

“Doing Science” as Service Learning

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Abstract: Community service performed by students in university science departments has most often been in forms such as mentors in tutoring programs, supporting science fairs, or in outreach programs designed to ignite incipient scientists to a lifetime of discovery. However, the question has been raised, how can a science department in a college or university actually “do science” and be of service to the community? How can scientists-in-training perform testing and experiments in the field and in laboratories that will provide a quantifiable benefit to the local community? Oklahoma City University in partnership with the Blue Thumb Program has found a way to take this initiative in a new direction. Students, both majors and non-majors, in the Department of Biology at Oklahoma City University collect data and perform chemical testing on local streams. This information, collated and analyzed with data from other volunteer groups around Oklahoma, is used to guide decision-making by groups as diverse as neighborhood associations, the local food bank, the State Department of Environmental Quality. The University is also graduating citizens with a greater awareness and responsibility for their communities and with real skills to bring about change.

Introduction

Unfortunately, since its initiation on college and university campuses, service-learning, generally speaking, has been looked upon as a burden to be dispatched as quickly and painlessly as possible. Many class projects involve some form of tutoring, one-time clean-up activities or performance events. Specifically in the sciences this has meant a class clearing away trash from a

stream or creating a “magic show,” a performance of scientific experiments for an elementary or secondary school audience to stimulate interest in exploration. This is not service-learning.

Service is the easy part. Any activity that improves a condition can be considered a service to a community on some level and inclusion of service as an inextricable part of learning is long overdue. To be fair, a certain amount of learning does take place; however, not as it relates to a certain discipline. This is especially true in the sciences.

“Doing science” in service to the community is a much more elusive concept. This involves learning and performing actual tests or experiments which yield quantifiable or demonstrable information that is useful to a community be it local, state or national. In the scenario described here the Department of Biology at Oklahoma City University has partnered with the Blue Thumb Program, the educational arm of the Oklahoma Conservation Commission’s Water Quality Division, to create an experience that benefits the state at-large, yet is scientifically rigorous.

The Course

At its inception during the Spring 2005 semester, the service-learning project of Oklahoma City University’s Department of Biology was attached to a course in which it could become a seamless part such as Ecology, Environmental Science and the non-major’s course, Selected Concepts in Biology. A training section of one lecture and two labs were scheduled at the beginning of the course. The lecture opened with a discussion of the Continental Divide and a description of national, regional and local watersheds. It continued with a survey of the geography, biology and chemistry of a typical stream and ended with an appraisal of pollution and habitat destruction in the local area. The purpose of the first lab was to introduce the students to the six tasks performed on-site and the six chemical tests carried out in the lab each month to monitor a stream for the Blue Thumb Project. A maximum of 18 students were enrolled in this course; six lab teams were formed from the enrolled students. These were permanent teams so that tasks could be assigned on a rotational basis allowing each student to experience another part of the process with each monitoring session. During the second lab each student, with his or her lab partners, had the opportunity to practice every task and test. Each month following the training section a monitoring lab was scheduled during which the students were transported to the stream for the on-site portion and then returned to the lab to complete the chemical testing. The students completed a data sheet with the results for each monitoring session, which were sent to the local Blue Thumb office.

During the spring semester it was possible for the students to attend the macro-invertebrate collection of their adopted stream as it took place in January, however, the summer collection was performed in July when most classes were out of session. Special e-mails were sent during the summers of 2006 and 2007 to the Tribeta Biology Club members offering an opportunity to assist with the summer collection. A few local students were able to attend making it worth the effort.

The macroinvertebrate collection is another scheduled lab when the students were transported to the stream. A kicknet was used at three diverse locations in the riffle of the stream. The “take” from the three seinnings was amassed in a bucket from which a portion was randomly selected to be preserved in ethanol. The second portion of the outing involved documenting the dimensions and flow of the stream. Using field measuring tapes and poles the students recorded the width and depth of the stream over a one hundred meter section. A floating object and a stopwatch were used to clock the flow of the stream at prescribed intervals from bank to bank. On a rotating basis each student was able to contribute to this data collection opportunity.

This is an excellent introduction to fieldwork for budding biologists. The protocol is well planned and documented so that the data collected is precise and significant. As a continuation of a long history of data collection on the streams in the Oklahoma City area, students are able to have a positive real-time experience where they can readily understand the meaning of the procedure and utilize actual field equipment.

Another lab was scheduled for April and October to perform the macroinvertebrate sub-sampling on the preserved specimens from the earlier collection event. With expert supervision this was a student driven activity. The sample was washed in sieves after which large pieces of leaves and twigs were removed and what percentage they occupied of the overall sample was reported offering information on the makeup of the sample. The resulting portion was separated into piles, one of which was randomly chosen for the procedure. The pile was spread evenly on the bottom of a plastic pan into which a metal grid of 28 numbered squares was lowered. Using a list of random numbers, students were directed to a square where, with the aid of a magnifying lamp and forceps, they searched the sample for macroinvertebrates, which are later indentified. Two or three students were able to work per station.

Extensions

As with July macroinvertebrate collections, fish assessments are scheduled for the summer months when the university is not in regular session. However, in 2006 and 2007, some local students were available to take advantage of this opportunity. A fish assessment is an all day event. The team begins by walking the creek over a 400 meter area stopping every 20 meters to evaluate the section covered. The depth of the riparian zone is apportioned by percentage into such categories as canopy, ground cover and bare ground. The streambed and bank are evaluated for composition and structure, for example, bank height, slope, erosion, and streambed composition for hard pan, gravel, or silt. Anomalies are accounted for by comment. This procedure usually occupies the team for two to three hours in the morning. The afternoon session is occupied by seining the same 400 meters for fish. A single sample of each variety is preserved in ethanol for confirmation and speciation. Again this is a significant introduction to fieldwork. The import of the data is readily accessible.

By the Fall semester in 2007 it became apparent that many of the Biology majors were prevented from participating in the Biology Department's service learning project because it frequently was attached to a non-majors course. The department decided to list the course as a separate one-hour credit attached to the non-majors course, Selected Concepts in Biology, but to cross-list that one hour as a directed study for Biology majors. This move had two benefits: it created a balance of majors and non-majors and ensured that the enrolled students were committed to the project. As a one-hour credit lab course, the time increased from approximately 16 ½ hours to 44 hours during the semester, meeting for nearly 3 hours every week. This opened the project to an expansion that had been instituted by Blue Thumb the previous December.

The Blue Thumb Project wished to develop a history of each watershed being actively monitored. Along with the training and monthly monitoring, in-depth investigations of the testing procedures, a comprehensive examination of stream chemical and biological interactions, and chapters indentifying insects and fish were introduced. Using PBWiki as an on-line project site, the entire group is working together to produce a detailed, comprehensive watershed report to be

submitted in December to the Blue Thumb office. As discussed in class, this report is not only created for water quality professionals, but also for the community at large.

Other Projects

Soil analysis, like water analysis, can be “doing science” in service to the community. County extension offices do most of the soil analysis required by agricultural interests and charge a fee; however, there are many smaller projects that can be served such as community and home gardens and reclamation efforts from petroleum drilling sites or wetland drainage. Beyond the usual tests for soil texture, soil moisture, pH, nitrogen, potassium, and phosphorus, the soil can be analyzed for magnesium, manganese, aluminum, sulfates, chlorides, ferric iron, calcium, nitrate nitrogen and ammonia nitrogen.

Scientific testing can also be used to answer questions of interest to the local community. These questions can be of a forensic nature without the legal or criminal implications in that they cross discipline boundaries. A recent example would be: why a particular mineral becomes amplified in the system of patients taking a particular medication in a specific locale when the general population is unaffected. This would require an investigation into the diet of patients at the elemental level to uncover an interaction with the active ingredients in the prescribed medication.

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About the Author

Beth Landon worked for eleven years for a national medical reference laboratory in the microbiology department. In August of 2004, Oklahoma City University hired Beth as the Biology/Chemistry Lab Tech. At this time she had been working as a volunteer for Blue Thumb since August 2001. Along with several environmental trainings such as Project WET, Project Wild, Project Learning Tree, Project WOW (Wild on Wetlands) and the Globe Program, Beth is a recent graduate of the Oklahoma Master Naturalist Training. She is a member of the Oklahoma Association of Environmental Educators, the Southwest Association of Naturalists, the National Science Teachers Association and the Oklahoma Native Plant Society. Since coming to Oklahoma City University, along with her daily duties, Beth’s priority has been community outreach, which dovetails nicely with her focus for the last fifteen years on environmental education for the younger generations.

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