

From trash to teacher: utilizing unlabeled, unsealed, and unprocessed specimens for community engagement

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Abstract

Members of our society are currently spending an increasing amount of time engaging in virtual (digital) experiences and less time engaging in reality, including nature. It is imperative that people maintain a connection to the natural world and understand the value of natural history specimens. To facilitate that goal, the Museums in Miniature (MiM) project provides a drawer of curated local insect specimens for display in schools, libraries, and other educational institutions. Specimens of abundant taxa, or those missing data or otherwise unsuitable for research, are used as “ambassador specimens” in these drawers. Drawers provide real-life examples of pollinators, pests, invasive species, and beautiful and intricate insects. Additionally, fact sheets and other resources about specimens and entomology in general are provided as digital and hard copies. Museums in Miniature was inspired by difficulties in museum outreach experienced during the COVID-19 pandemic, when programs were entirely virtual. The first MiM drawers were created in 2022 at Clemson University and used exclusively in South Carolina, but since then the program has expanded to encompass the entire Southeast. Through partnerships with other natural history collections, suppliers, and volunteers, we aim to expand coverage and possibly even adapt the MiM model to disciplines beyond entomology.

Key words: Clemson University Arthropod Collection, entomology, informal education, Mississippi Entomological Museum, Museums in Miniature, outreach, science communication, wildlife, local animals

Introduction

Entomology can be thought of as a “gateway science” because many people are drawn to arthropods as children. Sadly, many adults in the United States fear insects. It is becoming increasingly apparent that urbanization and separation from the natural environment are significant reasons for that fear (Fukano and Soga 2021), which is compounded by rapidly shrinking insect biodiversity globally (Wagner et al. 2021). Increasingly, outdoor spaces are designed to exclude insects. Inevitably, this fails, and ultimately the only insects people interact with are pestiferous—pest ants, cockroaches, mosquitoes, fleas, stinging wasps, etc.—reinforcing dual ideas that insects and nature are “bad” or uncomfortable. Therefore, the challenge entomologists face is not sparking an initial



interest in arthropods—that is easy; it is alleviating the unjustified fear of bugs that most people have learned from their parents (and/or society in general), and doing so while there is still biodiversity to preserve. Through exposure and education, elementary children may overcome—or never develop—this learned handicap and replace fear with curiosity (Grando et al. 2018).

During 2020–2021, the global COVID-19 pandemic forced lockdowns across the world. Previously, the Entomology Club at Clemson and the Clemson University Arthropod Collection (CUAC) had a robust outreach program that largely focused on elementary and middle schools and public libraries. In person, young students were fascinated by demonstrations, activities, and specimens. However, as other teachers have reported (Kraft and Simon 2020), many tried-and-true outreach methods held no appeal over a screen. Once schools reopened, requests for demonstrations flooded in from teachers who wanted their students to be engaged again. The club and CUAC had neither time nor personnel to respond adequately to every request. Compounding the issue, many schools were hours away, making weekday travel logistically unfeasible for college students.

In an attempt to address the growing demand for entomological education, we looked to our then-unutilized backlog of teaching specimens: student-collected and unlabeled collections. At Clemson University, Insect Biodiversity is taught every fall semester to about 40 students. Approximately one-third of the total class grade is based on an insect collection project; students need to collect about 125 specimens within 50 insect families to earn 100%. Typically, about 4,000 specimens are turned in each semester. Most specimens in these collections are large, common, and/or easily captured taxa (e.g., paper wasps, Hymenoptera; June beetles, Scarabaeidae). A few specimens are integrated into the holdings of the CUAC or retained to replace broken specimens in the teaching collection. Some are damaged, poorly preserved, or beyond repair and are discarded. Most, while not museum quality, still have value.

These specimens are the core of a project to create small collections of outreach-worthy material that could be given to schools or other institutions, especially those that could not easily be reached from Clemson. The specimens, combined with fact sheets and other resources, serve a dual purpose: they are readily available for teachers and librarians even when entomological personnel are not, and they provide a starting point for potential future outreach visits by Clemson students (Wooden et al. 2024).

Herein, we provide an overview of the project, including construction, distribution, logistics, and maintenance. We aim to inspire other natural history collections, both within and outside of entomology, to incorporate similar programming into their outreach work and create their own Museums in Miniature.

Methods

Construction

Each Museum in Miniature (MiM) contains 100 pinned adult insect specimens. Some specimens are re-pinned or re-labeled to exemplify proper curation. A few selected species of interest, such as the eastern Hercules beetle (Coleoptera,

Scarabaeidae, *Dynastes tityus*), are included; otherwise, taxa are standardized at the family level (any horsefly, Tabanidae, will do). All taxa are present within the state the MiM was created for, whether they are native or invasive.

Most common insect orders are represented: Odonata, Dermaptera, Plecoptera, Orthoptera, Phasmida, Mantodea, Blattodea, Hemiptera, Hymenoptera, Neuroptera, Coleoptera, Trichoptera, Lepidoptera, and Diptera. The five major orders—Hemiptera, Hymenoptera, Coleoptera, Lepidoptera, and Diptera—along with the large and impressive Odonata, are given their own unit trays. The remaining orders are combined into two unit trays: “Other Awesome Insects” and “Orthopteroids” (Fig. 1).

In choosing taxa to include within the museum, the following points were considered: 1) Rarity: How common is the taxon in the state? Is it something easily collected by students? 2) Familiarity: How likely is the taxon to be recognized by a non-entomologist? 3) Economic or domestic importance: Is it a pest in homes or in crops, or is it invasive?

Additionally, specimens representing taxa of interest for each person involved in the project were included. For example, Dr. John Morse, curator emeritus of the Clemson University Arthropod Collection, is represented by a caddisfly (Trichoptera). People may commonly see caddisflies but rarely recognize them. Each South Carolina drawer also includes the state insect (Mantodea, Mantidae, *Stagmomantis carolina*) and the state butterfly (Lepidoptera, Papilionidae, *Papilio glaucus*). For Mississippi, a similar formula is utilized, with the state insect (Hymenoptera: Apidae, *Apis mellifera*), the state butterfly (Lepidoptera, Papilionidae, *Papilio troilus*), and a microlepidopteran for curator emeritus Dr. Richard Brown, etc.

Each Museum in Miniature uses the following supplies: one insect drawer; unit trays of appropriate sizes; bright yellow cardstock for header cards; tape (both double-sided and clear packing); and two packs of Kraft clay desiccant. Header labels are printed with illustrations, common names, and scientific names of orders, then placed in the appropriate unit trays. Specimens are then pinned neatly into the trays and arranged aesthetically. Two small unit trays used to display written information are turned upside down to hide the desiccant packets.

Once the drawer has been filled, it is frozen at -50 °C for 24 hours for pest control. The drawer is placed in a plastic bag during freezing and thawing to keep condensation off. After thawing, the lid is sealed to the base with a single strip of clear packing tape to deter pests such as skin beetles (Dermestidae). At the back of the drawer, a brief, printed care list with contact information is sealed under the tape. Additionally, the end of the tape is folded onto itself to create a handle for easy tape removal.

In addition to the drawer, a binder is included that contains teaching materials and access to a Google Drive folder with digital versions of lesson plans, coloring sheets, and fact sheets about each standard taxon in the museum (Figs 2, 3). Fact sheets are written by students, volunteers, and CUAC and Mississippi Entomological Museum (MEM) staff and faculty. They are designed to catch a community member’s interest and teach kids and adults about that taxon. In addition to the above-mentioned resources specific to the project, links are provided to highlight resources and entomological groups that community members may find interesting or helpful.



Figure 1. A MiM drawer ready for deployment.

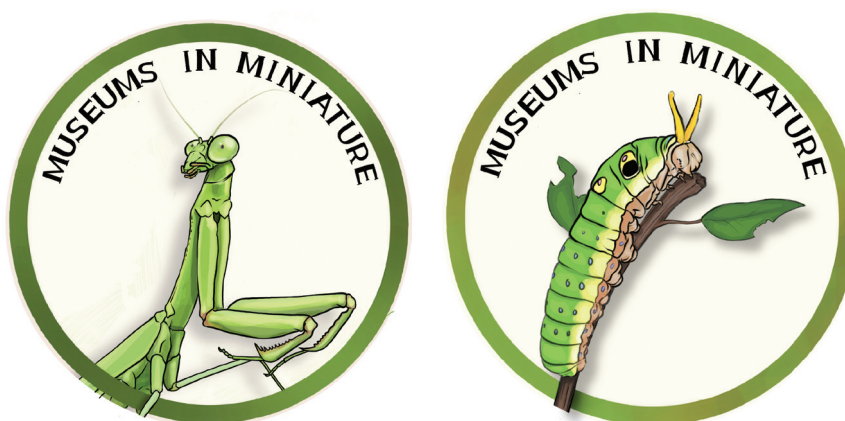


Figure 2. Logos for MiMs in current states: South Carolina (left) and Mississippi (right). As more states are added, logos are created with the state insect or butterfly. Illustrations by Caitlin Silva.

Distribution

Thanks to volunteers at the CUAC, Museums in Miniature have been distributed across the state of South Carolina. Starting with local libraries and schools, CUAC staff approached potential MiMs hosts and discussed what

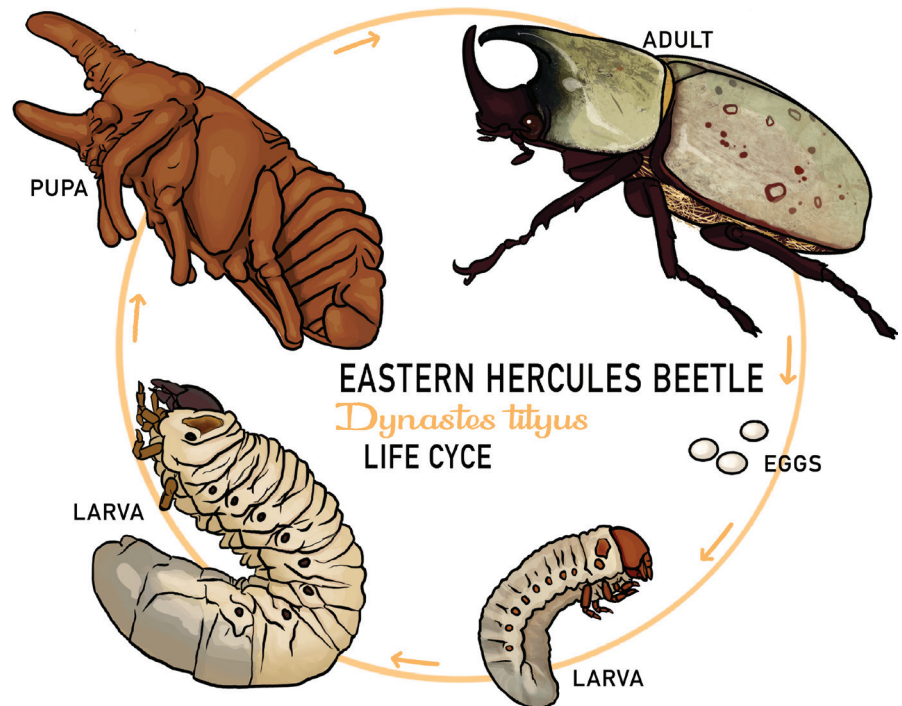


Figure 3. Life cycle of an eastern Hercules beetle (Coleoptera, Scarabaeidae, *Dynastes tityus*). A beetle was chosen to represent holometabolous insects to reframe the typical butterfly narrative. Illustration by Caitlin Silva.

they needed in terms of displays and information. From there, and with the assistance of a news article, word spread, and requests began to come from across the state. Fun fact sheets and information are currently hosted on the MEM website (<https://mississippientomologicalmuseum.org.msstate.edu/museumsites/MiMs.html>), and additional requests have come through that page and via word of mouth at outreach events. The MEM is in the beginning phases of distribution, with drawers being checked out by extension professionals and educators but not yet permanently in place. Schools and libraries are given MiMs free of charge and are encouraged to reach out with questions, concerns, or requests for additional resources.

Maintenance

When a museum is delivered, teachers and librarians are given a brief tutorial on caring for the drawer and its contents. If the drawer breaks or the specimens are damaged, the custodian may contact the CUAC or MEM, and repairs or replacements will be done free of charge. Maintenance costs may be alleviated by one drawer serving an entire district. For instance, 19 schools utilize one MiM in South Carolina, and the Pickens County library system can gather its drawers at its main location for pickup when needed. South Carolina and Mississippi MiMs are currently in place in 11 libraries (Fig. 4), five school districts (25 schools), and with an extension agent making rounds for 4-H students. While estimating impact is difficult due to the informality of the program, the central location of MiMs in the libraries and their integration into curricula have



Figure 4. MiM as part of a MEM display at the Starkville, MS, library. The display sits next to the circulation desk, and librarians commonly reference the binder of materials when answering questions.

enabled them to reach thousands of students and their families during the two years the program has been operating. To estimate outreach: if an average of five people per day look at a MiM in each library (11), the total would be over 14,000 views per year. If each school (25) utilized their MiM for one grade per year, assuming 100 students per grade, that would reach 2,500 students. Based on this simple estimate, the MiMs currently deployed would impact approximately 165,000 people over the first ten years.

As this has become an interstate movement, maintenance has multiple levels. Digital resources are updated and monitored regularly by author Wooden and Joe MacGown, resident ant expert and website manager for the MEM. South Carolina questions and requests are delegated to author Ferro and the CUAC team, while Mississippi relies on Wooden and the MEM. New museums adopting the project would be responsible for maintenance of their materials. All associates are connected to a Google Drive with a list of contact information and other relevant documents. Checks are done annually and upon request to ensure links are functional, fact sheets are scientifically sound and up to date, and impact data are collected regularly from teachers and librarians.

Funding and resources

The original 20 drawers of MiMs for South Carolina were funded by an Entomological Society of America Chrysalis Grant for \$2,000, and the South Carolina Entomological Society offered an additional \$500. BioQuip was gone, but the newly formed Pin-It! Entomological Supplies (<https://pinitentomology.com>) opened and provided the project with high-quality drawers. If new or tight drawers are unavailable or cost-prohibitive, donated and second-quality drawers may be used, as each MiM is taped shut.

The Mississippi Bug Blues outreach program is partnering with MiMs to fund additional drawers in Mississippi during the 2026 fiscal year. Institutions interested in joining the MiMs project are encouraged to seek out similar potential collaborators. In addition to mitigating some costs of expansion, these partnerships can help increase the impact of both the MiMs institution and the partner organization.

Results

Eighteen MiMs have been distributed across South Carolina. The MEM has received five requests for drawers and is working to fill them during summer 2025. Custodians' feedback has been positive; many librarians have observed that adults and children alike are fascinated by the display, and many teachers have sparked their students' interest in entomology. Because insects are a core component of many elementary curricula, the drawers are commonly used across multiple grades.

After a glass top broke in a partner library, a cardboard topper was included with each subsequent drawer to protect it during travel and storage. We have received no further reports of drawer or other damage to the currently deployed MiMs. Libraries have treated their displays with caution, keeping them under glass or at the circulation desk where children can be monitored (Fig. 4). Because schools use them for active programming rather than static display, children across a wider age range can interact with the drawers under supervision. Thus far, most MiMs drawers placed with educators have gone to public educators or elementary schools.

Discussion

As interest in nature declines, advocacy and protection for biodiversity follow suit—and thus there is less nature in which to be interested. (How many new housing developments include a park, much less an unmaintained “natural” area?). Natural history museums have seen this trend reflected in a lack of acknowledgment and funding. In some cases, this leads to the closure of public museums, putting their collections in jeopardy (Liebenrood 2020). Orphaned specimens may be rescued by other institutions, or they may be discarded. For example, the University of Mississippi recently discontinued support for its insect collection. Fortunately, the Mississippi Entomological Museum at Mississippi State University was able to take in the specimens, and they are currently being integrated into the collection there. These specimens are valuable, but they require resources to store and maintain—resources that are often scarce in natural history collections. The only way to reverse this trend is by working with people, especially those with decision-making power, and convincing them to value the services and experiences that collections provide.

Museums in Miniature represent a “biodiversity advertisement” that satisfies both emotional and intellectual components (Ferro and Flick 2014). Including both specimens (which hopefully induce a very emotional response—WOW!) and fact sheets (which provide an intellectual element) is a powerful way to spark curiosity, provide satisfaction, and hopefully positively change attitudes toward natural history and its subjects.

Based on feedback from teachers and other users, MiMs has been a huge success. Students engage with the drawers, talk with other students about the specimens, actively read the fact sheets, and ask their teachers impossible questions. In the coming years, we hope to include quantitative assessments of use and impacts to better understand how specimen collections are having a positive impact on local communities. We further aim to expand the program and accommodate states beyond Mississippi and South Carolina.



These mini-museums seem to spark great interest among non-entomologists; this enthusiasm could be directed toward community science projects that have the potential to significantly advance biodiversity research and advocacy (Gardiner and Roy 2022).

We hope that researchers and educators with specialties outside of entomology (e.g., botany, herpetology) will be able to utilize this model to advocate for their own collections and inspire their own future scientists and policymakers. Natural history museums of all kinds often have materials that do not meet their standards—whether due to pest management concerns or insufficient data—and their “trash” could easily be repurposed for a better future through this framework.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

Conceptualization: MLF, PLSW. Funding acquisition: PLSW, NKA, CMS. Methodology: MLF, PLSW. Project administration: PLSW, NKA. Resources: CMS, MLF. Supervision: PLSW. Writing - original draft: PLSW, NKA. Writing - review and editing: NKA, CMS, MLF, PLSW.

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Data availability

All of the data that support the findings of this study are available in the main text.

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