

Teaching Introductory Biology at a Field Station

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Extended Abstract

With the current emphasis on incorporating experiential learning in introductory college biology courses (AAS 2010), I proposed to teach an introductory level biology course at the UNL Cedar Point Biological Station (CPBS). I began teaching the course in the summer of 2011. The demand for enrollment in the course became so great that I have taught two separate sessions in 2014 and 2015. Bios 121/121L (Fundamentals of Biology II) is a 4 credit course which enrolls a diverse group of students including majors in Biological Science, Environmental Science, Animal Science, Nutrition, and a variety of pre-health majors. The course focuses on whole organism biology with emphasis on evolution, biodiversity, and ecology.

A sample of 121 field stations found that none of them offered a true introductory college level biology course. In fact, most stations require or highly recommend students to have already taken 1-2 years of biology courses before enrolling in courses at their field station. We have found this course not only teaches the fundamentals of whole organism biology but also builds an amazing sense of comradery between students planning a career in the biological sciences. The importance of field stations in teaching and research has been recently addressed in a white paper published by the National Research Council (NRC 2014) in which E.O. Wilson states: “*Field stations will serve as key centers of education at all levels. Universities and other institutions wise enough to invest in such stations now, even in the face of limited financial resources, will assure themselves of a much larger share in the future action.*”

Cedar Point Biological Station (CPBS) is the University of Nebraska-Lincoln’s teaching and research field facility in western Nebraska, 10 miles north of the town of Ogallala. It is located at the west end of Lake McConaughy, a 25 mile long man-made lake. The field station is in the heart of the western high plains near the juncture of tall grass and short grass prairie and the Southern edge of the Sandhills. CPBS has comfortable cabin housing, a dining facility, two air conditioned classrooms and an air conditioned library. CPBS hosts a number of researchers each year and 80-100 students enrolled in upper division field based biology courses as well as art and photography. I started teaching Life 121 (Fundamentals of Biology II) at CPBS during the summer of 2013. This 3 week course typically enrolls two sections each having 18–20 students, majoring in biology and biology related disciplines. This course integrates organismal biology, evolution, behavior, ecology, and biodiversity by engaging students in a lecture and field-based active learning environment.

A short-term research project which emphasizes scientific problem solving skills including experimental design, experimentation, and hypothesis testing using statistical analysis is carried out by teams of students. This project uses a native crayfish (*Orconectes virilis*) as the model organism. The crayfish are collected and maintained by the students. Students are provided with Vernier® EKG Sensors for measuring heart rate, optical dissolved oxygen sensors for measuring the oxygen concentration in water and oxygen sensors for measuring the oxygen concentration in air. With instructor guidance, students chose a variable to investigate and an appropriate experimental design and statistical analysis of their data. Each team of students give an oral presentation of their results.

Traditionally insect collections have been used as a method of teaching insect taxonomy and basic curatorial skills. Although these aspects are included, we have broadened our goals of the insect collection to teach insect phylogeny and the major events in insect evolution as outlined in a lab exercise from Cornell University (Danforth, 2013). Students are required to collect insects representing 12 different Orders and two different species of aquatic insect larvae. Adult insects must be identified to Order and Family. In addition, for each Order of insects collected, the students are required to collect: 1 order of Neopterans that can fold their wings, 1 Order of wingless hexapods, 1 Order of Neopterans that cannot fold their wings, 3 Orders that display hemimetabolous development, 3 Orders that display holometabolous development, 1 Order that displays eusociality. For each of these insects students are required to describe the ecological consequence/importance of the major evolutionary event which occurred in that Order. The students are also required to give the most ancestral insect order collected based on the insect phylogenetic tree.

A comparative physiology approach is employed in a survey of invertebrates which are observed and collected in the CPBS environs. The class discusses characteristics and adaptations of species they observe in the field.

In many introductory biology courses of this kind, plants and plant-like organisms (eukaryotic “algae”) are poorly covered. Since the natural areas in and around CPBS are inhabited by a rich diversity of eukaryotic algae as well as vascular and non-vascular plants, a great deal of emphasis is placed on the discussion of their evolution and life cycles. Field trips and lab analysis of such organisms as *Chara* sp., *Marchantia* sp., *Azolla* sp., *Woodsia oregana*. In addition, students are required to collect, curate and identify to species, angiosperms belonging to 14 different families and to list one way 5 of these plant families were used by Native Americans (medicinal, ceremonial, food, crafts, etc.).

There is little published data dealing with the effect on student learning of teaching an introductory biology course taught at a field station in comparison to students who completed a traditional, campus based course covering the same material. The NRC white paper strongly recommends that these types of studies be carried out as a way of justifying the generally touted educational benefit of field based courses. At the end of the course over the past 3 years, I have asked the students in a self-report survey the following question: **Do you think you learned more from this course about whole organism biology and biodiversity than you may have learned in the same course taken on campus. Explain why or why not.** Based on 48 responses, 100% felt they learned more about whole organism biology and biodiversity in this field course than they would have learned in the same course on campus. The following is a sample of common responses to this question:

- This class was so much more interesting and effective. Focusing on one subject helps me really learn it, instead of jumping between five different classes at once. Seemed to cover all required material. Loved the emphasis on how and why questions.
- I learn better in an environment where I get to see and interact with what I am learning about.
- Being able to go out into nature and see the organisms made understanding biology easier.
- Hands on learning, helpful activities and labs, experiences are better than memorization.
- Focus on a broad range of material that would not be possible on campus, hands on applications, more likely to retain information.
- There is no way the course on campus could of given me the same educational experience.
- Being in the field really benefits my learning style. Looking at everything in real life helps me understand the big picture.
- I was much more engaged than I ever could be from a textbook.

Keywords: introductory biology, field station, experiential learning

Cited References

- (AAAS) American Association for the Advancement of Science. 2010. Vision and Change in undergraduate biology education a call to action. Available from: www.visionandchange.org
- Danforth B. 2013. Insect orders and a timeline of insect evolution. Cornell University Department of Entomology. 1-8. <https://courses.cit.cornell.edu/ent201/content/diversity.pdf>.
- (NRS) National Research Council. 2014. Value and sustainability of field stations and marine laboratories in the 21st century. Washington (DC): National Academy Press. Available from: <https://www.nap.edu/catalog/18806/enhancing-the-value-and-sustainability-of-field-stations-and-marine-laboratories-in-the-21st-century>

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