying to accelerate a process that could in theory get started from even simpler building blocks," says Baum, who is also a discovery fellow at the Wisconsin Institute for Discovery.

The team mixed their primordial soup with fine grains of pyrite, a mineral of iron and sulfur also known as fool's gold. Building on German chemist Günter Wächtershäuser's 1988 proposal of chemical evolution, Baum's team believes that pyrite is an ideal material for cultivating lifelike chemistry.

"Pyrite was a common mineral on primordial Earth, it can bind to a lot of organic compounds, and it can catalyze reactions between them," says Lena Vincent, a graduate student in Baum's lab and the lead author of the study. "And, very elegantly, a lot of highly conserved enzymes across life have cores that are very similar to pyrite. They're basically pyrite wrapped in protein."

The researchers added a few drops of the enriched seawater soup to a small amount of crushed pyrite in a vial and mixed the solution for a few days. This was the first generation. To begin the next generation, Vincent took a small amount of the first solution and mixed it into a vial with fresh soup and pyrite. Over a dozen or more generations, only those chemical networks that could propagate faster than they were diluted would survive and spread.

After 12 or 18 generations, the researchers saw a drop in available phosphate — a readout of ATP use — in the dissolved organic material, which suggested that chemical compounds might be sticking to and spreading along the pyrite grains.

When they inspected the pyrite under ultra-high magnification, the researchers saw an abundance of fractal shapes spreading along the surface of the mineral in the experimental samples but not in control samples that lacked a history of selection.

While these fractal shapes appear to be salts and are not likely to be lifelike themselves, the researchers suspect they may be induced by a thin smear of organic compounds bound to the grains. The fractals never appeared when organic material was left out of the solution.

(continued on page 5...)

Art in the Greenhouse by Ingrid Jordon-Thaden

In the winter of 2018, a student came to me as she had heard through her photography class that the Botany Garden and Greenhouses are encouraging students to use them as a backdrop for their art. This was exactly the seed I had hoped to plant in my discussion with the photography professor, Dr. Darcy Padilla, earlier in the fall.

As the director of the Botany Garden and Greenhouse, I have been working on ways to bring more of the campus into our space. Art and artistic photography are a logical choice! I feel like we have a role to fill on campus to bring together the artistic and scientific minds of our students, to integrate nature into art appreciation.

Aside from our public tours, our 8,000 ft^2 of greenhouse space has traditionally only been used by students who are taking classes in the plant sciences. But what about all of the other students who could find themselves in a green space so full of life and fresh air right in the middle of campus? How do we bring them in? Our hidden gem, that our artist called "The Secret Garden", opened the eyes of many students in April 2019.

The artist, Xiaoyue Pu.
@xiaoyuepu_photography

"Shadow dance" in the Birge Lobby. Photo: Xiaoyue Pu

Xiaoyue Pu, UW-Madison senior photography and psychology major, came to me in December 2018 asking if she could have one of her fashion photoshoots in our greenhouse. Absolutely! She came with a team of two models and a camera assistant and spent the day with music and experimentation to create her show titled "The Secret Garden".

We printed the photos on canvas and scattered them throughout the greenhouse for 2019-2020 school year. In order to fully realize the concept of this art exhibit, we held an opening show in Birge Hall atrium in April 2019.

The contents and style of the show were kept a surprise to those invited. We had about 80 spectators from all over campus come to Birge Hall on a Friday night to see what this was all about.

Xiaoyue directed the whole opening show by calling on her student friends in the art and dance departments. The show consisted of dancers dressed as shadows coming out of the secret garden holding the intimate images of the models who were peering around plants. The choreographed dance by Yoshi Asai in the atrium was like nothing this science hall had likely ever experienced in its 100 years of existence. Neon artist Yuheng Chen made two unique pieces just for this opening show that were placed in the small display garden brought up from the greenhouse for the show. The music was created by Ke Xu specifically for the opening performance. Once the art installations had finished progressing into the center of the atrium on black, wooden easels carried by their shadows, the standing audience was invited by each dancer, one by one to "The Secret Garden" to get a closer look of the photos. When the performance ended, a reception carried on with food, laughter, and selfies for a few hours.

At the end of the evening, after the participants and their friends were heading out into the night, I thanked them for bringing beauty and creativity into this science building and invited them back whenever they could. I have seen a few of them since bringing their friends into the greenhouse, and hope word of mouth continues to bring curious students into our space.

Grandparents University by Donna Fernandez

It may be hot and sticky outside, but the Plant Physiology lab on the B2 floor of Birge Hall is bursting with youthful energy during two weeks in July as the Botany Department hosts the "Plant Science Major" at Grandparents University (GPU). A program organized by the Wisconsin Alumni Association, GPU brings grandparents and one or more grandchildren (ages 8 through 14) to campus for two consecutive days. Participants experience the campus environment, including the residence and dining halls, and spend two half-days exploring an academic "major". First offered in 2001, GPU is an incredibly popular program: the available seats for the three sessions offered in consecutive weeks in July are all taken within a few days once registration opens in February. The "Plant Science Major", organized around the theme "Movement in Plants", has been offered under the direction of Prof. Donna Fernandez for the past three summers. Botany graduate students Stacy Anderson, Kaija Goodman, Ariel Sorg, Johnny Johns, and Steven Augustine, from the Fernandez, Otegui, Gilroy and McCulloh labs respectively, have developed activities and served as instructors. The grandparents and grandchildren learn about the scientific method and work as investigative teams on overnight experiments examining the effect of light on tropisms of tomato seedlings as well as environmental effects on fluid transport, recording their results in a scientific notebook. The following morning, the grandchildren run down the stairs from the lobby and into the lab to see what has happened! A particularly exciting moment is when the inverted tomato seedlings that spent the night in a dark chamber are unveiled. The plant response often elicits gasps from the grandchild opening the chamber, and head-shaking from the grandparents ("That's not what I thought would happen"). The participants also tour the Botany gardens and greenhouses; learn about plant propagation and dispersal; trigger Venus fly traps and mimosas (hands-down the favorite activity of the grandchildren); isolate DNA from strawberries; and play a dispersal game. A total of 124 participants in six sessions have graduated with the Plant Science "degree" over the past 3 years. Upon completing the activities, 100% participants agreed with the statement "Plants are fun!"

Ariel Sorg, Johnny Johns & Kaija Goodman

Organic in the Gardens (continued from p.2)

taken residence in our houses and we do not need to release them any longer. We use mild horticultural soaps, plant-based insecticides, and other mild sprays as needed in hot-spots, and do plenty of hand removal of scale and mealy bugs. Our greenhouse is "cleaner" and the plants are healthier and show fewer nutrient deficiencies than before. The pesticide residue on pots and benches is all but gone, and our staff and students are not exposed to pesticides that could harm them in the short or long term.

Based on my previous experience at the organically-run Botanischer Garten Heidelberg at the University of Heidelberg and at the Biology Greenhouses at Bucknell University, I predict it will take 4 to 5 years for the entire annual insect care plan and integrated pest management (IPM) program to be fully realized. It is the subject of one of my recent co-authored publications (Hayes et al. 2019 APPS 7(8): e11281) on developing an integrated pest management program in greenhouses primarily used by students. We have begun the long process of finding the hotspots, determining how to improve the greenhouse climate to favor beneficial insects, and learning the life cycles of our specific pests. The next project is to create an entomology internship program for students in the greater Madison area to gain hands-on experience with using insects to control insects in a greenhouse setting.

Chemistry of Life's Origin (continued from p.2)

"Scientists have been looking for examples of reactions that spontaneously complexify and organize organic chemicals for a long time," says Jim Cleaves, a co-author on the work from the Earth-Life Science Institute (ELSI) at the Tokyo Institute of Technology in Japan. "Based on this work, and other experiments we have been conducting at ELSI, it seems possible such reactions may not be incredibly rare at all, it may simply be a matter of using the right tools to find them."

When the researchers ran the experiment out to 40 generations, they observed periods of gradual change interspersed by sudden reversals to the starting conditions. While the cause of these crashes remains unknown, this kind of non-linear feedback loop is found across life and is evidence that the experimental system induced complex behaviors in the chemical soup.

"This non-linearity is a prerequisite for all the interesting lifelike behaviors we're looking for, including self-propagation and evolution," says Vincent.

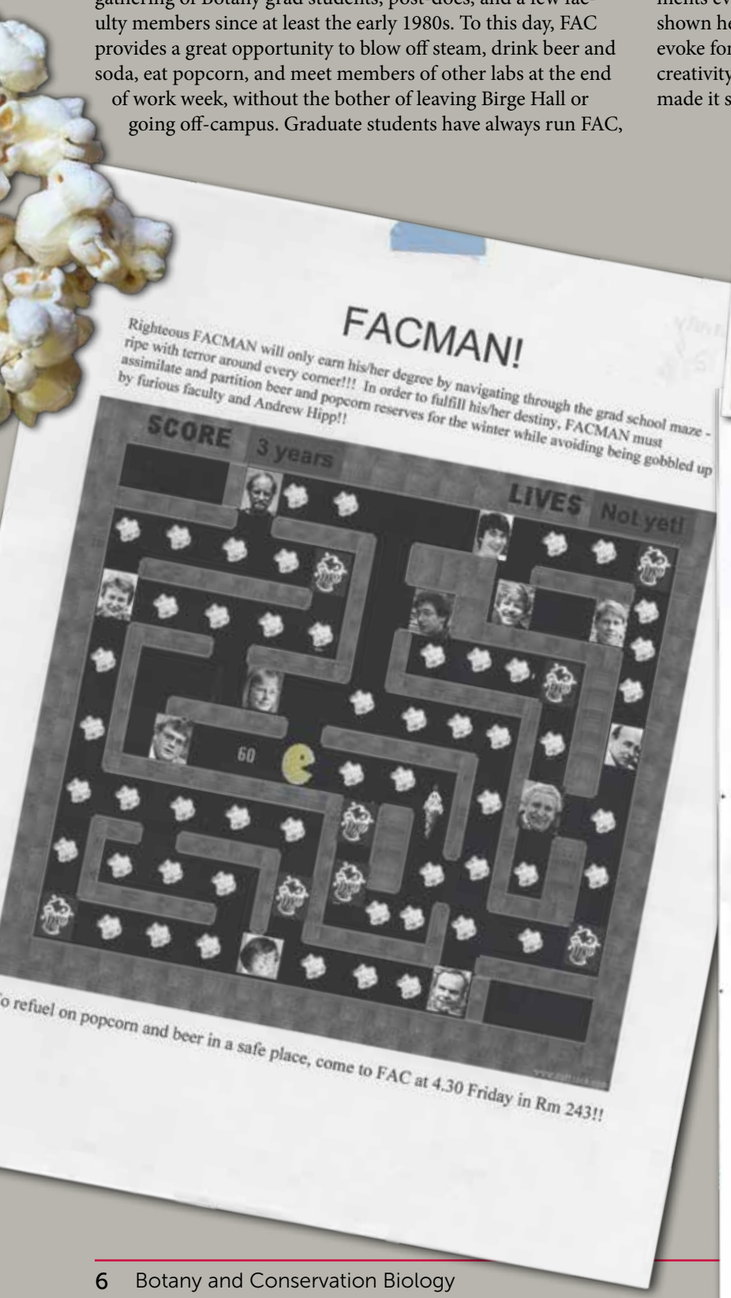
Cautiously excited with their preliminary success, Baum and his team are now eager to recruit others to help them refine their system.

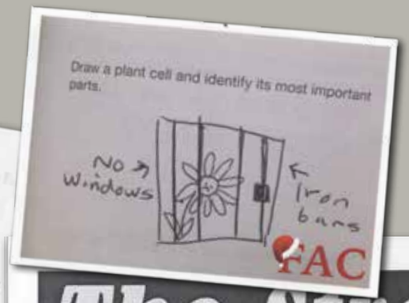
"We wanted to develop a system that we can probe further to address questions about evolvability. And hopefully other labs will use this protocol and improve it," says Baum. "This is exactly where we wanted to be."

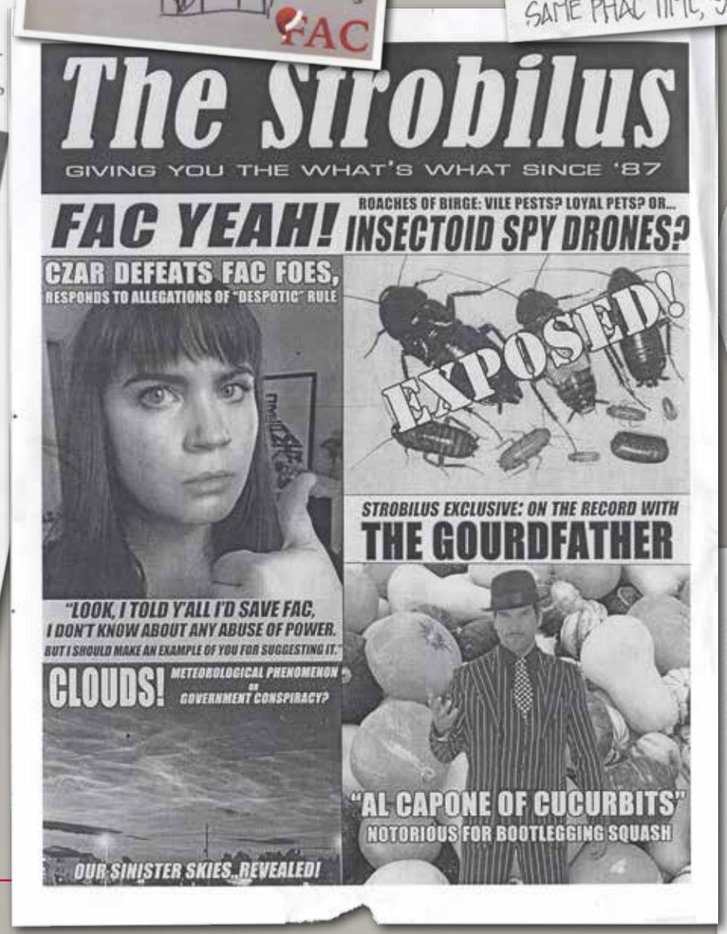
Just the FACs

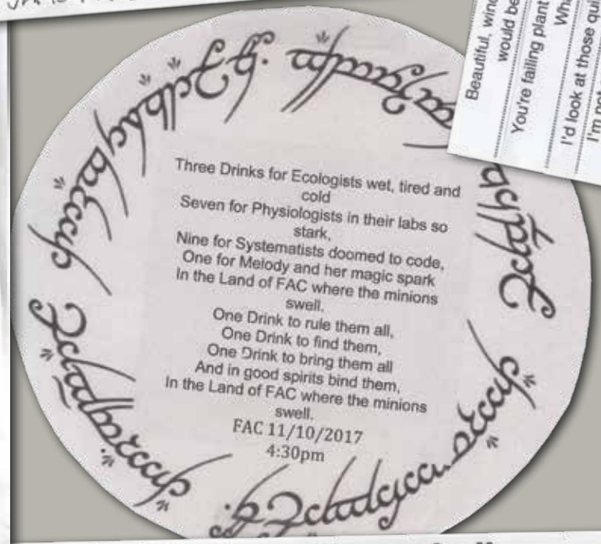
In appreciation of FAC by Thomas Givnish

FAC (Friday Afternoon Club) has been a weekly social gathering of Botany grad students, post-docs, and a few faculty members since at least the early 1980s. To this day, FAC provides a great opportunity to blow off steam, drink beer and soda, eat popcorn, and meet members of other labs at the end of work week, without the bother of leaving Birge Hall or going off-campus. Graduate students have always run FAC, which includes composing and posting snappy advertisements every week to encourage participation. The samples shown here provide a brief chronicle of ephemera that may evoke fond memories of the conversations, friendships, and creativity that have marked FAC from its beginnings and made it such an integral part of our Department.









Field Notes: Sam Ahler

Sam plans to graduate in 2021 with Conservation Biology & Environmental Studies majors as well as a LGBTQ+ Studies certificate.

I met Ellen Damschen in her Botany 460: General Ecology course in the fall of 2018. It is easily one of the most interesting, well put together courses I have taken while studying as a student at UW Madison. Through the course of Bot 460, I realized that plant ecology was what my future had in store. I approached Ellen towards the end of the semester hoping that she would write me a letter of recommendation for a summer research position I was pursuing. After I asked her, instead of saying yes as I had hoped, she had a counter offer. She told me the current lead lab technician in her lab was graduating in the spring and that she was looking for a replacement. When she offered me the job, I had to say yes. I began the following spring semester, shadowing the current lead tech to learn all the skills needed to manage the lab.

Once summer arrived, and the previous lead lab tech moved on to do great things with her life as an ecologist, I became a fully-fledged lead lab technician. In the lab, I was in charge of our summer trait collection in addition to assisting graduate students with any of their projects. Summer collection involved both processing samples from Wisconsin prairies and savannas and simultaneously processing samples that came from Ellen's study site in South Carolina. This involved collecting plant functional data, including plant heights, leaf tissue, and seed characteristics. This data, collected for all species in these Wisconsin natural areas, is entered into our vast trait database and used to determine how Wisconsin prairies are changing in response to a changing landscape. Similar data is collected in South Carolina, with the leaf tissue and seeds being shipped to Madison for me to process in the lab.

Ellen is leading the charge when it comes to determining how corridors and dispersal capabilities mitigate the impact of habitat fragmentation. It is a great opportunity to be in a lab working to understand how to reverse the damage humans have had on ecosystems.

Field Notes: Olivia Lopez

Olivia will graduate in 2020 in Conservation Biology & Environmental Studies and Afro-American Studies.

As an undergraduate at UW, I have been lucky enough to participate in several meaningful conservation initiatives. I was welcomed into the Marín-Spiotta Biogeo Lab as a sophomore, where I studied changes in carbon dynamics in Puerto Rican soils. Participating in this research introduced me to life in a lab setting, and I became familiar with the process of designing and executing a research project. As a member of the lab, I was invited to participate in the field as well, travelling to the field site in Puerto Rico to collect soil samples. On this trip I experienced many firsts: my first time doing field work, my first time out of the continental United States, and my first time swimming in an ocean. I had always appreciated nature through my studies, but there I was able to feel more connected to it.

Fall semester of my junior year, I decided to return to the tropics. I participated in a study abroad program provided by the School for Field Studies, titled Tropical Island Biodiversity Studies. We were situated in Bocas del Toro, an archipelago off the eastern coast of Panama, which continues to face major threats to its marine and terrestrial ecosystems. This program was unique, because we rarely spent time in a classroom setting. To better address the issues at hand, we had lectures within dense rainforests, snorkeled in the Caribbean Sea every week, and conducted interviews with local Panamanians in order to take their perspectives into consideration. The studies we conducted allowed us to uncover the complexities associated with creating and implementing conservation initiatives better than any textbook could. I also appreciated the way in which this program focused on the biological, scientific aspects of conservation while leading us to realize that conservation is also a social issue that impacts groups of people in different ways. Perhaps the most meaningful experience for me was my directed research project. I analyzed the ways in which tourism affects Indigenous livelihoods on the archipelago. The connections I have made through this research have been strong, and I continue to collaborate and contribute to this project almost a year later. Each of my research experiences have provided inspiration for my goals as a future scientist.

Thank you to all the alumni who took the time to send us their updates. Please keep the news coming!

Duane A. Kolterman (Botany PhD 1982) and his sister Susan visited **Eric S. Menges (Botany PhD 1983)** at the Archbold Biological Station in Venus, Florida, where Eric is a Senior Research Biologist, November 11-13, 2019. Duane completed the M.S. in 1978 and the Ph.D. in 1982, both under Robert R. Kowal; he retired from the Department of Biology at the University of Puerto Rico, Mayagüez Campus in 2015. Eric completed the M.S. in 1979 under Orie L. Loucks and the Ph.D. in 1983 under Donald M. Waller. Duane and Susan are very grateful to Eric for showing them so many rare and endangered plants!

Duane Kolterman (L) and Eric Menges (R)

Patrick Collopy (Botany BS 1998) is currently living in Copenhagen, Denmark working as the Global Product Manager for Plant Health at FMC Corporation at its European Innovation Center. He says "I love what I do and I'm so fortunate to have a career that's related to my studies at Madison."

Raffica La Rosa (Botany BS 2003) recently became an Environmental Scientist with the Native Plant Program in the California Department of Fish and Wildlife. This program is responsible for all of the state-listed endangered, threatened, and rare plants in California. Prior to this she was conducting research on endangered CA vernal pool plants (*Lasthenia* spp.) as a postdoc at the University of Colorado Boulder.

Raffica La Rosa

Jim Ford (2004 BAC) is currently an Education Specialist for the National Park Service. Before obtaining this position, he taught high school biology for eight years. He found he communicated best with students in non-traditional classroom settings, and this inclination led him to teach in places like a marine biology institute on Catalina Island, California, the inner city of Chicago, and finally to a juvenile detention center in Minnesota. As an Education Specialist for the Mississippi National River and Recreation Area, he works with partner organizations and school districts to develop and implement educational programming on the river. His primary responsibility is leading the Canoemobile Mississippi River program in partnership with non-profit Wilderness Inquiry. This program provides urban youth with meaningful experiences on the river by paddling ten-person voyageur canoes through the heart of the park. Jim writes, "The educational programming we conduct on the river is aligned with state standards and illuminates the historical, cultural, and environmental resources of our park, but I think the real victory is just getting them out there! Our mission is to reintroduce young people to the natural world and the river that sustains them in hopes that they grow into responsible stewards of their watershed. Our field trips help contextualize the student's sense of place in the Twin Cities, in the Nation, on this planet. These are all things that were strengthened in me by my time at UW. I find myself constantly referring back to content

Jim Ford

I learned in my Conservation Biology courses. Courses like William Cronin's American Environmental History completely shaped the way I perceive humanity's place in the biosphere, and continue to inform decisions I make in my profession when it comes to things like park planning. My experience studying tropical ecology in Costa Rica has been invaluable in preparing me for my work in the National Park Service, and in my formation as an adult in general! The older I get the more I appreciate the foundation that was built for me by the program at UW."

Rollin Reinart (Botany BS 2006) is still working for Federal Emergency Management Agency (FEMA), but recently has taken on an Environmental Planning and Historic Preservation (EHP) Lane Manager position in Sacramento, California. He will lead a team of EHP specialists helping to ensure disaster recovery grant applications are compliant with federal, state, and local EHP laws and executive orders. They assist public entities all over the United States, U.S. Territories, and Tribal Nations in navigating EHP laws and regulations so that they may avoid unnecessary delay receiving needed recovery funding while also promoting environmental conservation, historical preservation, floodplain/wetland management, and environmental justice.

Daniel Stanton (Botany BS 2006) is proud to announce that as of this summer, he now has a tenure-track faculty position at the University of Minnesota-Twin Cities in the Ecology, Evolution and Behavior department. He works on plants, focusing in particular on the functional ecology of bryophytes and lichens.

Emily Sessa (2012 PhD Botany) was promoted to Associate Professor with tenure at the University of Florida this past summer. She continues to conduct research on plant systematics, ecology, and evolution. Current projects in her lab include a study on the effects of ploidal level and climate change on fern gametophytes (funded by NSF IOS), and research on the phylogenetics and evolutionary history of African ferns (supported by a CAREER award from NSF DEB). Emily also received the 2019 Emerging Leader Award from the Botanical Society of America (BSA). She currently serves as Director-at-Large for Publications for the BSA, President-Elect of the American Fern Society, and is on the council of the Society of Systematic Biologists.

Elizabeth Georgian (2014 PhD Botany) has recently repatriated to work as the scientific editor for the Richard Michelmore Lab at the Genome Center, University of California, Davis.


Eric Miller

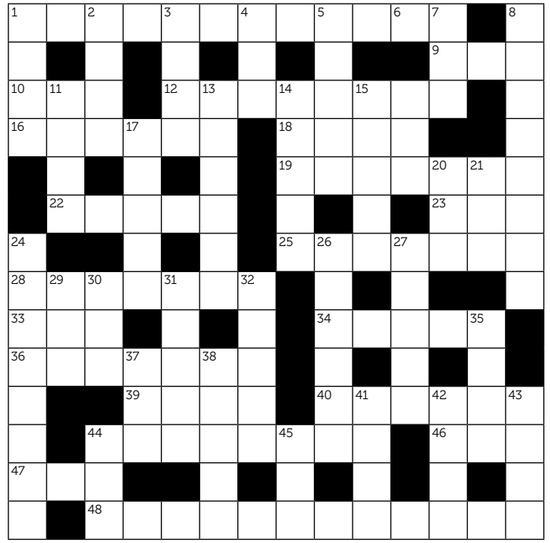
Eric Miller (2015 BAC) started working on his graduate work pursuing an M.S. Resource Economics and Policy and an M.A. International Environmental Policy at the University of Maine. At the moment, he is living in Lao PDR as a Fulbright Student Researcher trying to understand how transboundary governance and development of the Lower Mekong River Basin has affected small fisheries and land use throughout Laos.

Becca Rodriguez (2017 BAC) moved to College Station, TX to start graduate studies at Texas A&M University where she will be pursuing a PhD in Genetics. She is currently rotating through different laboratories researching topics such as breast cancer, disease genetics, and evolutionary biology, and will choose her final research topic early next year. She writes, "My experiences as an undergraduate in the Conservation Biology major along with those after graduating not only informed what field I've decided enter for my PhD studies, but have had an even greater effect on what choices I make everyday in order to try and do my part to protect the environment. Moving to Texas from Madison has definitely been a transition as things that I have always taken for granted, like access to recycling receptacles, are much harder to come by around here and reducing single-use plastics is not necessarily promoted. I luckily have been able to find a place on campus to bring my compost as well as a recycling center near my apartment. So what I've learned is that although it may have taken a little more effort, if trying to produce less waste is important to you it's still possible even if the infrastructure in the area you find yourself doesn't necessarily support it."

Julia Frangul (2018 ConsBio) writes "I spent the 2018-2019 school year living and teaching science and English in Madrid, Spain. I was actually allowed to develop a conservation curriculum that I taught my students, which was so fun! One of my students actually created a petition to make her neighborhood more green and brought it to city council. After my time abroad I moved back to Madison and am currently employed by a conservation nonprofit, the Ceiba Foundation for Tropical Conservation. Ceiba is an amazing organization that works mainly in Ecuador to support community-based wildlife and habitat conservation efforts, promote environmental education, and encourage resource management practices that maintain ecosystem biodiversity. I am also working with CALS Global at UW-Madison, helping connect CALS faculty, staff and students with international opportunities for collaboration.

2019 botany crossword: A juicy challenge

contributed by David Baum (answers at botany.wisc.edu/alumni-newsletter/)



Across

1. Member of a class of pathogenic, asexual fungi that grow as budding yeasts or as a mycelium
9. Part or full, horticulturally
10. Three letter abbreviation for the African baobab
12. Criminal study (and Wiedenhoeft speciality)
16. Familiar *Cercis*
18. UW-Madison graduate program for bacteriologists and mycologists (abbrev.)
19. *On ice! (famous Olympic triumph)
22. Dogwood's "horny" prefix
23. Olive, in cartoons
25. Applied a *Copernica cerifera* product again
28. *Fraxinus* seedling, informally
33. Opal stop codon
34. *Ops! (Top secret activity)
36. *Ace! (A winning shot)
39. Fruit that sounds like it looks
40.Famous botanical fossil
44. What a taxonomist does to a herbarium specimen
46. Slippery, for one
47. Growth chamber unit
48. Certain pondweeds, informally

Down

1. *Arms! (carry a gun, for example)
2. Oxalic, for example
3. *Glycine max* product
4. Count word, as for proteins in a complex
5. Delicious-sounding sugar product used in some brewing
7. Computer key that calls up an *Elsinoe fawcettii* citrus phytotoxin?
8. Diamond part, or an answer to the question: Where do you find grasses?
11. It must be included for a *sp. nov.* (abbrev.)
13. Keefover-Ring tries to identify their non-UK equivalents
14. An ancient grain
15. *Man! (intentionally misrepresented position)
17. *Chuck! (rock and roll pioneer; and the missing word for the themed answers)
20. Historically the most popular apple variety in the UK
21. Metal hydroxide obtained from plant ashes
24. Capacity of *Papaver somniferum* alkaloids, unfortunately
26. _____ Luther Little Jr., highly-regarded Oklahoma botanist
27. Apomixis by another name
29. Subdivision of a geological epoch
30. Bell! (gym weight)
31. Something to do with DNA sequences
32. Something you can do to a garden bed to control weeds
35. Headless cabbage variety (alt.)
37. Three-letter abbreviation of a certain single-flowered pansy
38. *Nine! (Ecstasy)
41. Self____ (*Prunella vulgaris*)
42. 10th element
43. Orchid herbarium that is not in Iowa
44. Old-school feller
45. Southern amino acid?

If the crossword is not a juicy enough challenge, try this. Take the first letters of the seven thematically indicated genera and remove the German woman. The remainder will provide an anagram to an Israeli edible that also fits the theme (botanically speaking). Good luck!

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Botanizing at Ferry Bluff

Each school year kicks off with a Botany field outing. This year we visited Ferry Bluff State Natural Area, overlooking the Wisconsin River.

Photo courtesy Ken Cameron