

A customizable framework to integrate undergraduate research and natural history collections

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ABSTRACT

Undergraduate research experience is a positive factor influencing retention in STEM fields. However, it is often difficult to frame meaningful hypotheses for projects that can be completed in a limited amount of time. We describe a framework that builds upon the historical legacy of biodiversity studies and integrates natural history, museum curation, field work, molecular laboratory techniques and social media outreach. This is exemplified here by a study of species diversity of fireflies (Coleoptera: Lampyridae) in the context of land use and climate change in an urban setting.

INTRODUCTION

Evidence is growing that undergraduate research experiences (UREs) are viewed positively by the students involved, and the experience translates into increased likelihood of graduation, acceptance into postgraduate programs, and entry into the scientific workforce (Linn *et al.* 2016, Hernandez *et al.* 2018). Benefits also extend beyond academia (Petrella & Jung, 2008).

Defining a project suitable in scope for a URE can be a challenge. The student demand for UREs and the time commitment required of the mentors places a premium on defining a framework for research that can both be reused and be individualized.

BENEFITS

Engagement in a project in this framework develops student skills in the molecular lab (extraction, PCR, sequence analysis); specimen handling; understanding of insect morphology; use of identification keys; data management; imaging; and science communication. Students also gain first-hand knowledge of insect biology, insect diversity, and the role of natural history collections. In this framework, projects are easily replicable from one group to another, or even within the same group by varying collecting habitats, time of year, etc.

LITERATURE CITED

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- Petrella JK & Jung AP 2008. Undergraduate research: importance, benefits, and challenges. International Journal of Exercise Science 1(3): 91-95.


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FRAMEWORK. We present a workflow that provides undergraduate students the opportunity to gain skills and experience across the entire range of activities associated with faunistic studies, from basic field and library work to dissemination of results. Each project can be individualized by focusing on a single taxon.

Legacy studies

We have over a century of legacy publications and theses concentrating on the insects of Ohio. Individual projects build upon that history and document faunal changes through time.







Photo by Terry Priest. Used with permission.

Collection Curation

At the **Triplehorn Insect Collection** students learn proper specimen handling, curatorial techniques, and insect classification. They also work on specimen metadata transcription following community standards.








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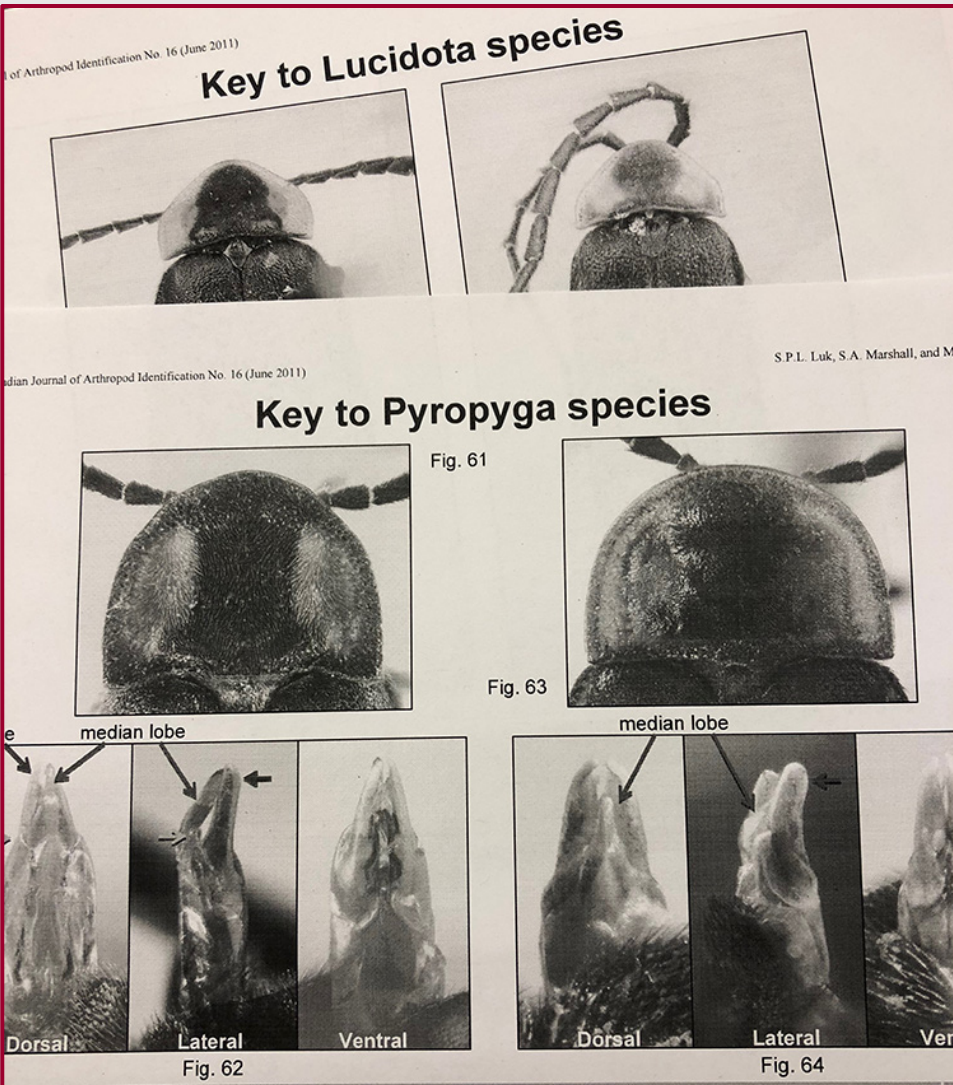
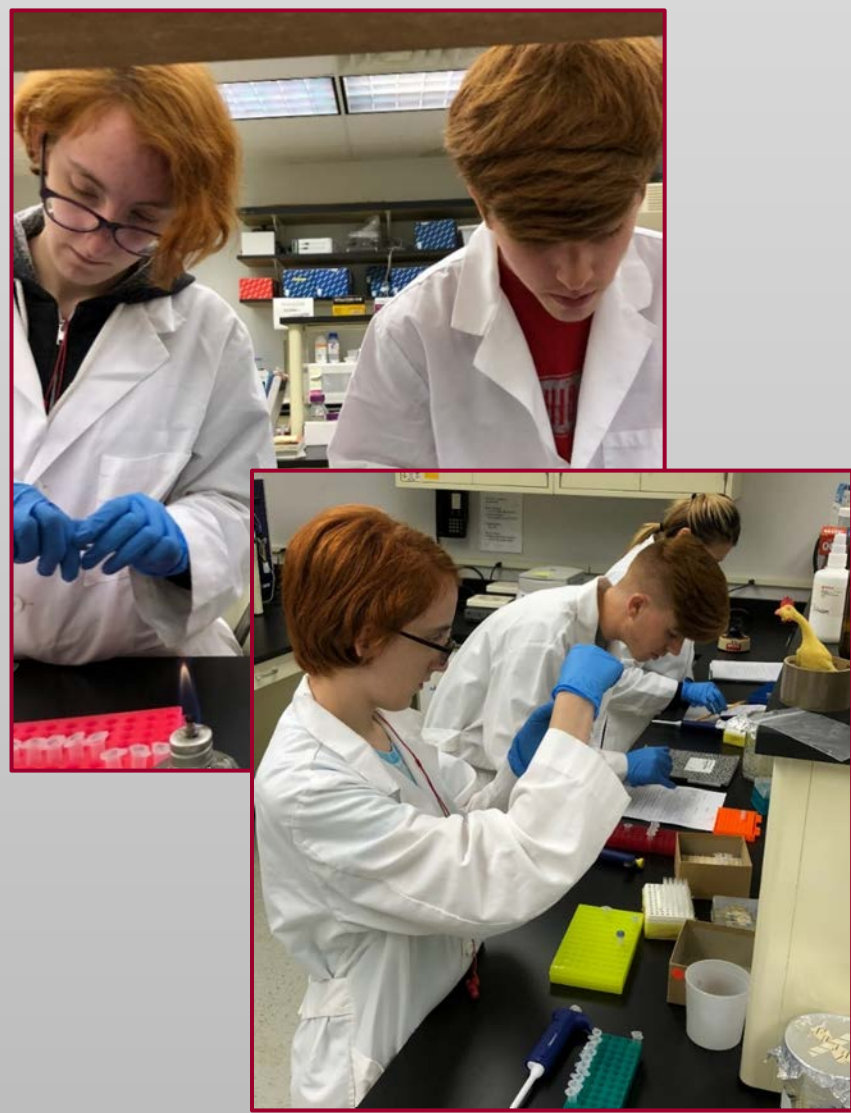
Field Experience

Students learn about the biology of their study group through field work to collect fresh material in local habitats. They learn to sort, mount, label, and database their focal taxon.



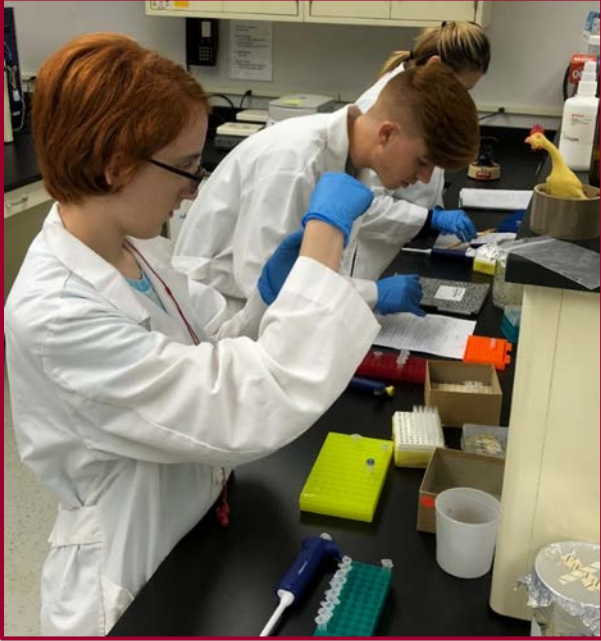
Morphological Study

Working with the published literature, students learn the techniques and terminology as they identify the species they have collected.



Molecular Work

Basic molecular skills are gained through DNA barcoding of morphospecies, males and females, adults and immatures. Sequences are deposited in publicly accessible databases.



Dissemination & Outreach

Communication with a variety of audiences is emphasized. Scholarly presentations are made at undergraduate research forums on campus. More general audiences are reached through the Triplehorn collection's online blog platform, **The Pinning Block**, and our social media outlets. These activities help the students to develop their metacognitive skills and thus enhance the research experience.

