AIM-UP! Museum-Based Approaches to Increasing Core Competencies in Undergraduate Education

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Undergraduate students at Harvard use specimens and associated data to explore speciation and molecular evolution in spring 2013. Photo: S.V. Edwards. (Figure 1 from Cook et al. 2014. *BioScience* **64**:725-734.)

What is AIM-UP?

Advancing Integration of Museums into Undergraduate Programs

We're a NSF-funded Research Coordination Network (RCN) that aims to increase the integration of natural history collections into undergraduate education. AIM-UP partners educators & researchers at many universities, community colleges, & natural history museums. Our goals are to:

- Train students in museum-based research
- Develop instructional tools that use museum specimens or databases
- Introduce educators to the instructional power of museum collections and databases
- Increase public awareness of the importance of natural history collections

Assessment using Surveys

Students across the U.S. have a range of experiences with natural history collections, yet we know very little about the possible educational outcomes of interacting with collections and specimens. We are currently surveying undergraduate students to assess their knowledge of natural history collections at two different stages:

- At the start of their 1^{st} biology course
- Science majors nearing graduation

These surveys will help us develop guidelines and recommendations for improving the student experience.

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The Challenge

Informing students and instructors about the potential role of collections in undergraduate teaching & research at all universities represents a significant challenge.

- Many educators are unaware of the educational potential of collections and associated databases.
- Survey of ∼100 UC Berkeley biology students: > 70% were unaware of the Museum of Vertebrate Zoology and < 10% had visited
- Survey of ∼100 U. New Mexico biology students: 50% were unaware of UNM's Museum of Southwestern Biology; only ∼15% had visited

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Art + Biology in the Museum

Communication between fields is important within science, but also between biologists, artists, and historians as we build collective knowledge. Natural history collections emphasize spatial & temporal variation and are uniquely situated to bridge the gap between traditionally segregated disciplines, as they foster development of creativity, generative thinking, and rigorous inquiry. By incorporating art and history into biology, we begin to strengthen ties between the sciences and the humanities within university curricula and research activities. A common interest in place-based research and inquiry-driven learning underpins integrated and experiential approaches to pedagogy. See more at unm-coev.blogspot.com.

The Relationship between Geographic Barriers and Divergence — Using museum specimen data, art, and online databases (arctosdb.org & GenBank) to demonstrate population divergence in response to geographic barriors. A learning module & e-book by K. Carillo, L. Davis, C. Espinoza, and A. Marquez of U. New Mexico (unm-coev.blogspot.de/p/dispersion-module-barriers.html)

"At this point, I wish to emphasize what I believe will ultimately prove to be the greatest value to our museum-and that is that the student of the future will have access to the original record of faunal conditions... Right now are probably beginning changes to be wrought in the next few years vastly more conspicuous than those that have occurred in ten times that length of time preceding." — J. Grinnel (1912)

Haskell Indian Nations University (Lawrence, KS) Mammal Preparation Course. Photo: C. Welch.

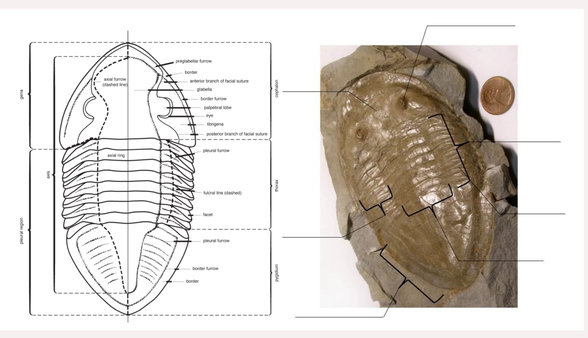
Educational Modules

Online materials intended to introduce key concepts in biology & educate students about the vast resources available in natural history collections worldwide. These modules make use of online resources—including biological databases—and cover topics such as

- Tree-thinking and phylogenetics
- Biodiversity assessment
- Coevolution (Art + Biology)
- Using GIS to analyze bat records
- Island biogeography
- Museum-based independent projects

Macroevolution: Trilobites

A paleontology module intended to introduce anatomy & terminology of trilobite biology, morphological structures found in fossil specimens, major events in the evolution of Trilobita, and macroevolutionary patterns in the fossil record.
By M. Casey & B. Lieberman (U. Kansas)



Introduction to the Trilobites — External trilobite anatomy. A) Diagram of the Ordovician trilobite, *Isotelus* from the *Treatise on Invertebrate Paleontology*. B) *Isotelus iowensis*. University of Kansas Museum, Invertebrate Paleontology (KUMIP) 294608. (Figure from http://bit.ly/1trv5ww)

Find out More

Visit the website – aimup.unm.edu – to learn more about AIM-UP, use our resources, or provide feedback. Check out our recent paper in *Bioscience* (**64**:725-734): Cook et al. (2014) "Natural History Collections as Emerging Resources for Innovative Education". Find out about joining this effort by emailing: aim-up@aim-up.org

Participating Museums: Museum of Southwestern Biology (U. New Mexico), Museum of Comparative Zoology (Harvard); Museum of Vertebrate Zoology (UC Berkeley); Museum of Natural History at the University of Colorado; Florida Museum of Natural History (U. Florida); Museum of the North (U. Alaska, Fairbanks); University of Michigan Museum of Zoology; U.S. National Parasite Collection; New York State Museum; University of Nebraska State Museum; Denver Museum of Nature & Science; Texas Cooperative Wildlife Collection (Texas A&M); Moore Laboratory of Zoology (Occidental College); Tulane University Biodiversity Research Institute; Museum of Biological Diversity (Ohio State); Central Michigan University Herbarium; Botanical Research Institute of Texas

Participating Networks: CollectionsWeb: Building a Community of Natural History Collections (RCN); InvertNet (invertnet.dyndns.org); Open Science Network in Ethnobiology (opensciencenetwork.net); iDigBio (idigbio.org); Open Tree of Life (opentreeoflife.org)