

Education and Outreach

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I have the best job in the entire laboratory. Hands down. I have never made that proclamation out loud or even dared to whisper it to anyone sitting next to me; I am afraid people will finally catch on and realize that the work I do is much more enjoyable than what they are doing. Here's why: I do not have to follow any taxing laboratory protocol; my instrumentation does not require fine-tuning; my results seldom (okay, never) end up in any peer-reviewed publications. My office resembles a toy store, where visitors spend more time scanning the shelves crammed full of useful materials (i.e. equipment) than they do maintaining eye-contact. My trip record forms display regional travel destinations that end in the words "school district" versus distant, more expensive, locations ending with "national laboratory". My calendar is peppered with a variety of exciting events; camps, tours, teacher workshops, lab activities/demonstrations, and even the much anticipated student field trips. My work day includes interactions with a range of people as young as third grade school children to as senior as emeritus faculty members. My job, directing outreach activities at CLASSE and helping fulfill the broader impact criterion established by the NSF, is a truly remarkable appointment.

One of the most rewarding aspects of this position is the time I get to spend with young children. They are so anxious to learn something, just about anything, about science. Before reaching puberty, children are blessed with a sense of awe and wonder; their minds are wide open and waiting to be filled. To a ten year old, nothing is cooler than looking at clusters of dead skin cells underneath a microscope! Discovering that

you can blow a bubble using a toilet-paper tube is sheer ecstasy. Donning safety goggles to witness the shattering of a flower after being submerged in liquid nitrogen is, to an elementary student, as good as life will ever get. After visiting with Wilson Lab as part of a class field trip, I have no doubt in my mind that these children run home and enthusiastically tell their family members about all of the fascinating science stuff they saw (and did!) that day. And, more importantly, they tell their parents and themselves that they want to learn more.

During the last year, the laboratory has provided after-school enrichment programming for nearly 100 elementary school students. That's a lot of kids receiving one-on-one, hands-on science programming outside of school hours! This programming is provided free of charge to any school within a sixty-mile radius of Ithaca. Many schools have children from disadvantaged backgrounds; their families live in remote, rural areas and they haven't even heard of Cornell University. Most programs run one hour a week after school for six weeks, which is just enough time for me to get to know the kids, figure out what they want to learn more about, and (hopefully!) inspire them to seek out science and be comfortable with it - not scared of it. The most popular program we deliver to schools on a regular basis is "Atoms for Kids!", but "The Science of Bubbles" comes in a close second. During the Atoms program, students get to operate light microscopes, investigate crystal formation, study light spectra, and witness what happens to atoms inside of a bell jar. All of which is extremely cool stuff when you are a 3-5th grader... and still cool stuff when you are an adult.

If only we could bottle the excitement of a fifth grade class and pass it along to class of high school students. By the time a typical high school physics class makes a trip to Wilson Lab, they are less enthralled by the wonders of science and are more concerned with grades, college, dating and a host of other distractions. This is not to say that these students are disinterested in science, but they are less enamored by its mysteries and more concerned with completing college applications! Some students have a genuine interest in conducting research, and it is the Lab's good fortune to be able to provide some research experiences for high school students. During the past year, a number



Middle school science teachers Mary Anne Ritinski (IS 234 Brooklyn) and Crisan Berina (IS 126 Queens) work together during the Summer Institute to build their own light bulb to observe the effects of resistance in a wire.

of high school students have worked alongside our laboratory's scientists, involved in projects of value to their mentors. One CHESS researcher, Richard Gillilan, worked with Ithaca High School student Sohyun (Sarah) Kim during the summer of 2007 to help her write a Java program to analyze 100,000 digital images of crystal growth. This past summer, she gave a poster presentation on her work at the CHESS user meeting. Currently Sarah is volunteering in MacCHESS's lab growing protein crystals for use in beam-line testing.

In addition to structured internships, the laboratory hosts a large number of visiting high school students as part of class field trips to Wilson. Many science teachers, from as far away as Buffalo NY, visit the lab as part of their one (and usually only) field trip during the school year. On average, 250 high school students each year amble along the passageways of the laboratory, gawking at the massive collection of electronic gadgetry, dodging the occasional drip of tunnel-juice, and timidly asking questions about the scope of the research being done here. A tour of the facility just can't but help some high school students feel a sense of awe and wonder about the opportunities that lie in store for them as budding young scientists.

Having spent six years as a middle school science teacher, I have grown comfortable interacting with children at this age level and even more at ease with the teachers who choose to make a profession out of educating this age-group. Consequently, the bulk of the professional development opportunities available to teachers through the outreach program at the Laboratory are geared towards 6-8th grade science teachers. Contrary to popular belief, middle school students are wonderful to have in the science classroom. They are capable, curious and internally motivated to "do science". They adore hands-on activities and investigations; they benefit tremendously from interactive experiences, and are not yet afraid to propose an explanation for observed phenomena. Much anecdotal evidence suggests that middle school is the time when students decide, somewhat subconsciously, that they enjoy or despise science. Knowing this, it is important that adults, especially teachers, fuel a student's passion for science before they leave middle school. If not properly fueled, that passion may not ever be reignited.

One can see how important it is that middle school science teachers have the capacity and training to confidently teach their students. The outreach program at Wilson lab has taken an active role in helping to provide science teachers with the professional development training they need by hosting the Cornell Physical Science Summer Institute for Middle School Science Teachers during the summer of 2008. The theme for the week-long institute was "Making Connections: What Science Research and Your Middle School Curriculum Have in Common". The Institute was partially funded through grant money received from the New York State Education Department; the other funding came from money devoted to Outreach at CLASSE. The Institute, held at Cornell for a week in July, provided eleven middle school science teachers from New York City with the opportunity to gain content knowledge aligned with NY State learning standards. It also provided teachers with the chance to interact with scientists who are conducting cutting-edge research and allowed participants to learn about state-of-the-art technology in the unique setting of a world-class research university. All participants earned one unit of graduate credit in Physics for the five days they spent on campus. A quote from one participant asked to reflect upon the week states; "My experience at the Physics Summer Institute was very exciting and informative. The hands-on explanations and the lectures from various experts in the field of physics can assist me in enhancing my knowledge in science as well as in delivering more research-based activities."

In addition to working with K-12 teachers and students, I am given the opportunity to interact with undergraduate students who spend time conducting research at our laboratory. These students, from diverse backgrounds and experience levels, are competent, motivated and frequently amaze me with their intellectual maturity. The science and engineering students participating in the Research Experience for Undergraduate (REU) program are selected from a large pool of applicants from



Lincoln Street Elementary School
(Waverly, NY)

Students have a good time learning about surface tension and experimental design by blowing bubbles with various house-hold objects.



African Road Elementary School
(Vestal, NY)

Students look through the spectroscopes they built to observe the different colors of light released by heated gas bulbs.

throughout the country and come to Wilson Lab to work with faculty, research associates, and graduate students on a broad selection of research projects. These projects contain important elements of the overall research program at CLASSE; topics range from accelerator physics to microwave superconductivity to applications of synchrotron radiation in scientific research. During their final presentations delivered during the last week of the program, students showcase the complex research they have done and reveal the advanced level of thought and understanding required to work on projects alongside their Cornell mentors. Although these students work hard, they also play hard and take advantage of many social opportunities made available to them as part of the summer program. These college students live at the same dorm and hang out with REU students from other nationally sponsored programs at Cornell. REU'ers can be found playing soccer, bowling, dining, riding bikes, or sightseeing in downtown Ithaca with their colleagues throughout the summer months.

During the summer of 2008, seven of the ten REU students worked for ten weeks on substantive ERL-related research projects, the efforts of which will be referenced and utilized by future staff and students. For instance, REU student Justin Hugon worked with research scientist Don Bilderback and technician Tom Szebenyi to reduce the vibration that occurs during current x-ray capillary optics fabrication. Improvements in capillary design will be necessary to take full advantage of the synchrotron radiation generated by the ERL. Upon completion of the program Justin, currently a physics major at Rhodes College, stated that his experience at CLASSE was beneficial and rewarding; it helped convince him to pursue a doctoral degree instead of a bachelors or masters degree. For many REU students, the time spent in the program and on campus has encouraged them to seriously consider applying for graduate school at Cornell University. Seven students from past REU programs at Wilson Lab have continued their graduate work at Cornell and have enrolled in PhD programs or have pursued STEM (Science, Technology, Engineering, and Mathematics) teaching careers.

Having a particle accelerator facility in the neighborhood is not only a unique attribute of the Ithaca community (how many cities advertise tours of a particle accelerator in their Visitor's Guide?), but it also offers remarkable opportunities for people throughout central New York to learn more about physics and other fields of science. Through the outreach program at CLASSE and nearly a dozen other STEM Outreach programs on campus, Cornell provides informal science education opportunities through a number of different venues. A glimpse into the outreach program at the lab reveals staff involved in the following events: hosting informative, hands-on activity booths at local and state-wide science fairs; funding and offering workshops for campus-wide events such as Expanding Your Horizons and Career Explorations; participating in regional events to promote science literacy such as NanoDay and CCC Math Day; providing professional development training to educators from underperforming schools in New York City through the Science Sampler Series and Science Leadership Academy; escorting groups of community members through the tunnel that houses one of the most powerful tools for studying the atomic world; and many other examples. Through these volunteer efforts, and through the hard work of the outreach staff at CLASSE, thousands of people throughout the state of New York have been exposed to the many wonders of science. And hopefully, these people and others will recognize the important role that science research plays in their own lives and the lives of their children's children.



At the New York State Fair, Lora Hine explains to a visitor how potatoes create an electrochemical reaction between two probes in a Two Potato Clock which powers the digital clock. Visitors are invited to test various fruits and vegetables for themselves.

So, if you happen to be walking by my office and quickly glance at the vast collection of materials stacked on the shelves, see me carting tubs full of science equipment to and from the parking lot, or you see me escorting a young group of visitors throughout the Lab, ask me what I am doing and how you can help. The secret is out: I have the best job in the entire lab. And I will be more than delighted to share it with you!