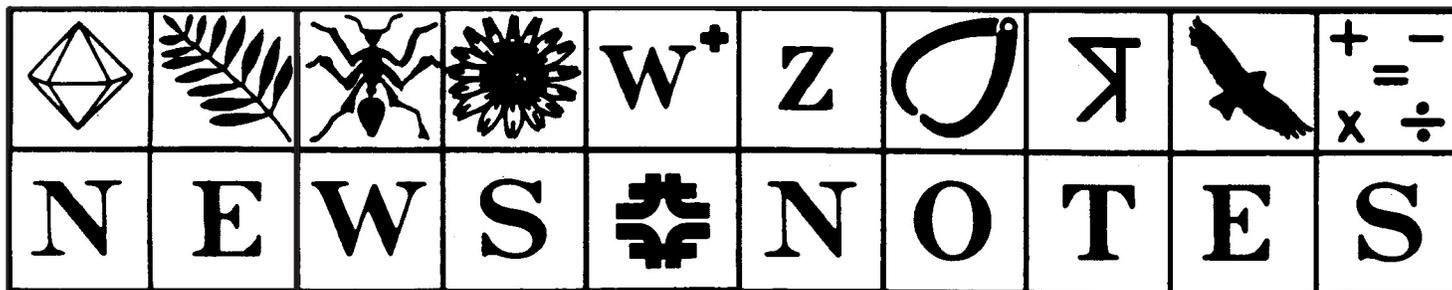


Fermilab Friends for Science Education



P.O. Box 500, MS 226, Batavia, IL 60510-0500

Fall, 2007

BCS@50 in the Schools

This year marks the 50th anniversary of the publication of the groundbreaking paper by John Bardeen, Leon Cooper and John Schrieffer explaining the phenomenon of superconductivity. The research was so significant that it merited a Nobel Prize for its authors. A number of institutions are planning “BCS@50” events during 2007, and since superconducting technology is critical to the work done at Fermilab, the Education Office found its own way to celebrate.

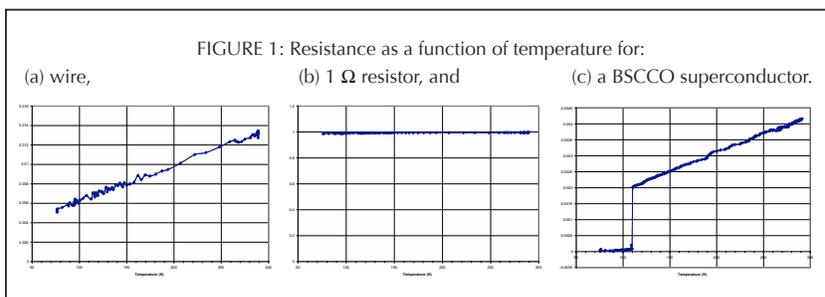
In the summer of 2005, Jeff Rylander (Glenbrook South H.S.) and Phil Sumida (Maine West H.S.), both physics teachers, met with Marge Bardeen to brainstorm a workshop that could be offered to other physics teachers to help them understand superconductivity and learn activities appropriate for teaching about it in a high school classroom.

Jeff and Phil began their research by spending time at Fermilab’s Magnet Test Division, increasing their own understanding of the theory and the technology used there. Drawing on that background, they developed a two-day workshop featuring two activities appropriate for the high school level. They presented the workshop to a group of physics and physical science teachers in the summer of 2006 so that the material would be used in classrooms during the BCS celebration year.

The first activity asks students to investigate the temperature dependence of resistance in various materials. It extends an experiment with Ohm’s law that students commonly perform in physics classes. Normally, students do not explore the effect of temperature on their materials. However, in this extension, they investigate the temperature dependence of resistance for three materials: a copper wire, a

manufactured resistor, and a superconducting material.

Students find that resistance remains steady in the resistor as it cools and decreases steadily in the copper wire. They are able to observe the dramatic change that occurs in a superconducting material at around 110 Kelvins. In the superconducting material, at the critical temperature, resistance falls suddenly to zero and stays there for as long as the material remains below the critical temperature.



Illustrations courtesy of Jeffrey Rylander

the train, but to consider which materials and conditions would lead to the best design for a train.

Summer workshop participants incorporated the new material to varying degrees in their classrooms. Some made extensive use of it, while others incorporated it to a lesser extent. But students responded very positively to their explorations. The concept of superconducting excited them, and they were intrigued to find that nature can behave very differently than might be expected.

The activities, “**The Effect of Temperature on Electrical Resistance**” and “**How Do We Levitate the Train?**” can be found in the Educators section of the Education Office website (<http://ed.fnal.gov/educators.html>) under “Fermilab Physics Resources.”

FIGURE 2: Set-up for the three samples that were lowered into a liquid N₂ bath. Resistance was determined using two multimeters (one acting as a voltmeter and ammeter); temperature was measured using a thermocouple which was displayed on a third multimeter.



Fermilab Friends made this project possible, providing stipends to the developers and to the teachers who attended the workshop. FFSE also paid for equipment, including the maglev train, made especially for Fermilab in China.

Phriendly Physics with Benedictine University

Phriendly Physics in its former format is back!

As part of a new degree program, Fermilab is offering Phriendly Physics as a five-day workshop to students at Benedictine University.

In the years since its inception, Phriendly Physics has changed from a five-day, multitopic program to a series of two-day workshops on individual topics, including motion, light, heat, and electromagnetism. Teachers who didn't teach the full spectrum of topics in their classes asked for the shorter, more focused format.

Recently, however, Benedictine University developed a Master of Science in Science Content and Process (M.S.S.C.P.) degree for those working professionally as K-8 teachers or science educators, and the Phriendly Physics workshop, as originally envisioned, will be one segment of the program, offered every summer to Benedictine's students.

Fermilab is not the only institution partnering with Benedictine. Other regional scientific institutions, such as The Morton Arboretum, Brookfield Zoo, and the Forest Preserve District of DuPage County, also offer segments based on their areas of expertise.

About a dozen students attended the first five-day workshop, taught by Bill Grosser (Glenbard South H.S.) and Wayne Wittenberg (Glen Ellyn School District 41). Funds from FFSE enabled the timely reimbursement of the facilitators.

Thank you
to members new and old!

Our thanks go out to new and renewing members of FFSE. Your generosity and commitment to supporting science education programs, especially when government budgets are tight, make an enormous difference in our local community and beyond.

Your donations enable students to experience the excitement of science and support dedicated teachers in their work of bringing science to a new generation.

With your support, we look forward to another year of excellence in educational opportunity and innovation.



New Summer Physics Institute Offered

This year, through the generosity of an anonymous donor, FFSE supported the development of a new one-week Summer Secondary Science Institute, "Introduction to Modern Physics and Fermilab."

The Summer Secondary Science Institutes began about five years ago as a resource for high school science teachers teaching outside their majors. They provide an opportunity for newer teachers to gather information and learn activities from experienced teachers. As a bonus, participants become acquainted with Fermilab's unique resources, giving them an opportunity to see how the science they will teach is related to particle physics. They hear talks by scientists and engineers speaking about their areas of expertise, and they attend the luncheon talks provided for summer interns.

Master high school physics teachers Jason English (Fremd H.S., Palatine) and Paul Madsen (Hinsdale South H.S., retired) developed the new institute. About ten teachers attended the session, taught this year by Paul Madsen. Participants pondered gravity and acceleration while rolling billiard balls, and considered the connection between Roentgen's X-rays and the illumination pouring from fluorescent lights. PASCO kindly donated material with which to replicate Millikan's oil drop experiment, allowing measurement of the charge-to-mass ratio of the electron. Side trips for this summer's participants included a visit to the Cockcroft-Walton and Linac to view Fermilab's acceleration equipment, and a visit to CDF, where physicist Rob Roser explained the complexities of a particle detector.

All four Summer Physics Institutes were offered this year, and several teachers attended all four sessions. According to them, the new institute, offered during the first week, provided the ideal preparation for the succeeding sessions.

Fermilab Friends supported this project by providing stipends to the course developers and by underwriting the cost of equipment used in the experiments.



A REMINDER THAT THE "TREE OF KNOWLEDGE" PLAQUE IN THE LEDERMAN SCIENCE CENTER CAN BEAR YOUR NAME OR YOUR FAMILY'S NAME FOR A \$1,000 DONATION.

2007 Volunteer Picnic

On July 19, FFSE hosted a picnic dinner at Kuhn Barn to celebrate all those whose contributions resulted in another successful summer of science teaching and learning at Fermilab. About 40 program leaders, instructors and participants in summer programs turned out to enjoy the hamburgers, brats and drinks provided courtesy of Fermilab Friends.

While guests enjoyed the sunny evening and tasty food, Andrew and Daniel Pearson, sons of board member Val Pearson, enhanced the ambience with lively fiddle tunes. After dinner, guests adjourned to the barn, where Dr. Alex Chen, a professor in the Department of Physics at Soochow University in Taipei, Taiwan, performed a series of physics demonstrations he has developed using everyday objects to show how physics explains phenomena that are all around us.



Membership Form

Annual Dues:

Director.....\$1,000
Patron.....\$500
Sponsor.....\$250
Benefactor.....\$100
Regular.....\$50

*Please check the appropriate membership category and enclose your check made out to **Fermilab Friends for Science Education**.
Include matching funds from your company, if applicable.*

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