# UNIVERSITY OF WYOMING
# ROCKY MOUNTAIN HERBARIUM (RM)

# ANNUAL REPORT 2023

ROCKY • MOUNTAIN • HERBARIUM

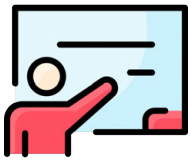
*Anelsonia eurycarpa* (Gray) Macbr. & Pays.

# THE NUMBERS

With **1,102,127 accessioned plant and fungal specimens**, the Rocky Mountain Herbarium (RM), including the US Forest Service Herbarium (USFS) and Solheim Mycological Herbarium (RMS), is the largest facility of its kind between Saint Louis and the West Coast. The herbarium is also a leader in the digitization of herbarium collections, and our digital collections include **932,892 digitized specimen records** and **459,593 digitized records with specimen images**.

## Visited by over 220 guests

Scientists, botanical enthusiasts, artists, students, and community members visited us for research, formal tours, and hands-on activities.



## 465 K-20 students participated in education programs

Through campus events, classroom visits, plant walks, and community workshops, the RM engaged a diverse group of learners.

## Added 10,727 new specimens

Nearly 11,000 new specimens from both our current research and specimen backlog were mounted and accessioned into the RM.

## 2,022 specimens digitized

Collections data for newly collected specimens and archived collections are digitized and made publicly available online (www.rmh.uwyo.edu).

## Imaged 49,591 specimens

High-resolution specimen images are linked with digitized collections data and added to our online data portal.

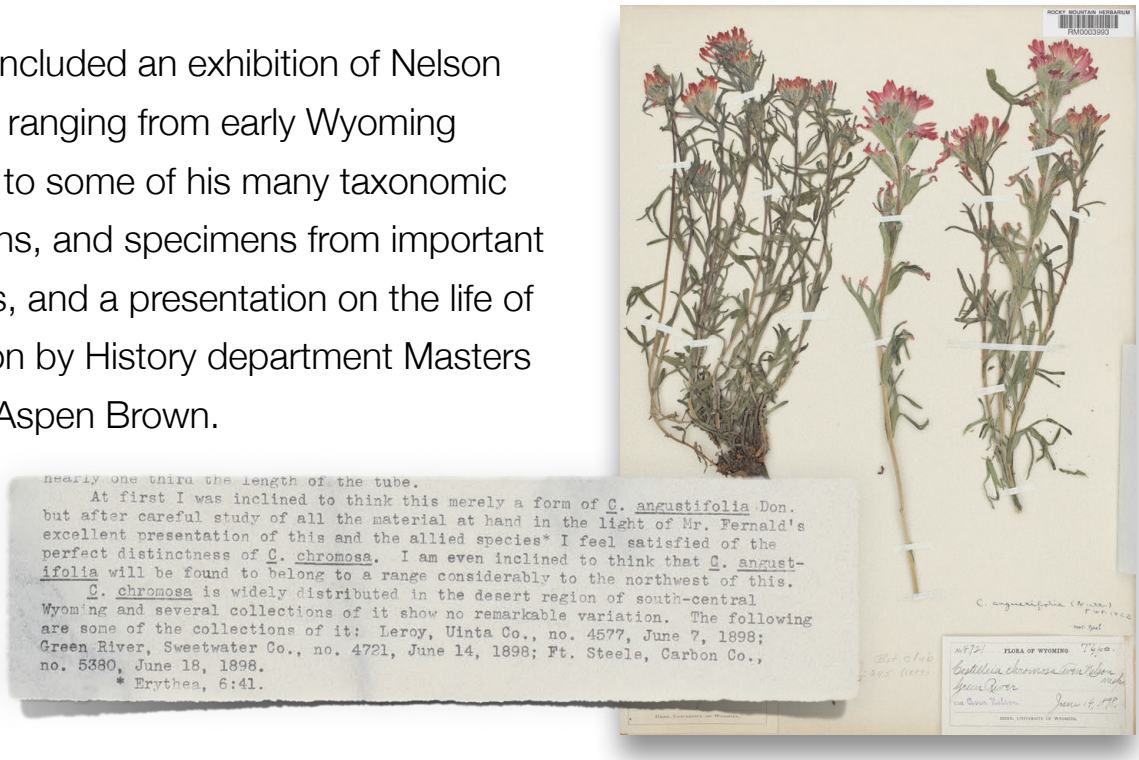
# 100 YEARS OF AVEN NELSON


## Botanical art & history through the lens of collections

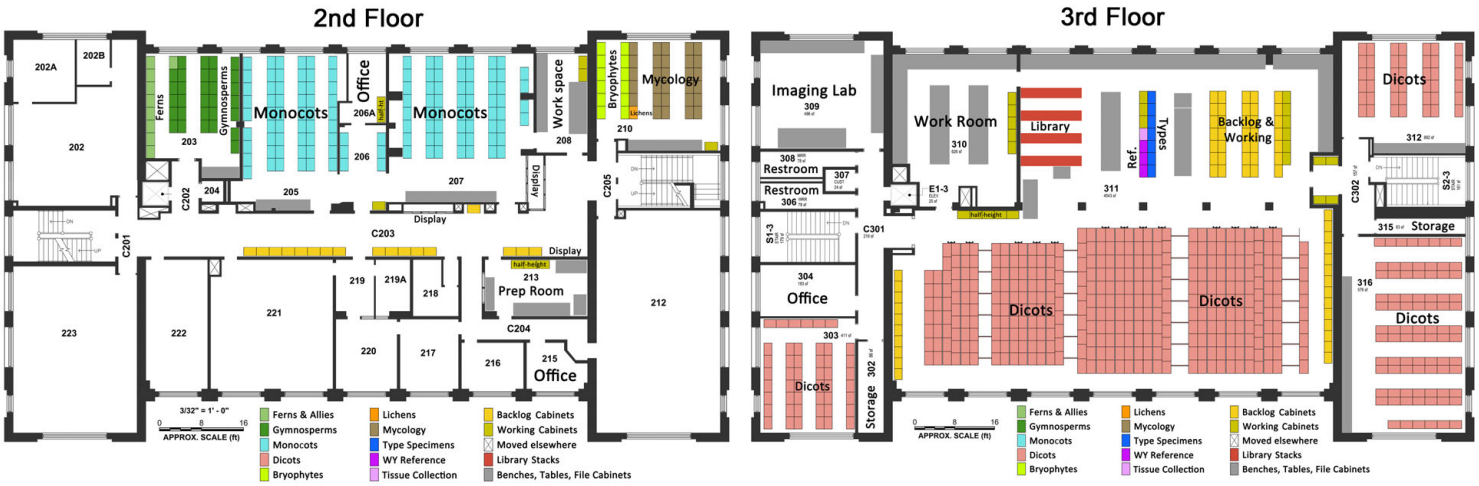
We kicked off 2023 with a celebration to honor Nelson's botanical contributions and to showcase the largest collection of Rocky Mountain plant diversity in the world.

Dr. Aven Nelson's legacy is preserved in his specimens housed in the Rocky Mountain Herbarium. The 100 year anniversary of the Aven Nelson Building - home of the Rocky Mountain Herbarium - provided an opportunity to communicate both the scientific importance and artistic beauty of these collections to the broader community.

The event included an exhibition of Nelson specimens ranging from early Wyoming collections to some of his many taxonomic contributions, and specimens from important expeditions, and a presentation on the life of Aven Nelson by History department Masters candidate Aspen Brown.



# HERBARIUM EXPANSION



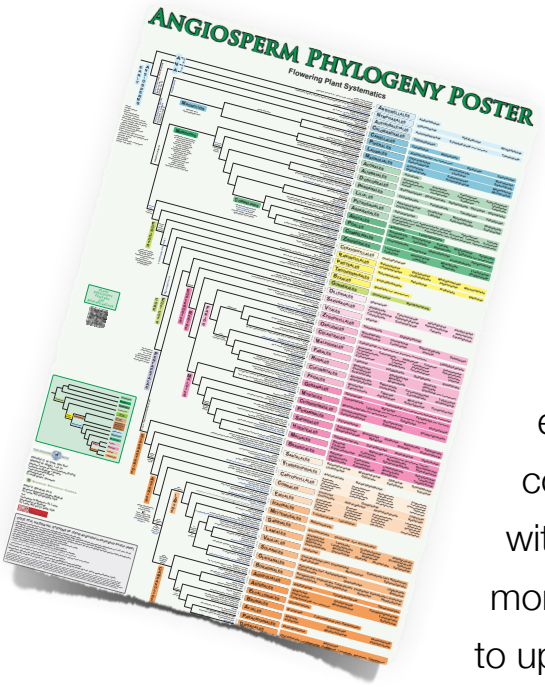

**New floor plans for the expansion of the herbarium onto the second floor of the Aven Nelson building detailing the the reorganization of major plant groups (by color). This increase in space will allow for all of the mounted backlog to be integrated into the collection and for the unmounted backlog to be properly stored before processing.**

## The National Science Foundation funds critical improvements to the RM

With a $900K grant from the National Science Foundation and support from UW the herbarium is expanding on to the second floor of the Aven Nelson Building. This three-year NSF-funded project funds the addition of over 200 herbarium cabinets, allowing us to secure the more than 400,000 specimens that have been largely inaccessible to the research community while stored in hopper boxes on the tops of existing cabinets.

As part of this project, we have also transferred the ~45,000 specimen Central Wyoming College Herbarium from Riverton to the RM, and are in the process incorporating those specimens into our collection.


**Partial view of the mounted (A & B) and unmounted (C) specimens not in cabinets, emphasizing the urgent need for increased specimen storage capacity.**




## An updated family-level classification

Importantly, we are also updating the organization of the collection to accommodate the many name changes that are associated with modern classification systems and reorganizing for more efficient use and continued growth. While we will continue to have families organized alphabetically within our major groups (e.g., ferns, gymnosperms, monocots, dicots, etc.), this will give us the opportunity to update family circumscriptions to follow the Angiosperm Phylogeny Group IV classification.

## Novel imaging workstations increase efficiency

**RM Curator, Ben Legler, designed, fabricated, and tested our new high-throughput imaging workstations that optimize the physical aspects of specimen image capture for high-throughput imaging while maintaining optimal lighting on the specimens. These workstations more than triple our imaging throughput from ~100 specimens/hour to >300 specimens/hour!**

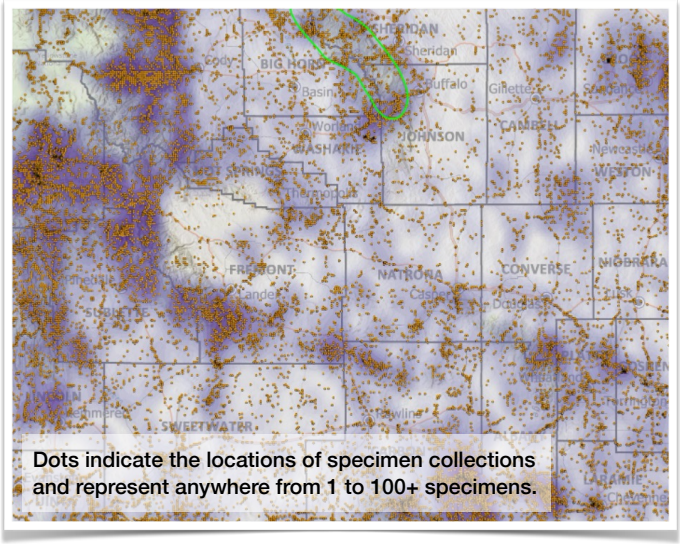
While we are moving and reorganizing specimens, a key piece of this project is to image all the remaining mounted specimens, which is only possible using our high-throughput imaging workstations. Many of these specimens represent historical collections from outside of Wyoming, so this will greatly increase the taxonomic and geographic coverage of our digitized specimens that are accessible through the RM's online specimen portal (www.rmh.uwyo.edu).

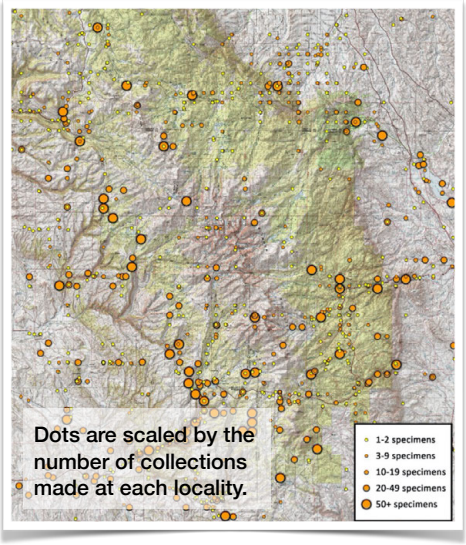
# FLORISTICS REBOOTED

From 1978 to 2017, the RM completed more than 75 major floristic inventories - 52 of these by MS students - resulting in over 600,000 new collections documenting the diversity and distribution of plants in the Rocky Mountains. We are proud that many of these RM alumni are part of the land management workforce across western North America, and we are excited to continue this tradition of training Botanists in this important work

## Data-driven approach & new partnerships reinitiate the RM's famed program in floristics.

There is a lot of interest among students and employers (e.g., agencies, non-profits, consulting firms) for hands-on training in conducting plant inventories, including formal training in plant identification.




**LEFT: Map of Wyoming showing collection localities laid over a heat map indicating the density of collections, with darker purple areas indicating a higher density of collections. Notable gaps in the documentation of Wyoming's mountain ranges include much of the Bighorn Mountains (circled in green), a portion of the Wind River Range on tribal lands, and areas near Yellowstone National Park.**

**RIGHT: Distribution of herbarium collections from the central portion of the Bighorn Mountains, showing a paucity of documentation from the core of the range and from high elevations.**

Given the RM's long history of floristics, it is important that we use our existing data to identify the gaps in our knowledge of the regional flora. For example, although Wyoming has been heavily collected, when we take a data-driven approach to identifying the gaps, several notable areas emerge as still needing attention, leading to our current partnerships with the Bighorn National Forest in Wyoming and the Kootenai National Forest in northwest Montana.

# RESEARCH HIGHLIGHTS

## Partnering with the U.S. Forest Service on *Botrychium* surveys in Wyoming

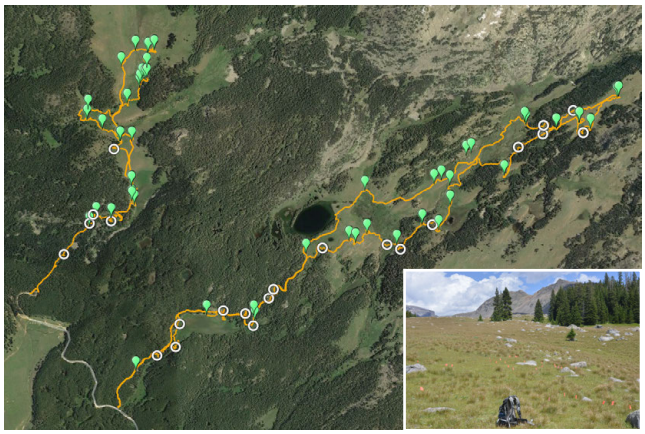
Curator Ben Legler spent several weeks conducting field surveys for *Botrychium* (moonworts) as part of ongoing efforts to improve documentation of the genus in Wyoming. These surveys were supported with funds from the Bighorn National Forest and Region 4 of the United States Forest Service—the latter through a project led by the Wyoming Natural Diversity Database (WYNDD).

***Botrychium crenulatum*** **from a new site in the Wind River Range.**

Moonworts belong to a peculiar lineage of ferns and are usually very small (some plants are the size of a pinhead!), challenging to identify, and notoriously difficult to find. Globally, 48 species of *Botrychium* are recognized today, and North America is the global hotspot of *Botrychium* diversity. Wyoming falls smack in the middle of that hotspot, yet *Botrychium* remains poorly documented across most of the state. Although that is improving, with 19 species currently known (up from the 7 species included in Dorn's 2001 Vascular Plants of Wyoming), most are documented by few specimens, and additional species should be expected.

**A dense cluster of *Botrychium furculatum* in the Bighorn Mountains, likely formed from underground vegetative propagules called gemmae.**

2023 turned out to be a stellar year to conduct surveys! Ben documented 14 *Botrychium* species from nearly 100 sites, including 6 of the 9 species of concern tracked by WYNDD. Many sites contained more than one species (as is common in the genus) resulting in a total of 177 individual records, of

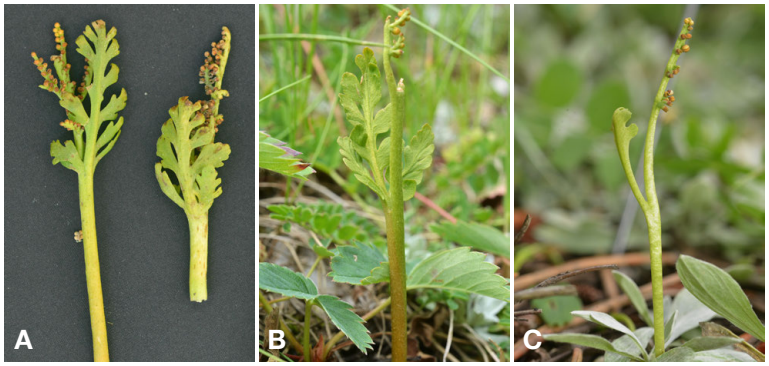


**One of several areas surveyed in the Bighorn Mountains showing survey routes recorded with a GPS data logger (orange lines), sites where *Botrychium* were found (green markers) and sites with suitable habitat where no plants were found (white circles). INSET: A site with *B. furculatum*, *B. paradoxum*, and *B. simplex* co-occurring.**

which 62 were vouchered with specimens. These new records will inform land management decisions and conservation priorities.

One notable find was *B. echo*, a new addition to the flora of Wyoming. Medicine Bow National Forest Botanist Greg Pappas first reported on this species in the December, 2022 issue of Castilleja, based on surveys with Ben, yet they were unable to obtain a specimen. This year, Greg and Ben continued surveys, and Ben made two collections of *B. echo*. Other noteworthy finds include a westward range-extension of *B. furculatum* (at the north end of the Wind River Range), and the first RM collection of *B. michiganense* for Wyoming.

Surveys will continue into 2024. On the Bighorn National Forest, Ben will continue searching for the elusive *Botrychium 'farrarii'*, which is currently among the rarest vascular plants in North America and known from only a single metapopulation containing about 30 aboveground plants. Look for Ben's publication of this new species (with coauthor Steve Popovich) in the American Fern Journal in early 2024—it will be much easier to find than the plants themselves!

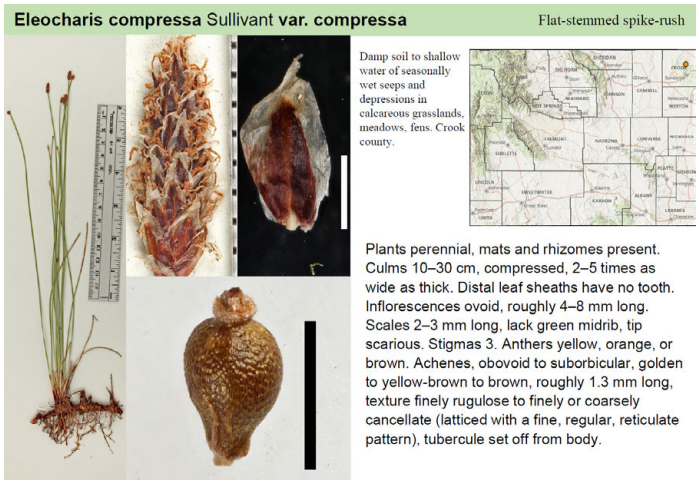



**(A) The first collection of *Botrychium echo* from Wyoming. (B) This individual of *B. michiganense* from the Bighorn Mountains was vouchered as RM's first Wyoming specimen of the species. (C) One of 30 known plants of *B. 'farrarii'*, currently known only from the Bighorn Mountains.**

**Joshua Mattson**
**Botany**

# Undergraduate Research: A guide to *Eleocharis* in Wyoming

While an undergraduate in Botany at UW, Joshua Mattson spent several semesters in the herbarium—first as a student in the Herbarium's internship program, then as an hourly employee helping to mount and process specimens and assist with field work for surveys of alpine peaks, and finally, as an undergraduate researcher during his last semester in Spring, 2023. For his undergraduate research, Josh developed an updated identification guide to the genus *Eleocharis* (spikerush) in Wyoming.




**Species profile page for *Eleocharis compressa* var. *compressa*, first documented from Wyoming in 2021.**

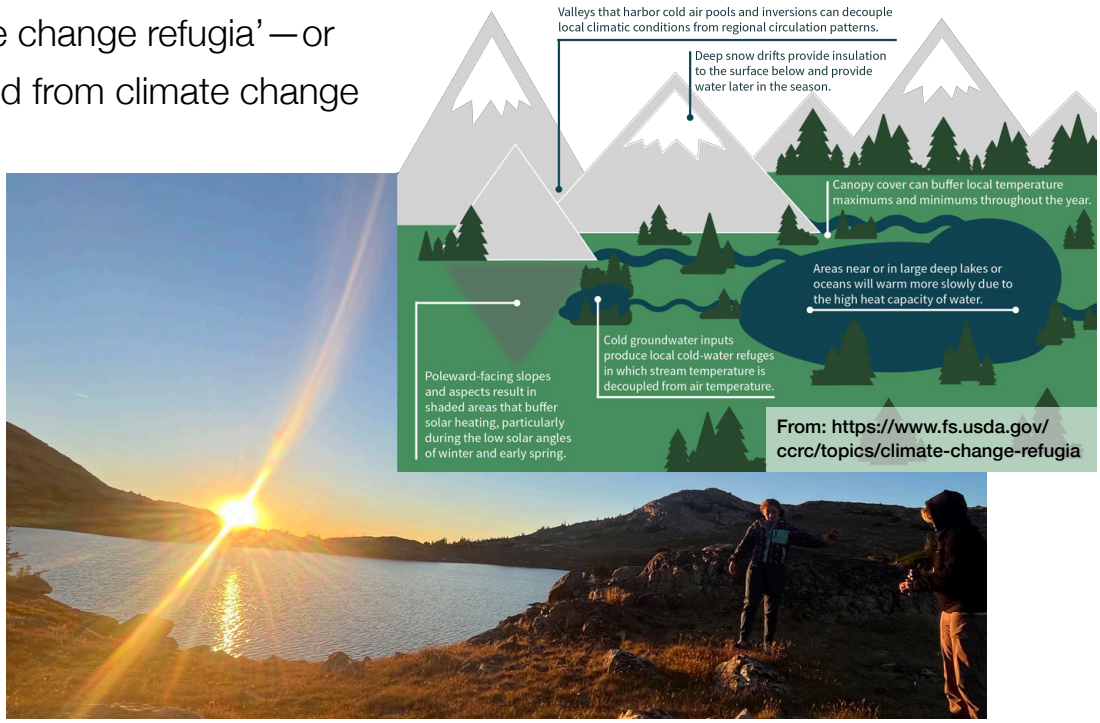
Why *Eleocharis*? Wyoming's flora is not static. New species continue to be found in the state, and taxonomic research introduces name changes to familiar species. Both scenarios have recently occurred for *Eleocharis* in Wyoming, rendering prior identification keys, such as Dorn's 2001 Vascular Plants of Wyoming, incomplete.

The identification guide includes a technical key to *Eleocharis* covering all species now known from the state, and species profile pages with species descriptions, distribution maps, habitat info, and photographs. The photographs include extreme close-ups of inflorescence scales and achenes, captured by Josh using RM's recently acquired macroscope imaging equipment and focus-stacking software. The completed identification guide will be made available through RM's in-development Flora of Wyoming website as a PDF document.

**Chelsea Turner**
**Plant Production and Protection**

# Undergraduate Research: Investigating climate change refugia in the Bighorns

While Chelsea Turner's major is in Plant Production and Protection, she has a Botany minor and has been working in the herbarium as an undergraduate assistant since her first day on campus when she confidently came into the herbarium asking about volunteer opportunities. Chelsea's undergraduate research is designed to test the hypothesis of 'climate change refugia'—or areas that are shielded from climate change based on specific attributes.




Using the intensive RM floristic surveys as a baseline, Chelsea spent the summer of 2023 recollecting a series of specific localities in the Bighorn National Forest that spanned a gradient in the physical and biological characteristics hypothesized to play a role in climate change refugia. Comparisons between the original surveys from over 40 years ago to today will allow Chelsea to assess plant community changes in the face of rapid climate change and test what characteristics lead to resistance to rapid climate change, which may help to prioritize future management decisions. The data and basic analyses that Chelsea is conducting will provide much needed preliminary data for future grant proposals aimed at investigating these ideas on a larger scale.

# THANK YOU!

At the Rocky Mountain Herbarium, we work to champion the stewardship of plant diversity, inspire and prepare the next generation of botanists, and advance collections-based botanical research, education, and outreach at the University of Wyoming through innovative thinking, transformative educational experiences, and community engagement. We could not do this without your continued support and want to take this space to thank our many donors, volunteers, and students for an exciting, productive, and successful 2023!

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