

Short Communication

Use of insect specimens for Science Olympiad entomology exam in Georgia, USA

Kelly Carruthers¹, Yash Sajjan^{1,2,3}, Vaishnavi Balaji^{4,5}¹ Department of Entomology, University of Georgia, Athens, USA² Department of Microbiology, University of Georgia, Athens, USA³ Department of Physiology, University of Georgia, Athens, USA⁴ Division of Biological Sciences, University of Georgia, Athens, USA⁵ Department of Psychology, University of Georgia, Athens, USACorresponding author: Kelly Carruthers (kelly.carruthers@uga.edu)

This article is part of:

**Entomological Outreach Collections
and Community Engagement**Edited by Victor Gonzalez, Jennifer C.
Girón Duque

Academic editor:

Jennifer C. Girón Duque

Received: 31 March 2025

Accepted: 29 April 2025

Published: 22 May 2025

ZooBank: <https://zoobank.org/A59844DD-5DE8-4863-9D99-780C83874ACE>**Citation:** Carruthers K, Sajjan Y, Balaji V (2025) Use of insect specimens for Science Olympiad entomology exam in Georgia, USA. Natural History Collections and Museomics 2: 1–10. <https://doi.org/10.3897/nhcm.2.153727>**Copyright:** © Kelly Carruthers et al.
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Abstract

Science Olympiad is a non-profit organization with a mission to increase science, technology, engineering and mathematics (STEM) participation among students of all grade levels by creating engaging tournaments that allow students to interact with a variety of STEM topics in a hands-on way. Entomology is included in a regular rotation of tested subjects for the Science Olympiad. In 2024, students participated in the entomology competition at the University of Georgia during both a regional invitational event and an inaugural outreach day that allowed underserved schools in surrounding counties to engage with Science Olympiad materials to which they would not otherwise have access. During both events, insect specimens were used to provide a more realistic understanding of entomology. For the exam, students answered between four and seven questions related to insects using specimens and models at 15 different stations. For the outreach day, students and their teachers were able to observe real specimens for a majority (70 of 100) of the families that were included in the Science Olympiad Entomology testing guide. Overall, positive feedback was received about including real specimens from students, teachers and the State Director for the Georgia Science Olympiad. Engaging with Science Olympiad as entomologists and including insect specimens can help foster better relationships with teachers, who can have positive impacts on students entering STEM careers.

Key words: Arthropods, education, informal learning, insects, insect collections, outreach

Introduction

Science Olympiad was founded in 1984 and currently encompasses over 6300 teams from all US states and is known as one of the premier science, technology, engineering and mathematics (STEM) competitions for kindergarten through 12th grade (K–12) students. Science Olympiad competitions are similar to the Olympics, where a team of 15–25 students compete in over 23 different science-related events with 2–3 students participating per event. Students can place individually and/or as a team, through the combination of all the individual scores providing the overall team score. Science Olympiad competitions of-



for a diverse range of challenges including testing, lab and build events in which students engineer a device (whether technological or not) and test it on competition day to see if it fulfills the event's mission. These tournaments foster leadership, teamwork and exploration across scientific disciplines. Similar to sports meet-ups, Science Olympiad tournaments require intensive preparation whether through trial and error for building the winning machine or studying past practice exams for test events. Moreover, Science Olympiad allows students to explore different schools and colleges, providing them with a glimpse of higher education (Science Olympiad: About Science Olympiad; Singh (2014)).

Science Olympiad's mission is to increase K–12's participation in STEM by creating exciting tournaments that allow students to get hands-on experience in the main scientific domains: Geology, Biology, Chemistry and Physics. The Science Olympiad is separated into four divisions that serve all pre-college students. Divisions A1 and A2 are for elementary students, Division B is for middle school students and Division C is for high school students. As students start thinking about career paths in middle and high school, Science Olympiad offers a way to explore different fields of interest (Amy Chisam, personal communication).

Smith et al. (2021) conducted a study to evaluate Science Olympiad's importance on colleges and major choices and found that former Science Olympiad participants are more likely to pursue a STEM major in college. For instance, around 45% of participants reported that the competition influenced their major choice and helped them explore different science-related specialties. While most participants already had an interest in STEM, Science Olympiad further strengthened their passion by providing them with a chance to network with like-minded peers and enhance their problem-solving and research skills. Additionally, the study found that Science Olympiad influenced college decisions, especially for those who competed at the local institutions. Students who chose their in-state institution reported a sense of comfort and familiarity gained through their years of participation in Science Olympiad (Smith et al. 2021).

Science Olympiad in Georgia, US

Science Olympiad is in its 41st year nationally. Georgia was one of the 17 States to compete in the very first national tournament hosted by Michigan State University (Amy Chisam, personal communication; Science Olympiad: What is Science Olympiad?).

Science Olympiad holds 23 events at the middle and high school levels in the State of Georgia. Students begin with invitational competitions at the local level, where top scorers from each competition advance on to state competitions. Top scorers at the state level can then advance to compete at the national level. Science Olympiad typically rotates through various field biology subjects, such as Forestry, Herpetology, Ornithology and Entomology. In 2024 and 2025, the Entomology subject cycled back into the schedule for testing. The last time that the entomology exam was administered for the Science Olympiad was in 2014 and 2015 (Amy Chisam, personal communication). It should be noted that entomology is in regular rotation for all divisions and it is expected to be tested roughly every 10 years. This regular rotation provides opportunities for future involvement by entomologists. After each cycle, the rules are slightly modified to ensure new topics are tested. In



2024 and 2025, the University of Georgia's Department of Entomology was asked to contribute both specimens and test questions to the regional invitational held on the university campus.

Entomology Science Olympiad at University of Georgia in 2024

There is an official list of 29 orders and 100 families of insects, some which require students to know both the adult and larval forms (Science Olympiad: Entomology). Students must learn up-to-date orders and families, but there are a few taxonomic inaccuracies. For instance, Cicindelidae and Carabidae were still listed as two separate beetle families, as were Danaidae and Nymphalidae (butterflies) in the 2025 National Entomology List (Science Olympiad: Entomology). According to the Entomological Society of America, Cicindelidae and Danaidae are now considered subfamilies of Carabidae and Nymphalidae, respectively.

For the Science Olympiad Entomology Exam, questions at each station can include a picture, specimen or model. Students can be asked questions pertaining to internal or external anatomy, ecology, economic impacts and management. The ecology of insects can include behavior, symbioses and effects on public health. Economic impacts can include beneficial or pest insects in both positive and negative capacities (Science Olympiad: Division C Rules Manual 2025). Teams of students are allowed to bring in a three-ring binder up to 5.08 cm (or 2 inches) in size containing information in any form from any source of their choosing. Each team may also bring in a field guide that may be tabbed and annotated, as well as a hand lens (Science Olympiad: Division C Rules Manual 2025).

Students may have plenty of resources available to them during the exam, but they would need to navigate their materials quickly, as they only have 50 minutes to take the entire exam. Students rotate through 15 stations, each containing 4–7 multiple choice and short answer questions. This meant that students only had about three minutes per station and roughly 30 seconds per question, requiring a solid understanding of where to find the information in their resources quickly (Science Olympiad: Division C Rules Manual 2025). Roughly 88 high school students took the entomology exam in 2024 and 52 middle school students took the exam in 2025. There were 22 students in each of four rotations, which were administered consecutively in the room designated for entomology.

Example tests and study materials frequently use images of insects (Science Olympiad: Entomology), which can often be incredibly detailed and meaningful, matching more precisely the field guide they are allowed to bring. However, photographs are limited in depicting the true size and full range of characteristics of the insects. Thus, it was decided to use mostly real specimens. Of the 15 stations, 14 of them included insect specimens (Fig. 1) and one used a model of a bee to identify internal anatomy. The specimens represented nine separate insect orders (Coleoptera, Diptera, Lepidoptera, Hymenoptera, Orthoptera, Mantodea, Hemiptera, Blattodea and Dermaptera) and one arachnid order, Ixodida. The specimens for the exam came from author, Kelly Carruthers' personal collection, since those specimens were the most accessible during the process of writing the exam.

Several questions were asked for each specimen. Many specimen stations required students to identify insect order and common names as short answers and, occasionally, the family name (e.g. Cicadidae) in multiple choice



Figure 1. Sample specimens used for the Science Olympiad Entomology Exam. Unit trays include the specimen for the individual station and the station number pinned in the top right corner.

questions. Some required students identify whether the specimen was male or female (e.g. carpenter bee), unique behavior (e.g. earwig parental care), wing types (e.g. tegmina and hemelytra), ecological niches (e.g. smokybrown cockroaches are found in tree holes), leg types (e.g. saltatorial, natatorial and raptorial) and environmental and public health considerations (e.g. pest species status and mosquitoes feed on blood). Students were also asked to use two dichotomous keys for identification, including one from Zettler et al. (2016) and to identify some internal structures (e.g. heart and nerve cord) on a bee model. After the tests were completed and scored, printouts were made of the types of questions administered during the exam to aid in the inaugural outreach day.

Outreach Day

On 9 November 2024, University of Georgia's Science Olympiad held its first annual Outreach Day, aiming to encourage STEM education and participation for students in Athens, Georgia, US and surrounding underserved counties. Many local schools lack access to official tournaments and this initiative provided



90+ students and their teachers with hands-on scientific experiences on campus. Workshops covered topics such as microbiology, chemistry, entomology, engineering and anatomy and included a cadaver lab for those interested in medical sciences. By engaging students in interactive STEM activities, the outreach day aimed to introduce new students to the possibilities of higher education and scientific careers, fostering curiosity and providing important contacts for those with limited academic resources.

For the Outreach Day, many more insect specimens were provided for student observation than were used for the invitational exam. The Outreach Day specimens were provided by the surplus collection from University of Georgia's Insect Taxonomy (ENTO 8010) course. As Wooden (2024) noted, many schools like Clemson University and University of Georgia have introductory entomology courses that require students to build insect collections and many of those collections are left behind, leading to a large pool of surplus specimens which could be used to serve a variety of outreach events, including those related to Science Olympiad.

From the official 2025 National Entomology List, the surplus collection was searched for a representative insect for each of the 29 orders and 100 families. A good demonstrative specimen was located for 23 orders and 70 families. The goal was to have at least one specimen that represented each family well, while also being large or extravagant enough to engage students that were not as enthusiastic about entomology.

During the Outreach Day, students were given 30 minutes to explore entomological resources and materials. After a brief introduction of the event and how it works, students were allowed to explore open Schmitt boxes (Fig. 2) with a diversity of specimens grouped by taxonomic orders. Students rotated through five different stations that included representative specimens from the surplus collections and were given a printout of a variety of stations used during the actual entomology exam (Fig. 3). All the specimens were labelled with order names, which allowed for a chance to discuss the meaning of the order names and talk through scientific root words, in general. Of the 12 schools that were invited, seven attended the event, exposing over 100 teachers and students to the diversity and wonders of entomology.

Discussion

Between the invitational competition and the Outreach Day, positive feedback was received at multiple levels, including students, teachers and the Georgia Science Olympiad Director. Students were intrigued to look through the diversity of insects that were brought to the Outreach Day. While quite a few students had a typical, "Ew," response, at least one came with a field guide in-hand ready to look at the specimens. Students from Oglethorpe County commented that they enjoyed the event and our specimens. Many of them were more interested in trade school, but after the Outreach Day, they had an increased motivation to explore STEM fields and higher education. Out-of-school STEM programs, like Science Olympiad, can have a positive impact on student perceptions and interests in STEM fields (Sahin et al. 2015; Swanson et al. 2022).

Aside from the usual shock and aversion from a couple of students and teachers, teachers from schools at neighboring counties commented on how they

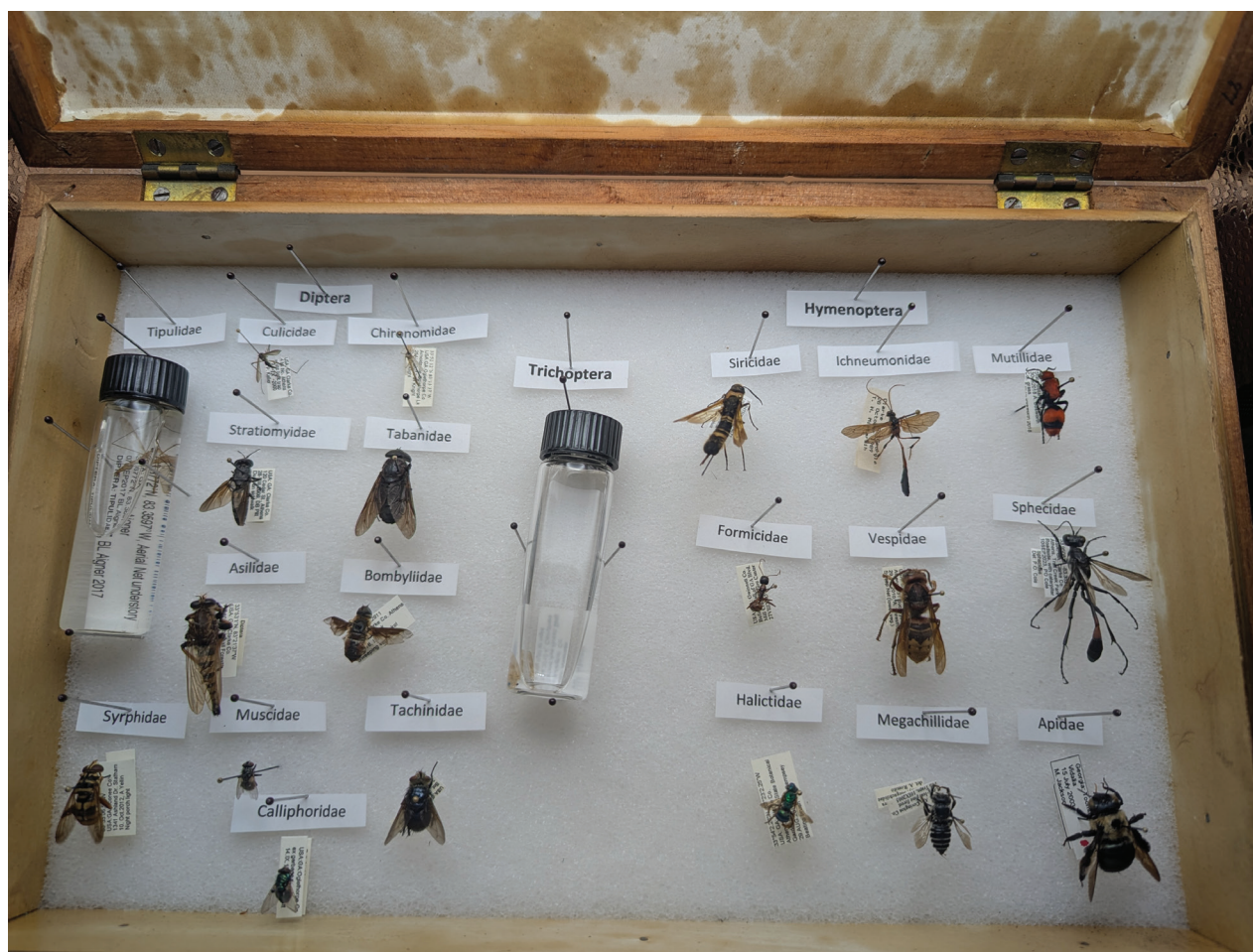


Figure 2. Schmitt boxes prepared for students to observe and interact with during the Outreach Day. This box displays families within the orders Diptera, Trichoptera and Hymenoptera and were selected, based on their large size and charismatic features. Students were allowed to view and handle specimens carefully to observe features and characteristics of each family.

appreciated seeing real insect specimens. A teacher from White County appreciated that students were able to engage with and explore insect specimens in a hands-on way. Having specimens available allowed students to visualize the insects in a more tangible manner. Teachers may feel intimidated to coach Science Olympiad because of lack of specialized content knowledge (Swanson et al. 2022), but teachers that participate in coaching Science Olympiad typically found that it strengthened their content knowledge, broadened their knowledge base of a variety of topics and increased their confidence (Swanson et al. 2022). Additionally, several teachers mentioned reaching out directly to the Department of Entomology for help with the Science Olympiad event after the Outreach Day. Entomologists who engage with coaches and Science Olympiad may be able to help increase teacher awareness and confidence in entomological topics that they do not often encounter, which can translate into increased student awareness. Sahin et al. (2015) noted that, of the high school students they surveyed, most were interested in STEM careers due to a science teacher (Campbell and Tirri 2017), which should absolutely encourage entomologists to engage more with science teachers.

The State Director of the Georgia Science Olympiad commented positively on the use of specimens for the event. Other regional tournaments use pictures and photographs only, but the national committee appreciated the use of real



Figure 3. Students and a teacher observe a Schmitt box with a variety of specimens during the Outreach Day for the Science Olympiad. Descriptions and meanings of the orders of insects are projected on the screen.

insect specimens for the competition. It had enough impact that the Department of Entomology was asked to contribute to the state level Science Olympiad Division B competition for middle school students.

Students involved in the Science Olympiad have the autonomy to choose the events in which they want to participate, specifically those that are aligned with their interests. Over the past four decades that Science Olympiad has been active, subject material and topics have changed over time, matching the needs and the interests of students as they evolve (Loehr and Kopach 2023). While most entomologists have recognized the need for entomology-related topics, it can often be harder to communicate that to students. Even at these two events, many students came in heavily focused on engineering and pre-med career paths, but having exposure to the wide variety of events offered by Science



Olympiad opened their eyes to the diverse fields that exist in STEM outside of these common career pathways.

Participation in events like these increase exposure and awareness that entomology as a field exists and using real specimens helps students see insects as real living organisms beyond images on paper. Science Olympiad increases the likelihood of students entering a STEM field. If entomologists are able to integrate into a framework which already aids in STEM careers, we may be able to expose more students to a typically under-represented field. For entomologists, being involved in events and organizations like Science Olympiad helps promote visibility for entomology in general, but also allows for students, who are potentially the next generation of entomologists, to see the work of entomologists and network, since networking with professionals is a key part of Science Olympiad (Loehr and Kopach 2022).

This collaboration materialized because both authors, Yash Sajjan and Vaishnavi Balaji were heavily involved in Science Olympiad for several years as both participants and event organizers. They began their Science Olympiad journeys in middle school, actively competing in various events and have given back to the community by helping to organize the competitions as college students. Knowing that entomology was rotated into the 23 competitions, they reached out to the Department of Entomology at University of Georgia to help create the exam and curate specimens. The aim of this article is to increase awareness of entomology opportunities among students through Science Olympiad organizers and entomologists. By being aware and supporting each other's endeavors, the reach of entomology can be expanded and a program that bolsters STEM for students both immediately and in the long run can be supported. Using insect specimens and collections is one of the tools available to help entomologists interact with a new generation of students and make entomology a more tangible and realistic field to enter. Collections also just show students how interesting and diverse insects are beyond what paper images can provide.

Future Directions

For future replication research, it would be beneficial to track the scores of schools that participated in Outreach Day events and monitor their progress in subsequent invitationals or even state competitions. Additionally, we could survey students after each tournament to gather feedback on whether they enjoyed having physical specimens to observe and handle, providing a more engaging experience compared to a purely verbal approach.

As Science Olympiad is a nationwide event, it would be fruitful to have more insect specimens used and more entomologists engaged in testing across the nation, especially the next time entomology is rotated into the competitions. Perhaps, engaging more as an entomological community with Science Olympiad and other STEM-focused events, we can help entomology as a subject increase reach to teachers and students, especially since these vital topics do not always make it into formal education settings. The more opportunities we find as entomologists to connect with STEM activities, students, teachers and the public, the more awareness we gain, which can only help the field, which in-turn, helps the community.



Acknowledgements

We would like to thank Scott Cole, State Director of the Georgia Science Olympiad and Amy Chisam, Assistant State Director of the Georgia State Olympiad, for their feedback on the specimens and support for this article. We would also like to thank Joe McHugh, Professor of Entomology at University of Georgia, for allowing access to the surplus insect collection to provide specimens for the outreach event. We would also like to thank all the students, teachers and coaches that participate in Georgia Science Olympiad tournaments and Outreach Day for being excited about STEM subjects and open to learning more about entomology.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Funding

No funding was reported.

Author contributions

K.C. conceived the idea for this article and curated specimens for the exam and outreach day. Y.S. and V.B. provided background and context for Science Olympiad. K.C., Y.S., and V.B. wrote the original draft of the article, and K.C. edited.

Author ORCIDs

Kelly Carruthers  <https://orcid.org/0009-0005-0312-0889>

Yash Sajjan  <https://orcid.org/0009-0008-9115-4801>

Vaishnavi Balaji  <https://orcid.org/0009-0009-6831-2215>

Data availability

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

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