

August, 2010

**The William F. and Edith R. Meggers Project Award
Physics Lab Suitcases
Mount Holyoke College**

Overview of the Project

This project was inspired by a similar outreach project that Mount Holyoke College's Janice Hudgings started several years ago in which area pre-college teachers could borrow science lab equipment for an extended period of time, much like a person borrows a book from a library. These suitcases were typically used for one experiment or one concept and were for experiments typically in biology and chemistry, so this new initiative funded by The William F. and Edith R. Meggers Project Award built upon these past efforts with modifications to the suitcase format and were specific to physics. This project included purchasing materials for two suitcases (one in mechanics and one in electricity and magnetism) that would contain all of the needed materials to study many concepts and would be borrowed by a given school for as long as they were working on those topics. This allowed the students to become familiar with the materials and to therefore spend more time learning the concepts rather than how to manipulate equipment. Because the students used the equipment over an extended period of time (weeks or even months), this change was a benefit to teachers as well since they could then spend more time *teaching physics* rather than teaching students how to use different equipment for different experiments. Because lab materials can sometimes be costly (especially when buying a classroom set), the teachers could be better able to achieve administrative buy-in since they would have already tested the materials over a long period of time and had a chance to see how they could benefit student learning. The hope is that over time, participating schools will be able to purchase their own sets of equipment and borrow a diminishing number of suitcases from Mount Holyoke, therefore allowing the outreach suitcases to be used by other schools and educational organizations.

How it was Implemented

The College's Community Based Learning Program generously provided funding for a student Community Fellow to aid in the implementation of the grant. This Fellow, Reyna Juan, is currently planning on teaching chemistry and physics at the high school level upon completion of her undergraduate program. Juan worked with Christine DeRunk to test the equipment and to run training sessions with the borrowing teachers. Juan also created "quick-start" handouts on how to use the materials and worked on creating new and modifying existing curricular materials that are linked to the state education frameworks. These materials are now available on the physics department outreach webpage (www.mtholyoke.edu/acad/physics/outreach.html).

To borrow the equipment, a teacher or educational director from a school contacted DeRunk and inquired about a specific suitcase. If it was available, DeRunk or Juan

delivered the materials to the teacher and completed a training session on how to use the equipment and made suggestions for possible investigations using the materials. When questions arose about the materials during use, the borrowing teacher contacted DeRunk and she was able to troubleshoot.

When the borrowing teacher was finished using the equipment, DeRunk or Juan picked up the materials and returned them to Mount Holyoke where they were stored until another teacher wanted to borrow them.

Who Used the Equipment?

During the first year of the project, the equipment was borrowed by two institutions - The Springfield Renaissance School and The Care Center. The Renaissance School is a charter school that just completed its fourth year. This was the first year that physics was offered as this was the first year that there was a senior class (all seniors take physics). Because physics was a new course offering and the physics budget was part of the general science budget, the available physics equipment, in general, was limited to demonstration materials and very few classroom set-ups. The suitcases offered through this grant were particularly useful to The Renaissance School as there were enough materials for six lab groups with the mechanics suitcase and eight lab groups with the E&M suitcase.

The Renaissance School is an Expeditionary Learning School and the physics classes did a special study of auto collisions. Rebecca Jackson, the physics teacher, reported that having the mechanics equipment was especially helpful and applicable to the special study because there were enough tracks and carts to allow for the study of collisions. The class used the materials 2-3 days each week so students were quite comfortable with the equipment and that allowed for “natural experimenting” to take place, according to Jackson.

The Renaissance School borrowed both the mechanics and the E&M suitcases and the materials were used by all of the senior class as physics is a required course for graduation. There were 42 girls and 31 boys taking physics and the class sizes ranged from 9 to 29. The school demographics are roughly 26% African American, 39% Hispanic, 27% White and 8% Asian, Native American, Pacific Islander and multi-racial.

Another educational organization that borrowed the equipment is The Care Center, a Holyoke-based GED completion and college preparatory program for teenage mothers. The Care Center already had a relationship with Mount Holyoke, however, this relationship existed primarily within the humanities and athletics. The Care Center was looking to strengthen its science curriculum and to build upon their relationship with Mount Holyoke and to provide opportunities for campus visits so that students could begin to get comfortable on a college campus and start to imagine what it might be like to attend college. To help The Care Center reach these goals, DeRunk provided two professional development workshops at The Care Center around topics in physics and worked with Juan and other Mount Holyoke students to host a campus visit for twelve

students from The Care Center. During this visit, Care Center students completed a lab activity and ate lunch with college students. Students from Mount Holyoke, including members of the Society of Physics Students (SPS), were involved in making the visiting day possible and assisted in leading the laboratory activities. Some of the Mount Holyoke students are bilingual and assisted in translating the lab handouts and in explaining concepts to some of the visiting Care Center students for whom English was a second language.

After the lab was completed, the lab materials were packed up and borrowed by The Care Center so that students who did not attend the campus visit would have an opportunity to do the lab back at The Care Center. The hope was that students from The Care Center who attended the campus visit would be able to go back to their home institution and assist the other students in using the equipment and doing the lab activities. In this way, the young women who had been through the lab while at Mount Holyoke would have the opportunity to be positive leaders among their peers and a chance to excel academically.

Conclusions

Overall, we would evaluate this project to be a success in meeting the objectives of improving high school physics education for students as well as being of value to pre-college teachers. Teachers at both participating schools report students being interested in learning and using the equipment and being more engaged than they were when there were only classroom demos and/or worksheets. When we would visit the schools and interact with students, it was clear that they were enjoying using the lab equipment and were more interested in physics as a result of using the suitcase materials. One student stands out in particular. She was attending the campus visit with The Care Center and was working on the lab. She said, “*I like this!* I mean, it is really hard and I have to think, but *I like this!*”

We also consider the project to be successful in developing relationships with pre-college institutions. While Mount Holyoke did already have some collaborations with both schools prior to the start of this project, many of these relationships were within the humanities and not the sciences. Those projects that did involve science were typically not in physics. Now we have some concrete experiences and equipment upon which we can build. It was also a great opportunity to converse with pre-college teachers about educational philosophy, use of materials and to have interesting conversations about some of the subtleties of certain concepts in physics not limited to those directly related to the suitcases.

Because the project was so well received and we expect that The Renaissance School, The Care Center and a growing number of other schools will be interested in using the suitcases, we would also like to expand the number and variety of available suitcases. We would like to increase the number of set-ups for an individual suitcase to be a minimum of eight since some of the borrowing schools have class sizes that approach thirty students and we would like to allow for the students to work in groups that are as small as possible to increase individual participation and student learning. We would also like to

include a wider range of available suitcases. For example, we would like to purchase some materials to study heat energy and alternative energy sources as these are topics required by the State but for which we currently do not have materials. We would also like to include some equipment to study waves, sound and optics more deeply.

Because of the positive reception of the project, it is also clear that there are some improvements to be made to the infrastructure of Mount Holyoke outreach on at least two primary levels. The first is on the pure mechanical level and the second is on an institutional level. We found that it was difficult to find good meeting times for things as simple as dropping off and picking up the materials as there were several parties involved, each person's schedule was hectic and we were trying to match the pre-college and the college teaching day, which clearly run differently. Scheduling time for trainings was also sometimes difficult for similar reasons. We will continue to seek funding to support at a minimum a part-time Physics Outreach Coordinator to direct this project on a mechanical and logistical level as well as to work on the greater objectives as outlined below. Ideally, the person in this position would work closely with the Community-Based Learning Program so that partnerships could be built across all of science and a greater number of students could be involved.

We found that students from SPS (and generally from Mount Holyoke) were interested in and excited by helping out with outreach efforts, particularly when the projects involved pre-college girls. The proposed Physics Outreach Coordinator would work with the Community-Based Learning Program to build relationships with area schools and to create opportunities for SPS students to assist in outreach activities. This would allow SPS students the opportunity to participate in a meaningful way at a greater frequency which would be beneficial to both the community and to the Mount Holyoke chapter of SPS as it can be difficult for SPS to directly plug in to area schools to participate in meaningful ways.

Involving SPS students would expose them to teaching and perhaps inspire them to go on to become pre-college physics and science teachers, which would improve the quality of high school physics education by having more pre-college physics teachers with a degree in physics. We can imagine working with the Education Department to include in outreach projects students who are planning on becoming pre-college teachers. This provides not only the feeling of goodwill in helping others to learn but also provides practical, hands-on experience with teaching and education and can potentially encourage college students to go into pre-college physics education. This would also make Mount Holyoke College students more competitive when applying to selective programs such as Teach for America.

We can even imagine that this project could expand to become a research opportunity for a physics student who is not interested in traditional research but *is* interested in science (and specifically physics) education. As there is a greater and greater push for undergraduates to complete some type of research or independent study, this could provide an opportunity for students to learn about the process of learning, appropriate use of technology and current trends in physics education research. Networking with others

on campus and developing such program infrastructure could be a part of the Physics Outreach Coordinator's charge.

On a financial level, this project was also a success because it allowed for the purchase of non-consumable physics lab equipment that can be used for years to come. In the first year of the project, over 100 students used the equipment with approximately two thirds of the students being female and approximately two thirds of the students being students of color. We already know that The Renaissance School and The Care Center would like to use the equipment again and that there are some other interested schools as well. This brings the cost per person down while not diminishing the quality of the materials because they are well-constructed, non-consumable items that can be used for many years with only small investment in maintenance.

While there are certainly some issues to be resolved around increasing the number and variety of available suitcases and infrastructure, the project by and large was a success and provides an excellent starting place for building up the suitcase program and establishing meaningful connections within the community. This project could be easily adopted by other colleges and universities and we feel it would be particularly successful at those institutions with at least a half-time science outreach coordinator or a motivated individual to take on such an extensive project.

We can envision that a whole college or university physics department could take on a similar project with great success given that virtually all large grants require an outreach component in order to be considered for funding. Each member of the department could fund a different suitcase such that all areas of physics are covered. In this way, it becomes possible for a college or university physics department to assist under-resourced schools in their local communities in establishing quality physics curriculum complete with lab materials and curricular materials if they are needed. With an increased budget, this project could be expanded to cover not only topics that are required by the state frameworks but could also cover topics on the SAT II and the AP exams, which is important as these standardized exams are needed to apply to certain colleges and universities.

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article can be viewed at http://issuu.com/mhcalumnae/docs/2010_spring1.1. *The Town Reminder* article is on page 5 of the May 21, 2010 issue. A copy is attached for reference.

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