

Project Title: Enhancing Zoology with Digital Technology: Digital Microscopes and the Production of the DVD Manual, “A Practical Laboratory Guide to Invertebrate Structure, Function and Behavior”

Project Type: Professional Development Grant

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Requested Funds: \$7945

Summary: This proposal requests funds for the development of a DVD to be used in four courses in the Department of Biological Sciences at UML: Invertebrate Zoology, Advanced Invertebrate Zoology, Marine Biology and Parasitology. The DVD will function as a Laboratory Manual (“A Practical Laboratory Guide to Invertebrate Structure, Function and Behavior”) to enhance students’ education and awareness of invertebrates through their exposure to a diverse collection of practical images and exercises that emphasize anatomy, behavior and ecology. The DVD will include labeled photographs of live, dissected, and slide material that are traditionally used in laboratory courses, as well as video footage of specimens for understanding animal behavior. A stipend will be used to fund two undergraduate students to aid in the production of the electronic manual, which will help develop their skills in invertebrate taxonomy and dissection, digital photomicrography, and the production of electronic artwork. Funds are also requested for the purchase of a multi-DVD duplicator and DVDs, and a DigiVu Digital stereomicroscope and DigiVu Digital compound microscope for image capture and collection. The microscopes will be used in the production of the DVD and also function to promote the value of digital technology in the laboratory portion of the four courses.

I. PROJECT NARRATIVE

“For a gentleman should know something of invertebrate zoology, call it culture or what you will, just as he ought to know something about painting and music and the weeds in his garden.” Martin Wells, *Lower Animals*, 1968

Synopsis

Invertebrates make up approximately 95% of all living animals and account for more than 1.1 million species organized into about 33 phyla. Consequently, invertebrates figure prominently in discussions of biodiversity, biotechnology, ecosystem sustainability, evolution, and medicine, and yet while enjoying such prominence, the study of invertebrate zoology has taken a precipitous decline in American education. This decline has ramifications that extend well beyond current interests in biodiversity and conservation. Invertebrate zoology contributes to our knowledge of evolutionary history, environmental health, and the health of our own species. Without a sustained effort to increase student awareness and appreciation of invertebrate structure, function, and ecology, future generations will be unaware of the role that invertebrates have played, and continue to play, at local, regional, and global scales. This proposal encourages awareness and appreciation of invertebrates by incorporating digital technology into four courses offered at the University of Massachusetts Lowell. Digital microscopes with image and video capture capabilities will be used to spurn student interest in invertebrate anatomy and behavior, and contribute to the production of a simple and navigable DVD to enhance student learning and supplement and strengthen current traditional lectures.

In the Beginning

The study of invertebrates has a long and distinguished history, dating as far back as the early writings of Aristotle, whose observations of the natural world laid the foundation for modern zoology. While the foundations of Invertebrate Zoology were established as early as the 3rd century BC, and have remained strong in Europe, it was not until the 19th century when America began to show a burgeoning interest in the topic, spawned in part by the policies of Thomas Jefferson¹. Subsequently, labs devoted to the study of marine organisms began to crop up around the country, and by the 20th century, became a staple of marine education at American institutions. These labs, together with their founders such as Louis Agassiz, were initially responsible for the upswing in the study of Invertebrate Zoology in North America. This surge was strengthened by perhaps the most influential invertebrate zoologist of the 20th century, Libbie Henrietta Hyman, who compiled “the most compelling single-authored synthesis of invertebrate structure and development of the 20th century.”² Hyman’s six-volume series on *The Invertebrates* reinvigorated this growing discipline, which reached its zenith in the 1980s when a majority of academic institutions offered a variety of invertebrate courses³.

More recently, with the advancements in molecular biology, many academic departments have changed their focus from an organismal theme to a cellular and/or molecular theme³. This has led to a unexpected decline in the number of Invertebrate Zoology courses offered at American institutions, and subsequently, a decline in student enrollment and interest. As a testament to this decline, the Department of Biological Sciences at the University of Massachusetts Lowell has not offered a course in

Invertebrate Zoology (or related organismal courses) for nearly a decade, which means that students in the Biological Sciences have had little or no exposure to courses in animal form, function, or evolution for several years. However, a recent spate of new hires in the Biological Sciences, with the hope of diversifying the department and reviving the organismal theme, has led to the reintroduction of Invertebrate Zoology (and other related courses) back into the program. Unfortunately, this absence of attention has translated into a lack of appropriate resources for teaching such a course – a course that could well be enhanced with the newest technologies to attract students, promote interest, and make the wealth of information on invertebrates accessible and easy to use.

Objectives

This proposal has three broad objectives that function to improve the quality of education in the Department of Biological Sciences at UML:

- 1) To produce an electronic guide to the Invertebrate Zoology Laboratory for use in four courses: Invertebrate Zoology, Advanced Invertebrate Zoology, Marine Biology, and Parasitology
 - a. The guide will be made freely available to biology students enrolled in the aforementioned courses
 - b. The guide will allow students to study invertebrate anatomy outside of the traditional lecture and laboratory setting and thereby promote and improve student interest in the discipline
- 2) To actively involve undergraduate and graduate students in studies of invertebrate zoology
 - a. Select students will be actively engaged in the production of the DVD, which will enhance their education in invertebrate zoology by providing them opportunities to work with specimens and apply the terminology and concepts they learned in previous courses
 - b. All students will have access to digital microscopy in the classroom and become familiar with the use of this technology for studying anatomy and recording behavior
 - c. The DVD guide will be updatable and incorporate images and recordings captured by students in future courses
- 3) To improve the quality of my teaching by incorporating digital media into a traditional lecture format
 - a. Traditional laboratory specimens (slide material, dissections, live specimens) will be incorporated into lectures through electronic media, allowing the instructor to improve his overall effectiveness and bring relevant laboratory material directly into the lecture hall

II. PROJECT DELIVERABLE

The immediate deliverable of the proposed project will be a DVD for use in classes such as Invertebrate Zoology, Advanced Invertebrate Zoology, Marine Biology, and Parasitology. While interactive DVDs on Invertebrate Zoology are currently on the market, all come with stock images, video clips and illustrations directly from textbooks for the purpose of visualizing invertebrate diversity. None contain detailed collections of labeled photographs that strictly apply to what students encounter in the laboratory. As

such, students are generally provided a plethora of images that lack relevance to true laboratory specimens (slide, live and preserved material); consequently, students are often unprepared for what awaits them in the laboratory. The use of a more relevant collection of images and videos in lecture will better prepare students for the laboratory component, and allow them to study aspects of animal behavior, histology, and taxonomy outside the classroom. This DVD has potential to be a marketable item.

III. DISSEMINATION OF PROJECT RESULTS

The results of this project will be a DVD that is disseminated to students in the aforementioned courses. The DVD will be tested in courses in Fall 2007 (Invertebrate Zoology) and Spring 2008 (Marine Biology, Advanced Invertebrate Zoology), and modified according to student input (including suggestions on format and images collected by students in lab). To assess its worthiness to the market, the DVD will be sent out for review to colleagues at various institutions for testing in their courses. Peer reviews will help to improve the DVD and assess its educational and market value.

IV. PROJECT BUDGET

The following budget includes stipends and materials for the initial collection of images and creation of the DVD. I have budgeted for 2 students (30 hrs/week total) to collect images over a 3 month time period. Following DVD production, the digital microscopes will be housed in Olsen Hall 509 (the laboratory of the 4 courses) for teaching purposes.

1. Student Stipend Support
 - a. Graham Lilley – 15 hrs/wk x 12 wk = \$1800
 - b. Ryan Brown - 15 hrs/wk x 12 wk = \$1800
2. Kanguru DVD Duplicator - \$1095.00
3. DVDs (500) - \$150
4. DigiVu CVM Digital Stereomicroscope - \$1600
5. DigiVu CVM Digital Compound Microscope - \$1500

Total Requested budget: \$7945

Additional items to be used in the production of the DVDs, including specimens and a laptop PC for image collection and storage, will be provided by the PI.

V. PROJECT TIMETABLE

Production of the DVD will take place from June to September, 2007. The projected timetable is a 3-month period for image capture, image labeling, and file structuring of the DVD. The first draft (Version 1) of the project will be ready by September 2007 and used in Invertebrate Zoology. Student input will be assessed and evaluated throughout the course, and recommendations incorporated into Version 2. Depending on the extent of the revision, Version 2 will be made ready by Spring 2008 and used in Marine Biology and Advanced Invertebrate Zoology. It is expected that a full academic year of revision and enhancements will be required before submission to colleagues at other institutions for review in their courses.

VI. PRINCIPAL INVESTIGATOR, PARTICIPANTS AND QUALIFICATIONS

The principal investigator for this project is Dr. Rick Hochberg, an Assistant Professor of Zoology at UMass Lowell. Dr. Hochberg is an experienced zoologist with broad training in the zoological and microscopical sciences. He is responsible for the development of 4 new courses at UML including: Invertebrate Zoology, Advanced Invertebrate Zoology, Marine Biology, and Practical Parasitology. Dr. Hochberg is committed to expanding the organismal theme within the Biological Sciences at UML, and views the production of the DVD as an effective tool to achieve this end. Additional active participants in this proposal include two undergraduate students, Graham Lilley and Ryan Brown. Graham Lilley received the top score in Invertebrate Zoology in Fall, 2006 and has a burgeoning interest in invertebrates. Ryan Brown received the second highest score in Invertebrate Zoology and has a strong interest in the use of digital technology to enhance effective teaching. In particular, Ryan is interested in how effective this technology is in college classrooms, and if this effectiveness can be extended to high school classrooms as well.

References

1. Eckelbarger, K. 2006. The dawn of Invertebrate Zoology in America: A tribute to the pioneers. Oral Presentation, Society for Integrative and Comparative Biology, Orlando, FL.
2. Jenner, R.A. 2004. Libbie Henrietta Hyman (1888-1969): From developmental mechanics to the evolution of animal body plans. *J. Exp. Biol.* 204: 413-423.
3. Fautin, D.G., Watling, L. 1999. Review of textbooks of Invertebrate Zoology. *Am. Zool.* 39: 818-824.